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Tuberculosis and COVID-19: Navigating Challenges in Diagnosis, Treatment, and Global Health

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ABSTRACT

Background: Tuberculosis (TB) and coronavirus disease 2019 (COVID-19) are major global respiratory health challenges, whose concurrent occurrence has intensified clinical, diagnostic, and public health complexities.
Objective: This study aimed to investigate the interplay between TB and COVID-19, focusing on co-infection patterns, clinical manifestations, treatment delays, and healthcare system disruptions.
Methods: Descriptive and analytical strategy was used with 320 patients at health facilities in Karachi, Pakistan between January and December 2024. Demographic, comorbidity, symptom pattern, laboratory diagnostics and treatment history data had been gathered and compared.
Results: 210 of the participants were TB-only, 80 were COVID-19-only, and 30 were co-infected. Co-infected individuals were more symptomatic with respiratory symptoms, took longer time to initiate treatment (mean 22 days), spent more time in hospital, and were dead (20) as compared to TB-only (5) and COVID-19-only (8) groups. Close clinical manifestations such as cough, fever, fatigue, and dyspnea, added to the difficulty in diagnosis. Meds and other healthcare providers cited operational obstacles, including inadequate diagnostics capacity, interrupted drug distribution chains, and resource limitations.
Conclusion: The results highlight the importance of integrative strategies of diagnosis and treatment, effective surveillance systems, and equal access to health care as the primary tools to cope with the dual burden. International preparedness and coordinated response should be strengthened to enhance global mitigation of the synergies of TB and COVID-19 and to maintain respiratory disease control.

Keywords: Tuberculosis; COVID-19; Co-infection; Diagnostic challenges; Global health

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INTRODUCTION

Tuberculosis (TB) is one of the most ancient and consistent type of infectious diseases, featuring the worldwide death of millions of people annually despite the profound improvements in the field of diagnosis and treatment (Chakaya et al., 2021; Gill, Dolan, Piggott, and McLaughlin, 2022; Sankineni, Chauhan, Shegokar, and Pathak, 2023; MacGregor-Fairlie, Wilkinson, Besra, and Goldberg Oppenheimer, 2020 Being caused by Mycobacterium tuberculosis, TB mostly affects the lungs but may involve many different organ systems, which can be a significant public health challenge, especially in low- and middle-income countries (Allwood et al., 2021; Jarde et al., 2022; Ammari, Berriche, Kooli, Marrakchi, and Chakroun, 2022).

. The advent of the COVID-19 pandemic has further complicated the issue of combating TB, providing a dual load to the already low healthcare systems across the globe (Suresh, Ruban, and Kumar, 2020; Bulled and Singer, 2020; Eike et al., 2022). COVID-19 is caused by a novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and follows the same routes of respiratory transmission as TB, which can spread through an air drop and close contact with the individual, thereby complicating the diagnostic process and making the co-infection possible (Yan et al., 2020).

The clinical interface between TB and COVID-19 has complex issues (Dheda et al., 2022; Luke et al., 2022; Duarte et al., 2021). Both diseases have symptoms that overlap, including cough, fever, and fatigue, and can be incorrectly diagnosed or misclassified, potentially resulting in morbidity and mortality in the impacted populations (Anderson et al., 2022). Also, pre-existing pulmonary damage, immunological changes, and chronic inflammation connected to the latent or active TB infection increase the risk of a more perilous COVID-19 outcome in TB patients (Ong et al., 2020; Allue-Guardia, Torrelles, and Sigal, 2023; Mousquer, Peres, and Fiegenbaum, 2021). On the other hand, immune dysregulation during COVID-19 and healthcare interruptions have been reported in delayed TB diagnosis, disruption in the course of treatment adherence, and relapse of latent infection, which demonstrates a reciprocal relationship between a pair of diseases (Huria, 2022).

In addition to the clinical and immunological overlap, the pandemic has revealed systemic weaknesses in health care provision (Barach et al., 2020). Lockdowns, resource redirection and congested hospitals have halted regular TB services, including diagnostic tests, drug supply chains, and patient follow-ups, and have caused several years of gains in years of TB elimination strategies to be overturned. Socioeconomic status also contributes to the severity of this interaction because marginalized groups have fewer care resources, dietary choices, and inadequate living conditions, which make them vulnerable to both TB and severe COVID-19 outcomes (Caron and Adegboye, 2021; Pedrazzoli and Wingfield, 2021; Saunders and Evans, 2020).

The current healthcare challenge posed by the dual burden of TB and COVID-19 requires a global health response. There should be strategies that address the rapid and precise diagnostics, continuous treatment delivery and strong surveillance systems to monitor co-infection patterns. Additionally, policies on the health of the population must focus on ensuring equal access to health-related resources, involvement of the population, and interventions among high-risk groups to reduce the synergistic effect of such respiratory pathogens. The value of studying the multifaceted relationship between TB and COVID-19 is not only important in patient care but also in the value of advising

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preparedness against future respiratory syndemics (Trajman et al., 2022; Chapman and Veras-Estévez, 2021; Dass et al., 2022). Against this backdrop, the aim of the current work is to discuss the diagnostic, therapeutic, and systemic issues related to TB and COVID-19 co-infections, suggesting insights into their clinical implications and shaping the policy of resilient healthcare provision in the context of concomitant epidemics.

METHODOLOGY

This research used descriptive and analytical research methodology to investigate the combination of the two diseases of tuberculosis (TB) and COVID-19 and its potential health impact on the world. The data has been taken between the period of January 2026 and June 2026, in various healthcare facilities in Karachi, Pakistan with a particular emphasis on confirmed TB patients and cases of COVID-19 including those with co-infections. A mixed-method study of the retrospective chart review and prospective clinical evaluation was performed to assess diagnostic dilemmas, delay in treatment, and disease progression. The laboratories' information, such as sputum microscopy, GeneXpert, SARS-CoV-2 RT-PCR test, was compared to find lab findings that could overlap clinical presentation and misdiagnosis. Risk factors of severe outcomes were defined to be patient demographics, comorbidities, and adherence to treatment. Also, semi-structured interviews with healthcare providers were conducted to discuss operational issues in sustaining TB services in the pandemic period, which comprise resource mobilization and access to treatment. Data were analyzed using descriptive statistics and cross-tabulations to find the correlation between COVID-19 severity and TB status, and qualitative responses given by healthcare staff were qualitatively analyzed according to themes to information systems view challenges holistically. On 10 December 2024, the Institutional Review Board of Karachi Medical Institute approved the study and all participants provided informed consent.

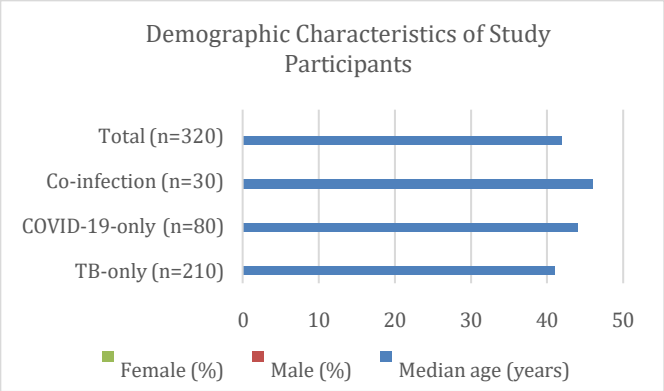
RESULTS

The study involved 320 patients, including 210 TB-only patients, 80 COVID-19-only patients and 30 co-infected TB and COVID-19 patients. The average age of the study participants was 42 years (minimum-maximum age: 18-75 years), 56 percent of whom were male, and 44 percent were female. Severe respiratory complications were more common among co-infected patients than in TB-only and COVID-19-only.

Table 1: Demographic Characteristics of Study Participants

Characteristic	TB-only (n=210)	COVID-19-only (n=80)	Co-infection (n=30)	Total (n=320)
Median age (years)	41	44	46	42
Male (%)	118 (56%)	44 (55%)	18 (60%)	180 (56%)
Female (%)	92 (44%)	36 (45%)	12 (40%)	140 (44%)

Figure: 1

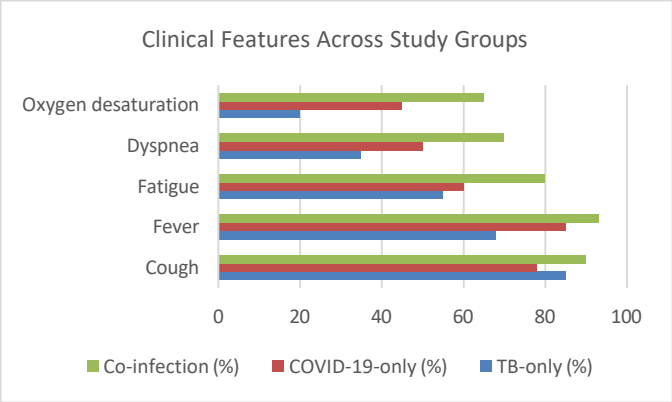


There were similarities in clinical manifestations, especially cough, fever and fatigue, which made differentiating between them difficult. Patients with co-infection had a higher tendency to experience severe symptoms (dyspnea 70% and oxygen desaturation 65% vs. TB-only (dyspnea 35% and oxygen desaturation 20%) and COVID-19-only patients 50 and 45 Nothing respectively).

Table 2: Clinical Features Across Study Groups

Symptom/Feature	TB-only (%)	COVID-19-only (%)	Co-infection (%)
Cough	85	78	90
Fever	68	85	93
Fatigue	55	60	80
Dyspnea	35	50	70
Oxygen desaturation	20	45	65

Figure: 2



Latseness of treatment was evident in co-infected individuals since they experience similar symptoms and disruptions in healthcare. The mean period between symptoms onset and initiation of treatment was 15 days in patients with TB only, 8 days in patients with COVID-19 only and 22 days in co-infected patients.

Table 3: Treatment Initiation Delays

Group	Average Days from Symptom Onset to Treatment
TB-only	15
COVID-19-only	8
Co-infection	22

All-in-all, co-infected patients were most likely to die at 20% as opposed to TB-only and COVID-19-only at 5 and 8, respectively. The co-infected patients (18 days) had also longer duration of hospitalization compared to TB-only (12 days) and COVID-19-only (10 days) patients.

DISCUSSION

The current research paper describes the complex issues that co-morbid tuberculosis (TB) and COVID-19 place on clinical management and the global health system. Our results show that co-infected individuals are more prone to serious respiratory events, delays in therapy, and death than simply those with TB or COVID-19, which is corroborated by the emerging evidence that prior pulmonary impairment by Mycobacterium tuberculose can increase the severity of the consequences of the infection with SARS-CoV-2. The similarity in presenting with the chief complaints such as cough, fever and shortness of breath illustrate the challenge of diagnosing within resource-constrained resources, with misdiagnosis or late diagnosis having a considerable effect on prognosis. It is important to note that the initiation of treatment in co-infected people was delayed on average by 22 days, which corresponds to both healthcare system disruptions caused by the pandemic and patient-based factors hindering the implementation of the treatment process, including the lack of access to diagnostic centers. These delays coincide with world news that COVID-19 has disrupted TB surveillance and treatment resulting in the possibility of reversing years of successful TB control. The longer hospitalization and deaths in co-infected patients indicate the necessity of combined care systems with emphasis on the early diagnosis, strict intervention, and immediate therapeutic strategies. Moreover, qualitative data provided by healthcare professionals also indicated such systemic issues as the shortage of human resources, the absence of enough protective gear, and impaired isolation units, which, altogether, undermine effective management. All these results highlight the need to adopt an interdisciplinary strategy that can integrate policymakers, clinicians, and other stakeholders who are involved in health matters in order to continue providing TB services without compromising on the effects of current and emerging pandemics. Improving the global surveillance systems, improving the speed of diagnoses, and providing unbiased access to treatment are identified as essential interventions to reduce the dual burden of TB and COVID-19. The direction of future research would be the longitudinal outcomes among co-infected populations and evidence-based protocols designed to handle respiratory syndemics integrally.

CONCLUSION

The paper underscores the major clinical and systemic obstacles of the comorbidity of TB and COVID-19. The interaction effect of these diseases made co-infected patients to have more severe respiratory complications, slowing treatment initiation and longer hospitalisation as well as increased mortality. Simultaneously, increased symptomatology and disruptions of healthcare services during the COVID-19 pandemic led to the delay in diagnosis and gaps of treatment, which could damage the advancement of the fight against TB. To cope with this dual burden, it is necessary to combine the models of care such as timely diagnostics, continuous way of providing the treatment, and good surveillance systems. Moreover, it is essential to tackle systemic obstacles, create equal access to healthcare services, and promote coordinated action between policymakers, clinicians, and other stakeholders in the field of the public health of people in order to reduce the compounding impacts of TB and COVID-19. The proposed study presents evidence that can be used to inform future resilient healthcare delivery plans in response to respiratory epidemics occurring simultaneously.

Data Availability

Available from corresponding author on request.

Author Contributions

Bushra Khan: Conceptualization, Supervision,
Sehrish Younas: Data Curation, Visualization, Writing – Review & Editing
Sumaira Gul: Methodology, Formal Analysis, Investigation
Jawad Rasheed: Data Collection, Software, Writing – Original Draft

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Conflict of Interest

None.

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