



International Journal of Advanced Community Medicine

E-ISSN: 2616-3594

P-ISSN: 2616-3586

<https://www.comedjournal.com>

IJACM 2024; 7(1): 114-119

Received: 15-01-2024

Accepted: 22-02-2024

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Statistical overview on tuberculosis in Nigeria: Epidemiological insights and public health implications

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DOI: <https://doi.org/10.33545/comed.2024.v7.i1b.298>

Abstract

Tuberculosis (TB) remains a significant public health challenge in Nigeria, with high morbidity and mortality rates. This statistical overview provides insights into the epidemiology of TB in Nigeria, highlighting regional disparities, demographic factors, and key public health implications. Drawing from referenced studies and World Health Organization reports, the analysis reveals Nigeria's classification as a high TB burden country, with an estimated 460,000 new cases reported annually. The prevalence of TB stands at 616 cases per 100,000 population, with notable regional variations observed across different geographical zones. The findings emphasize the need for multifaceted approaches to TB control, including enhanced surveillance, improved diagnostics, and targeted interventions addressing social determinants of health. By understanding the complex epidemiological landscape of TB in Nigeria, policymakers and public health officials can formulate evidence-based strategies to mitigate disease burden and improve health outcomes for affected populations.

Keywords: Tuberculosis, epidemiology, public health implications, policy formulation, Nigeria

Introduction

Background

Tuberculosis (TB) remains a significant global public health concern, characterized by its chronic infectious nature and substantial impact on morbidity and mortality worldwide^[1, 2]. The disease poses a considerable challenge to healthcare systems and populations, particularly in resource-limited settings^[3]. It represents one of the most common and impactful communicable diseases worldwide^[4]. With its chronic infectious nature and associated high morbidity and mortality rates, TB continues to pose a substantial burden on public health systems and populations globally^[1]. Of particular interest is the intersection between TB and Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS), which has profoundly influenced the clinical and epidemiological landscape of TB^[5]. The coexistence of HIV infection with TB presents a formidable threat to human health, exacerbating disease severity and transmission dynamics.

In Nigeria, TB is of special concern due to its high prevalence and impact on public health⁶. The country faces significant challenges in TB control and management, further compounded by the concurrent HIV/AIDS epidemic^[6]. The interplay between TB and HIV/AIDS in Nigeria underscores the urgency of addressing both diseases comprehensively to mitigate their impact on human health. Efforts to control TB in Nigeria must address not only the disease itself but also the underlying factors contributing to its spread and persistence within communities. Socioeconomic disparities, inadequate healthcare infrastructure and limited access to diagnostic and treatment services all contribute to the burden of TB in Nigeria.

Tuberculosis (TB) stands as a prominent cause of mortality globally, particularly in the developing nations of sub-Saharan Africa, with Nigeria serving as a notable example^[7]. Its impact has persisted throughout history, affecting up to one-third of the world's population, with the lifetime risk of contracting the disease potentially exceeding 10%^[8]. This enduring presence has rendered TB a global pandemic, exerting a significant negative influence on the growth and development of nations⁵. In response to this challenge, the United Nations established TB-specific indicators with the goal of reversing the disease's incidence by 2015^[9]. However, despite concerted efforts, particularly in developing nations, this objective remains elusive^[10].

TB manifests as an infectious disease primarily affecting the respiratory system, caused by the acid-fast bacillus *Mycobacterium tuberculosis* [11]. Its clinical presentations vary, with the pulmonary form being the most common and epidemiologically significant. This variant is responsible for transmitting the infection, with initial infection leading to the formation of a primary complex, known as the Ghon focus, in the lungs [11]. As the disease progresses, complications such as caseous pneumonia, hematogenous dissemination to other body systems, and the development of bone and joint lesions may arise, culminating in miliary tuberculosis.

Progressive lung parenchymal destruction, characterized by fibrosis and cavitation, leads to symptoms such as cough, hemoptysis, weight loss and systemic manifestations, the severity of which depends on the extent of disease involvement [11]. Without timely and adequate treatment, TB can result in severe morbidity and mortality. The incubation period of the disease typically ranges from 4 to 6 weeks. TB remains a significant global health concern, particularly in sub-Saharan Africa, including Nigeria. Its complex epidemiology and clinical manifestations underscore the importance of continued efforts to control and eliminate the disease. Enhanced surveillance, improved diagnostic tools, and expanded access to effective treatment are essential components of comprehensive TB control strategies.

The burden of tuberculosis (TB) is a pressing global concern, with significant implications for public health, particularly in developing countries. In 2019 alone, there were approximately 10 million new cases of TB reported worldwide, resulting in about 1.2 million deaths among HIV-negative individuals and an additional 208,000 deaths in people living with HIV [7]. The World Health Organization (WHO) has highlighted the disproportionate impact of TB on the African region, which accounted for approximately 25% of the global burden of TB, with Nigeria contributing about 8% of this burden in 2016 [7]; however, it's worth noting that the reported 8% figure for Nigeria may be an underestimate, as less than 15% of TB cases were notified during the survey period.

The emergence of the COVID-19 pandemic has further underscored the significance of TB as a top communicable disease-causing mortality worldwide [7]. In Nigeria, TB remains a major public health challenge, with a prevalence of 616 cases per 100,000 population [12]. Nigeria carries one of the highest burdens of TB among nations globally, with an average of 460,000 new cases reported yearly [12].

Studies conducted across different geographical zones in Nigeria have provided valuable insights into the prevalence and characteristics of TB. For instance, a study in the south-south geopolitical zone reported a TB prevalence of 24.8% over a 10-year period, with a case fatality rate of 18.2% [13]. Similarly, studies from the north-central and northern parts of Nigeria revealed TB prevalences of 25.5% and 23%, respectively, with males being significantly affected [14, 15].

The Global Burden of Disease (GBD) study has provided valuable data on TB epidemiology in Nigeria, including standardized prevalence rates, absolute prevalence and incidence rates [16]. The study found that TB prevalence was highest among individuals aged 50-69 years and lowest among children under 5 years. Additionally, TB co-infection with HIV presents a significant challenge, particularly among children in Nigeria, where co-infection rates range from 10% to 60% [15]. Children infected with HIV are about

50 times more likely to develop progressive TB disease, highlighting the urgent need for targeted interventions in this population [15].

Moreover, studies have demonstrated the adverse impact of TB on the quality of life among individuals living with both TB and HIV, with significantly lower quality of life compared to HIV-infected patients without TB [17]. Disability-adjusted life years (DALYs) resulting from TB vary across different age groups in Nigeria, with the highest burden observed among individuals aged 15-49 years [16]. Importantly, factors such as alcohol ingestion, diabetes mellitus, and smoking have been identified as contributors to TB mortality and DALYs, underscoring the need for comprehensive prevention and management strategies [16].

TB remains a significant public health concern in Nigeria, exacerbated by the concurrent HIV/AIDS epidemic and underlying socioeconomic factors. Addressing the TB epidemic requires sustained commitment and investment in comprehensive, evidence-based interventions to reduce the burden of disease and improve health outcomes for affected populations. Considering the huge burden of this disease, it is, therefore, imperative to put in place mechanisms and efforts of sustained review of the disease with a view to determining progress made in the area of the disease control and prevention

Understanding the disease frequency of Tuberculosis in Nigeria

Tuberculosis (TB) remains a significant public health challenge in Nigeria, with high morbidity and mortality rates. This narrative review aims to provide an in-depth analysis of the disease frequency of TB in Nigeria, exploring the epidemiological trends, contributing factors and implications for public health policy and practice.

Epidemiology of TB in Nigeria

TB is a leading cause of morbidity and mortality in Nigeria, contributing substantially to the burden of infectious diseases. According to the World Health Organization (WHO), Nigeria is among the high TB burden countries, with an estimated 460,000 new cases reported annually (WHO, 2008) [12]. The prevalence of TB in Nigeria is notably high, with a reported prevalence of 616 cases per 100,000 population (WHO, 2008) [12].

Regional disparities and demographic factors

Studies conducted across different geographical zones in Nigeria have highlighted regional disparities in TB prevalence and incidence rates. For instance, a study in the south-south geopolitical zone reported a TB prevalence of 24.8% over a 10-year period, with a case fatality rate of 18.2% [13]. Similarly, studies from the north-central and northern parts of Nigeria revealed TB prevalences of 25.5% and 23%, respectively [14, 15]. Males have been found to be disproportionately affected by TB, with higher prevalence rates observed compared to females [13-15].

TB-HIV Co-Infection

TB-HIV co-infection presents a significant challenge in Nigeria, with implications for disease management and control. Studies have shown that TB-HIV co-infection rates range from 10% to 60% in sub-Saharan Africa, including Nigeria (Okechukwu and Okechukwu, 2011) [15]. Children infected with HIV are particularly vulnerable, with a higher

risk of developing progressive TB disease compared to HIV-negative individuals^[15].

Impact on quality of life and disability-adjusted life Years (Dalys)

TB exerts a significant toll on the quality of life of affected individuals in Nigeria. Studies have demonstrated lower quality of life among individuals living with both TB and HIV compared to HIV-infected patients without TB^[17]. Additionally, disability-adjusted life years (DALYs) resulting from TB vary across different age groups in Nigeria, with the highest burden observed among individuals aged 15-49 years^[16]. Several factors contribute to the high burden of TB in Nigeria, including socioeconomic determinants, inadequate healthcare infrastructure, and limited access to healthcare services. Additionally, behavioral factors such as alcohol ingestion, diabetes mellitus, and smoking have been identified as contributors to TB mortality and DALYS^[16].

TB remains a significant public health challenge in Nigeria, with high disease frequency and substantial impact on morbidity, mortality, and quality of life. Addressing the burden of TB requires multifaceted approaches, including strengthening healthcare systems, enhancing TB-HIV co-infection management, and addressing social determinants of health. Implementing evidence-based interventions and policies is essential to mitigate the impact of TB and improve health outcomes in Nigeria.

Epidemiologic evidence: Risk factors and disease progression in Tuberculosis

Epidemiologic evidence underscores the importance of identifying and addressing TB risk factors to mitigate disease burden and transmission. Understanding the interplay between host-related factors, behavioral determinants, and environmental exposures is essential for designing targeted interventions and preventive strategies. Future research should focus on elucidating the complex interactions between these factors to inform comprehensive TB control efforts and improve public health outcomes. Understanding the risk factors for the development and progression of tuberculosis (TB) is crucial for effective disease prevention and management. This narrative review also aims to explore the epidemiologic evidence surrounding TB risk factors and disease progression, highlighting their implications for public health interventions.

Risk factors for TB development

Risk factors play a significant role in the determinants, distribution, and prevention of TB. Following infection, approximately 5% of individuals progress rapidly to TB within the first two years, while 10-15% develop active disease later in life^[18-20]. However, the risk of progression is notably higher in HIV-positive patients and individuals with other Immunocompromised states^[18]. Factors influencing the risk of infection include the infectivity of the source, proximity to infectious cases, and Behavioral and social determinants such as smoking, alcohol use, indoor air pollution, and delays in diagnosis. Host-related conditions, including co-existing HIV infection, diabetes mellitus, malnutrition, and smoking, significantly influence the rate of disease progression^[18].

TB Transmission Among Close Contacts

Studies have consistently demonstrated an increased risk of TB infection among close contacts of infectious TB cases, including household contacts and healthcare providers^[21, 22]. A systematic review examining the yield of household contact investigations reported an overall TB yield of 4.6% among contacts, with latent TB infection detected in 51.4% of individuals assessed^[22]. However, limitations such as the lack of bacteriological diagnosis and absence of community TB rates hindered the comprehensive assessment of transmission dynamics and disease development in these settings.

TB transmission among healthcare workers

A meta-analysis investigating TB infection risk factors among healthcare workers identified several significant associations^[23]. Healthcare workers below 30 years of age had a reduced risk of TB infection compared to older counterparts, while those above 40 years had an increased risk^[23]. Additionally, longer work duration (>5 years) was associated with a higher risk of TB infection, with a particularly elevated risk observed among healthcare workers with over 10 years of service^[23]. Interestingly, physicians were found to have a higher risk of TB infection compared to other healthcare workers. However, factors such as sex, active contact with TB patients, and workplace type were not significantly associated with TB infection risk.

Interplay between Co-infection, diabetes mellitus and alcohol consumption in Tuberculosis

Co-infection with MT and HIV-1: MT-HIV-1 co-infection poses a formidable challenge to public health, with both pathogens exerting reciprocal influences on disease progression. Co-infection accelerates TB development by altering MT course, while HIV-1 replication and genetic variation are influenced by MT, providing a synergistic advantage to both pathogens^[24]. Barr *et al.* demonstrated that MT blood infection in HIV-TB co-infected patients predicts mortality within 30 days, underscoring the urgency of early diagnosis and intervention^[25].

Association between DM and TB: Evidence suggests a strong association between DM and TB, with increasing DM prevalence impeding TB control efforts. Yu *et al.* and Lu *et al.* highlighted the heightened TB risk among individuals with DM^[26, 27]. Jeon and Murray reported a significant association between DM and TB development, emphasizing the need for comprehensive screening and management strategies^[28]. Moreover, Ottmani *et al.* emphasized the neglected role of TB as a risk factor for DM, especially in endemic communities where the population attributable risk could be as high as 20%^[29].

Impact of alcohol consumption on TB: Alcohol ingestion exacerbates TB burden by impairing immune responses and increasing susceptibility to TB infection. Fok *et al.* demonstrated a strong association between alcohol consumption and TB clustering, highlighting its role in TB transmission dynamics^[30]. Moreover, Tharmalingam *et al.* elucidated the immunomodulatory effects of alcohol on cytokine release, providing mechanistic insights into alcohol-induced TB susceptibility^[31].

Multifactorial determinants of Tuberculosis development: insights from epidemiological Studies

Understanding the multifaceted determinants of tuberculosis (TB) development is crucial for effective disease prevention and control strategies. This narrative review examines the interplay between various risk factors, including smoking, indoor air pollution, malnutrition, age, socioeconomic status, and their contributions to TB incidence.

Smoking and indoor air pollution: Smoking has been consistently linked to increased TB risk, with meta-analyses reporting higher relative risks among smokers compared to non-smokers³². Feng *et al.* further demonstrated the association between smoking and latent TB infection, emphasizing the role of nicotine-induced immune impairment³³. Additionally, indoor air pollution, particularly from firewood in developing countries, serves as an independent risk factor for TB infection³⁴. Animal studies suggest that wood smoke may alter alveolar phagocytic function, contributing to TB development^{35,36}.

Malnutrition and age-related Risk: Malnutrition significantly compromises immune function, predisposing individuals to TB infection^{37,38}. Children, particularly those below 2 years old, face higher TB risk, often acquiring infection from household sources or within the community³⁹. Household source cases remain a critical contributor to childhood TB development⁴⁰.

Socioeconomic Status and TB Incidence: Socioeconomic disparities exacerbate TB burden, with rapid urbanization and poverty driving disease transmission⁴¹. Low socioeconomic status correlates with increased TB risk, attributed to overcrowding, HIV co-infection, indoor air pollution, and malnutrition⁴¹. Marginalized populations, including prisoners, face heightened TB susceptibility due to crowded living conditions and higher HIV co-infection rates⁴².

Implication to epidemiologic research and public health action

TB development is influenced by a complex interplay of risk factors, ranging from individual behaviors like smoking to broader socioeconomic determinants. Addressing these multifactorial influences requires comprehensive public health interventions, including tobacco control measures, indoor air quality improvements, nutritional support programs, and efforts to alleviate poverty and inequality. By addressing the underlying determinants of TB, policymakers and healthcare providers can effectively reduce TB incidence and improve overall population health.

The interplay between MT-HIV-1 co-infection, DM, and alcohol consumption significantly amplifies TB burden, posing challenges to TB control efforts globally. Comprehensive strategies addressing these synergistic factors, including early diagnosis, integrated management approaches, and targeted interventions, are imperative for mitigating TB morbidity and mortality. By understanding the complex interactions between these factors, public health initiatives can be optimized to combat the TB epidemic effectively.

The burden of tuberculosis (TB) infection remains substantial in Nigeria, prompting the country to implement various strategic policies and guidelines to align with global

control measures outlined in the "Stop TB Strategy"⁴³⁻⁴⁵. These measures aim to address gaps in reducing the incidence and prevalence of TB, lowering morbidity and mortality rates, and achieving specific targets such as detecting and treating at least 70% of new cases under Directly Observed Therapy Short-course (DOTS), as well as successfully treating at least 85% of individuals with positive smears⁴⁴.

Key components of these measures include the establishment of research cohorts and training programs aimed at influencing policies and actions related to TB control and prevention¹. By implementing these strategic policies and guidelines, Nigeria seeks to enhance its TB control efforts, mitigate the impact of the disease, and improve health outcomes for its population.

Currently, efforts are underway to reinforce the structure of community advocacy in order to raise awareness among community members about the burden of tuberculosis (TB), promote lifestyle adjustments, and enhance the detection of latent TB infection⁴⁶. Available data indicates a significant decrease in TB-related mortality between 2000 and 2016, which can be attributed to targeted policy modifications, interventions, improvements in socioeconomic conditions, political commitment, and the impact of Sustainable Development Goals (SDGs)⁴⁷.

Delayed diagnosis and treatment of TB contribute to sustained community transmission and increased morbidity and mortality rates⁴¹. At the national level, initiatives are underway to enhance early detection and diagnosis of TB by providing training to public health experts and healthcare providers across all levels of care¹. Efforts also include improving coordination and decentralization of TB control programs, alongside enhancing health financing structures.

Additionally, there have been policy interventions aimed at curbing excessive alcohol consumption, including the imposition of taxes on alcohol. However, a notable gap exists in the absence of a national monitoring system for alcohol use, which should be established to track and address this issue effectively. Similar policies should also be extended to smoking, given the strong association between smoking, alcohol use, and TB development⁴⁸.

Implementing comprehensive measures to address both alcohol use and smoking will be crucial in furthering TB control efforts and reducing disease burden in Nigeria.

To address the socioeconomic disparities in Nigeria, the government has implemented housing support schemes at the local, state, and federal levels to combat overcrowding⁴⁹. Additionally, regulatory bodies for environmental pollution have been established to mitigate health risks associated with poor living conditions. There has been increased advocacy for early detection, treatment, and prevention of diabetes mellitus (DM) and HIV, with additional funding allocated to these areas to improve health outcomes. Furthermore, the Nigerian government is working to strengthen the National/Expanded Programme on Immunization, with a particular focus on TB vaccination. This involves ensuring the availability of TB vaccines, maintaining a quality cold chain, and providing adequate manpower for the administration and coordination of immunization efforts⁴¹.

Conclusion

TB remains a significant public health burden in Nigeria, with the country facing unique challenges in combating the

disease. Co-infections with HIV, DM, smoking, alcohol use, and poor socioeconomic conditions contribute to the high prevalence of TB. It is imperative to reinforce and sustain existing policies and programs aimed at addressing socioeconomic disparities and improving the early detection and treatment of TB cases. Additionally, there is a need for continued surveillance and research to identify and address gaps in TB control and prevention efforts.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article

Adeniyi OO, Olofinbiyi BA, Adewumi OA, Akinsipe CI, Abayomi W, Thomas AA, *et al.* Statistical overview on tuberculosis in Nigeria: Epidemiological insights and public health implications. *International Journal of Advanced Community Medicine*. 2024;7(1):114-119.

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