

# A Comprehensive Overview of Epidemiological Patterns of Tuberculosis with a Special Reference of Kashmir valley

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## Abstract

Tuberculosis (TB) continues to be a major global health challenge, causing high rates of mortality and straining public health systems. Although there has been a gradual decline in incidence over the past few decades, in 2022 globally, there were as many as 10.6 million new cases reported by the WHO, affecting 5.8 million men, 3.5 million women, and 1.3 million children. According to the World Health Organization, TB is the second leading cause of death from an infectious agent, resulting in 1.3 million deaths in 2022. This disease disproportionately affects low and middle-income countries, with India experiencing particularly high prevalence and transmission rates. One of the major challenges in TB control is the presence of multidrug-resistant strains of *M. tuberculosis* in most countries, including India. In the specific context of the Kashmir valley in India, there has been a critical situation with emerging cases of multidrug-resistant tuberculosis. The COVID-19 pandemic has also posed new challenges for TB detection and control efforts worldwide, including in the Kashmir Valley. The disruptions caused by the pandemic have significantly impacted TB testing and diagnosis, potentially leading to underreporting of cases and delayed treatment. This review aims to provide an overview of global TB epidemiology, including its origins,

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historical context, scientific milestones and to highlight the main challenges that need to be addressed post-COVID in order to eliminate the disease as a global public health problem.

**Keywords:** Multidrug-resistant TB; RNTCP (revised national TB control program); latent tuberculosis infection (LTBI) Prevalence of tuberculosis, MTB; TB globally; TB in India and TB in Kashmir valley.



## INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by the strains of bacteria *Mycobacterium tuberculosis* which typically affects the lungs and if left untreated, can be fatal. However, the majority of infected people don't exhibit any disease symptoms. Tuberculosis is one of the most ancient diseases of mankind, having co-evolved with humans for thousands or even millions of years.<sup>1</sup> One of the oldest molecular evidences of tuberculosis has been documented in fossilized remains of an extinct bison (*Pleistocene bison*) teeth which has been radiocarbon dated to 17,870+230 years old<sup>2</sup> and in the remains of 9000-year-old humans recovered from a neolithic site in the Eastern Mediterranean.<sup>3</sup> It is believed that people have known about tuberculosis since old times, this is evident by the fact that the lungs of Egyptian mummies dating back 3000 years have been found to contain traces of tuberculosis lesions. The disease was also described in the writings of the Greek physician Hippocrates (450–370 BC), known as "the father of medicine". This disease was known as *phthisis* in Classical Greek times which means wasting away. The same reasoning led to its common label of "consumption" until recently. In the 17<sup>th</sup> century, it was termed as silvious of Leyden, after the name of the Dutchman Franciscus silvius of Leyden who first used the term "*tubercle*" to describe the knobby lesions found in the lungs of people who died because of this disease. However, Dr Richard Morton first established the link between the pulmonary form of tuberculosis and "tubercles," claiming that, this was because of the variety of symptoms in which this form of the disease manifested. TB was not recognized as a single disease until the 1820s, when it was named "tuberculosis" by J. L. Schönlein.<sup>4</sup> The bacillus that causes tuberculosis, "*Mycobacterium tuberculosis*" was discovered by Robert Koch in 1882, for which he won the Nobel Prize in physiology or medicine in 1905.<sup>4</sup>

The first of many drugs now used for the treatment of TB was discovered by scientists in the 1940s. As a result, tuberculosis began to fade away from the planet. But Following 1984, the total number of cases of tuberculosis reported in Asian countries began to rise which officially marked the return of tuberculosis.<sup>5</sup> In spite of more recent methods for TB diagnosis and treatment, millions of people continue to suffer and die from this disease. TB is one of the world's top three infectious killer diseases, with HIV/AIDS killing 3 million people per year, TB killing 2 million, and malaria

killing 1 million.<sup>6</sup> Even though tubercle bacilli were identified nearly 130 years ago<sup>6</sup>, a definitive understanding of the pathogenesis of this disease is still lacking.<sup>7,8</sup> The bacterium has the ability of attacking any area of the body, but it typically targets the lungs. Tuberculosis is mainly passed from an infected person to a normal person through the air. In case of some people, particularly those with a weakened immune system, the bacteria become active and cause tuberculosis (TB). Tuberculosis in the lungs or throat are contagious which means that the bacteria can be passed on to others<sup>9,10</sup> When a person infected with tuberculosis coughs or sneezes, the bacteria get released into the air in the form of droplets and the People in the vicinity may inhale these bacteria and become infected. When a normal person inhales those bacteria, the bacteria can settle in his lungs and grow<sup>5</sup> From there, they head towards various organs, including the kidney, spine, and brain by means of the blood. However, the other parts of the body, such as the kidney or spine, are usually not infected with tuberculosis. TB infection in healthy individuals is frequently asymptomatic due to the immune system's ability to wall off the causative bacteria. This bacterium thrives and multiplies in macrophages, eluding the patient's natural defence system present within the blood. TB infection can progress through two stages: asymptomatic latent tuberculosis infection (LTBI) and tuberculosis disease. If left untreated, this disease has a mortality rate of more than 50%. It has always been endemic, and it is likely that the other mycobacteria commonly reported from other countries were unable to emerge due to this complexity.

The development of the recent SARS-CoV-2 pandemic, there is a growing understanding of the importance of investing the early identification and treatment of transmissible respiratory diseases.<sup>11</sup> The lessons from the COVID-19 pandemic, demonstrated the efficacy of case detection, case isolation and contract tracing of TB cases, which provided a much-needed motivation to reorient healthcare services in high-TB burden areas and setting them towards prevention. Examining regional tuberculosis epidemiology is the best way to assess the efficacy of existing prevention and management strategies. Before the COVID-19 pandemic, tuberculosis (TB) affected one-third of the world's population.<sup>12</sup> The COVID-19 outbreak has jeopardized TB diagnosis, its treatment as well as prevention, compromising recent advances in TB detection and reduction. In comparison to 2019, there is a significant drop in the number of new cases of TB reported globally in 2020. According to

some studies the disruptions in TB prevention and treatment programmes may result in an additional 6.3 million new TB cases and 1.4 million additional deaths by 2025<sup>13</sup> India was the leading contributor to the global TB notification shortfall, followed by China, Indonesia, and the Philippines.<sup>14</sup> The COVID-19 pandemic has also imperilled India's public health system and highlighted its flaws. COVID-19 impacted many high-performing health programs, including the tuberculosis program.<sup>12,15</sup> When compared to average levels, The incidence rate of TB cases in India decreased during the lockdown period.<sup>16,17</sup>

World Health Organization's has started some strategies in order to End the TB, However, achieving the global targets of 'End TB 2035' requires a dramatic decrease in TB deaths and incidence cases, as well as the elimination of the economic and social burden of TB<sup>18</sup> Since the incidence of TB is not decreasing in line within the milestones of global End TB Strategy targets.<sup>19</sup> As a result, the World Health Organization's End TB Strategy establishes ambitious targets to which concerned countries must strive for the end of the global TB epidemic.<sup>19</sup> While it is clear that the burden of TB in Kashmir valley is disproportionately high, there is little published data characterising the local TB epidemic. It is critical to estimate the prevalence of pulmonary tuberculosis in order to guide intervention policies and program management strategies. As a result, we conducted a systematic review of published literature to get a more precise understanding of the current TB burden in order to provide a comprehensive and up-to-date assessment of the prevalence of pulmonary tuberculosis with a special reference of Kashmir valley.

### Global scenario

Tuberculosis (TB), long recognised as a major cause of morbidity and mortality across the globe, has been a neglected disease in both developed and developing countries for several decades. It is one of the top ten causes of death worldwide and one of the leading causes of death from infectious diseases. Globally, controlling tuberculosis is a significant challenge and it leads to death of millions of people every year, causing a significant morbidity and mortality worldwide. Among the 15 countries with the highest estimated TB incidence rates, 13 are in Africa, while half of all new cases are from six Asian countries, viz., India, China, Indonesia, Pakistan Bangladesh and Philippines. In a report by WHO, TB is described as a global pandemic that remains

a persistent developmental challenge, placing an enormous strain on authorities, especially in developing countries.<sup>14</sup> The recently released the World Tuberculosis Report 2022 noting the impact of Covid-19 pandemic on the diagnosis, treatment and burden of disease for Tuberculosis (TB) globally.<sup>14</sup> It is reported that in Every second, someone in the world is newly infected with TB bacilli and 1 in every 10 of these newly infected people will become sick or infectious later in life.<sup>14</sup> The report stated that approximately 10.6 million people got diagnosed with TB in 2021 which shows an increase of 4.5% from 2020 data which estimated 10.1 million cases of this disease globally while 1.6 million patients die of the disease, reversing the decline incidence of TB from many years.<sup>20,21</sup> Out Of the total TB deaths, 187,000 patients were also positive for HIV (Human Immunodeficiency virus). Nearly 82% of global TB deaths among HIV-negative people occurred in the African and South-East Asia regions. Similarly, the TB incidence rate (new cases per 100000 populations per year) is estimated to have increased by 3.6% between 2020 and 2021, following declines of about 2% per year for the past 2 decades.

### Indian scenario

The extent of TB Problem is generally described in terms of incidence, prevalence and mortality. India accounts for one fifth of the global TB burden i.e., 1.98 million out of 9.4 million new cases annually. In India, more than 40% population is infected with *Mycobacterium tuberculosis*. Approximately 75 new smear positive TB cases occur per lakh population per year. It is also estimated that about 2,76,000 people die due to TB annually. According to some studies in every three minutes two patients die because of tuberculosis in India.<sup>22</sup> In India, the TB burden remains staggering with a higher proportion of TB patients, because of its poor socioeconomic and environmental conditions. Every year approximately 1.8 million people contract the disease of which approximately 8,00,000 are infectious and until recently, 3,70,000 people died from it annually which counts for a mortality rate of 1000 patients every day.<sup>23</sup> The disease also has a significant impediment to social and economic development. It is estimated that 100 million workdays are lost due to this illness.<sup>23</sup> According to the RNTCP report, in India nearly three times more male than female TB cases are observed, although the extra-pulmonary disease has been reported more commonly in women.<sup>24</sup>

According to the most recent WHO TB report,

with 28% cases, India was among the eight countries accounting for more than two-third (68.3%) of the total TB cases. The other countries were Indonesia (9.2% cases), China (7.4% cases), Philippines (7% cases), Pakistan (5.8%), Nigeria (4.4%), Bangladesh (3.6%) and Democratic Republic of the Congo (2.9%)<sup>14</sup> The report also stated that India accounted for 36% of the global TB related deaths among HIV negative people. India was among the three countries (along with Indonesia and the Philippines) that accounted for most of the reduction in TB cases for the year 2020 (67% of the global) and made partial recoveries in 2021.<sup>14</sup> India's TB incidence for the year 2021 is 210 per 100,000 populations - compared to the baseline year of 2015 (which was 256 per 100,000 populations). There has been an 18% decline (7 percentage points); better than the global average of 11%, placing India at the 36th position in terms of incidence rates.<sup>14</sup>

### Kashmir Scenario

In India tuberculosis is one of those disease having highest mortality rate, it has been observed that Tuberculosis (TB) almost kills close to half a million Indians every year.<sup>14</sup> The union Territory Jammu and Kashmir of India, situated in the extreme north of India, has two distinct geographical regions: Jammu and Kashmir. Kashmir Valley lies to the north of Jammu region at the altitude of 1800-4000 m above sea level. It is famous for its temperate climate with a severe winter and a moderate summer. The Kashmir valley is a demographically mountainous region where the winter season lasts four to five months, forcing people to stay indoors and rely on wood, coal and gas for heating and cooking. Many studies have identified indoor air pollution as a significant risk factor for tuberculosis disease.<sup>25,26</sup> The current literature suggested a number of factors associated with tuberculosis infection, including age, gender, level of education, marital status, place of residence, wealth, overcrowding, poor housing, and household environment factors.<sup>27,28</sup> *Mayurnath et al.* conducted the first Tuberculosis prevalence study in Kashmir in 1978.<sup>29</sup> Since then, there has been no relevant data on TB prevalence in Kashmir. In Kashmir, the National Tuberculosis Control Programme (NTCP) was launched in 1964 while as the RNTCP was implemented in the valley in 2004 to stop further TB disease progression in the Kashmir valley, which showed very good results and assisted in disease decline and the removal of social stigma among patients regarding the disease and treatment. According to the RNTCP data from Kashmir, over the last 10 years the ratio

among male: female was nearly 1:1 (range 0.96:1 to 1.06:1).<sup>30</sup> A significant finding from Kashmir valley was that the prevalence of TB was higher in North Kashmir (Kupwara, Baramulla) and less in South Kashmir (Anantnag, Pulwama)<sup>30</sup> Although there is no statistically significant difference, the same regional difference was reported by *Mayurnath et al.* in 1978.<sup>29</sup> It was also observed that Females were more prone to this disease than males, and the age of female Tuberculosis patients was comparatively less than that of males.<sup>30</sup>

According to the latest data of INDIA TB REPORT 2023 from Ministry of Health and Family Welfare and from the data of state tuberculosis department of Kashmir, there has been a significant decrease in TB cases in the Kashmir division since 2021 which can be attributed to the strengthening of TB-control activities through RNTCP and implementation of Rifampicin-based DOTS regime. According to this report the UT of Lakshadweep and the district Budgam of Jammu and Kashmir were declared as the first UT and the first district in the country to achieve more than 80% reduction of TB incidence.<sup>32</sup>

In 2022, Kashmir recorded over 3376 Tuberculosis (TB) cases, with Srinagar topping the list with an estimate of 1465 cases. In 2021, The Covid-19 pandemic causes less screening for TB and during this year the Kashmir division reported less TB cases i.e., 3442 TB cases compared to 2840 TB cases in 2020.<sup>33</sup> The state tuberculosis department reported 1465 positive TB cases in Srinagar, followed by district Anantnag with 665 Positive TB cases, District Baramulla with 599 positive TB cases, Kupwara district with 361 cases, Pulwama district with 172 positive TB cases and District Budgam with only 114 positive TB cases (Fig. 1).<sup>33</sup> According to the State Tuberculosis department, Tuberculosis cases have gone down in 2022 and likely every district will be TB free by 2025.

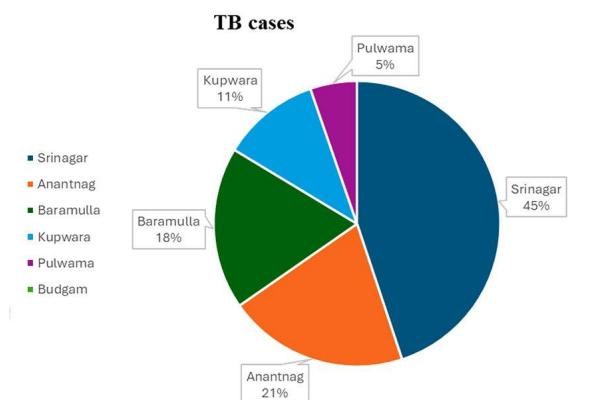


Fig. 1: Graphical representation of TB cases according to State tuberculosis department (Kashmir)

## CONCLUSION

In comparison to the rest of the Indian subcontinent, the Kashmir valley has a low TB burden. In India, tuberculosis remains one of the most common diseases in terms of mortality and morbidity. This is as a result of early infection stages not being reported, misdiagnosis, and an increase in drug-resistant TB cases. India has set an ambitious goal of TB elimination by 2025. The outbreak of the Covid-19 pandemic also slows progress towards the goal. Despite this, the Government of India is making significant efforts to combat the disease through revised plans and implementation across the country. However, there is still a long way to go to significantly reduce the high incidence and prevalence of tuberculosis in India.

The aim of the review is to gain an understanding of the burden of TB in India including Kashmir in order to identify ways by which TB control can be improved. For India to successfully combat this disease, a precise understanding of the current TB burden is required. Moreover, the effective combat can only be achieved with the help of a multifaceted approach focused on enhancing diagnostic capability, ensuring quality care, and preventing the transmission. Studying the epidemiology and service usage at a micro level within these centres could be beneficial in developing the specific strategies for actively finding and addressing the cases. Having a precise assessment of the tuberculosis (TB) burden on a national scale is crucial for informing policy decisions and can greatly aid in enhancing efforts to control the disease.

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