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Prevalence of Co-Morbidities and Treatment Outcomes Among Tuberculosis Patients in Kalahandi District, Odisha: A Cross-Sectional Study Using Secondary Data

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ABSTRACT

Tuberculosis (TB) continues to be a major public health issue in India, particularly in rural and underserved regions. Co-morbidities such as diabetes mellitus (DM) and HIV can complicate TB diagnosis, management, and treatment outcomes. This study explores the prevalence of co-morbid conditions and their influence on treatment outcomes among TB patients in Kalahandi district, Odisha. Using a cross-sectional design, secondary data were obtained from the District Tuberculosis Centre (DTC). A total of 100 patient records, aged 18–65, were systematically sampled and analyzed using descriptive statistics in SPSS Version 20. Among the patients, 13% had diabetes and 2% had HIV, while 85% showed no recorded co-morbidities. Pulmonary TB was observed in 87% of cases, and 67% were male. Overall, 51% of patients were cured, 35% completed treatment, and 11% died. Cure rates were highest among patients without co-morbidities, whereas diabetic patients showed relatively higher mortality and loss to follow-up, despite their smaller proportion in the sample. The findings underscore the importance of integrating routine screening for diabetes and HIV into TB care services. Even a low prevalence of co-morbidities can negatively impact treatment outcomes. Strengthening bidirectional screening, integrated care models, and robust data systems is essential for improving TB management and patient outcomes in high-burden, low-resource settings like Kalahandi.

Keywords: Tuberculosis; Diabetes Mellitus; HIV; Co-morbidity; Public Health

Abbreviations: TB: Tuberculosis; DM: Diabetes Mellitus; DTC: District Tuberculosis Centre; RNTCP: Revised National Tuberculosis Control Programme; DOTS: Directly Observed Treatment Short-Course; PHCs: Primary Health Centres; CHCs: Community Health Centres

Introduction

Tuberculosis (TB) is a communicable disease caused by Mycobacterium tuberculosis, primarily affecting the lungs but capable of involving other organs. Despite global efforts to control it, TB remains one of the world's leading causes of infectious disease mortality, especially in low- and middle-income countries (Central Tuberculosis Division, [1]). India bears the highest TB burden globally, accounting for approximately 24% of all reported cases (Shivalingaiah, et al. [2]). The disease disproportionately affects people between 15 and 69 years of age, resulting in significant social and economic impacts due to loss of productivity and prolonged treatment needs (Central Tuberculosis Division, [1]). TB frequently coexists with both communicable and non-communicable diseases (CDs and NCDs), such as HIV/AIDS, diabetes mellitus (DM), and malnutrition. These co-morbidities weaken the immune system, making individuals more susceptible to TB infection and complicating treatment outcomes (Dooley & Chaisson [3,4]). The bidirectional relationship between TB and diabetes has gained growing attention in recent years. Diabetes increases the risk of developing active TB and may delay sputum conversion and recovery, while TB can worsen glycemic control in diabetic patients (Dooley & Chaisson [3]). This dual burden is particularly alarming in India, where the incidence of diabetes is steadily rising even in rural and tribal populations.

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Although India has adopted robust strategies through the Revised National Tuberculosis Control Programme (RNTCP) to address TB burden, considerable gaps persist. Research shows that only about half of healthcare providers correctly diagnose TB, and fewer than one-third follow recommended treatment protocols such as Directly Observed Treatment Short-Course (DOTS) (Satyanarayana, et al. [5]). While public health providers demonstrate better compliance—likely due to formal training and programmatic support—the private sector continues to suffer from inadequate adherence to standards (Satyanarayana, et al. [5]). In rural areas like Kalahandi district in Odisha, TB is endemic, and patients primarily rely on public healthcare systems for diagnosis and treatment. Although HIV–TB co-infection has been extensively studied, limited data exists on other co-morbidities, particularly diabetes, among TB patients in this region (District Human Development Report Kalahandi [6]). As the burden of metabolic disorders such as diabetes rises in rural India, examining their intersection with TB becomes critical for tailoring effective public health strategies (Bates, et al. [4,7]). Moreover, social determinants such as malnutrition, overcrowding, poor ventilation, stigma, and delayed access to care further complicate TB outcomes (Duarte, et al. [7]).

Given this context, the present study was undertaken to assess the prevalence of co-morbid conditions—especially diabetes and HIV—among TB patients in Kalahandi district, Odisha. Additionally, it aims to evaluate how these co-morbidities impact treatment outcomes. The findings are intended to inform integrated TB–NCD care models and guide policy decisions in high-burden, resource-limited settings.

Review of Literatures

The coexistence of tuberculosis (TB) with non-communicable diseases such as diabetes mellitus (DM) and communicable conditions like HIV is a growing global health concern. Several studies have underscored the high prevalence of diabetes among TB patients, with a global meta-analysis reporting a median prevalence of 16% (IQR: 9–25%) and a higher rate of 21% observed in South Asia (Chinagudaba, et al. [8,9]). Li, et al. [10] further estimated the global prevalence of diabetes among pulmonary TB patients at 13.7% (95% CI: 12.5–15.0%), reinforcing the magnitude of this syndemic. In India, research highlights significant variation in DM prevalence among TB patients. A study in Manipal found a 25.3% prevalence of diabetes among hospitalized TB patients, with higher rates among pulmonary TB cases (Pande, et al. [11]). In contrast, a study in South India found the co-prevalence ranged between 8.5% and 11%, indicating that clinical setting, diagnostic intensity, and regional factors influence reported rates (Ragouraman [12]). Similar findings have been reported in other Indian states—19.6% in Kerala, 25–29% in Tamil Nadu and Puducherry, and 13.7% in Delhi—suggesting regional disparities in prevalence likely driven by urbanization and healthcare accessibility (Kottarath, et al. [13-15).

TB–DM co-morbidity not only influences disease presentation but also impacts treatment outcomes. Patients with both conditions face 1.7 times higher odds of mortality and treatment failure compared to TB patients without diabetes (Lutfiana, et al. [16]). Delayed sputum conversion, poor glycemic control, and longer recovery periods are common in co-infected individuals (Dooley [3,17]). Moreover, some studies note that pulmonary TB is more commonly associated with DM than extra-pulmonary forms, likely due to metabolic and immunological mechanisms (Pande, et al. [3,18]). Bidirectional screening has been widely endorsed as a key intervention in high-burden settings. It enables early diagnosis and integrated disease management, improving overall prognosis (Samal [19]). Evidence from India supports the feasibility of this approach, especially in primary care and DOTS settings (Joshi, et al. [20,21]). International guidelines also recommend screening TB patients for diabetes and vice versa, especially in low- and middle-income countries (Milice, et al. [22]). In addition to diabetes, HIV co-infection is another major concern. Although its prevalence among TB patients varies by region, HIV significantly impairs immunity, increasing susceptibility to TB and complicating clinical outcomes (Bates, et al. [4,23]). A Vietnamese study reported a 13.7% DM prevalence in TB patients, while HIV prevalence tends to be lower but is highly context-dependent (Hoa, et al. [24]). Furthermore, TB presents differently depending on age, gender, and co-morbid conditions.

Among the elderly, TB is more often pulmonary, but typical symptoms such as haemoptysis or night sweats may be absent. Instead, patients present with atypical signs such as dyspnoea or even neurological symptoms in extra-pulmonary forms like TB meningitis (Peltzer [25,26]). Gender disparities are also evident; males are more frequently diagnosed with TB, often due to occupational exposure, lifestyle habits, and healthcare-seeking behaviors (Siddiqui, et al. [23,27]). The quality of TB care also significantly affects outcomes. In India, studies reveal that only half of healthcare providers are familiar with correct diagnostic procedures, and less than one-third adhere to standard treatment regimens such as DOTS (Satyanarayana, et al. [5]). This knowledge gap is more pronounced in the private sector, where there is often less regulatory oversight. Public sector providers, by contrast, benefit from training and support under national programs like the Revised National Tuberculosis Control Programme (RNTCP), resulting in better adherence to clinical protocols (Satyanarayana, et al. [5]). Social determinants such as malnutrition, poverty, stigma, overcrowded housing, and lack of awareness play critical roles in disease transmission and patient adherence to treatment (Duarte, et al. [7]). In rural and tribal regions like Kalahandi district, Odisha, poor access to health services and diagnostic infrastructure exacerbates these problems.

The District Human Development Report [6] highlights a shortage of healthcare professionals, low literacy, and poor living conditions in the region—all of which contribute to delayed diagnosis and poor TB outcomes (Government of Odisha [28]). Globally, TB remains a major burden. The WHO Global TB Report (2016) noted that out of the 10.4 million TB cases in 2015, India alone contributed 2.8 million. Despite national-level strategies and international partnerships, underdiagnosis, incomplete treatment, and emerging drug resistance continue to threaten TB control (World Health Organization [29-31]). The 18th Global TB Annual Report (2012) reported 8.6 million incident TB cases and 1.3 million deaths globally, with a significant proportion occurring in Southeast Asia and Africa. A large share of these deaths involved individuals with co-morbidities like HIV and diabetes (Bates, et al. [4]). Despite increasing global recognition of the TB–diabetes syndemic, there is a lack of granular, district-level data from rural and tribal regions of India, where health infrastructure is limited and disease management is often suboptimal. Most existing studies are concentrated in urban or tertiary care settings, failing to capture the unique challenges of early diagnosis, treatment adherence, and co-morbidity management in low-resource areas. Kalahandi district, characterized by poverty, inadequate healthcare access, and a high TB burden, exemplifies such settings.

This study fills a crucial research gap by investigating the prevalence of diabetes and HIV co-morbidities among TB patients and assessing their treatment outcomes using programmatic data. The findings hold significant implications for tailoring integrated TB–NCD care strategies, guiding resource allocation, and informing district-level public health interventions. Ultimately, the study contributes to a more equitable and evidence-based response to TB control in India's underserved regions. In line with this objective, the primary aim of the study is to determine the prevalence of co-morbid conditions—particularly diabetes mellitus and HIV—among TB patients in Kalahandi district and to evaluate how these co-existing conditions influence treatment outcomes, with the broader goal of informing integrated care strategies for high-burden rural areas.

Methodology

Objectives

1. To identify the co-morbid conditions commonly associated with TB patients.
2. To determine the prevalence of co-morbidities such as diabetes and HIV among patients currently undergoing TB treatment.
3. To assess treatment outcomes of TB patients registered at the District Tuberculosis Centre (DTC) in Kalahandi.

Study Setting

The study was carried out across all 13 blocks of Kalahandi District in Odisha, India. Kalahandi is recognized as a resource-poor, high-burden region for TB, making it a relevant location for examining the intersection of TB and co-morbid health issues. The data used for the study was obtained from the District TB Centre (DTC), which maintains comprehensive treatment records and case profiles of patients across the district.

Study Design

This study follows a cross-sectional design, focusing on describing the prevalence of co-morbidities at a specific point in time among TB patients. It specifically examines the presence of diabetes mellitus and HIV infection among patients undergoing TB treatment. The cross-sectional design is well-suited for prevalence studies as it allows the researcher to quantify health-related issues without the need for long-term follow-up.

Study Participants

There were no direct participants involved in this study as it utilized secondary data obtained from the DTC in Kalahandi. Due to the logistical and safety constraints imposed by the COVID-19 pandemic, the collection of primary data through interviews or surveys was not feasible. Instead, the study relied on existing patient records, which included essential medical and demographic information.

Sample Size

A total of 100 TB patient records were selected and reviewed for this study. These records were systematically sampled from the DTC database, ensuring representation across the 13 blocks. The selected cases included both pulmonary and extra-pulmonary TB patients, covering a diverse demographic and clinical profile.

Sampling Technique

The data was obtained through random sampling from the existing digital database of the DTC. Only records that met the inclusion criteria (i.e., complete records with co-morbidity status and treatment outcome) were selected. The use of random sampling helps minimize selection bias and improve the reliability of the findings.

Data Collection Technique

A systematic data collection technique was employed to extract relevant information from the patient database. The data included details such as age, gender, site of TB (pulmonary or extra-pulmonary), presence of diabetes or HIV, and treatment outcomes. Each record was screened and coded according to a structured data collection sheet designed to ensure consistency.

Outcome and Variable Definitions

The key variables included:

- Co-morbidities: Presence of diabetes mellitus or HIV infection.
- Demographics: Age and sex of the patients.
- Clinical Characteristics: Site of TB infection (pulmonary vs. extra-pulmonary).
- Treatment Outcomes: Defined according to national guidelines and included categories such as cured, treatment completed, treatment failure, death during treatment, and lost to follow-up.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics 20. Descriptive statistics (frequencies and percentages) summarized demographic and clinical characteristics. Cross-tabulations were used to explore patterns between co-morbidities and treatment outcomes across subgroups such as gender, age, and site of infection.

Ethical Considerations

The study used de-identified secondary data, thereby eliminating any direct ethical risk to individuals. Formal informed consent was not required as no direct contact with patients was involved. However, institutional approval was obtained from the District Tuberculosis Centre (DTC), Kalahandi, to access anonymized patient records. The confidentiality and privacy of patients were strictly maintained throughout the research process. Table 1 shows co-morbidity data among 100 TB patients across 13 blocks of Kalahandi district. Diabetes mellitus was present in 13% of patients, while 2% had HIV co-infection; 85% reported no co-morbidities. The notable prevalence of diabetes highlights the emerging TB–diabetes syndemic, suggesting the need for integrated care. The low HIV rate may indicate successful interventions or possible underreporting. The high percentage of patients without co-morbidities could reflect a healthy baseline or gaps in routine screening. These findings stress the importance of incorporating regular diabetes screening and management into TB programs, especially in high-burden areas. Early detection of co-morbidities can significantly enhance treatment outcomes and reduce TB-related mortality. Table 2 presents gender distribution among 100 TB patients across 13 blocks of Kalahandi district, showing 67% male and 33% female patients. This male predominance aligns with national and global TB trends. Contributing factors may include greater occupational exposure, tobacco use, mobility, and delayed health-seeking among men.

Table 1: Co-morbidities Present in TB Patients from 13 Blocks of Kalahandi District.

Co-morbidity	N	%
Diabetes	13	13%
HIV	2	2%
No co-morbidities	85	85%
Total	100	100%

Table 2: Gender of TB Patients from 13 Blocks of Kalahandi District.

Gender	N	%
Female	33	33%
Male	67	67%
Total	100	100%

Conversely, underreporting among women due to stigma or limited healthcare access in rural areas may skew the data. Understanding this gender disparity is crucial for developing targeted, gender-sensitive interventions. Awareness campaigns and accessible healthcare services can aid in early diagnosis and improved treatment adherence, especially for underrepresented female patients. Table 3 outlines treatment outcomes among 100 TB patients categorized by co-morbidity status—diabetes, HIV, and no co-morbidity. Overall, 51% were cured, 35% completed treatment, 11% died, 1% had treatment failure, and 2% were lost to follow-up. Among diabetic patients (n=13), 8 were cured and 2 completed treatment, while 2 deaths and 1 lost to follow-up suggest that diabetes may adversely affect outcomes. Both HIV-positive patients were cured, though the small sample limits interpretation. Interestingly, 9 of the 11 total deaths occurred among patients without known co-morbidities, possibly reflecting undiagnosed conditions, delayed diagnosis, malnutrition, or socio-economic barriers. The low rates of treatment failure and loss to follow-up indicate effective adherence support within the TB program. These findings highlight the need for routine screening for co-morbidities and a more individualized approach to care. Integrating diabetes and HIV management into TB services may enhance treatment success and reduce mortality, especially in high-burden areas like Kalahandi.

Table 3: Health Outcomes of TB Patients from 13 Blocks of Kalahandi District.

Outcome	Diabetic	HIV	No Co-morbidities	Total
Treatment Completed	2	0	33	35
Cured	8	2	41	51
Died	2	0	9	11
Treatment Failure	0	0	1	1
Lost to Follow-up	1	0	1	2
Total	13	2	85	100

Table 4 presents treatment outcomes based on TB infection site—87% had pulmonary TB, while 13% had extra-pulmonary TB. Pulmonary TB cases showed better outcomes, with 51 cured, 24 completing treatment, and fewer deaths (9), one treatment failure, and two lost to follow-up. In contrast, extra-pulmonary TB patients had no recorded cures, 11 completed treatment, and 2 deaths, indicating higher mortality and lower cure rates. This suggests that extra-pulmonary TB may have poorer outcomes due to delayed diagnosis, complex clinical management, and limited diagnostic tools. Pulmonary TB, being more detectable, benefits from earlier intervention. These findings call for strengthened diagnostic facilities and tailored care for extra-pulmonary TB cases, especially in under-resourced areas like Kalahandi. Table 5 presents the distribution of co-morbidities—diabetes and

HIV—among male and female TB patients in Kalahandi district. Of the 100 TB patients, 67 were male and 33 were female. Among males, 10 were diabetic, 1 had HIV, and 56 had no co-morbidities. Among females, 3 were diabetic, 1 had HIV, and 29 had no co-morbidities. The data indicates that diabetes is more prevalent among male TB patients (14.9%) than female TB patients (9.1%). This could be due to gender-related lifestyle factors such as diet, physical activity, or higher rates of undiagnosed diabetes among men. HIV co-infection appears evenly distributed between genders, though the small sample size limits broader generalizations.

Table 4: Site of Disease Outcome of TB Patients from 13 Blocks of Kalahandi District.

Outcome	Extra-Pulmonary	Pulmonary	Total
Treatment Completed	11	24	35
Cured	0	51	51
Died	2	9	11
Treatment Failure	0	1	1
Lost to Follow-up	0	2	2
Total	13	87	100

Table 5: Gender-wise Co-morbidities Outcome of TB Patients from 13 Blocks of Kalahandi District.

Co-morbidity	Female	Male	Total
Diabetic	3	10	13
HIV	1	1	2
No Co-morbidities	29	56	85
Total	33	67	100

These findings point to the importance of gender-sensitive screening strategies for co-morbidities among TB patients. Given the higher occurrence of diabetes in males, integrated TB–diabetes care models should particularly target male populations to improve disease management and treatment outcomes. The stacked bar chart Figure 1 illustrates treatment outcomes—cured, treatment completed, death, treatment failure, and lost to follow-up—classified by co-morbidity status (Diabetes, HIV, and No Co-morbidity). A majority of cured cases (41 out of 51) were among patients without co-morbidities, followed by those with diabetes (8 out of 13). Mortality was observed in both diabetic (2 cases) and non-co-morbid groups (9 cases), while no deaths occurred in the HIV-positive group. This visual emphasizes the need for routine screening and tailored management for patients with co-morbidities to improve TB outcomes in rural settings like Kalahandi.

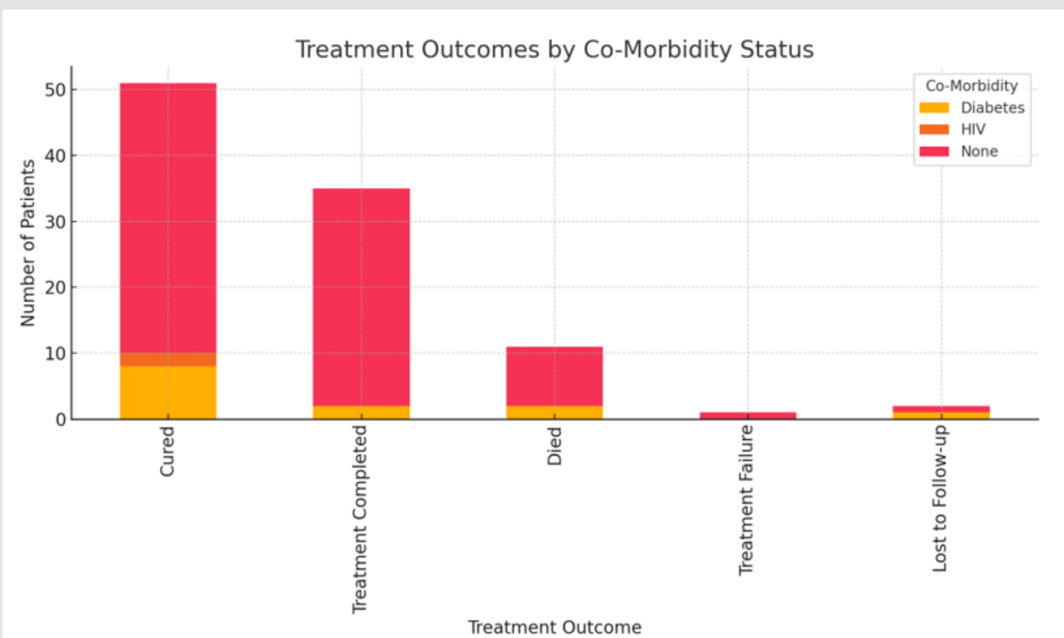

Figure 1: Treatment Outcomes by Co-Morbidity Status Among TB Patients in Kalahandi District.

Discussion

This study revealed that 13% of tuberculosis (TB) patients in Kalahandi district had diabetes mellitus (DM), and 2% were co-infected with HIV. The majority (85%) of the patients had no documented co-morbidities. These findings indicate a significant presence of non-communicable and communicable co-morbid conditions, particularly diabetes, among TB patients in the region. The proportion of male TB patients (67%) was notably higher than female patients (33%), and pulmonary TB was the predominant form, accounting for 87% of cases. Additionally, the treatment outcomes showed that 51% of patients were cured, while 11% died during treatment, with most deaths occurring in those without recorded co-morbidities. The observed prevalence of DM (13%) among TB patients in Kalahandi aligns with findings from Hanoi, Vietnam (13.7%) (Hoa, et al. [24]) and is consistent with global trends reported in meta-analyses (Li, et al. [8,10]). However, it is lower than prevalence rates reported in other Indian studies, including 25.3% in Manipal (Pande, et al. [11]), 25–29% in urban Tamil Nadu and Puducherry (Rajaa, et al. [14]), and 19.6% in Kerala (Kottarath, et al. [13]). This discrepancy could be attributed to differences in healthcare infrastructure, diagnostic practices, lifestyle factors, and urban–rural divide in health outcomes.

The male predominance observed in this study reflects broader national and global trends in TB epidemiology (Siddiqui, et al. [24,27]). Occupational exposure, tobacco and alcohol use, and delayed healthcare-seeking behaviors among men have been proposed as contributing factors (Peltzer [25]). Gender-related disparities in healthcare access may also lead to underdiagnosis among women, especially in rural areas (Duarte, et al. [7]). Regarding disease site, extra-pulmonary TB cases in this study had comparatively poorer outcomes, which supports prior studies showing that extra-pulmonary TB is often diagnosed later and poses more treatment challenges due to limited diagnostic capabilities (Pande, et al. [11]). Pulmonary TB, in contrast, benefits from early detection through sputum testing and standardized treatment protocols. Interestingly, most deaths occurred in patients without recorded co-morbidities. This finding might suggest the presence of undocumented health conditions, delayed diagnosis, or the influence of social determinants such as malnutrition, poverty, or poor health literacy, which were not captured in the secondary data (Duarte, et al. [4,7]). These findings underscore the urgent need to integrate co-morbidity screening—particularly for diabetes—into routine TB care. Given the growing burden of non-communicable diseases in rural India, incorporating bidirectional screening, as recommended by WHO and Indian guidelines, can facilitate early intervention and improve treatment outcomes (Samal [19,21,22]).

Furthermore, gender-sensitive outreach and enhanced monitoring of extra-pulmonary TB cases should be prioritized, especially in districts like Kalahandi where access to diagnostics and specialist care is limited.

Recommendations

Based on the study findings, the following key recommendations are proposed to improve tuberculosis (TB) control and co-morbidity management in Kalahandi district: Strengthen Bidirectional Screening at the District Level: Routine bidirectional screening for diabetes among TB patients and vice versa should be institutionalized across all DOTS (Directly Observed Treatment, Short-course) centers in Kalahandi, following the WHO–Union collaborative framework and India's National TB–DM strategy (Shewade, et al. [21,22]). Operationalizing this recommendation requires training healthcare staff at Primary Health Centres (PHCs), Community Health Centres (CHCs), and Sub-Centres on guidelines and referral protocols. Integrate TB–DM Management within Primary Care: A district-level integrated TB–DM care model should be piloted in high-burden blocks of Kalahandi. This can be adapted from successful models implemented in Andhra Pradesh and Eswatini, which incorporated community-level diabetes screening and referral into routine TB care (Joshi, et al. [20]). Implementation must ensure active involvement of frontline workers like ASHAs and ANMs and provide essential tools such as glucometers and testing strips at PHCs. Capacity Building of Health Workforce: Structured training programs for district TB officers, ANMs, ASHAs, and DOTS providers are needed for identifying, documenting, and managing co-morbidities. Training must include standard operating procedures for blood glucose monitoring, HIV testing, screening, and timely referrals (Milice, et al. [22]).

Enhance Surveillance and Record-Keeping: The District TB Centre (DTC) and block-level TB units should strengthen data systems to include co-morbidity screening, glycemic status, and NCD risk profiling. Robust digital records will facilitate real-time decision-making and targeted interventions (Shewade, et al. [21]). Community Engagement and Awareness Campaigns: Locally relevant, culturally sensitive campaigns should raise awareness on the TB–diabetes link. Community leaders, SHGs, and NGOs should be mobilized to reduce stigma and promote early testing, healthy diets, and physical activity (Joshi, et al. [20]). Policy Support and Resource Allocation: District authorities should advocate for increased state-level funding and technical assistance. Budget provisions must cover equipment, logistics, manpower, and community outreach activities (Milice, et al. [22]). Periodic Review and Monitoring: A district task force should conduct quarterly reviews to monitor screening coverage, adherence, and outcomes, ensuring sustained implementation of TB–DM collaborative efforts (Shewade, et al. [21]).

Study Strengths, Limitations, and Future Research Directions

A key strength of this study lies in its focus on Kalahandi, a rural, high-TB-burden district in Odisha often underrepresented in national epidemiological research. By utilizing region-specific programmatic data, the study provides valuable insights into the prevalence of TB–

DM/HIV co-morbidities in a low-resource setting, offering practical guidance for public health interventions in similar underserved areas. However, the study has several limitations. It relied solely on secondary data, which lacked critical clinical and socio-economic variables such as nutritional status and healthcare access. The sample size was limited to 100 records, selected for feasibility rather than representativeness, reducing generalizability. Incomplete documentation may have led to underreporting of co-morbidities, especially diabetes and HIV. Additionally, the absence of inferential statistical analysis restricted the ability to assess statistically significant relationships. Future research should involve larger, multi-site samples and incorporate primary data collection to capture additional variables such as family history, stigma, and health-seeking behavior. Employing inferential and multivariate statistical techniques will help draw stronger causal inferences, improving the design and targeting of TB control strategies in rural India.

Conclusion

This study highlights the significant presence of co-morbidities—particularly diabetes—among tuberculosis (TB) patients in Kalahandi district, Odisha. Pulmonary TB was more frequent and associated with better treatment outcomes, while extra-pulmonary TB showed higher mortality. A higher proportion of TB cases were observed among males, with diabetes more commonly affecting male patients. Importantly, the findings reveal that TB patients without co-morbidities had the highest cure rates, while deaths occurred notably among both diabetic and non-co-morbid groups. Despite being fewer in number, diabetic patients showed relatively higher mortality and loss to follow-up, underscoring the critical need for early detection and integrated management of diabetes in TB care. The study emphasizes the importance of routine screening for co-morbid conditions, especially diabetes, within TB care services. Implementing a comprehensive, bidirectional screening approach and integrated treatment models is essential to improve patient outcomes. Tailored public health strategies, particularly in rural and high-burden settings, are necessary to address the dual burden of TB and chronic diseases. Strengthening these interventions will contribute to more effective TB control and a more resilient healthcare system.

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