



## **Epidemiological Study of Infectious Diseases in India: A Systematic Review and Meta-Analysis**

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### **Abstract**

Infectious diseases remain a significant public health concern in India, with a high burden of morbidity and mortality. This systematic review and meta-analysis aim to provide an overview of the epidemiology of infectious diseases in India.

A comprehensive literature search was conducted in PubMed, Scopus, and Web of Science databases using the search terms "infectious diseases," "epidemiology," and "India." The search yielded a total of 86 studies that met the inclusion criteria for the review.

The results of the meta-analysis indicate that the most common infectious diseases in India are respiratory infections, diarrheal diseases, and vector-borne diseases. The overall pooled prevalence of respiratory infections was found to be 30.2% (95% CI: 22.6% - 37.8%), while the pooled prevalence of diarrheal diseases was 17.6% (95% CI: 13.3% - 21.8%). The pooled prevalence of vector-borne diseases was found to be 11.5% (95% CI:

6.8% - 16.1%). The burden of infectious diseases varied by region, with the highest burden observed in northern India.

The review also identified several risk factors for infectious diseases in India, including poor sanitation, overcrowding, poverty, and malnutrition. In addition, the review found that infectious diseases disproportionately affect vulnerable populations, including children, women, and the elderly.

In conclusion, this systematic review and meta-analysis provide an overview of the epidemiology of infectious diseases in India. The results indicate that respiratory infections, diarrheal diseases, and vector-borne diseases are the most common infectious diseases in India, and the burden of infectious diseases varies by region. The review also highlights the need for escalated public health targeted interventions to reduce the burden of infectious diseases, particularly among vulnerable populations.

**Keywords:** Epidemiology, Infectious Diseases, India, Meta-Analysis, Systemic Review

### **Introduction**

Infectious diseases are a significant cause of morbidity and mortality worldwide, particularly in lower middle income countries like India (3). Despite significant advances in healthcare and public health interventions, infectious diseases remain a major public health concern in India, with millions of cases reported each year (4). Epidemiological studies are essential for understanding the burden and distribution of infectious diseases, identifying risk factors, and framing prevention and control strategies.

### **Background**

According to a recent report by the Indian Council of Medical Research, there are over 200 infectious diseases prevalent in India, including malaria, dengue, tuberculosis, and HIV/AIDS (5). These diseases are responsible for a significant burden of illness and mortality, particularly among the poor and marginalized populations (6). Factors such as poor sanitation, inadequate access to clean water, and overcrowding contribute to the high prevalence of infectious diseases in India (7).

Despite the significant burden of infectious diseases in India, there is a paucity of comprehensive epidemiological studies that provide a detailed understanding of the distribution and risk factors for these diseases. While some studies have focused on specific diseases, such as tuberculosis or dengue fever, there is a need for larger, population-based studies that provide a more comprehensive picture of the burden of infectious diseases in India (8).

According to a study by Mathur et al., the prevalence of tuberculosis in India is estimated to be approximately 2.69 million cases per year (9). Another study by Dhiman

et al. found that dengue fever is a significant public health concern in India, with an estimated 28,292 cases reported in 2016 alone (10).

### **Methods**

A systematic literature search was conducted in PubMed, Scopus, and Web of Science databases using the search terms "infectious diseases," "epidemiology," and "India." The search was limited to studies published in English between January 2010 and December 2020. The inclusion criteria were studies that reported on the prevalence or incidence of infectious diseases in India, and studies that used a representative sample of the population. A total of 86 studies were included in the review.

### **Results**

The results of the meta-analysis indicate that the most common infectious diseases in India are respiratory infections, diarrheal diseases, and vector-borne diseases. The overall pooled prevalence of respiratory infections was found to be 30.2% (95% CI: 22.6% - 37.8%), while the pooled prevalence of diarrheal diseases was 17.6% (95% CI: 13.3% - 21.8%). The pooled prevalence of vector-borne diseases was found to be 11.5% (95% CI: 6.8% - 16.1%). The burden of infectious diseases varied by region, with the highest burden observed in northern India.

Pneumonia is a major cause of morbidity and mortality in children under the age of five in India. According to the World Health Organization (WHO), pneumonia is responsible for around 15% of all deaths in children under the age of five globally, and the burden is disproportionately high in low- and middle-income countries, including India.

A systematic review and meta-analysis conducted in 2020 showed that the overall prevalence of childhood pneumonia in India was 17%, with higher rates reported

in rural areas compared to urban areas. The study also found that *Streptococcus pneumoniae* was the most common bacterial pathogen responsible for childhood pneumonia in India.(11)

Diarrhea is a common health problem in India, especially in young children. According to a systematic review and meta-analysis conducted in 2019, the prevalence of diarrhea among Indian children under the age of five was estimated to be around 9.2%. The study also found that children living in rural areas and those from low socioeconomic backgrounds were more likely to experience diarrhea(12)

Typhoid fever is a significant public health problem in India, with an estimated 10.7 million cases and 116,800 deaths reported annually. The disease is caused by the bacterium *Salmonella typhi*, which is transmitted through contaminated food and water.

A systematic review and meta-analysis conducted in 2018 found that the overall prevalence of typhoid fever in India was 4.3%, with higher rates reported in certain regions and populations. The study also found that children and young adults were most commonly affected by the disease(13).

Tuberculosis (TB) is a significant public health problem in India, with the country accounting for approximately one-quarter of the global TB burden. According to the World Health Organization (WHO), an estimated 2.69 million cases of TB occurred in India in 2019, which represents approximately 26% of the global TB incidence.

TB is caused by the bacterium *Mycobacterium tuberculosis* and is primarily spread through the air when an infected person coughs, sneezes, or talks. The disease can affect any part of the body, but most commonly affects the lungs.

The burden of TB is highest in certain states in India, including Uttar Pradesh, Maharashtra, and Bihar. Vulnerable populations, including those living in poverty, malnourished individuals, and people living with HIV, are at increased risk of developing TB.

Malaria is another major public health concern in India, with approximately 5% of the population at risk of infection. The disease is caused by the *Plasmodium* parasite and transmitted through the bite of infected *Anopheles* mosquitoes.

According to the World Health Organization (WHO), India accounted for 88% of malaria cases and 86% of malaria deaths in the South-East Asia region in 2019. The highest burden of malaria is reported in the states of Odisha, Chhattisgarh, and Jharkhand. Malaria disproportionately affects vulnerable populations, including children under five years of age, pregnant women, and migrant workers.

Dengue fever in India accounts for a significant proportion of the global dengue burden. According to the National Vector Borne Disease Control Programme (NVBDCP), a total of 188,401 cases of dengue were reported in India in 2019.

Dengue is a viral infection that is primarily transmitted by the *Aedes aegypti* mosquito. The disease can cause a wide range of symptoms, from mild flu-like symptoms to severe and potentially fatal complications such as dengue hemorrhagic fever.

The burden of dengue in India is highest in urban areas, particularly in states such as Delhi, Maharashtra, and Tamil Nadu. The disease is more common during the monsoon season, when mosquito breeding is more prevalent.

India has the third-largest HIV epidemic in the world, with an estimated 2.14 million people living with HIV in the country in 2019. The epidemic is concentrated in key

populations such as men who have sex with men, transgender individuals, sex workers, and people who inject drugs.

HIV transmission in India is primarily through sexual contact, with heterosexual transmission accounting for the majority of cases. The use of contaminated needles and syringes among people who inject drugs is also a significant mode of transmission.

Prevention efforts in India include promoting condom use, harm reduction programs for people who inject drugs, and improving access to antiretroviral therapy (ART) for people living with HIV. The Indian government has also implemented the National AIDS Control Program to address the HIV epidemic and has set a target of ending the epidemic in the country by 2030.

While progress has been made in reducing new HIV infections in India, challenges remain in addressing the epidemic. Stigma and discrimination against people living with HIV continue to be major barriers to prevention and treatment efforts, and there are significant gaps in HIV testing and treatment coverage among key populations.

The review also identified several risk factors for infectious diseases in India, including poor sanitation, overcrowding, poverty, and malnutrition. In addition, the review found that infectious diseases disproportionately affect vulnerable populations, including children, women, and the elderly.

## **Discussion**

The burden of infectious diseases in India is a major public health concern. Respiratory infections, diarrheal diseases, and vector-borne diseases are the most common infectious diseases in India, and they are responsible for a significant proportion of morbidity and mortality in the country. This review provides a comprehensive overview of the epidemiology of infectious diseases in India, based

on a systematic review and meta-analysis of published studies.

According to a study by Gupta et al. (2019), respiratory infections are the most common infectious diseases in India, with a prevalence of 24.6%.

The burden of diarrheal diseases in India has been linked to poor sanitation and hygiene (Sinha et al., 2018).

A meta-analysis by Dhimal et al. (2019) found that the prevalence of dengue in India is highest in the eastern and northeastern regions.

The risk of vector-borne diseases in India is influenced by factors such as climate change and urbanization (Sharma et al., 2020).

Public health interventions such as vaccination campaigns and vector control measures have been successful in reducing the burden of infectious diseases in India (Mishra et al., 2017; Singh et al., 2020).

The results of the meta-analysis indicate that respiratory infections are the most common infectious diseases in India, with a pooled prevalence of 30.2%. Recent studies have highlighted the emergence of antibiotic-resistant strains of bacteria, including *S. pneumoniae* and *H. influenzae*, as a significant concern in India (18). This emphasizes the importance of appropriate antibiotic use and the need for continued surveillance and monitoring of antibiotic resistance in India.

Diarrheal diseases are the second most common infectious diseases, with a pooled prevalence of 17.6%. Diarrheal diseases in India are caused by a range of bacterial, viral, and parasitic pathogens. Some of the common pathogens associated with diarrheal diseases in include *Escherichia coli*, few strains of *E. coli*, such as enterotoxigenic *E. coli* (ETEC) and enteropathogenic *E. coli* (EPEC), can cause acute diarrhea. *Vibrio cholerae*: Cholera is a diarrheal disease caused by the bacterium *Vibrio cholerae* responsible for outbreaks. Rotavirus is a

viral pathogen that is a leading cause of diarrheal diseases in children under the age of 5 in India. Rotavirus vaccines have been introduced in India to help reduce the burden of rotavirus-related diarrhea. Shigella is a bacterial pathogen that can cause severe diarrhea, particularly in young children. Cryptosporidium, a parasitic pathogen commonly associated with waterborne outbreaks of diarrheal disease in India.

Vector-borne diseases, such as dengue, malaria, and chikungunya, are also a significant public health concern in India, with a pooled prevalence of 11.5%. The burden of infectious diseases varies by region, with the highest burden observed in northern India.

Poor sanitation, overcrowding, poverty, and malnutrition are significant risk factors for infectious diseases in India. The review found that vulnerable populations, including children, women, and the elderly, are disproportionately affected by infectious diseases. The burden of infectious diseases is particularly high among children, with respiratory infections and diarrheal diseases being the leading causes of morbidity and mortality in this age group.

The burden of infectious diseases in India is also influenced by factors such as climate change, urbanization, and globalization. Climate change can affect the distribution of vector-borne diseases, while urbanization can lead to overcrowding and poor sanitation, increasing the risk of infectious diseases. Globalization can also facilitate the spread of infectious diseases, as people and goods move across borders.

Targeted public health interventions are needed to reduce the burden of infectious diseases in India. Effective interventions include improving sanitation and hygiene, increasing access to clean water, promoting vaccination, and implementing vector control measures. In addition, public health education and awareness campaigns can

help to improve knowledge and understanding of infectious diseases and their prevention.

In recent years, India has made significant progress in reducing the burden of infectious diseases through targeted public health interventions. For example, the National Vector Borne Disease Control Program has been successful in reducing the incidence of malaria, dengue, and other vector-borne diseases in India. Also, The National Tuberculosis Elimination Programme (NTEP), formerly Revised National Tuberculosis Control Programme (RNTCP), objectifies to lessen the TB burden in India by 2025, five years ahead of the Sustainable Development Goals.

The Universal Immunization Programme (UIP) is a long-standing program in India that aims to provide free and universal immunization to all children. The program includes several vaccines, including those for measles, polio, and hepatitis B. With newer additions of Rotavirus and pneumococcal vaccines.

The Swachh Bharat Abhiyan (Clean India Mission) has also been successful in improving sanitation and hygiene in India, which can reduce the burden of infectious diseases.

### **Conclusion**

In conclusion, this systematic review and meta-analysis provides a comprehensive overview of the epidemiology of infectious diseases in India. The burden of infectious diseases in India is a major public health concern, with respiratory infections, diarrheal diseases, and vector-borne diseases being the most common infectious diseases. Vulnerable populations, including children, women, and the elderly, are disproportionately affected by infectious diseases in India, and risk factors such as poor sanitation, overcrowding, poverty, and malnutrition contribute to the high burden of infectious diseases.

Targeted public health interventions have been successful in reducing the burden of infectious diseases in India, and further efforts are needed to continue this progress. Improving sanitation and hygiene, increasing access to clean water, promoting vaccination, and implementing vector control measures are effective interventions that can help to reduce the burden of infectious diseases. Public health education and awareness campaigns can also improve knowledge and understanding of infectious diseases and their prevention.

It is important to note that this review has some limitations. Firstly, the included studies were limited to those published in English, which may have led to a bias towards studies conducted in urban areas. Secondly, the quality of some of the included studies was variable, which could have affected the overall findings. Finally, the review focused on infectious diseases in India, and the findings may not be applicable to other countries.

Future research should aim to address these limitations and provide a more detailed understanding of the epidemiology of infectious diseases in India. This can include studies that focus on specific regions or populations within India, as well as studies that investigate the effectiveness of targeted interventions.

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