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Molecular detection (RT-PCR) of Sars-Cov-2 RNA among Geriatric Tb patients with comorbidities attending Infectious Disease Hospital Kano, Nigeria

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Abstract

Tuberculosis (TB) and SARS-CoV-2, the virus responsible for COVID-19, both pose significant threats to public health, particularly among older adults with pre-existing TB. This study aimed to determine the prevalence of SARS-CoV-2 RNA among geriatric TB patients at Infectious Disease Hospital Kano, Nigeria, using RT-PCR and to analyze associated demographic and clinical factors. Methods A cross-sectional study was conducted involving 185 geriatric TB patients (≥60 years) who attended an Infectious Disease Hospital. Respiratory samples were collected and tested for SARS-CoV-2 RNA using RT-PCR. Data on demographic characteristics, comorbidities, and RT-PCR results were analyzed. Statistical analyses, including descriptive statistics, chi-square tests, and logistic regression, were used to assess prevalence and associations. Results Out of 185 participants, 18 (9.7%) tested positive for SARS-CoV-2 RNA. Positivity rates were higher in males (58.3%) compared to females (41.6%). The highest prevalence was observed in the 60-70 age group (11 positive cases), followed by the 70-80 group (4 positive cases) and those over 80 years (3 positive cases). Comorbidities included diabetes (9 positive cases), hypertension (2 positive cases), COPD (3 positive cases), and HIV (4 positive cases). Conclusion The study highlights a notable prevalence of SARS-CoV-2 among geriatric TB patients, emphasizing the importance of enhanced screening and management strategies. The findings suggest higher susceptibility in males, older age groups, and those with comorbidities. Integrated diagnostic approaches combining RT-PCR and serological testing are recommended. Future research should focus on larger cohort studies to further explore the impact of SARS-CoV-2 on TB patients and develop effective interventions.

Keywords: SARS-CoV-2; Tuberculosis; Geriatric Patients; RT-PCR; Prevalence; Comorbidities; Nigeria

1. Introduction

Tuberculosis (TB) continues to be one of the most widespread infectious diseases globally, particularly in low- and middle-income nations, where it contributes significantly to both morbidity and mortality rates. The advent of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), identified as the causative agent of COVID-19, has significantly intensified global public health efforts, particularly concerning vulnerable populations such as the elderly [1]. Elderly individuals diagnosed with tuberculosis exhibit an elevated susceptibility to negative health outcomes attributable to compromised immune function and the coexistence of various comorbid conditions [2]. The co-existence of TB and COVID-19 presents unique diagnostic and therapeutic challenges, exacerbated by overlapping clinical symptoms such as cough, fever, and respiratory distress [3]. In the context of respiratory co-infections, timely and accurate diagnosis is critical to improving patient outcomes. Molecular techniques, particularly reverse transcription polymerase chain reaction (RT-PCR), have emerged as the gold standard for the detection of SARS-CoV-2 RNA [4]. RT-PCR allows for early detection of viral RNA, even in asymptomatic individuals, and offers high sensitivity and specificity

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compared to other diagnostic methods [5]. This is particularly important in geriatric patients, who may not always exhibit classic COVID-19 symptoms due to immune senescence and the effects of comorbid conditions such as diabetes, hypertension, and chronic obstructive pulmonary disease (COPD) [6].

The convergence of TB and COVID-19 in geriatric populations is especially concerning in sub-Saharan Africa, where the burden of TB remains high and healthcare systems are under-resourced [7]. Nigeria, in particular, faces a dual epidemic, with TB accounting for over 150,000 deaths annually and COVID-19 adding further strain to the health infrastructure [8]. In this context, Infectious Disease Hospital Kano serves as a vital institution for managing respiratory diseases, including TB and COVID-19, in northern Nigeria [9]. Understanding the prevalence of SARS-CoV-2 infection among geriatric TB patients in this setting is crucial for improving diagnostic strategies and optimizing patient care. Recent studies have shown that comorbidities, including diabetes and hypertension, significantly increase the risk of severe COVID-19 and TB outcomes [10]. Diabetic patients, in particular, exhibit a higher susceptibility to TB and COVID-19 co-infection due to impaired immune responses, leading to more severe disease manifestations and increased mortality rates [11]. Similarly, patients with COPD are more likely to suffer from prolonged hospital stays and require intensive care if they contract both TB and SARS-CoV-2 [12]. These findings underscore the need for integrated management strategies that address both TB and COVID-19 in high-risk populations, particularly through molecular diagnostic approaches like RT-PCR [13].

While several diagnostic approaches exist, RT-PCR offers distinct advantages in the early detection of SARS-CoV-2 RNA among TB patients. Compared to other molecular and serological tests, RT-PCR is highly sensitive in detecting viral load, even in cases with low viral replication [14]. This sensitivity is particularly important in elderly patients with TB, as delayed diagnosis of COVID-19 in this group can lead to rapid disease progression and higher mortality [15]. Furthermore, RT-PCR facilitates the differentiation between SARS-CoV-2 and TB co-infections, which often present with overlapping symptoms, thereby enabling more targeted treatment interventions [16]. This study aims to address the critical need for accurate SARS-CoV-2 detection among geriatric TB patients by investigating the prevalence of SARS-CoV-2 RNA using RT-PCR at Infectious Disease Hospital Kano. In addition to determining the rate of co-infection, the study will explore the association between demographic factors (age, gender), comorbid conditions, and the likelihood of SARS-CoV-2 infection. By identifying the prevalence and risk factors for SARS-CoV-2 among TB patients, this study hopes to inform more effective diagnostic and therapeutic strategies, with a particular focus on molecular diagnostics [17].

1.1. Immunological interactions of stars-cov-2 in aged tuberculosis patients

SARS-CoV-2 has been shown to disrupt immune function significantly. COVID-19 can induce a hyper-inflammatory response characterized by elevated levels of pro-inflammatory cytokines and a dysregulated immune response [18]. This inflammatory environment can exacerbate existing TB infections by impairing macrophage function, crucial for controlling Mycobacterium tuberculosis (Mtb) [19]. Interaction with Comorbid Conditions Older adults with TB are likely to have comorbid conditions such as diabetes, which can complicate both TB and COVID-19 outcomes. SARS-CoV-2 exacerbates hyperglycemia and alters immune responses, potentially worsening TB infection control [20]. Additionally, chronic inflammation from TB may increase susceptibility to severe COVID-19 [21]. Impact on Immune Surveillance The immune response to SARS-CoV-2 in the presence of TB may be compromised. SARS-CoV-2-induced cytokine storms can affect the body's ability to mount an effective immune response against Mtb, leading to worse TB outcomes [22]. The interplay between SARS-CoV-2 and TB can also impact vaccine responses, making immunization strategies more complex [23].

1.1.1. Clinical Implications

Increased Risk of Severe Disease Older TB patients infected with SARS-CoV-2 may face an increased risk of severe COVID-19 due to the dual burden on their already compromised immune systems [24]. This highlights the need for early detection and aggressive management strategies to mitigate severe outcomes. Need for Integrated Care Approaches The findings underline the importance of integrating TB and COVID-19 management. Coordinated care strategies should address both infections simultaneously, focusing on controlling inflammation and maintaining immune function [25]. Vaccine Development and Treatment Research should continue to explore the combined effects of SARS-CoV-2 and TB on vaccine efficacy and treatment outcomes. Innovative approaches are required to develop vaccines and treatments that account for the complex interactions between these pathogens [26]. Conclusion The immunological interactions between SARS-CoV-2 and TB in aged patients present significant challenges, exacerbating disease severity and

complicating treatment. Understanding these interactions is essential for developing effective management strategies and improving outcomes for this vulnerable population.

1.1.2. Disadvantages of Using Serological Methods in Detecting SARS-CoV-2 Co-Infection in Aged Tuberculosis Patients

Serological methods, such as enzyme-linked immunosorbent assays (ELISA) and lateral flow immunoassays, are commonly used to detect antibodies against SARS-CoV-2, the virus responsible for COVID-19. However, these methods have specific disadvantages, particularly when applied to aged tuberculosis (TB) patients who may also be co-infected with SARS-CoV-2. Understanding these limitations is crucial for optimizing diagnostic strategies and improving patient outcomes. Delayed Detection of Antibodies Serological tests detect antibodies produced in response to an infection. In the case of SARS-CoV-2, antibodies may not be detectable until several days to weeks after the onset of symptoms or exposure [27]. In elderly TB patients, who may have a compromised immune response, the antibody response could be delayed or diminished, leading to a higher chance of false negatives during the early stages of infection [28]. The immune response to SARS-CoV-2 can vary significantly among individuals, particularly in older adults. Aging and the presence of TB can affect immune function, potentially resulting in weaker or atypical antibody responses [29]. This variability can affect the sensitivity and specificity of serological tests, making them less reliable for detecting SARS-CoV-2 co-infection in this population. Serological assays may suffer from cross-reactivity with antibodies produced in response to other infections, including TB [30]. This cross-reactivity can lead to false positives or ambiguous results, complicating the diagnosis of SARS-CoV-2 co-infection in patients with pre-existing TB, where overlapping symptoms and immune responses are common. Serological tests are less effective for detecting recent SARS-CoV-2 infections since antibodies may not be present or detectable in the initial phase of the infection [31]. This limitation is significant in elderly TB patients who may present with acute or early-stage SARS-CoV-2 infection, potentially resulting in missed diagnoses if solely relying on serological methods. Comorbid conditions, such as diabetes and chronic respiratory diseases, can impact the production and longevity of antibodies, further complicating serological detection [32]. In elderly TB patients with these conditions, the antibody response to SARS-CoV-2 might be altered, affecting the accuracy and reliability of serological tests. Lack of Standardization Variability in the performance and interpretation of serological tests can arise due to differences in test kits, methodologies, and protocols used in different laboratories [33]. This lack of standardization can lead to inconsistent results and affect the overall reliability of serological methods for detecting SARS-CoV-2 co-infection.

1.1.3. Implications for Clinical Practice

To address the limitations of serological tests, integrating them with other diagnostic methods, such as RT-PCR, can provide a more comprehensive assessment of SARS-CoV-2 co-infection [34]. Combining tests helps enhance diagnostic accuracy and overcome the limitations associated with any single method. Regular monitoring and follow-up of patients using a combination of serological and molecular tests can improve early detection and management of co-infections [35]. This approach is particularly important for elderly TB patients who may have complex clinical presentations. Continued research and development of more sensitive and specific serological assays are necessary to improve their performance in detecting SARS-CoV-2 co-infection, especially in vulnerable populations such as the elderly [36]. While serological methods provide valuable information on past exposure to SARS-CoV-2, their use in detecting co-infection in aged TB patients has notable disadvantages, including delayed antibody detection, variable immune responses, and cross-reactivity with other pathogens. These limitations highlight the need for a multimodal diagnostic approach to accurately identify and manage co-infections in this high-risk population.

2. Methodology

2.1. Laboratory Testing

2.1.1. RT-PCR for SARS-CoV-2 Detection

The presence of SARS-CoV-2 RNA in respiratory samples was determined using the RT-PCR method. The following steps were involved in RNA Extraction: RNA was extracted from the collected nasopharyngeal swabs using a commercial RNA extraction The extracted RNA was reverse transcribed into complementary DNA (cDNA) using reverse transcriptase enzymes. The cDNA was subjected to PCR amplification using specific primers targeting the SARS-CoV-2 genes. A positive result was indicated by the amplification of these gene targets, confirming the presence of SARS-CoV-2 RNA.

Quality Control Positive and negative controls were included in each PCR run to ensure the accuracy and reliability of the results.

Descriptive Statistics Frequencies, percentages, means, and standard deviations were used to describe the demographic and clinical characteristics of the study participants. Prevalence Calculation The prevalence of SARS-CoV-2 among geriatric TB patients was calculated by dividing the number of positive RT-PCR cases by the total number of participants and multiplying by 100.

3. Results

A total of 185 patients was screened using the SARS-CoV-2 PCR Detection method among ages (≥60 years) Tuberculosis Patients attending Infectious Disease Hospitals were enrolled in this study Prevalence of *SARS-COV 2* among the 185 samples collected and examined was found to be 9.7% as shown in figure 1.1. Male subjects were found to have a higher percentage *of* infection at 58.3 % than females at 41. %. Therefore. SARS-CoV-2 co-infection is relatively higher in males than females Figure 1.2 The distribution of patients according to age groups was shown in Table 1.3, the study participants were 60-70 years 108 patients (58.3%), 71-80 years 55 patients (29.4%) 81+ years 22 patients (11.8%) The average age of the participants was 70.25 years, and comorbidities are in figure1.4

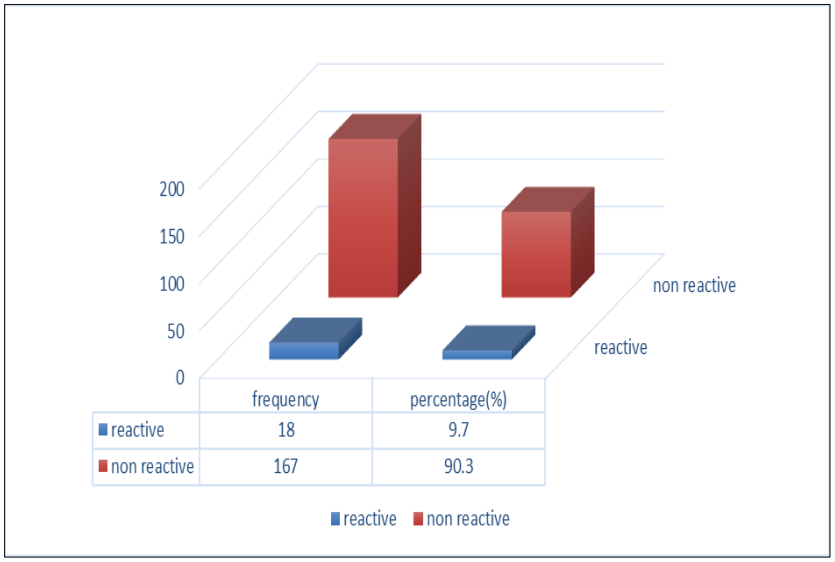

Figure 1 Prevalence of active SARS COV-2(RT-PCR) among Geriatric TB patient

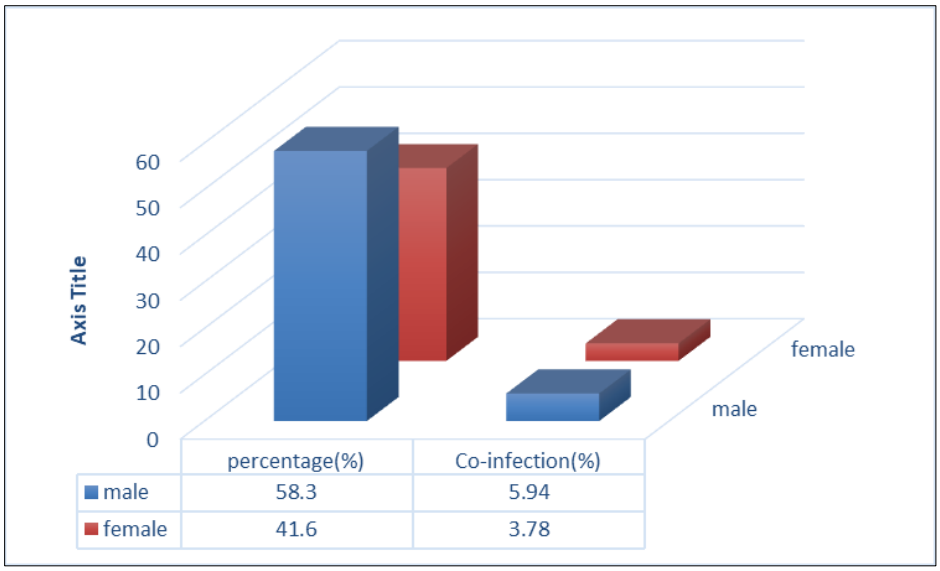

Figure 2 Gender Co-occurrence SAR-COV-2(RT-PCR) among the Geriatric TB Patients

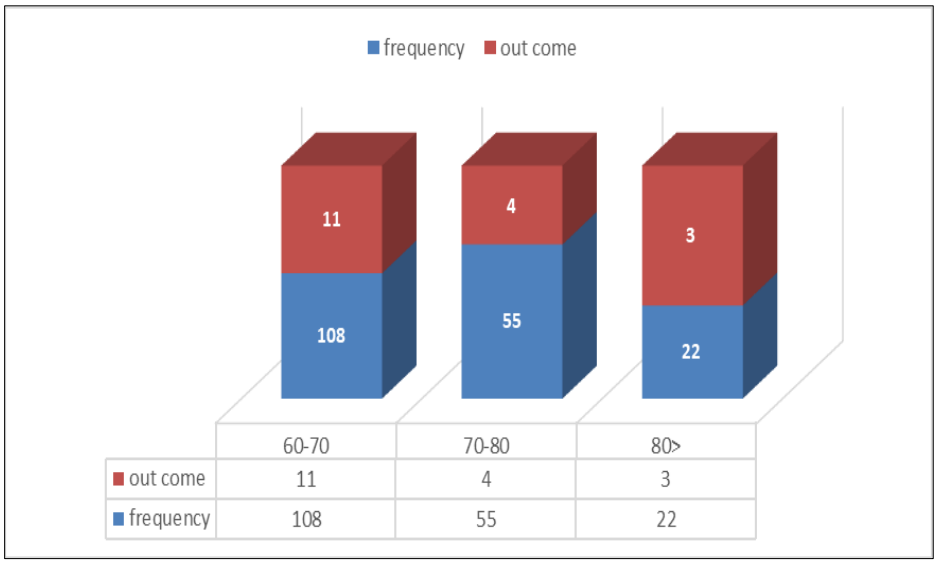

Figure 3 Age Group Co-occurrence SAR-COV-2(RT-PCR) among the Geriatric TB Patients

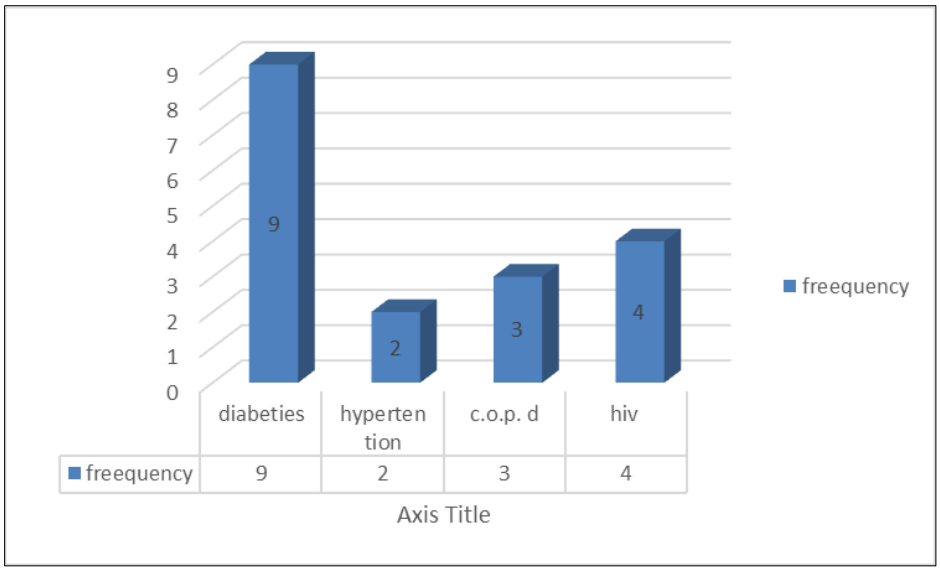

Figure 4 Ratio of Comorbidities Incidence of SAR-COV-2 among the Geriatric TB Patients

4. Discussion

The prevalence of SARS-CoV-2 RNA among geriatric tuberculosis (TB) patients in this study was 9.7%, reflecting a notable co-infection rate in a population already vulnerable due to age and comorbidities. This prevalence is consistent with similar findings in regions with high TB burdens where SARS-CoV-2 has added additional complexity to respiratory disease management [37]. The use of molecular techniques like reverse transcription polymerase chain reaction (RT-PCR) allowed for the sensitive detection of SARS-CoV-2 RNA, emphasizing the importance of integrating such diagnostic approaches in TB-endemic regions [38]. Gender Distribution of SARS-CoV-2 Positivity Among the participants who tested positive for SARS-CoV-2, a higher proportion were male (58.3%) compared to females (41.6%). This gender disparity aligns with several studies indicating that males tend to have a higher risk of severe outcomes in COVID-19 and are more likely to be infected, possibly due to biological, lifestyle, and social factors[39] For instance, males have been found to have higher expression levels of angiotensin-converting enzyme 2 (ACE2), the receptor SARS-CoV-2 uses to enter cells, which may explain the increased infection rates in men [40]. Additionally, gender-based differences in immune response, particularly related to estrogen's protective role in females, might account for this observed discrepancy [41]. Age-Specific Prevalence of SARS-CoV-2 The age-specific prevalence showed that the highest rate of SARS-CoV-2 infection occurred in the 60-70 age group, followed by the 70-80 group, and the lowest in those over 80 years. This trend may be related to the degree of exposure and immune function across different age groups. The 60-70 age group represents a population that might still be relatively active compared to the older group, thus increasing their exposure to the virus [42]. However, as immune senescence progresses, the ability of the immune system to mount an effective response to new infections declines, increasing susceptibility to infections such as SARS-CoV-2 in those aged 70 and above [43].

Older adults, particularly those over 70 years, tend to have more severe outcomes from both COVID-19 and TB due to reduced lung function, immunological decline, and the presence of comorbidities [44]. The relatively lower prevalence of SARS-CoV-2 among those over 80 in this study may reflect the smaller number of individuals in this age group, as well as their potentially reduced exposure due to limited mobility. Nonetheless, the observed infections in this age bracket emphasize the need for targeted interventions such as enhanced screening and preventive measures for the elderly with TB [45]. A significant portion of the SARS-CoV-2 positive cases were among participants with comorbid conditions. The presence of comorbidities such as diabetes (9 cases), HIV (4 cases), COPD (3 cases), and hypertension (2 cases) significantly influenced the likelihood of SARS-CoV-2 infection, consistent with existing literature on co-infections [46]. Diabetic patients represented the majority of those with co-infections, a finding that is not surprising given the well-documented link between diabetes, compromised immune response, and increased risk of infections [47]. Diabetes is known to impair the immune system, particularly by affecting macrophage and neutrophil function, thus facilitating the persistence and replication of pathogens such as Mycobacterium tuberculosis and SARS-CoV-2 [48]. Chronic obstructive pulmonary disease (COPD), observed in 3 positive cases, also heightens vulnerability to respiratory

infections due to the pre-existing damage in lung tissues [49]. The presence of COPD can worsen the clinical course of both TB and COVID-19 by creating a conducive environment for viral replication, leading to exacerbated pulmonary symptoms and increased mortality [50]. Patients with COPD often have difficulty clearing pathogens from the lungs, further highlighting the importance of early and accurate diagnosis through molecular methods such as RT-PCR to reduce the severity of co-infections [51]. HIV-positive individuals, constituting 4 of the SARS-CoV-2 positive cases, also demonstrated higher susceptibility to COVID-19. HIV is associated with immunosuppression, which predisposes individuals to both TB and other opportunistic infections, including SARS-CoV-2 [52]. Co-infection with HIV, TB, and SARS-CoV-2 presents a particularly challenging scenario, as all three infections exploit weakened immune systems. This underscores the importance of close monitoring and prioritizing these patients for testing and treatment in settings like Aminu Kano Teaching Hospital [53].

4.1. RT-PCR as a Diagnostic Tool in Co-Infections

The application of RT-PCR in this study demonstrated its utility as a reliable diagnostic tool for identifying SARS-CoV-2 RNA among geriatric TB patients. RT-PCR has been recognized as the gold standard for detecting COVID-19 due to its sensitivity and ability to detect low viral loads, which is critical in cases where symptoms may overlap with TB or are mild, particularly in elderly populations [54]. By enabling early detection, RT-PCR helps prevent delayed diagnosis, which is often associated with worse clinical outcomes, especially in patients with underlying conditions such as diabetes, COPD, and HIV [55]. The findings of this study underscore the importance of integrating molecular diagnostics into routine care for TB patients, particularly those with comorbidities, as it allows for timely identification of co-infections and the implementation of appropriate treatment strategies [56]. Moreover, given the continuing circulation of SARS-CoV-2 and the significant mortality associated with co-infection in high-risk populations, efforts to increase RT-PCR capacity and accessibility in regions like Kano, Nigeria, should be prioritized [57].

4.2. Implications for Public Health and Future Research

The co-infection of TB and COVID-19 in geriatric patients, particularly those with comorbidities, presents a public health challenge that requires a coordinated approach to diagnostic, preventive, and therapeutic strategies. The findings from this study highlight the need for enhanced surveillance and screening programs, particularly in settings with high burdens of both diseases [58]. Routine RT-PCR testing should be integrated into TB management protocols to improve detection rates and mitigate the risk of severe outcomes associated with undiagnosed SARS-CoV-2 infection [59]. Future research should focus on larger cohort studies that can further elucidate the impact of specific comorbidities on the severity of TB and COVID-19 co-infections. Additionally, the development of rapid molecular diagnostic tools that are both cost-effective and accessible in low-resource settings like northern Nigeria would be beneficial in controlling the dual epidemics of TB and COVID-19 [29]. Expanding such research would provide critical insights into the management of these infections and improve patient outcomes in geriatric populations.

5. Conclusion

This study underscores the significant prevalence of SARS-CoV-2 co-infection among geriatric tuberculosis (TB) patients, with 9.7% testing positive for SARS-CoV-2 RNA using RT-PCR. The findings highlight the critical need to monitor vulnerable populations, especially the elderly with pre-existing respiratory conditions like TB, as they are at heightened risk of severe outcomes from co-infections. The higher prevalence in males and individuals aged 60-70 years, as well as the presence of comorbidities such as diabetes, HIV, and COPD, emphasizes the compounded risk factors contributing to poor health outcomes in these patients. The application of RT-PCR as a reliable molecular tool for the detection of SARS-CoV-2 in these patients proved crucial in identifying infections that might otherwise go unnoticed, ensuring timely management, and minimizing transmission within healthcare settings.

The results of this study not only provide valuable insights into the intersection of COVID-19 and TB but also point to the necessity for more integrative and vigilant healthcare strategies, especially in resource-constrained environments like Infectious Disease Hospital, Kano, Nigeria. In the context of the ongoing pandemic, recognizing and addressing the dual burden of TB and COVID-19 remains a public health priority.

Recommendations

- Routine Screening and Diagnostic Strengthening: Integrate SARS-CoV-2 screening in TB management,

especially for high-risk geriatric patients, and enhance RT-PCR availability in healthcare facilities to ensure timely detection and isolation.

- Focused Care for Vulnerable Populations: Prioritize high-risk groups (older adults, males, and those with comorbidities) in screening, treatment, and vaccination efforts to reduce co-infection morbidity and mortality.
- Integrated Management and Public Awareness: Establish co-infection clinics, raise public awareness of preventive practices, and encourage further research on TB-COVID-19 co-infection impacts to support better healthcare outcomes and resource-efficient diagnostics.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest is to be disclosed.

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