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Original Research Article

PREVALENCE OF MULTI DRUG RESISTANCE TUBERCULOSIS AMONG PREVIOUSLY TREATED TUBERCULOSIS PATIENTS IN FCT, NIGERIA.

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This study was a collaborative effort among all authors. Each author reviewed and approved the final version of the manuscript for publication.

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ABSTRACT

Background: Multidrug-resistant tuberculosis (MDR-TB) remains a significant public health concern worldwide, particularly in countries like Nigeria, where the burden of TB is high. Among those previously treated for tuberculosis, the risk of developing drug-resistant strains increases, making it critical to monitor resistance patterns in this population.

Objective: This study aimed to determine the prevalence of MDR-TB among patients in the Federal Capital Territory (FCT), Abuja, who had undergone treatment for pulmonary tuberculosis (PTB) in the past.

Methods: A cross-sectional survey was conducted involving 203 individuals with a prior history of PTB treatment. Participants were recruited from selected TB treatment centers in the FCT. Structured questionnaires were used to obtain demographic and clinical data. Sputum samples were analyzed using Ziehl-Neelsen staining and cultured for drug susceptibility testing against first-line anti-TB drugs. Data were analyzed using SPSS version 25, with statistical significance set at $p < 0.05$.

Results: Of the 203 participants, resistance to isoniazid and rifampicin was observed in 24.0% and 18.1% of cases, respectively. The prevalence of confirmed MDR-TB was 15.0%, while the rate of MDR or rifampicin-resistant TB (MDR/RR-TB) stood at 18.6%. Poly-drug resistance was identified in 1.0% of cases. Although females showed slightly higher resistance rates than males, no statistically significant associations were found between resistance patterns and age or sex.

Conclusion: This study highlights a concerning prevalence of MDR-TB among previously treated PTB patients in the FCT. The findings underscore the urgent need to strengthen drug resistance surveillance, improve patient follow-up, and support treatment adherence through more targeted TB control programs.

Keywords: MDR-TB, drug resistance, pulmonary tuberculosis, Abuja, Nigeria, previously treated TB patients

1.0 Introduction

Tuberculosis (TB) continues to be one of the world's most persistent public health threats, despite being a disease that is both preventable and curable. Alarmingly, TB has re-emerged as the leading cause of death from a single infectious agent globally, especially in the aftermath of the COVID-19 pandemic. The World Health Organization (WHO) recently reported that TB caused nearly twice as many deaths as HIV/AIDS in 2023, affecting more than 10 million people worldwide—a figure that has steadily increased since 2021 (WHO, 2024). A particularly troubling dimension of this global challenge is the rise of multidrug-resistant tuberculosis (MDR-TB). MDR-TB is defined as infection with strains of *Mycobacterium tuberculosis* that are resistant to at least two of the most potent first-line anti-TB medications: isoniazid and rifampicin (WHO, 2008). Since 2016, WHO has also recognized rifampicin-resistant TB (RR-TB) alone as a sufficient indicator to initiate MDR-TB treatment, a classification now referred to as MDR/RR-TB (WHO, 2016b). Globally, MDR/RR-TB remains underdiagnosed and undertreated. In 2023, around 400,000 new cases were estimated, but only 44% received appropriate treatment (WHO, 2024). Contributing factors to the emergence of MDR-TB include treatment mismanagement, medication non-adherence, and systemic healthcare gaps. These factors are particularly pronounced in countries with high TB burdens, such as Nigeria (Adepoju, 2020). In Nigeria, the WHO estimates that approximately 14% of previously treated TB cases are multidrug-resistant (WHO, 2020). Unfortunately, Nigeria is among the top 30 high-burden countries for TB, TB/HIV, and drug-resistant TB (WHO, 2024), The Federal Capital Territory (FCT), Abuja, shares in this burden, with recent reports suggesting an increase in MDR-TB cases, particularly among those who have received prior TB treatment (FCTHHSS, 2019). Although various studies have explored MDR-TB prevalence in other Nigerian regions, limited current data is focusing specifically on the FCT. Previous studies in Abuja reported rifampicin resistance rates ranging from 4% to 4.2% (Dosumu *et al.,* 2008), but these figures may no longer reflect the current reality. Moreover, earlier studies often lacked broader demographic insights that could inform better-targeted interventions. This study was therefore designed to assess the current prevalence of MDR-TB in the FCT among previously treated TB patients. It also seeks to identify any demographic or clinical patterns associated with drug resistance, with the goal of providing data that can strengthen TB control strategies in this high-burden region.

2.0 Methodology

Study Design and Setting: This was a descriptive, cross-sectional study conducted over a 12-month period from July 2018 to July 2019. The research was carried out in selected tuberculosis treatment centers across the Federal Capital Territory (FCT), Abuja. The study settings were chosen to capture a diverse cross-section of the population, including urban, semi-urban, and rural communities. These treatment centers serve as key diagnostic and management hubs for TB cases in the region.

Study Population: The target population included adults aged 15 years and older who had previously completed treatment for pulmonary TB and presented for retreatment or follow-up care. Eligible participants had documented evidence of past TB treatment and a confirmed diagnosis of pulmonary TB. Individuals with extrapulmonary TB or incomplete clinical records were excluded.

Sample Size and Sampling Technique: A total of 203 participants were recruited using purposive sampling. Selection was based on patients' availability during the study period and fulfillment of the inclusion criteria. The sample size was determined using prevalence estimates from earlier MDR-TB studies in Nigeria, with a 95% confidence level and a 5% margin of error.

Data Collection: Structured questionnaires, which had been pre-tested for clarity and reliability, were used to collect socio-demographic and clinical information. Additional clinical data were obtained through a review of patient records when necessary. Variables captured included age, sex, education level, marital status, occupation, type of residence, and history of prior TB exposure.

Sample Collection and Transportation: Two sputum specimens (spot) were collected from each patient as recommended by NTBLCP. Only those samples positive for acid fast bacilli (AFB) by Ziehl-Nelson (ZN) staining technique were collected and stored in a fridge. These were then transported to the laboratory in a cold box (+4^{0}C) within 3 days

of collection. The samples were pooled into one 20ml sterile screwed capped bottle (Falcon tube) for each patient and processed for mycobacterial culture within 24 hours (Urassa *et al.,* 2008).

Sample Processing, Mycobacterial Culture and Isolation: A volume of 2.5 - 10ml, sputum was decontaminated, digested and homogenized using Standard Petroff's method (Kent and Kubica, 1985).

Mycobacterial Culture: The pellet from the homogenized was inoculated into L J slant tubes (containing 0.6% glycerol and 0.6% pyruvate) for primary isolation of the organisms. Two slopes of LJ medium were inoculated per specimen. After which the tubes were incubated on 37^0C and inspected for growth of mycobacteria for a period of 8 weeks.

Isolation: Primary identification of MTBC was carried out using the SD BIOLINE TB Ag MPT64 RAPID kit (Standard Diagnostics, Inc., Yongin, Korea) based on the manufacturer's guide. In brief, a loopful of colonies were picked from the solid medium and suspended in 200 µL of the extraction buffer. Then 100 µL of the suspension was added to the sample well and left to flow chromatographically for 15 min. The appearance of a red band on the test window alongside with the control band was indicative of a positive result.

Drug Susceptibility Testing

The Drug; First line anti -TB drugs including, Ethambutol, Isoniazid, Rifampicin and Streptomycin were used for the susceptibility testing. Stock solutions of isoniazid, streptomycin and ethambutol were prepared in sterile distilled water (SDW), while that of rifampicin in methanol. Working solution of isoniazid was prepared by further diluting it with SDW. All the stock solution and working solution of isoniazid were sterilized by filtering through 0.22 mm membrane filter. The drug solution was then added to LJ media to give a critical concentration (µg/ml) of: streptomycin 4 µg /ml, isoniazid 0.2 µg/ml rifampicin 40 µg /ml and ethambutol 2 µg /ml.

Susceptibility Testing: To prepare test inoculum, a loopful of mycobacteria from the culture was taken and emulsified in a test tube containing 1ml SDW and glass beads. Additional SDW was added and be allowed to stand for the particle to settle down. The mycobacteria solution was carefully decanted to other clear sterile test tubes and the turbidity matched with McFarland STD no 1 and adjusted by the addition of SDW drop by drop (10^6 to 10^8 cfu/ml). Two dilutions of 10^{-2} and 10^{-4} were prepared from this bacterial suspension. A loop full of each dilution was inoculated to drug containing and drug free LJ media in test tube. These were incubated at 37^0C and examined every week for growth. On the twenty-eight and forty-second days the results were recorded by counting the number of colonies that grows on each of drug containing and drug free media. No further reading of test was made for those strain classified as resistant on the 28 day. A second was made on the forty second day for those strains whose results are sensitive at the twenty-eight day. Final definitive results for all the drugs were reported on the forty second day. The proportion of resistance bacilli was calculated by dividing the number of colonies obtained on drug containing medium with the number of colonies on drug free medium. Critical proportion of resistant bacilli required to define a strain as resistant was 1% for each of the 4 drugs. A bacilli growth of more than 1% was taken as resistant. The proportion of bacteria less than 1% were considered as susceptible (Canetti *et al.,* 1969).

Drug resistance was classified in line with WHO definitions:

- MDR-TB: Resistance to at least isoniazid and rifampicin
- RR-TB: Rifampicin resistance regardless of isoniazid status
- Poly-drug resistance: Resistance to more than one first-line drug other than both isoniazid and rifampicin (WHO, 2023).

Data Analysis: All data were analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic information and resistance patterns. The chi-square test was employed to examine associations between drug resistance and variables such as age and sex. A p-value < 0.05 was considered statistically significant.

Ethical Considerations: Ethical approval was granted by the Health Research Ethics Committee of the FCT Health and Human Services Secretariat (Approval No: FHREC/2018/01/75/04-07-18). Informed consent was obtained from all participants, and all information was treated with strict confidentiality.

3.0 Results

Demographic Characteristics of the Participants

Out of 203 previously treated pulmonary TB patients enrolled in the study, the majority were male (70.4%, n=143), while females accounted for 29.6% (n=60). The highest proportion of participants fell within the 25–34-year age bracket (34.4%), followed by those aged 35–44 years (27%). Other age groups included 15–24 years (17.7%), 45–54 years (12.8%), and individuals aged 65 and above (5.4%). Most participants lived in semi-urban communities (71.9%), with rural dwellers making up 25.1% and only 3% residing in urban areas. In terms of accommodation, more than half (54.4%) lived in multi-occupant housing, while 41.6% resided in self-contained units. A smaller group (4.0%) lived in hostel or dormitory arrangements.

Table 1: Social–demographic characteristics of study participants based on sex, age group, location, accommodation and occupation distribution, No =203

Variable	Category	Frequency	Percent (%)
Sex	Male	143	70.4
	Female	60	29.6
Age Group (Years)	15–24	36	17.7
	25–34	70	34.4
	35–44	55	27.0
	45–54	26	12.8
	65+	11	5.4
Location	Rural	51	25.1
	Semi Urban	146	71.9
	Urban	6	3.0
Accommodation	Hotel/Dormitory	7	4.0
	Multiple Occupants	94	54.4
	Self-Contained	72	41.6
Occupation	Admin Worker	19	9.3
	Artisan	23	11.3
	Business	34	16.7
	Construction Worker	35	17.2
	Healthcare Worker	3	1.4
	Farmer	21	10.3
	Housewife	7	3.4
	Student	8	3.9
	Trader	23	11.3
	Transport Worker	19	9.3
	Others (Specify)	12	5.9

Occupationally, construction workers were the largest group (17.2%), closely followed by individuals in business (16.7%) and trading (11.3%). Other occupations included artisans, farmers, administrative staff, students, housewives, healthcare workers, and transporters (Table 1). Marital status data showed a near-even split: 50.7% were married and 47.8% single. Just one respondent (0.5%) was divorced. Educationally, the majority of participants had attained at least secondary education: 14.5% had primary education, 43.5% had secondary, and 35.0% had tertiary education. Only 7%

reported having no formal education. A notable 40.4% of participants also reported previous exposure to TB beyond their diagnosis (Table 2).

Table 2: Marital status, education, and TB exposure history among participants (N = 203)

Variable	Category	Frequency	Percent (%)
Marital status	Married	103	50.7
	Single	97	47.8
	Divorced	0.5	
Educational qualification	Illiterate	14	7.0
	Primary	29	14.5
	Secondary	87	43.5
	Tertiary	70	35.0
History of Tb exposure	No	121	59.6
	Yes	82	40.0

Prevalence of Drug-Resistant TB

The resistance pattern to first-line anti-TB drugs among the participants showed variable prevalence rates (Figure 1). Resistance to Isoniazid was highest (24.0%), followed by Rifampicin (18.1%), Streptomycin (11.3%), and Ethambutol (7.4%). The overall prevalence of multidrug-resistant TB (MDR-TB) was 15.0%, and MDR/RR-TB was 18.6%. Poly-drug resistance was recorded in 1.0% of participants.

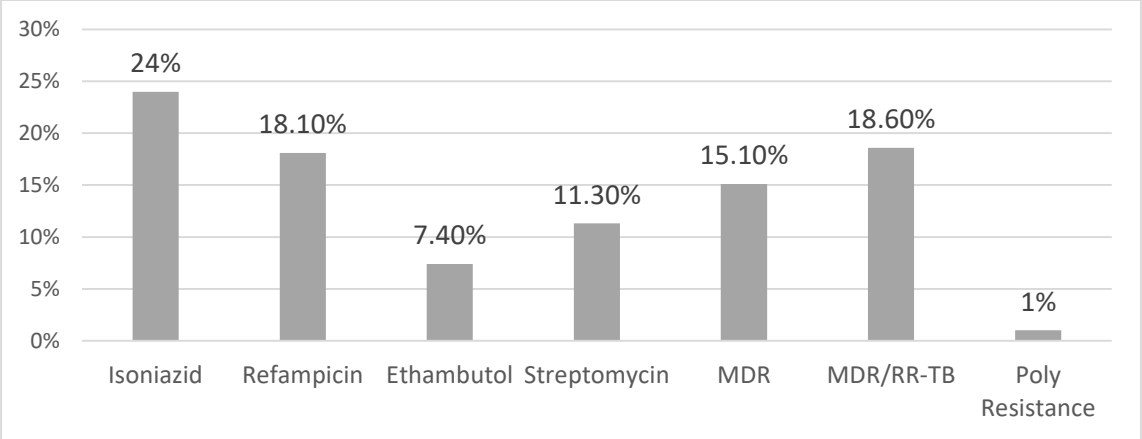

Figure 1: Prevalence of resistance to first-line anti-TB drugs among participants

These findings are consistent with WHO reports indicating that MDR-TB remains a significant challenge in high TB-burden countries, including Nigeria (World Health Organisation [WHO], 2023). The rates of resistance to Isoniazid and Rifampicin — the two key drugs defining MDR-TB — highlight the ongoing threat posed by inadequate adherence, inappropriate treatment regimens, and transmission of resistant strains (Centers for Disease Control and Prevention [CDC], 2022; Zumla *et al.,* 2013).

Age-Related and Sex-Related Prevalence of MDR-TB

Analysis of MDR-TB and MDR/RR-TB prevalence by age revealed no statistically significant differences. However, individuals aged 55–64 years had the highest prevalence of MDR-TB (18.0%), while those over 64 years had the highest MDR/RR-TB prevalence (27.0%) (Figures 2 and 3).

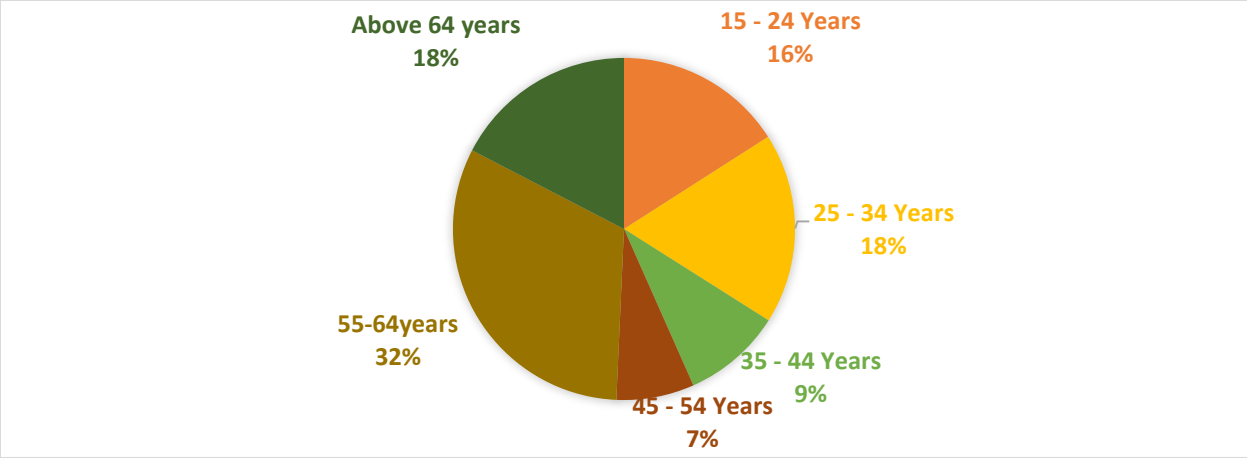

Figure 2: Age-related prevalence of MDR-TB

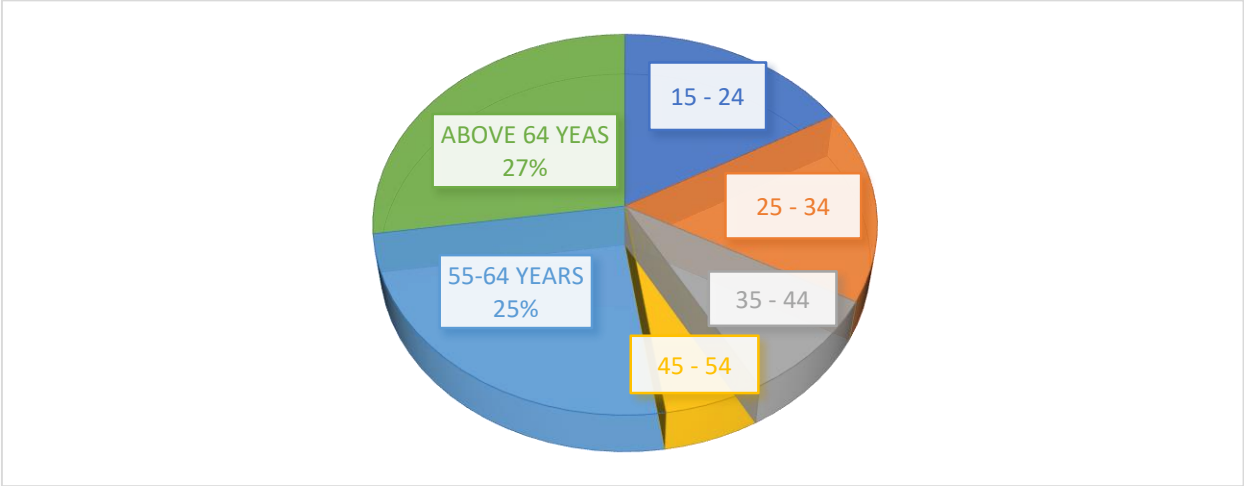

Figure 3: Age-related prevalence of MDR/RR-TB

This pattern aligns with other findings that suggest older adults may have had multiple TB exposures or incomplete treatments over time (Isaakidis *et al.,* 2015). Nevertheless, younger age groups also showed notable resistance levels, possibly indicating recent transmission of resistant strains (Udwadia *et al.,* 2010). Poly-drug resistance was highest among those aged 15–24 years (2.8%) and 25–34 years (1.4%), with no cases in other age groups (Figure 4).

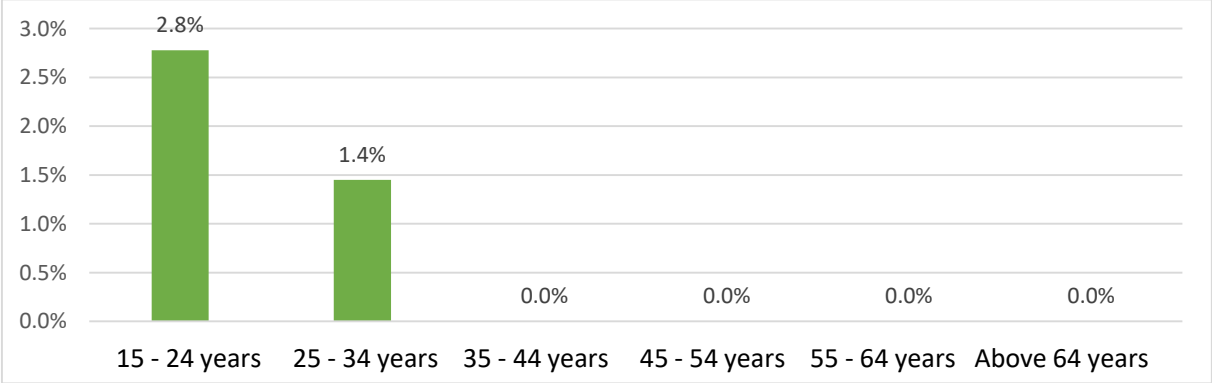

Figure 4: Age distribution of poly-drug resistant TB

This could be reflective of social mobility, increased exposure risk, and possibly poor treatment adherence in this population (Lönnroth *et al.,* 2010).

Gender Distribution of Resistance

Female participants had slightly higher rates of MDR-TB (16.1%) compared to males (14.1%), as well as higher rates of MDR/RR-TB (19.4% vs. 18.2%) and poly-drug resistance (1.6% vs. 0.7%) (Figure 5). However, these differences were not statistically significant.

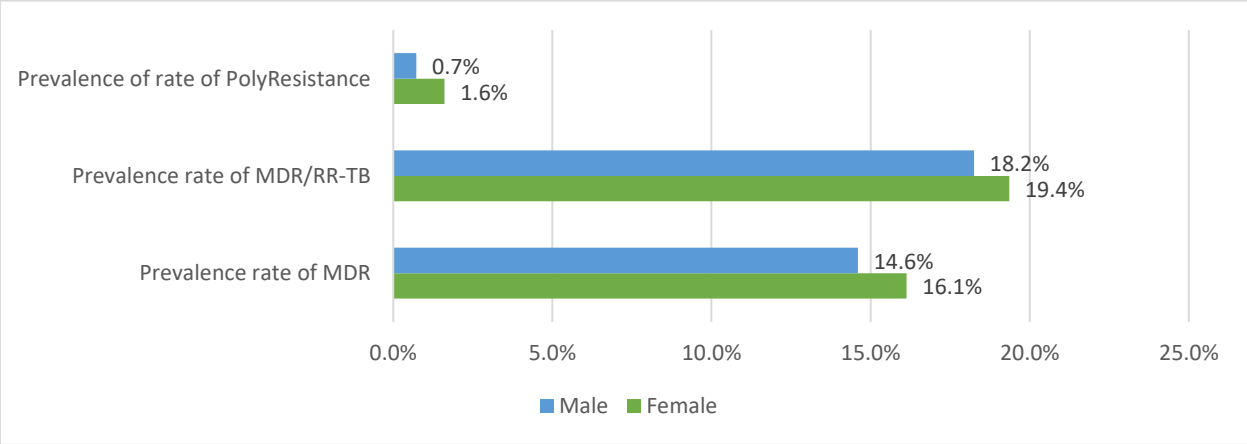

Figure 5: Sex-related distribution of MDR-TB, MDR/RR-TB, and poly-drug resistance

This may appear counterintuitive since TB is often more common among men (Horton *et al.,* 2016), but it may reflect gender-specific barriers in access to quality care, health-seeking behavior, or treatment adherence (Lönnroth *et al.,* 2010).

4.0 Discussion

This study set out to investigate the prevalence of multidrug-resistant tuberculosis (MDR-TB) among individuals who had previously undergone treatment for pulmonary TB in the Federal Capital Territory (FCT), Abuja. The results reveal a troubling level of drug resistance, underscoring the persistent challenges in controlling TB, particularly in retreatment cases. A striking majority of participants were male (70.4%), which aligns with global TB trends, where men are more frequently affected (World Health Organization [WHO], 2023)—possibly due to greater occupational exposure, delayed health-seeking behavior, or higher likelihood of incomplete treatment. However, despite fewer female participants, resistance rates were marginally higher among women MDR (16.1% vs. 14.1%) and MDR/RR-TB (19.4% vs. 18.2%) than males. This discrepancy, while not statistically significant, may point to gender-specific barriers in treatment adherence—such as healthcare access limitations, stigma, or sociocultural expectations (Horton *et al.,* 2016). The age group with the highest representation (25–34 years) is particularly concerning. Individuals in this group are often economically active and highly mobile, which can influence treatment continuity and increase community transmission (Isaakidis *et al.,* 2015). That drug resistance was also observed among both younger and older patients suggests that MDR-TB is not confined to a particular age bracket. For older participants, especially those aged 55 and above, previous incomplete treatments or multiple exposures may explain the increased resistance. Geographically, most participants lived in semi-urban areas (71.9%) suggesting the need for targeted interventions in these locations. These are communities that often straddle the challenges of rural underdevelopment and urban congestion. In such areas, overcrowded living conditions, poor ventilation, and inconsistent healthcare services can facilitate the spread of TB and hinder adherence to treatment regimens (Lönnroth *et al.,* 2010).

The resistance rate to isoniazid (24%) and rifampicin (18.1%) is worrisome, considering these are the backbone of standard TB therapy. With MDR-TB confirmed in 15% of cases and MDR/RR-TB in 18.6%, the figures in this study exceed the WHO estimates for retreatment cases in Nigeria TB (WHO, 2023). These numbers suggest that many patients are being re-infected with resistant strains, or that inadequate treatment support continues to allow resistance to develop during therapy. Our findings underscore the urgent need to reinforce drug susceptibility testing (DST) and ensure

treatment adherence through programs like DOTS. Poly-drug resistance, though low in this cohort (1%), was more pronounced among younger individuals. This raises concern that drug resistance is being transmitted, rather than only acquired through treatment failure. Moreover, the occupations most commonly reported—construction, trading, and business—are associated with frequent movement and irregular schedules, both of which may interrupt treatment.
Overall, the findings highlight the urgent need for more robust diagnostic protocols (including routine drug susceptibility testing), stronger patient follow-up mechanisms, and tailored public health strategies—especially in areas with semi-urban sprawl and economic instability.

5.0 Conclusion

This study provides compelling evidence of a significant burden of multidrug-resistant tuberculosis among previously treated pulmonary TB patients in the Federal Capital Territory. The high levels of resistance to both isoniazid and rifampicin—the cornerstone drugs for TB treatment—reinforce the need for urgent and sustained action to strengthen TB control measures. While no statistically significant links were found between resistance and demographic factors like age or sex, the observed trends offer important guidance for tailoring public health interventions. Older individuals and women, in particular, may benefit from more targeted support systems. The presence of poly-drug resistance among younger participants also suggests that drug-resistant TB is an active threat in the broader community, not just a legacy issue from past treatment mismanagement. To reduce the spread of MDR-TB, Nigeria must intensify its diagnostic capacity, improve patient adherence through community-level support systems, and ensure consistent access to second-line medications. Without these steps, the goals of the WHO's End TB Strategy will remain out of reach.

Recommendations

Based on the findings of this study, the following recommendations are proposed to strengthen the fight against MDR-TB in the FCT and beyond:

1. Expand DOTS Coverage: Directly Observed Treatment Short-Course (DOTS) programs should be scaled up in semi-urban and underserved communities. Healthcare workers and community volunteers should be trained and equipped to support patient adherence throughout treatment.
2. Invest in Molecular Diagnostic Tools: Widespread availability of rapid diagnostic methods such as GeneXpert MTB/RIF should be prioritized in both primary and secondary care facilities. Early detection of drug resistance enables timely and effective intervention.
3. Enhance Public Health Awareness: Awareness campaigns, particularly in local languages, should target at-risk populations—including construction workers, traders, and mobile workers. These efforts should emphasize the importance of completing treatment and seeking early care.
4. Support Gender-Sensitive TB Care: TB programs should take into account potential barriers faced by women, such as childcare responsibilities, financial dependence, or stigma. Mobile clinics and community outreach could help bridge these gaps.
5. Strengthen Surveillance and Data Collection: Routine and comprehensive data on drug resistance trends should be gathered, especially from semi-urban and rural communities. This will allow for more accurate planning and resource allocation.
6. Encourage Operational Research:
7. Further multi-center studies should investigate the underlying social, economic, and systemic factors contributing to drug resistance. Understanding these drivers is essential to designing more effective interventions.

Limitations

While this study provides valuable insights into the prevalence and patterns of multidrug-resistant TB among previously treated patients in the Federal Capital Territory, several limitations should be considered when interpreting the findings. The cross-sectional design limits the ability to establish causal relationships between drug resistance and demographic or clinical variables. The data captures a snapshot in time, making it difficult to assess the directionality of observed associations. The study relied on purposive sampling from selected TB treatment centers, which may not fully represent the broader population of TB patients in Abuja. This could introduce selection bias, particularly if those who access treatment at these centers differ significantly in behavior, exposure, or treatment history from others in the community.

Self-reported data—such as occupational status, previous TB exposure, and treatment adherence—may be subject to recall bias or social desirability bias, potentially affecting the accuracy of the information gathered. Although the study adhered to national and international guidelines for drug susceptibility testing, the use of conventional culture-based DST methods may not detect all resistance mechanisms, particularly those that require molecular confirmation. Despite these limitations, the study provides a meaningful contribution to the understanding of MDR-TB in a high-burden setting and offers a foundation for future research and policy development.

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Conflicts of Interest.
The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.