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Impact of co-epidemic tuberculosis and diabetes mellitus on health-related quality of life: A review

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ABSTRACT

The high comorbidity rate between diabetes mellitus and tuberculosis has a significant impact on the patient's health-related quality of life and eradication of tuberculosis program outcomes, especially in lower-middle-income countries that bear a "double disease burden". This review outlines the health-related quality of life of tuberculosis patients with diabetes. The search, selection, and article collection procedures were unmethodical. The retrieved articles were open-access and full-text in English. Health-related quality of life includes physical, psychological, social, and environmental domains. Health-related quality of life in diabetes, tuberculosis, and tuberculosis-diabetes comorbid patients experienced negative changes in all domains. Commonly used health-related quality-of-life measures can be generic or disease-specific. This review also highlights the importance of collaborative tuberculosis and diabetes management supported by the community, health workers, and stakeholders. Finally, this collaborative management support will enhance patient health-related quality of life and contribute to the accomplishment of the tuberculosis elimination program.

Keywords: tuberculosis, diabetes, health-related quality of life, instrument, co-epidemic

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INTRODUCTION

The increasing prevalence of diabetes mellitus has resulted in a double burden of tuberculosis and diabetes in low- to middle-income countries. The global incidence of more than one million cases of both comorbidities is estimated with 15% of tuberculosis cases linked to diabetes (W. Jiang et al., 2022; Ong et al., 2023). The World Health Organization (WHO), the International Diabetes Federation (IDF), and the International Union Against Tuberculosis and Lung Disease (IUATLD) have encouraged integrated healthcare programs in these countries due to the epidemiological link between the two diseases (Organization, 2011, 2022, 2023).

Tuberculosis and diabetes can negatively impact a patient's health-related quality of life (HRQoL), especially concerning medication. These diseases often lead to lower HRQoL and disease symptoms, exacerbated by stigma and discrimination. The term "health-related quality of life" is becoming popular as an alternative to "quality of life" which has a broader meaning. HRQoL is a comprehensive assessment of a person's physical, mental, and social well-being, including their daily function. Understanding disease's impact is vital and improves patients' overall quality of life by assessing awareness of their psychological and physical well-being (Al-Azayzih, Kanaan, & Altawalbeh, 2023; Dou et al., 2023; Sitlinger & Zafar, 2018).

Previous studies concluded that patients with active tuberculosis have been found to have worse HRQoL when weighed against latent tuberculosis or historically treated TB, untreated individuals, or healthy controls. The research showed that there were marked impairments in general well-being and HRQoL in every dimension (Adebayo, Adejumo, & Odusanya, 2023; Kastien-Hilka, Rosenkranz, Sinanovic, Bennett, & Schwenkglenks, 2017; Saleem, A. Malik, Ghulam, Ahmed, & Hussain, 2018). Several cross-sectional studies prove diabetes affects the HRQoL of patients in the physical and environmental domains showing the lowest HRQoL compared to the psychosocial domain. There is a strong correlation between low HRQoL scores and being elderly, single, and unemployed (Abegaz & Ali, 2023; Aschalew, Yitayal, & Minyihun, 2020; Fuentes-Merlos, Orozco-Beltrán, Quesada Rico, & Reina, 2021; Galán, León, Guerrero-Martín, Jurado, & Durán-Gómez, 2021; Wonde, Ayene, Moges, & Bazezew, 2022).

The mortality rate due to TB is greater in DM patients compared to other comorbid factors. However, studies assessing HRQoL in TB patients with concomitant diabetes mellitus are relatively rare and mostly published separately, between HRQoL-TB and HRQoL-DM (Edwards et al., 2020; Gautam et al., 2021; G. Xu, Hu, Lian, & Li, 2023). This brief narrative review emphasizes covering HRQoL in patients with type 2 diabetes and tuberculosis without other comorbidities, and HRQoL tools are commonly utilized for evaluating HRQoL in patients with TB and DM.

METHODS

We conducted searches between June and September 2023 using the keywords "tuberculosis" OR "lung AND tuberculosis" OR "lung AND tuberculosis"; "diabetes" OR "diabetes AND mellitus" OR "diabetes AND mellitus AND types AND 2"; "health AND related AND quality AND life" OR "quality AND life". The electronic databases PubMed, Scopus, and Google Scholar are used to collect all data. Subsequently, we revised the search in December 2023 by checking the bibliography of related publications for important citations.

The procedure for searching and selecting is not methodical. The publications included in this review are limited to articles available in English and full text. Furthermore, articles discussing DM that refer to type-1 DM or have comorbidities other than diabetes mellitus will be excluded.

RESULTS OF STUDY

Health-related quality of life in diabetes mellitus

The results of research on chronic diseases focus on assessing the effectiveness of patients in response to therapy and clinical care, taking into account objective aspects (physiological indicators) and subjective aspects (mental well-being, self-management of disease burden, and social functioning and roles, as well as physical functioning) (Chen et al., 2022; Correia et al., 2023). These subjective aspects are important because diabetes mellitus is largely an autonomic condition, and self-management impacts almost every area of daily life. Assessing population health outcomes using health-related quality of life (HRQOL) is an important tool, emphasizing individual general well-being and life satisfaction. Aspects of HRQOL are increasingly hampered by diabetes and its consequences, medical interventions, and patient attitudes. Diabetic patients need to "strictly adhere to prescribed treatment" and make sustainable behavioral changes in their health. Diabetes and its effects on HRQOL affect not only the health of patients but also families and the general population (Gebremariam et al., 2022; Oluchi et al., 2021).

In people with diabetes, demographic characteristics are independent drivers of HRQoL. Gender is known to be the most significant indicator of HRQoL, whereby women have worse HRQoL and most significant especially in the physical and psychological domains (Alsayed Hassan, Helaluddin, Chahestani, Mohamed, & Islam, 2022; Barua, Faruque, Chowdhury, Banik, & Ali, 2021; Chantzaras & Yfantopoulos, 2022; Homady et al., 2023; Natarajan & Mokoboto-Zwane,

2022; Tran Kien, Phuong Hoa, Minh Duc, & Wens, 2021). The majority of studies assessing HRQoL in people with DM report that age, particularly aging, is substantially correlated with poorer HRQoL (Gupta, Kapoor, & Sood, 2021; Teli, Thato, & Rias, 2023; Zare, Ameri, Madadizadeh, & Reza Aghaei, 2020). Patients with diabetes may experience decreased HRQoL due to poor glucose management and the consequences of the disease (Pham et al., 2020; Teli et al., 2023; Tusa, Geremew, & Tefera, 2020). Marital status, monthly income, and education are among the factors that are significant predictors of HRQoL. People with unmarried DM, poor economic status, and having lower levels of education were significantly associated with poorer HRQoL (Alsayed Hassan et al., 2022; Barua et al., 2021; Chantzaras & Yfantopoulos, 2022; Gebremariam et al., 2022; Homady et al., 2023; Natarajan & Mokoboto-Zwane, 2022; Shamshirgaran, Ataei, Alamdari, Safaeian, & Aminisani, 2016). Research in Bangladesh and Nepal reported that the residence of a person with DM was a significant factor influencing HRQoL, whereas people with DM living in rural areas had better HRQoL (Barua et al., 2021; S. R. Mishra, Sharma, Bhandari, Bhochhibhoya, & Thapa, 2015). Research in Malaysia found religiosity affects HRQoL well in people with DM (Chew, Mohd-Sidik, & Shariff-Ghazali, 2015).

Health-related quality of life in tuberculosis

Tuberculosis is still a major public health problem worldwide although effective therapies have long been available (Oktamianti et al., 2021). TB management generally prioritizes the treatment of microbiology and pays less attention to the impact on the HRQoL in patient. In fact, the duration of TB treatment is generally long and several factors (such as physical, psychological, financial, and social) have the potential to reduce the patient's HRQoL which in turn can affect the success of TB patient treatment (Motta et al., 2023; Pandia, Syafiuddin, Bachtiar, & Rochadi, 2019; Pradipta et al., 2021).

HRQoL is a predictor of patient-reported outcomes (PRO) that refers to the multidimensional nature of health directly from the patient's point of view. Many studies have been conducted that attempt to assess HRQoL experienced by people infected with tuberculosis (Yadav et al., 2021). HRQoL in TB patients before starting treatment was reported to be significantly worse than at the end of treatment for all health domains (Jaber & Ibrahim, 2019). DR/MDR-TB patients are also reported to have poor HRQoL especially in the domain of physical and psychological health (C.-T. Li, Chu, Reiher, Kienene, & Chien, 2017; Ozoh et al., 2021).

Social and demographic factors of TB patients, such as age, smoking habits, place of residence, marital status, and length of illness, significantly affect all domains of HRQoL i.e. physical, psychological, social, and environmental (Sartika, Insani, & Abdulah, 2019; Yasobant et al., 2022). Age over 45 years and smokers reported having worse HRQoL in the physical domain (Chikaodinaka, 2018; Kakhki & Masjedi, 2015). Female patients even have twice the risk of developing depression due to biological responses, self-concept, and coping mechanisms (Solmi et al., 2022). Marital status affects the poor HRQoL of TB patients at the beginning of treatment. The patient's HRQoL significantly improved during treatment probably due to the care and emotional support provided by the patient's partner and family (Chikaodinaka, 2018; Jaber & Ibrahim, 2019; Kuchukhidze et al., 2021). Various studies demonstrate that long duration of TB treatment decreases patients' HRQoL in the physical and psychological domains (Ahmad et al., 2016; Araia et al., 2021). Education is one of the significant factors affecting patient HRQoL, where TB patients with higher education show good HRQoL in the psychological and environmental domains (Kakhki & Masjedi, 2015; Sartika et al., 2019). Interestingly, religiosity had a positive impact on HRQoL in TB patients (Grill, Wang, Cheng, & Lyon, 2020; Panzini et al., 2017). This suggests that there is a significant link between mental health and a person's religious nature. In addition, the stigma faced by TB patients includes the social domain, in addition to the physical domain, which is most significant in influencing the HRQoL of TB patients (Alene et al., 2018; Roba et al., 2018; Yadav et al., 2021). Tuberculosis significantly affects the patient's HRQoL, even after treatment, especially in the domains of physical and psychological health. However, HRQoL in the social and environmental domains has also changed due to tuberculosis.

Health-related quality of life in tuberculosis and diabetes co-epidemic

People living with DM are particularly susceptible to the harmful effects of tuberculosis. Diabetes populations are extra vulnerable to getting *M. tuberculosis* infection, and untreated latent TB can reactivate more easily (Ahmed, Omer, Osman, & Ahmed-Abakur, 2017; Hayashi & Chandramohan, 2018; Shayo & Shayo, 2021). Population aging, urbanization, changes in diet and physical activity, and other lifestyle factors are causing obesity rates to rise, which in turn fuels a global rise in DM prevalence (Aras, Tchang, & Pape, 2021; Jarzebski et al., 2021). Diabetes affected 537 million people in 2021 and anticipates reaching 783 million by 2045. Since 90% of people with DM have type 2 DM (T2DM) and 80% live in lower-middle-income countries, it is estimated that in the next thirty years, the number of DM cases will increase most sharply in areas with high TB incidence rates (Lam, Lepe, Wild, & Jackson, 2021; Magliano & Boyko, 2021).

Diabetes jeopardizes the fight against TB because it increases the chances of developing TB threefold and produces unfavorable outcomes, such as unsuccessful therapies and death. Among TB patients, DM has a rather high prevalence, especially in countries where TB and DM occur together (Oliveira Hashiguchi et al., 2023; Siddiqui, Khayyam, Siddiqui, Sarin, & Sharma, 2017). The frequency of TB patients with diabetes in a case-control study in Indonesia was reported at 13 percent (Izhar, Butar, Hidayati, & Ruwayda, 2021). A Thai study reported 16 percent of people had diabetes of which 70 percent were diagnosed before a TB diagnosis (Oo et al., 2020). Referring to India's epidemiological approach, DM had a significant association with 24.2 percent of previously treated TB and 23.1 percent of new TB patients (Hirayama

et al., 2021), added to studies from Pakistan at 26.1 percent (Aftab et al., 2017), and South Korea at 23.8 percent (Yoon et al., 2017).

Tuberculosis patients with comorbid diabetes mellitus (TB – DM) have HRQoL disorders that affect the physical, psychological, social health and environmental domains that have been associated with age, social class, physiological fulfillment, and relationships to society. Assessing HRQoL in comorbid TB – DM patients can assist in the assessment of variables that impact unknown comorbid features. Previous research points to the fact that TB-DM significantly affects patients' quality of life, both their mental and physical health (Oluchi et al., 2021; Yasobant et al., 2022).

Poor HRQoL, in the social and psychological domains, is significantly associated with old age in DM-TB patients (Zare et al., 2020). The aging process has a significant negative influence on HRQoL through several variables such as degenerative changes, inadequate adherence to medication, inability to change lifestyle, disability for usual tasks, receding ability to labor, and fatigue (Etxeberria, Urdaneta, & Galdona, 2019). Decreased immunity and T cell function caused by aging may contribute to low HRQoL scores (Althoff, Smit, Reiss, & Justice, 2016). Furthermore, there was a negative link established between HRQoL and poorer social and family life in comorbid TB-DM patients aged 41 to 60 years (Siddiqui et al., 2017).

HRQoL in comorbid TB-DM patients is substantially predicted by education, alcohol consumption, profession, social and financial position (Al Amri et al., 2023; Alemu, Bitew, Diriba, & Gumi, 2021; Alturki, Al Amad, Mahyoub, Al Hanash, & Alhammadi, 2023). Previous research has also found a negative correlation between increases in total HRQoL and HbA1c (Al-Taie, Maftei, Kautzky-Willer, Krebs, & Stingl, 2020; Svedbo Engström et al., 2019). The results imply that keeping HbA1c within the target range may help TB-DM patients experience elevated HRQoL (Koesoemadinata et al., 2023). To improve HRQoL in comorbid TB-DM patients, it is imperative to undertake adequate collaborative management of TB-DM simultaneously with improved education (Isfandiari, Wahyuni, & Pranoto, 2022; R. Mishra et al., 2021). It is associated with increased self-confidence, a positive mindset that refers to illness, and better social standing.

Health-related quality of life measurements

HRQoL assessment tools might be either disease-specific or generic. Tools of different scales have been used in infectious and non-communicable disease patients. Certain tools evaluate the entirety of HRQoL, whereas others examine particular domains, including mental or physical dimensions. Several questionnaire tools are commonly used to assess HRQoL for TB, DM, and TB-DM patients.

Generic Tools

The SF-36 questionnaire is a Medical Outcomes Trust short-form questionnaire with 36 questions (Lins & Carvalho, 2016). SF-36 is used extensively to measure relevant general health status and falls into eight domains: physical function, physical role limitation, body pain, social functioning, mental health in general, emotional role limitation, vitality, and general health (Lins-Kusterer et al., 2019; Lins & Carvalho, 2016). The SF-12 is a developed HRQoL instrument and is a shortened version of the SF-36. Big surveys regarding the public and particular groups, including sizeable long-term investigations examining medical results, utilize the SF-12 (Gornet, Copay, Sorensen, & Schranck, 2018; Loosman et al., 2015). The Sickness Impact Profile (SIP) has two domains, physical and psychosocial, consisting of 136 items and grouped into 12 categories. SIP tools are used for self-administration or interviews (Coons, Rao, Keininger, & Hays, 2000). SF-6D is a preference-based scoring system that utilizes the six dimensions of SF-36. The eight dimensions of SF-36 are reduced to six by eliminating the perception of general health and incorporating role limitations due to physical and emotional problems. The six dimensions included were physical function, role limitation, soreness, social function, emotional wellness, and energy (Brazier et al., 2020; Elmallah et al., 2015; Mazari et al., 2016).

EuroQoL (EQ-5D) has important components that are simply developed but have good reliability and validity (N. J. Devlin, Shah, Feng, Mulhern, & Van Hout, 2018). The EQ-5D consists of two parts and designed for self-administration and can be used in public health surveys or combined with condition-specific tools for the assessment of specific conditions (N. Devlin, Pickard, & Busschbach, 2022). The first section has five domains, covering mobility, self-care, usual activities, pain/discomfort and anxiety/depression; and rated on three levels, namely "no problem," "specific problem" or "extreme problem". Part two self-assessment of perceived health status based on visual analogue scale (VAS) (N. Devlin et al., 2022; N. J. Devlin et al., 2018; Xie et al., 2023). The World Health Organization (WHO) QoL-BREF questionnaire instrument covers broader domains, including physical, psychological, social relationships and environmental capacity (Vu et al., 2022). WHO-QoL BREF consists of 26 items which are divided into 24 HRQoL assessment items for four domains and 2 items for assessing general HRQoL and general health (Abbasi-Ghahramanloo et al., 2020; Lodhi et al., 2019; Reba, Birhane, & Gutema, 2019).

Specific Tools

Specific HRQoL tools such as DR-12 are new specific tools for assessing HRQoL of TB patients consisting of 12 items, 7 of the 12 items include symptoms of TB (i.e. coughing up of sputum or blood, fever, dyspnea, chest discomfort, anorexia, and losing weight) and 5 items are related to social, psychological, and physical adaptability (Khan, Tangiisuran,

Imtiaz, & Zainal, 2017; Sun et al., 2018). When computing two domain rating and a total rating, every reaction alternative is offered on a 3-point scale, and each item receives equal weight (Aggarwal, 2019; R. Mishra et al., 2021). The St. John's George Respiratory Questionnaire (SGRQ) is a popular specialist tool for measuring HRQL for people suffering from chronic obstructive pulmonary disease (COPD) and other lung disorders. The overall rating can be calculated from three domain-specific ratings (symptoms, activity, and influence) (Kotanen et al., 2020; Rocha, Jácome, Martins, & Marques, 2021). St. George's Hospital School of Medicine in England created SGRQ and is currently adapted into many different languages (Capparelli et al., 2018; Prior et al., 2019; Rehman et al., 2020; Sherpa et al., 2015).

The Symptoms Checklist 90 (SCL-90) is a ninety items symptom inventory developed to assess an assortment of mental health issues and symptoms, involving nine parameters: somatization, obsessive-compulsive disorder (OCD), interpersonal sensibility, anxiousness, depressive symptoms, enmity, fearful anxiety, paranoid notions, and psychoticism (Sereda & Dembitskyi, 2016). The Social Support Rating Scale (SSRS) composed of ten items designed to assess the accessibility and utilization of self-perceived support from social services (Y. Li, Peng, & Tao, 2023; R. H. Xu, Shi, Xia, & Wang, 2022). The General Health Questionnaire 12 (GHQ-12) is a shortened version of GHQ-60, developed to screen for non-psychotic mental ailments among the broad community (Nouri, Feizi, Roohafza, Sadeghi, & Sarrafzadegan, 2021). The Brief Disability Questionnaire (BDQ), obtained using the Medical Outcomes Study (MOS) public health study brief form, served to determine the severity of mental and physical impairment among patients (Sezgin, Hocaoglu, & Guvendag-Guven, 2016; Topak, BALTALARLI, Gökhan, & ÖZDEL, 2022; Turan, Dayapoğlu, & Özer, 2021). The Beck Depression Inventory (Beck-DI) is a questionnaire of 21 items created to assess indicators of depression and severity (Elovanio et al., 2020; Peyrovian et al., 2019). The Center for Epidemiological Studies Depression Scale (CES-D) and the 5-item Mental Health Index (MHI-5) (Elovanio et al., 2020; Rivera-Riquelme, Piqueras, & Cuijpers, 2019) are an array of tools or inquiries applied to evaluate the physical state, psychologic history, mental wellness, support systems, and availability and utilization of healthcare facilities by vagrants diagnosed with tuberculosis (Henry, Grant, & Cropsey, 2018; L. Jiang et al., 2019; Vilagut, Forero, Barbaglia, & Alonso, 2016).

Collaboration in tuberculosis and diabetes management

Patients with diabetes have an increased incidence of acquiring tuberculosis (TB), and tuberculosis itself exacerbates the diabetic patient's glycemic management. Surveillance programs and services for infectious diseases (TB) and non-communicable diseases (DM) must be improved and accelerated to mitigate the possibility of DM sufferers contracting TB or TB patients experiencing infection reactivation. This program must involve all parties including community health centers, public health workers, the community, local government, Ministry of Health, and academics to improve HRQoL and reduce morbidity and mortality due to TB and DM comorbidities (Bachtiar et al., 2009; Fazaludeen Koya et al., 2022; Nikoloski et al., 2021).

In the management of tuberculosis and diabetes, currently managed by community health centers more, but not many private primary care providers (PPCs) are involved yet. Currently, especially in urban areas, the majority use these facilities. Research in Yogyakarta recommends that private primary care providers, namely private clinics and private general practitioners, their potential role in implementing health promotion, two-way screening, patient referral, TB treatment, and data reporting should continue to be improved (Arini, Sugiyo, & Permana, 2022).

To ensure the implementation of bidirectional scheme in the management of TB and DM, WHO together with the International Union Against Tuberculosis and Lung Diseases (Union) formulated bidirectional collaborative strategy for TB and diabetes management and prevention. This strategy provides guidelines for countries in the world to form national collaborative TB and DM eradication programs at regional, district and regional/or local level by considering the national characteristics of each country to include representation of all relevant stakeholders. Therefore, these recommendations should be used by policymakers and implementers to control the TB-DM co-epidemic and complement existing national systems for the prevention and management of TB and DM. The framework focuses on TB and DM co-epidemic surveillance, monitoring, and evaluation of collaborative activities, and detecting and managing TB in DM patients, and vice versa, aiming to improve the overall health outcomes (Dlodlo et al., 2021; Organization, 2011, 2022).

CONCLUSION

Diabetes mellitus that has gone untreated, unnoticed, and mismanaged poses an infinitely bigger problem for tuberculosis treatment and prevention in countries with a higher rate of TB than previously anticipated. Chronically elevated glucose levels cause the immune system's response to function to be hyperactive and uncontrolled, boosting vulnerability to infections like tuberculosis. The link connecting tuberculosis and diabetes is appealing, and a paradigm for addressing the combined burden is required. Yet, neglecting or disparaging that connection could jeopardize years of advancement toward eradicating tuberculosis, leading to disastrous health and financial consequences. Furthermore, community and stakeholder support for collaboration in TB and diabetes management will enhance patient HRQoL and contribute to the accomplishment of the tuberculosis elimination program.

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