

# Guillain–Barré Syndrome: Investigating the Link between Rapid Urbanization and Rare Disease Outbreaks

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## INTRODUCTION

Guillain–Barré syndrome (GBS) is a rare but common cause of acute flaccid paralysis globally.<sup>1</sup> This syndrome, first described in 1916 by Georges Guillain, Jean Alexandre Barré, and André Strohl, has captured the interest of clinicians, researchers, and patients all over the world.<sup>2</sup>

GBS is acknowledged as a neurological emergency of concern, where despite treatment, 20% of patients are left with persistent and significant disability.<sup>3</sup> GBS frequency and clinical features fluctuate significantly between various populations and geographical areas, with an estimated yearly incidence ranging from 0.89 to 1.89 cases per 1,00,000 people. Male predominance is reported, with the male-to-female ratio of the syndrome being 1.78.<sup>4</sup> Nonetheless, outbreaks of GBS are extremely rare.

During the second week of February 2025, Pune Municipal Corporation hinted at an epidemiological alert with the hospitalization of 180 cases of a GBS cluster. This GBS outbreak was notable due to the unusually high number of cases.

The above-reported Pune outbreak was surpassed only by the 2019 Peru epidemic of GBS, which affected several regions of the country, with almost 700 reported cases (incidence: 1.2 per 1,00,000 inhabitants).<sup>5</sup>

Geographical mapping of GBS cases in Pune depicted the origin of clusters from newly developed regions of Pune Municipal Corporation. The large number of cases and rapid increase pointed toward point-source exposure. A general water source to these newly merged areas of Pune Municipal Corporation, through a common pipeline from a well, was primarily identified to be contaminated.

Clusters of GBS have been reported with outbreaks of diarrheal illness caused by contaminated water.<sup>6</sup> A comprehensive systematic review of approximately 2,500 GBS cases identified *Campylobacter jejuni* as the most frequently associated preceding infection, accounting for 30% of GBS cases.<sup>7</sup>

Past GBS outbreaks linked to *Campylobacter* have primarily been observed during large outbreaks of cases with symptomatic bacterial enteritis.<sup>8</sup> The demographics of the GBS cases are depicted in Figure 1.

In the Pune GBS outbreak, the highest number of cases were in the 20–29-year age-group. Most of the cases were reported to have had diarrheal illness weeks prior to the development of flaccid paralysis. These findings are contrary to evidence in the literature reporting greater incidence with increasing age. The clinical significance of this observation is unclear.

Based on the clinical-epidemiological characteristics and the study of the identified agents in water samples conducted by the National Institute of Virology in Pune, it was concluded that the outbreak was associated with the presence of *C. jejuni*.

Campylobacteriosis is a major public health issue worldwide, ranking among the top causes of infectious diarrhea and foodborne disease. Sequelae such as GBS and reactive arthritis are widely recognized. Eating undercooked poultry and the cross-contamination of other food and untreated water sources are additional major risk factors for human infection.<sup>9</sup>

Urban planning pitfalls could be an environmental factor playing a key role in such outbreaks. Multiple studies have highlighted challenges of rapid urbanization, which include maintaining sanitation and waste management, ensuring access to clean drinking water, providing secure housing, and ensuring adequate nutrition.<sup>10</sup>

## INSIGHTS FROM PAST EPIDEMIC

The H1N1 influenza pandemic of 2009 caused widespread alarm in India. Pune, a city in southwest India, was the worst hit and was mapped as the epicenter of the pandemic. Of the 93 documented influenza deaths in Pune, 65 were from urban areas and 28 from rural areas.<sup>11</sup>

Epidemic models rely on the disease reproductive rate, which measures how many people the first infected individual transmits the disease to while infectious. Higher population density increases encounters, leading to a higher reproductive rate.<sup>12</sup>

In 2019, the emergence of a novel coronavirus disease was reported in a single city, Wuhan. In a short period, it rapidly escalated into a global pandemic.

A study by Tamrakar et al. analyzed district-level comparisons of COVID-19 data

from March to October 2020. Maharashtra was identified as one of the states with the highest infection ratio (101.63), much above the overall national ratio of 42.85 per 1,000 people. The study concluded that the pandemic spread in Indian districts was driven by their characteristics of a larger working-age population, greater population density, a higher proportion of urban residents, and increased testing rates.<sup>13</sup>

Pune was then labeled as a hotspot for COVID-19, positioning urban centers as critical hubs in crisis response. The situation compelled cities across India to confront the challenges posed by unplanned urbanization, where many residents lacked access to essential services and facilities. The preexisting infrastructure deficit significantly hindered the quality of life.<sup>13,14</sup>

To solve these issues, as well as to find solutions to these widely discussed challenges, the impact of urbanization needs to be looked at more critically, especially in the context of outbreaks.

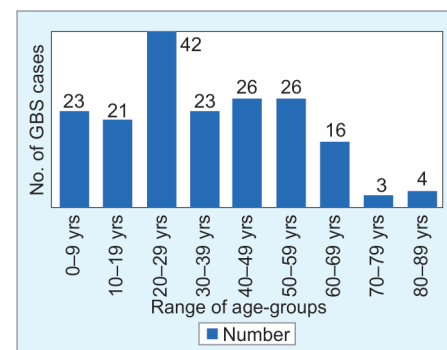


Fig. 1: GBS Patients Distribution categorized by age groups

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## PREVENTIVE IMMUNIZATION LINK TO GUILLAIN-BARRÉ SYNDROME

Beyond infectious triggers, vaccinations have attracted attention as possible causes of GBS.

The potential link between the influenza vaccine and GBS has been a concern since 1976, when a U.S. vaccination campaign was abruptly halted due to a rise in GBS cases following the administration of the A/New Jersey/76 “swine flu” vaccine.<sup>15</sup>

The global distribution of various formulations of A/H1N1/2009 vaccines during the pandemic has renewed attention on their potential association with GBS.<sup>16,17</sup>

In response to the COVID-19 pandemic, India launched the “World’s Largest Vaccination Drive” on January 16, 2021. However, the rapid development of COVID-19 vaccines led to widespread hesitancy and concerns about their safety and effectiveness.<sup>18</sup>

Jeong et al. studied the global burden of vaccine-associated GBS, finding the highest link with the influenza vaccine and the lowest with the COVID-19 vaccine. Vaccine-associated GBS was more common in older adults, with a mean time of onset at 5.5 days.<sup>19</sup> This highlights the need for vigilance in the 1st week postvaccination, especially during mass immunization events in pandemics.

## RESCUE MEASURES IMPLEMENTED BY LOCAL GOVERNMENT (PUNE MUNICIPAL CORPORATION)

Ongoing epidemiological surveillance by the local government body, Pune Municipal Corporation (PMC), aims to identify the potential antigenic source of suspected infection through *Campylobacter*-specific IgM and antiganglioside antibody testing.

Active systematic sample testing and further isolate sequencing for emerging cases are being carried out in collaboration with the

National Institute of Virology (NIV) laboratory in Pune.

Strengthening public health initiatives through education, awareness, and surveillance is essential in preventing future epidemics. Reinforcing hygienic practices at the individual level at each link in the food chain—from producer to consumer—is critical in preventing the disease.

## SAFEGUARDING PUBLIC HEALTH TO AVERT FUTURE EPIDEMICS

Initiatives ensuring health- and hygiene-related services, such as supplying sufficient clean drinking water, proper sanitation and sewage systems, city cleanliness, and the upkeep of quarantine centers as well as public health care facilities, will help avert future outbreaks.

## CONCLUSION

Urban planning pitfalls may significantly contribute to disease outbreaks.

Effectively managing outbreaks requires collaborative efforts from citizens and strategic coordination between the public and private sectors.

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