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Global Research Trends on Oral Diseases Amid the Double Burden of Diabetes and Tuberculosis: A Bibliometric Analysis

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ABSTRACT

Introduction: Diabetes Mellitus (DM) and Tuberculosis (TB) present significant health challenges in low- and middle-income countries (LMICs). DM increases the risk of active TB by 2 to 4 times due to weakened immunity, and the number of adults with DM is projected to rise from 463 million in 2019 to 700 million by 2045, with 80% in LMICs where TB is common. This co-occurrence complicates treatment, as TB can worsen glycemic control and poorly managed DM affects immunity. Although DM is linked to periodontitis and TB can cause ulcers, the oral health implications remain underexplored. The objective was to identify research themes and collaboration networks for improving oral healthcare among patients with tuberculosis and diabetes mellitus comorbidities, who also have oral diseases. The broader aim is to improve oral healthcare and reduce the burden of chronic diseases in these populations.

Methods: A qualitative literature review was conducted using peer-reviewed journals from 2018 to 2024 in the Scopus database. The search employed the keywords "oral AND diseases AND tuberculosis AND diabetes AND mellitus," focusing solely on English documents in various medical fields. Data collection in March 2025 aimed to minimize bias. Descriptive and bibliometric analyses were performed using RStudio and VOSviewer to examine trends and correlations among oral diseases, tuberculosis, and diabetes mellitus. This analysis is conducted through cocitation and keyword patterns.

Results: A review of 146 publications from 2018 to 2024 found that only six (4.1%) focused on oral health in tuberculosis and diabetes mellitus (TB-DM). The average annual growth rate of publications was 8.89%. Four main themes emerged: (1) complications of diabetes mellitus, (2) tuberculosis examination and treatment, (3) prevalence and risk factors of type 2 diabetes, and (4) TB-DM interactions. India, the USA, and Japan were the leading contributors. The top keywords were "diabetes mellitus" (900), "tuberculosis" (735), and "non-insulin-dependent diabetes mellitus" (431).

Conclusion: Future research should adopt an interdisciplinary approach to investigate the effect of systemic inflammation and medication interactions on oral health in DM-TB populations. Longitudinal studies are necessary to assess the impact of oral interventions on glycemic control and treatment success for TB. Collaboration among dental and medical professionals is essential for delivering integrated care models that prioritize both oral and systemic health.

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INTRODUCTION

Diabetes Mellitus (DM) and Tuberculosis (TB) are two significant global health challenges, increasingly converging as a syndemic in low- and middle-income countries (LMICs). DM is a chronic metabolic disorder characterised by hyperglycemia resulting from impaired insulin secretion or resistance. TB, caused by *Mycobacterium tuberculosis*, remains one of the leading causes of infectious disease-related mortality worldwide. Notably, DM increases the risk of developing active TB by two- to fourfold due to immune dysfunction (1,2). As the global prevalence of diabetes mellitus (DM) rises, especially in low- and middle-income countries (LMICs), the interaction between these two diseases poses profound implications for both clinical management and public health systems.

The global burden of diabetes mellitus (DM) is projected to increase dramatically, from 463 million adults in 2019 to 700 million by 2045 (3). Approximately 80% of individuals with diabetes reside in LMICs, where TB prevalence is also high, creating a scenario of overlapping disease burdens (4). TB infection can worsen glycemic control, while poorly managed DM impairs innate and adaptive immunity, making individuals more susceptible to both primary TB infection and reactivation of latent TB (5,6). This bidirectional relationship complicates diagnosis, treatment outcomes, and long-term health trajectories.

The oral health implications of this comorbidity remain under investigation. DM contributes to various oral conditions, including periodontitis, xerostomia, oral candidiasis, and delayed wound healing, due to microvascular changes and a reduced immune response (7). TB, while less commonly associated with oral manifestations, can result in ulcers and lesions in immunocompromised individuals, especially when poor oral hygiene and mucosal trauma are present (8,9). These complications significantly impact oral health-related quality of life (OHRQoL), yet their overlap in TB-DM patients has not been systematically examined.

While there is growing interest in the immunopathological and clinical dimensions of the TB-DM interaction, limited attention has been given to its oral health consequences. Current literature is fragmented, often focusing on TB or DM independently, and seldom addresses the combined impact on oral health. Some of the systematic review-based studies have reported on global burden and risk factors of TB-DM comorbidity, and others have reported on oral health issues in diabetic patients (10–12). While case reports offer valuable insights, stronger population-level evidence consistently shows that diabetes is linked to poorer oral health, and improving periodontal status can enhance metabolic control. A nationwide analysis from Korea (n = 70,554) revealed that adults with diabetes experience significantly worse oral outcomes. Notably, higher HbA1c levels were found to be progressively associated with having 19 or fewer remaining teeth (adjusted OR of 1.91 for HbA1c ≥ 8% compared to < 6.5%) (13). Recent evidence syntheses indicate that periodontal therapy can lead to clinically meaningful reductions in HbA1c among individuals with diabetes (14,15). Additionally, contemporary reviews of infectious diseases reaffirm that diabetes complicates the risk and outcomes of tuberculosis (TB), with poor glycemic control exacerbating this relationship (16). Collectively, these strands of evidence underscore the importance of integrating systematic oral health surveillance into tuberculosis-diabetes management services to support glycemic stability and reduce treatment complications associated with oral disease. Furthermore, there is a lack of bibliometric studies that map the evolution of global research on oral diseases within the context of this dual burden. Bibliometric analysis enables the quantitative evaluation of scientific outputs, including research trends, thematic areas, and collaboration networks, which can highlight knowledge gaps and inform future priorities (17,18).

This study addresses this gap by conducting a bibliometric analysis of literature published between 2018 and 2023 on oral diseases associated with tuberculosis (TB) and diabetes mellitus (DM). Using tools such as VOSviewer and RStudio, we identify emerging themes, high-impact publications, contributing countries, and core research networks. By doing so, this research contributes to understanding oral disease burden in TB-DM populations and provides insights into the strategic direction of interdisciplinary research. Given the high prevalence of both diseases in vulnerable populations, this study is timely and essential for guiding integrated approaches in oral health care, infectious disease control, and chronic disease management.

METHOD

This study employed a qualitative literature review methodology. The search focused on peer-reviewed journals of international standing published between 2018 and 2024, all of which are accessible via the Scopus

database (scopus.com). The search keywords were "oral AND diseases AND tuberculosis AND diabetes AND mellitus". We included only English documents that reached the final publication stage and aligned with our inclusion criteria. Eligible documents were restricted to the following topical areas: medicine, immunology, parasitology, microbiology, pharmacology, toxicology, pharmaceutics, biochemistry, genetics, molecular biology, and dentistry. Documents outside these disciplines were excluded.

The screening process was conducted based on the specific subject area, the relevance of the topic, the publication year (to reflect recent findings), and the relevance of keywords, including considerations of oral health within the context of comorbidities such as tuberculosis and diabetes mellitus, with a particular focus on English texts. Articles that did not meet the requirements regarding language, subject matter, or publication status were excluded. This information is crucial for researchers in identifying and analyzing patterns and trends related to oral diseases in tuberculosis and diabetes mellitus. A PRISMA flow diagram is provided to illustrate, via a flowchart, the steps involved in selecting documents (identification, screening, eligibility, and final inclusion). This methodological transparency facilitates reproducibility and allows researchers to observe patterns and trends within the literature on oral diseases in TB–DM populations.

Data were gathered in March 2025 to eliminate biased data. Figure 1 presents the comprehensive study flow diagram created using the methods applied in this research. The study maps were analyzed by exporting the data in RIS export file format. A descriptive methodology was employed to evaluate the Scopus search results based on parameters such as publication year, publishing entity, country of origin, publication title, and research topic. This approach facilitated an in-depth examination of the study maps, providing valuable insights into the trends and patterns in the respective research areas. The findings of this analysis could be instrumental in shaping future research endeavours and academic pursuits.

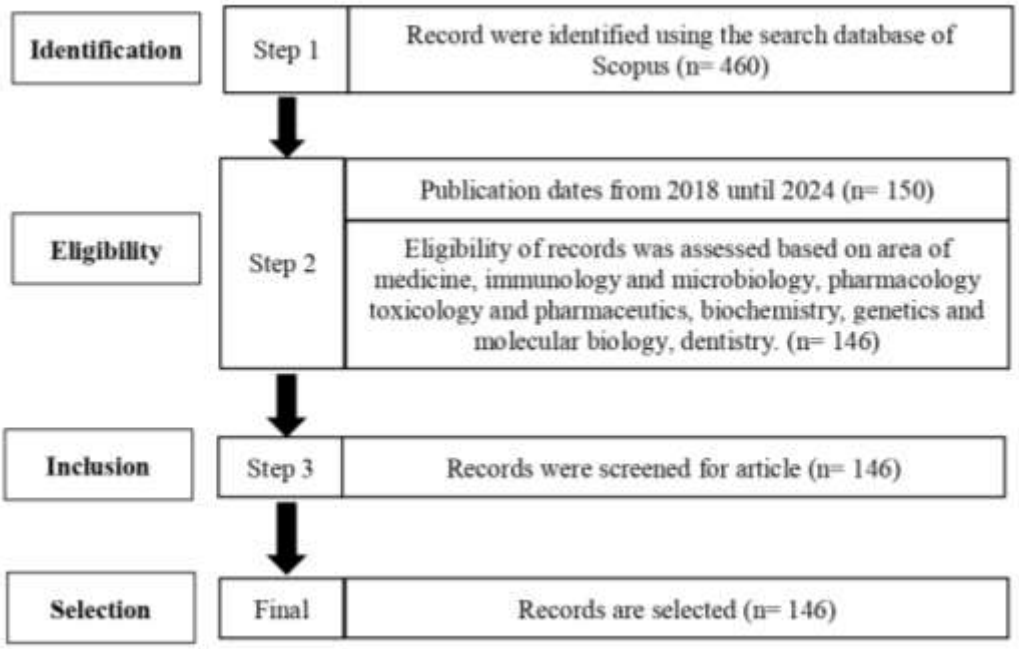

Figure 1 Steps in collecting article

The Scopus database was analysed using RStudio and VOSviewer, which generated a bibliometric analysis map. The study has important implications for dentists, healthcare practitioners, and researchers. The RStudio software provides easy-to-use tools to enhance R productivity by visualising yearly keyword trends. VOSviewer was used to extract pertinent information about the co-occurrence of oral diseases with tuberculosis and diabetes mellitus. These refinements aim to increase the accuracy and specificity of the extracted information by minimising any potential errors that may arise from the extraction process. The extracted information can be valuable in the identification of patients who are at risk of developing both oral Diabetes Mellitus and Tuberculosis and in the

development of targeted interventions to mitigate the risk of these co-occurring conditions. The researchers conducted a comprehensive bibliometric search to gain a deeper understanding of the social structure and patterns within the research area. This search analysed citations, co-authorships, and co-occurrences, providing valuable insights into the field. Researchers applied bibliographic coupling and co-citation methods to compare references and identify conceptual frameworks. They generated figures and data through analyses including keyword co-occurrence, significant author and country distribution analysis, cited sources co-citation, document and organization citation analysis, and co-citation network analysis. The results comprised 146 documents sourced from the Scopus database.

RESULTS

Document Publication

The analysis in Figure 2 examines the prevalence of oral diseases among patients with Tuberculosis and Diabetes Mellitus over five years (2018-2024), based on a review of 117 sources. A total of 146 relevant documents were analyzed, involving 1,058 authors, indicating the importance of this research area. The study noted an 8.89% annual growth rate in publications related to oral diseases, despite a decline from 2022 to 2023. This highlights the urgent need for further research to improve care for affected patients and enhance their quality of life through innovative treatment strategies.

Figure 2. Research Trend on Oral Diseases on Tuberculosis and Diabetes Mellitus (Source: RStudio Analysis)

According to the data presented in Figure 3, there has been a notable increase in the publication of research papers concerning Oral Diseases associated with Diabetes Mellitus and Tuberculosis over recent years. This trend has intensified, with a significant surge in publications observed between 2020 and 2022. Our study conducted an extensive analysis of the data, resulting in the identification of a total of 67 papers published during the COVID-19 pandemic. The research encompassed contributions from 57 countries, with the principal contributors identified as India (with 35 published papers), the United States (with 28 published articles), and Japan (with 12 published papers). This finding underscores the significance and urgency of the topic, particularly to managing Oral Diseases in the context of Diabetes Mellitus and Tuberculosis during the pandemic. Thematic salience was evaluated using bibliometric indicators, resulting in a network modularity score of 0.74, indicating distinct thematic clusters. Cluster centrality analysis showed that the keyword "diabetes mellitus" had the highest betweenness centrality (0.21) and total link strength (900), serving as a key connector across themes, while "tuberculosis" followed with a centrality of 0.18 and a total link strength of 735. Furthermore, co-citation frequency analysis indicated that the most co-cited pair, van Eck & Waltman (2010) and Donthu et al. (2021), appeared together in 52% of documents, underscoring the importance of bibliometric methodology in this area. Overall, these results suggest that the intersection of Oral Diseases with diabetes mellitus and Tuberculosis represents an area of growing interest and relevance for researchers, warranting ongoing attention and investment.

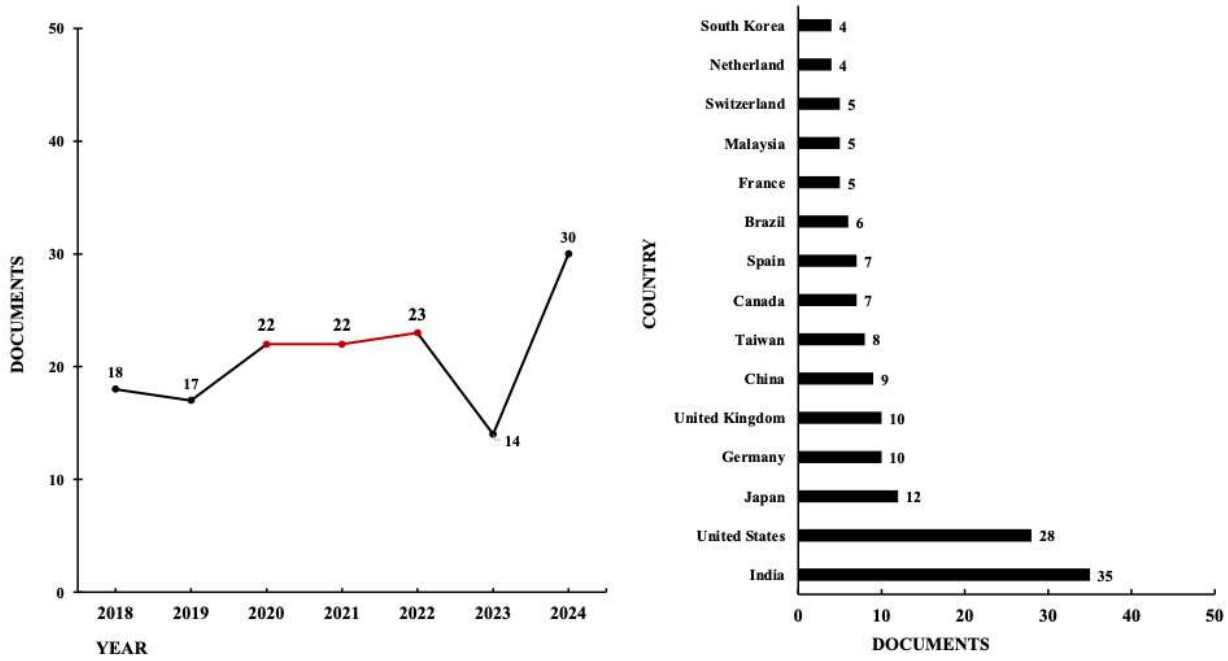

Figure 3. Number of document publications by year (left) and by country (right) on Diabetes Mellitus and Tuberculosis

Tuberculosis (TB) is the second leading cause of death from infectious diseases globally. In the United States, TB incidence rates had been declining since 1992, until they rose for the second consecutive year in 2022, although they remained lower than pre-pandemic levels. The latest report indicates 7,882 TB cases, with an incidence rate of 2.4 per 100,000 individuals and a mortality rate of 0.2 per 100,000, resulting in 600 TB-related deaths in 2020. Furthermore, about 22.5% of TB patients had diabetes, and there has been a 69.1% reduction in TB-related fatalities since 1992.

In India, diabetes mellitus (DM) and tuberculosis (TB) are critical health issues, with uncontrolled DM increasing the likelihood of treatment failure for TB. The TB-DM syndemic, combined with the COVID-19 pandemic, has worsened the situation, leading to more cases of uncontrolled diabetes. To improve TB treatment outcomes, national programs should screen for both TB and DM and implement aggressive measures to manage glycemia.

Research Trends on Oral Diseases on Diabetes Mellitus and Tuberculosis

Table 1 presents the top ten keywords associated with Oral Diseases in relation to diabetes mellitus and tuberculosis. The keywords identified include diabetes mellitus, tuberculosis, non-insulin-dependent diabetes mellitus, hypertension, haemoglobin A1c, insulin, fever, complications, risk factors, and comorbidities. Additionally, keyword trends for diabetes mellitus and tuberculosis from 2020 to 2024 were correlated with factors such as diabetes mellitus, tuberculosis, gender, and age, as depicted in Figure 4. This study was conducted on an annual basis, and the figure illustrates the identified trends in keywords.

The findings indicate that in 2020, the predominant research keywords pertained to diabetes mellitus, tuberculosis, and non-insulin-dependent diabetes mellitus. However, in 2021, there was a noticeable shift in research trends towards hypertension, lung tuberculosis, and related complications. In 2022, the focus of the research community transitioned to body mass, dyspnea, and chronic kidney failure. The 2023 findings revealed an emphasis on treatment response and antibiotic agents. These results are poised to assist researchers and policymakers in gaining a comprehensive understanding of the critical issues related to oral diseases associated with diabetes mellitus and tuberculosis, thereby guiding their efforts to address these challenges effectively.

Table 1. Top 10 keywords on Oral Diseases on Diabetes Mellitus and Tuberculosis (Source: Vosviewer and RStudio)

	VOSVIEWER			RSTUDIO			
No	**Keywords**	**Occurences**	**Total Link Strength**	**Word**	**Length**	**Count**	**Weighted Percetage (%)**
1.	diabetes mellitus	103	900	diabetes	8	2032	106
2.	tuberculosis	89	735	tuberculosis	12	1573	82
3.	Non insulin dependent diabetes mellitus	45	431	patients	8	1242	65
4.	hypertension	46	419	disease	7	867	45
5.	hemoglobin a1c	35	400	treatment	9	734	38
6.	insulin	29	335	clinical	8	720	37
7.	fever	31	298	health	6	682	36
8.	complication	32	297	mellitus	8	669	35
9.	risk factor	33	295	oral	4	600	31
10.	comorbidity	47	259	risk	4	598	31

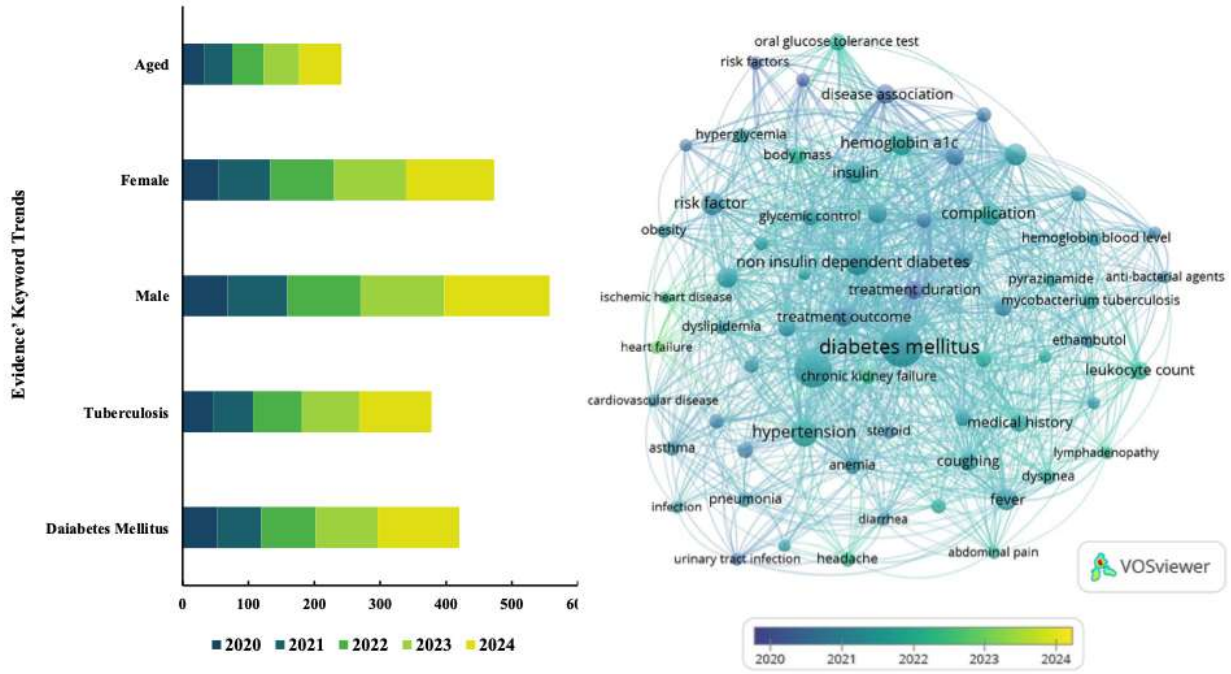

Figure 4. Keyword trends of Diabetes Mellitus and Tuberculosis by year (left: RStudio, right: VOSviewer)

Cluster Themes on Oral Diseases on Tuberculosis and Diabetes Mellitus

The visual representation of keyword connections, as illustrated in Figure 4, along with the data presented in Table 2, provides a comprehensive account of the keywords. This is further supplemented by essential metrics, including frequency, co-occurrence, and centrality measures, all of which have been generated by the VOSviewer application. This tool has proven indispensable in interpreting the results, enabling a thorough evaluation of the retrieved keywords and unveiling significant patterns and trends within the data. Developed by van Eck and Waltman (2010) (17), the VOSviewer application is highly regarded for its capacity to construct and visualize bibliometric networks. Each cluster is denoted by a distinct color: red indicates complications associated with diabetes mellitus, representing 28% of the total clusters; blue is assigned to the examination and treatment of tuberculosis, encompassing 27% of the total clusters; green denotes the prevalence and risk factors of type 2 diabetes mellitus,

accounting for 23% of the total clusters; and yellow represents the interaction between diabetes and tuberculosis, comprising 21% of the total clusters, as illustrated in Figure 5. Furthermore, Table 2 provides a detailed and organized overview of the keywords, facilitating a deeper understanding of their significance and implications for the reader.

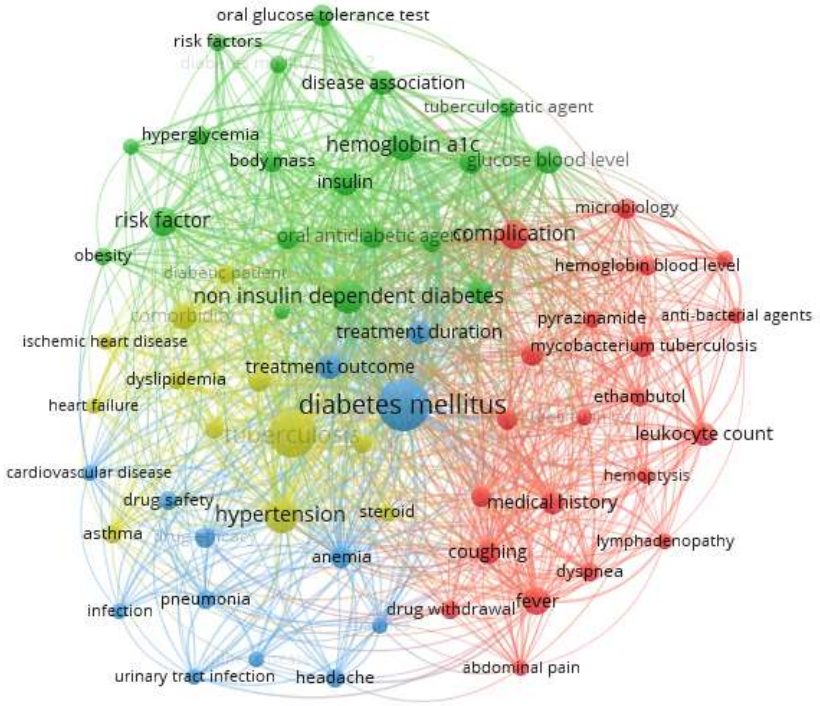

Figure 5. Visualization of the Correlation by Keywords (Source: VOSviewer)

Table 2. The Clusters' Themes of Oral Diseases on Tuberculosis and Diabetes Mellitus Using VOSviewer

Clusters' Theme	Items	Total	Percentage
Cluster 1: Complications of Diabetes Mellitus	Abdominal pain, anti-bacterial agents, antiinfective agent, body weight loss, complication, coughing, drug withdrawal, dyspnea, ethambutol, fever, hemoglobin, hemoglobin blood level, hemoptysis, leukocyte count, lymphadenopathy medical history microbiology, mycobacterium tuberculosis, pyrazinamide, rifampicin, tuberculin test	21	28%
Cluster 2: Examination and Treatment of Tuberculosis	Body mass, body weight, diabetes mellitus, type 2, disease association, glucose, glucose blood level, glycemic control, hemoglobin a1c, hyperglycemia, impaired glucose tolerance, insulin, lung tuberculosis, metformin, noninsulin dependent diabetes mellitus, obesity, oral antidiabetic agent, oral glucose tolerance, risk factor, risk factors, tuberculostatic agent	20	27%
Cluster 3: Prevalence and Risk Factors of Diabetes Mellitus Type 2	Anemia, cardiovascular disease, diabetes mellitus, diarrhea, drug efficacy, drug safety, headache, infection, kidney disease, pneumonia, treatment duration, treatment outcome, urinary tract infection	13	23%
Cluster 4: The Interaction of Diabetes and Tuberculosis	Asthma, chronic kidney failure, chronic obstructive lung disease, comorbidity, diabetic patient, dyslipidemia, heart failure, hypertension, ischemic heart disease, smoking, steroid, tuberculosis	12	21%

Table 3 displays both local and global citation counts for the most influential publications on oral diseases within the context of TB–DM comorbidity. Local citations denote the number of times a document is referenced within our bibliometric dataset, highlighting its relevance to TB–DM oral health research. In contrast, global citations represent the total number of citations across the entire Scopus database, indicating broader scholarly impact. This distinction emphasizes that some publications, such as Teng et al. (2019), exhibit a high global impact with 122 citations but a relatively modest local influence of just 6 citations. This underscores the importance of differentiating between general relevance and topic-specific significance in bibliometric analysis. However, a notable gap remains in research investigating oral diseases among individuals affected by diabetes mellitus and Tuberculosis. In our TB-DM dataset derived from Scopus (n = 146), only six studies (4.1%) explicitly addressed oral health. When we broadened our search to include all TB-DM publications indexed in Scopus between 2018 and 2024 (n = 2,913), we found that studies focusing on oral health constituted a mere 0.27% of the total output. This significant disparity underscores the underrepresentation of oral health in TB-DM research, despite the established links between systemic inflammation, glycemic control, and oral pathology.

Table 3. Document publication on Oral Diseases on Diabetes Mellitus and Tuberculosis

Author	Title	Source	Year	Key findings	Local Citations	Global Citations
Dessirier F.; Arnault J.-P.; Denamps J.; Sevestre H.; Attencourt C.; Lok C (19).	Actinomycosis revealed by ulceration of the palate and gingiva	Ann Dermatol Venereol	2018	• Actinomycosis revealed by oral ulceration is rare. • No opportunistic infections under BRAF (a gene in chromosome seven that encodes a protein) inhibitors reported. • Tuberculosis cases linked to sorafenib, not BRAF inhibitors	2	14
Noratikah A.H.; Ajura A.J.; Lau S.H (20).	Oral histoplasmosis in Malaysia: retrospective analysis	Tropical Biomedicine	2018	● Oral histoplasmosis cases in Malaysia: 39 identified from 1995-2016. ● Predilection towards male patients, with tongue being the most affected site. ● Common clinical presentation: ulcer (61.5%) and swelling (38.5%). ● 17.9% of patients were seropositive for HIV.	1	11
Chu E.C.-P.; Trager R.J.; Chen A.T.C.; Shum J.S.F (21). .	A 60-Year-Old Man with Gingivitis...	Clinical Oral Investigations	2022	● Rare case of S. oralis spinal infection in an immunocompromised patient post-COVID-19. ● Antibiotics for 6 weeks, MRI with	0	5

				gadolinium for spinal infection diagnosis. ● Patient had low back pain post-COVID-19, diagnosed with S. oralis infection		
Cao B.; Liu M.; Zhao Y.; Gong C (22) .	Chronic oral mucocutaneous candidiasis...	Frontiers in Pediatrics	2018	● The signal transducer and activator of transcription 1, autosomal dominant gain-of-function (STAT1 GOF) mutations linked to chronic candidiasis and autoimmune diseases. ● Over 20 cases of diabetes with STAT1 GOF mutation reported	3	28
İnan S.; Çaylaklı F.; Canpolat T (23).	Parotid gland tuberculosis accompanied by brucellosis	Case Reports and Clinical Pearls	2021	● Parotid gland TB is rare and mimics tumors without pathology evaluation. ● Brucellosis is transmitted through unpasteurized dairy and affects multiple organs. ● Diagnosis of TB and brucellosis based on clinical suspicion. ● Antibiotic therapy for systemic brucellosis includes doxycycline and rifampicin. ● Surgery is crucial for diagnosing and treating parotid masses	1	9
Anton A.I.; Andrei T.P.; Nicoleta M.; Bechir E.S.; Ecaterina T.D (24).	Tongue, tonsil and lung - rare synchronous...	Acta Medica Mediterranea	2020	● Tongue, tonsil, and lung synchronous TB cases in smokers and non-smokers. ● Oropharyngeal TB is often misdiagnosed, especially in immunosuppressed individuals. ● Clinical implications emphasize early diagnosis of TB in the oropharyngeal area.	2	13

Mikhaylova E.S.; Lashchenov P.V.; Koroleva I.V (25).	Non-surgical treatment of chronic periodontitis...	Acta Clinica Croatica	2019	• Oral TB can mimic tumors and must be considered in ulcerative lesions. • Primary oral TB can indicate HIV immunosuppression • Diabetes prevalence globally is increasing, estimated at 425 million individuals. • Reduction in pathogenic species after therapy in patients with type 2 DM.	4	31
Teng C.-J.; Huon L.-K.; Zheng Y.-M.; Yeh C.-M.; Tsai C.-K.; Liu J.-H.; Chen T.-J.; Liu C.-J.; Lee Y.-L (26).	Increased risk of tuberculosis in oral cancer patients...	Clinical Oral Investigations	2019	• Oral cancer patients have a higher risk of tuberculosis. • Risk factors for TB in oral cancer patients include age, sex, and comorbidities. • Chemotherapy and radiotherapy for oral cancer increase TB risk. • Hyperlipidemia is a protective factor against TB in oral cancer patients.	6	122

(source: scopus.com)

DISCUSSION

The current study presents a bibliometric analysis of global research on oral diseases in the context of diabetes mellitus (DM) and tuberculosis (TB). These two conditions frequently co-occur, presenting significant challenges to public health. We examined 146 documents indexed in Scopus, published between 2018 and 2024, to identify trends in publications, contributions by various countries, thematic clusters, and the evolution of research interests. The results highlight a burgeoning, albeit still nascent, field of interdisciplinary inquiry that connects infectious diseases, chronic conditions, and oral health outcomes. To interpret these findings, we employed the syndemic framework proposed by Singer et al (27), which conceptualizes tuberculosis (TB), diabetes mellitus (DM), and oral diseases as interconnected epidemics aggravated by social determinants such as poverty, limited access to healthcare, and malnutrition. This approach clarifies the observed clustering of systemic complications and highlights the necessity for integrated, cross-disciplinary interventions. By situating our bibliometric results within a syndemic model, we underscore the compounded disease burden present in low- and middle-income countries (LMICs) and provide a theoretical foundation for developing comprehensive prevention and treatment strategies.

Interpretation of Bibliometric Trends

Our findings reveal a notable upward trend in the number of publications focusing on oral diseases among patients with tuberculosis and diabetes mellitus (TB-DM) since 2018, although a slight dip was observed in 2023. This decline may be indicative of shifting research priorities during the COVID-19 pandemic, which temporarily siphoned resources away from non-COVID-related studies (28,29). The leading contributors to this body of work—

primarily, India, the United States and Japan—belong to regions characterized either by a high prevalence of these diseases or by well-established research infrastructures. Among them, India stands out as a crucial epicentre for scholarly output, grappling with the dual challenges posed by tuberculosis and diabetes (30).

Through our comprehensive keyword analysis utilizing VOSviewer, we identified significant themes including "diabetes mellitus," "tuberculosis," "non-insulin dependent diabetes," and "oral complications," thereby underscoring the interdisciplinary nature of the study. The cluster analysis identified four primary themes in the research: complications arising from diabetes mellitus, the intricacies of tuberculosis treatment, the prevalence of type 2 diabetes, and the interactions between comorbidities. Despite this comprehensive overview, a concerning gap emerged, as fewer publications specifically delved into the manifestations of oral diseases. This observation aligns with the insights of Rohani (2019) and Verhulst et al. (2019) (7,31), who have highlighted that while the oral complications associated with diabetes are well-documented, their relationship with tuberculosis remains largely underexplored.

Gaps in Oral Health Research Among DM-TB Populations

Despite the increasing recognition of tuberculosis-diabetes mellitus (TB-DM) comorbidity, oral health is often neglected in the management of these interrelated conditions. Current literature tends to focus on systemic complications associated with TB and diabetes, while significantly overlooking crucial oral manifestations. Conditions such as periodontitis—characterized by inflammation and infection of the gums—xerostomia, which leads to dry mouth and difficulty in swallowing, candidiasis, a fungal infection in the mouth, and delayed healing of oral mucosal tissues, are all critical factors that can adversely affect patients' overall health. These oral health issues not only diminish the quality of life for individuals but also impede adherence to TB treatment regimens and hinder nutritional intake, particularly among at-risk populations (8,31,32).

Another significant oversight in clinical practice is the absence of standardized oral health screening protocols specifically tailored for patients suffering from TB-DM comorbidity. The existing management guidelines for tuberculosis and diabetes mellitus do not integrate assessments of oral health, despite accumulating evidence that suggests a correlation between periodontal disease and heightened systemic inflammation, as well as instability in glycemic control (33,34). Moreover, while medications used to manage diabetes, such as metformin, have been studied for their immunomodulatory effects in tuberculosis patients, a notable gap remains in research regarding how these pharmacological interactions may impact oral health outcomes (35,36). Addressing these aspects is essential for a comprehensive approach to treating patients with TB and diabetes, ensuring that oral health receives the attention it deserves.

Implications for Clinical and Public Health Practice

The results of this comprehensive bibliometric analysis underscore the immediate necessity for the development and implementation of integrated care models that prominently include oral health as a fundamental aspect in the management of comorbid diabetes mellitus (DM) and tuberculosis (TB). Oral lesions can serve as potentially indicative early indicators of underlying systemic conditions or may signify adverse effects from treatments, particularly in patients with compromised immune systems. Given the fragmented nature of healthcare access in many resource-limited environments, dentists can assume a crucial role in the early identification of such complications and subsequent referrals to appropriate medical specialists (37,38).

Furthermore, fostering interdisciplinary collaboration among healthcare professionals—specifically dentists, endocrinologists, and pulmonologists—is vital to ensure a comprehensive approach to patient care. Such collaboration allows for the merging of diverse expertise to enhance overall health outcomes for affected individuals. Furthermore, it is imperative to establish targeted educational and training programs that systematically integrate the interconnections among tuberculosis, diabetes, and oral health. Such initiatives will enhance the capacity of healthcare providers to effectively manage patients presenting with these overlapping conditions.

The limited scope of current research is concerning; our bibliometric sample revealed that only 6 out of 146 articles addressed the interplay of oral health and these diseases, indicating a significant gap in the literature that fails to support robust integrative healthcare approaches (21,24). Addressing these gaps is crucial for enhancing the quality of care for patients facing the dual challenges of diabetes mellitus (DM) and tuberculosis (TB).

Future Research Directions

This study has unveiled several promising avenues for further exploration. Firstly, it is crucial to conduct clinical research that specifically investigates the prevalence, types, and severity of oral diseases among patients suffering from both tuberculosis (TB) and diabetes mellitus (DM). Clinically focused studies should investigate the interactions between tuberculosis (TB), diabetes mellitus (DM), and oral diseases at both physiological and treatment response levels. Furthermore, such research should aim to identify specific oral health challenges faced by patients with comorbid conditions. An additional focus should be placed on effective integration strategies of dental health into existing TB and DM programs. The research should also explore gaps in treatment provision and determine optimal methods for delivering enhanced health services and promoting health equity.

Secondly, longitudinal studies are recommended to assess the long-term effects of targeted oral health interventions on TB treatment outcomes and the management of glycemic control in diabetic patients. These studies should focus on understanding whether improvements in oral health can lead to better adherence to TB treatment regimens and more stable blood sugar levels in DM patients.

Furthermore, research emphasizing the oral microbiome presents a significant opportunity. Investigating how systemic inflammation—often heightened in TB-DM patients—and the use of immunosuppressive therapies affect the composition and function of the oral microbial community could yield important insights. These observations could inform the identification of diagnostic biomarkers or targeted probiotic therapy to restore microbial homeostasis. Clinically, this can be employed for earlier detection of oral complications and more personalized management strategies for TB-DM comorbid individuals. This line of inquiry could help clarify the biological mechanisms behind oral health issues in this unique patient demographic (6,39).

In addition to clinical implications, cost-effectiveness studies should be undertaken to evaluate the practicalities and economic viability of introducing routine oral health screening processes within TB-DM care frameworks. These analyses could demonstrate the potential for preventive oral health care to enhance overall treatment outcomes while reducing long-term healthcare costs.

From a policy standpoint, integrating oral health indicators into national health surveys focused on TB and diabetes could create a stronger evidence base for making informed decisions about resource allocation and program development. Such integration would not only highlight the intersection of these health issues but also underscore the importance of holistic health approaches.

Ultimately, there is an urgent need for a collaborative global research agenda aimed at ensuring equitable access to oral health services, particularly in low- and middle-income countries (LMICs) where the burden of TB and diabetes is disproportionately high. By fostering international partnerships and sharing resources, health inequities faced by these vulnerable populations can be addressed more effectively.

CONCLUSION

This bibliometric analysis has highlighted the emerging but underdeveloped intersection between oral diseases, diabetes mellitus (DM), and tuberculosis (TB). While global interest in TB-DM comorbidity is increasing, the specific focus on oral health remains limited, with few studies addressing its prevalence, clinical implications, or management strategies. Our findings revealed distinct thematic clusters in the literature, yet only a small subset of publications explicitly explored oral manifestations in TB-DM patients. This gap highlights the urgent need to prioritize oral health as a research and clinical focus in the context of coexisting infectious and non-communicable diseases.

From a policy perspective, integrating oral health assessments into national diabetes mellitus (DM) and tuberculosis (TB) management protocols—particularly in low- and middle-income countries (LMICs)—is both necessary and feasible. Routine screening for oral complications should be implemented in healthcare settings managing DM-TB patients, as early identification may improve treatment adherence, reduce complications, and enhance quality of life. Investment in oral health infrastructure, workforce training, and public health education can further strengthen service delivery in high-burden settings.

Future research should prioritize interdisciplinary approaches to investigate how systemic inflammation, medication interactions, and microbial dynamics contribute to the progression of oral disease in DM-TB populations. Longitudinal studies are also necessary to evaluate the effects of oral interventions on systemic outcomes, including

glycemic control and TB treatment success. Furthermore, collaborative efforts between dental and medical professionals are crucial for developing integrated care models that reflect the complex interplay between oral and systemic health.

By mapping the current landscape of global research and identifying critical gaps, this study provides a foundation for advancing scientific inquiry and public health interventions at the intersection of diabetes mellitus (DM), tuberculosis (TB), and oral disease. Strengthening these connections is essential to achieving more equitable and effective healthcare outcomes for vulnerable populations worldwide.

AUTHOR'S CONTRIBUTION STATEMENT

Dian Yosi Arinawati: conceptualized the study, supervised the research process, contributed to manuscript revision, conducted the data collection, performed the data analysis, drafted the initial manuscript, contributed to the literature review, assisted with data interpretation, and critically reviewed the manuscript for intellectual content.

Seshy Tinartayu: conceptualized the study, supervised the research process, contributed to manuscript revision, conducted the data collection, performed the data analysis, drafted the initial manuscript, contributed to the literature review, assisted with data interpretation, and critically reviewed the manuscript for intellectual content.

Maria Ulfa: conceptualized the study, supervised the research process, and contributed to manuscript revision, conducted the data collection, performed the data analysis, drafted the initial manuscript, contributed to the literature review, assisted with data interpretation, and critically reviewed the manuscript for intellectual content.

Shaista Afroz: assisted with data interpretation and critically reviewed the manuscript for intellectual content.

CONFLICTS OF INTEREST

There is no conflict of interest in this article.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors utilize Grammarly to enhance sentence structure and rectify grammatical errors.

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