




## Editorial

# The whispering sands: Climate's microbial shift in India's urban children

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India, a nation of vast diversity and rapid development, stands at the forefront of the climate crisis. While the stark images of flooded coastal cities and parched farmlands dominate headlines, a more subtle, yet equally critical, health challenge is emerging: the impact of climate change on the delicate microbial ecosystems of India's urban children. We argue that the “whispering sands” of climate change, carried by shifting populations and altered environments, are reshaping the very foundation of childhood health.

The Indian subcontinent is experiencing increasingly erratic weather patterns. Rising temperatures, intensified monsoons, and prolonged droughts are forcing families to migrate from rural areas to already overcrowded urban centres.<sup>1</sup> This climate-induced migration disrupts not only livelihoods but also the intricate balance of children's microbiomes – the communities of bacteria, fungi, and viruses that reside within and on their bodies.<sup>2</sup> These microbiomes, crucial for immune development, metabolic function, and even cognitive development, are highly sensitive to environmental changes.

Consider a child from a rural farming community, accustomed to a diet rich in fresh produce and exposure to diverse soil microbes, as well as the diverse microbial exposure that comes with outdoor living. They are now relocated to a densely populated urban slum in Mumbai or Delhi, facing limited access to clean water, sanitation, and nutritious food. The shift to processed foods, often high in refined sugars and low in fibre, coupled with increased

exposure to urban pollutants and a drastically altered microbial environment, triggers a cascade of changes within their gut, skin, and respiratory microbiomes.<sup>3</sup> This is a rapid shift, and the microbiome often struggles to adapt.

In India, where infectious diseases and malnutrition remain significant public health challenges, the disruption of these vital microbial ecosystems can have profound consequences.<sup>8</sup> Dysbiosis, or microbial imbalance, can weaken the immune system, making children more susceptible to infections like diarrhoea and pneumonia.<sup>4</sup> Furthermore, it can contribute to the development of chronic conditions such as allergies, asthma, and even metabolic disorders like type 2 diabetes, which are increasingly prevalent in urban Indian populations.<sup>5</sup> The stress of displacement, coupled with the lack of access to familiar and culturally appropriate foods, exacerbates these issues.

The impact is particularly acute in India due to several factors. Firstly, the high density of urban populations and the limited infrastructure in many areas exacerbate the effects of climate-related stressors.<sup>7</sup> Secondly, the vulnerability of children to environmental changes is amplified by the existing burden of malnutrition and infectious diseases. Thirdly, the lack of comprehensive data on the microbiome of Indian children, especially those in displaced and vulnerable populations, hinders our ability to develop targeted interventions. We need to understand the impact of specific pollutants, diet changes, and social stressors on the Indian pediatric microbiome.

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We therefore urge a multi-pronged approach to address this emerging health crisis. We need to invest in research to understand the specific impacts of climate change on the microbiomes of Indian children. This includes large-scale studies to map microbiome diversity and function across different urban environments and populations. We must also strengthen public health infrastructure to improve access to clean water, sanitation, and nutritious food, particularly in vulnerable communities. This should include access to pre and probiotic foods, and education on maintaining healthy gut flora.

Furthermore, we need to integrate climate change considerations into existing public health programs. This includes developing early warning systems for climate-related health risks and implementing community-based interventions to promote healthy lifestyles and microbial balance. It is also imperative to support sustainable agricultural practices and food systems that ensure access to nutritious and affordable food for all, and to promote urban green spaces that can help children to regain some exposure to beneficial environmental microbes.<sup>6</sup>

The “whispering sands” of climate change are carrying a hidden health burden for India’s children. By acknowledging and addressing the impact of climate change on their microbiomes, we can safeguard their health and build a more resilient future for the nation.

## Conflict of Interest

None.

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