Indian Journal of Clinical Psychiatry
An Official Journal of **Association of Clinical Psychiatry**
(Indian Psychiatric Society- Uttar Pradesh State Branch (IPS-UPSB))

EDITORIAL
doi: 10.54169/ijocp.v6i01.02

Air pollution and mental health in India: A Neglected Public Health Crisis

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Introduction

Air pollution is among the leading risk factors for mortality globally, comparable to tobacco use and an unhealthy diet.[1] The harmful effects of air pollution on our respiratory and circulatory systems are well established, but more often, we do not focus on the mental health impact of air pollution, particularly in low and middle-income countries such as India. A substantial number of premature deaths, approximately 4 million, are attributed to air pollution as recognized by the World Health Organization (WHO).[2] Majority states across India fall below the universal advisory air pollution cutoffs given by both the National Ambient Air Quality Standards (NAAQS) and WHO, while the northern states along the Indo-Gangetic Basin region take the worst hit, with the highest air-quality index (AQI) rating across the world, especially during winters.[3]

Air pollution encompasses a wide range of particulate matter, amongst which fine particulate matter (PM2.5; diameter ≤2.5 µm) is considered particularly harmful due to its ability to penetrate deep into the respiratory system.[2,4] While fine particulate matter deposits in the lungs, ultrafine particulate matter (PM <0.1 µm) can enter the bloodstream and affect multiple organ systems, including the central nervous system, exerting neurotoxic effects[2]. Particulate matter acts as a foreign body, triggering an inflammatory response and enhancing oxidate stress within the brain. Long term exposure leads to structural alterations in brain regions such as the hippocampus, amygdala, and prefrontal cortex, as well as function changes, at the level of neurotransmitters, which might trigger psychiatric illnesses.[5] The systemic inflammation triggers the body's stress response with further contributes to adverse mental health outcomes.[6]

With the world's focus shifting to this emerging problem, more and more evidence is being found linking air pollution with increased risk of depression, anxiety, cognitive decline, and relapse of severe mental illnesses, with a systematic review reporting that 73% of studies found increased psychiatric symptoms following higher pollution exposure.[5] Depression, anxiety, and post-traumatic stress disorder were shown to be more common in another systematic review that looked at climate-related suffering.[7] Additionally, short-term exposure to pollutants such as sulphur dioxide has been associated with schizophrenia

ARTICLE INFO

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Dates:
Received: 15-01-2026
Accepted: 10-04-2026
Published: 26-06-2026

How to Cite:
Singh S, Shukla R. Air pollution and mental health in India: A Neglected Public Health Crisis. Indian Journal of Clinical Psychiatry. 2026;6(1): 5-7.
doi: 10.54169/ijocp.v6i01.02

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relapse and postpartum depression.[8] The population most at risk is women, widows, and elderly folks. Air pollution significantly impacts their cardiovascular health, negatively affects sleep quality, lowers life happiness, and also impairs their cognitive ability.[9] The most vulnerable times appear to be during pregnancy and the postpartum period. Pollutant exposure, particularly PM2.5, during pregnancy has been linked to a higher risk of neurodevelopmental disorders like and ADHD in children.[10,11]

The mental health effects of air pollution go beyond the traditional biological mechanisms, as the environmental changes around us are a trigger for psychological distress. Persistent exposure to smog-filled environments, reduced visibility, and ecological degradation, as well as the uncertainty about future health and well-being, may directly impact our psychological state. This phenomenon is termed as eco-anxiety, which encapsulates the anxiety and distress associated with climate change and environmental degradation, which affects individuals across various demographics, particularly among youth facing multiple academic and social pressures about their own future[12]. This highlights the complex interplay between air pollution-related ecological change and mental health.

A large proportion of India's population is exposed to air pollution levels exceeding recommended limits, with a disproportionate burden in northern regions.[13] Key contributors include vehicular emissions, industrial activity, crop residue burning, and household biomass fuel use. While environmental air pollution is usually the focus of discussion, the hidden problems associated with household pollution often remain under-addressed, especially in the lower socio-economic as well as rural settings, where the accessibility to air purifying technology is still limited.

Policy initiatives such as the National Clean Air Program (NCAP) represent important steps toward mitigation. However, implementation gaps, rapid urbanization, and socio-economic constraints continue to limit their impact.[14] Addressing air pollution in India, therefore, requires not only technological and regulatory solutions but also sustained political commitment and intersectoral coordination across urban as well as rural sectors. Although absolute PM<2.5 exposure differences are much more severe in high Socio-Demographic Index (SDI) states (ranging from 6090 microgm/m3), the psychiatric burden disproportionately affects lower-income rural cohorts. This is primarily because, despite having lower AQI, they end up having more exposure due to a lack of protective infrastructure and limited access to healthcare, which may exacerbate neurobiological vulnerability.[15]

Despite mounting evidence, mental health considerations are largely absent from air quality discourse and policy frameworks. This is particularly concerning for our nation, which is already facing a substantial burden of mental disorders and limited mental health resources. Integrating mental health into environmental policy is therefore imperative. Public health strategies must expand beyond traditional illness outcomes to include psychological well-being as a key indicator of environmental impact.

India has started taking measures in the right direction by focussing a shift to electronic vehicles, expanding green corridors in the city, and reducing dependency on biofuel for household needs by switching to central lines of LPG, as well as making policies in terms of controlling pollution.[16] However, like most issues in India, the problem is the inadequate enforcement of the existing laws. Rules regarding efficient management of construction sites and transportation, which include adequate coverage, dust mitigation, regular sprinkling with proper segregation and disposal of waste material, already exist under Central Pollution Control Board guidelines, but we fail to see this getting implemented around us. At a personal level, we can shift to public transport and carpooling as much as possible, use energy-efficient devices and spread awareness at the community level regarding the hazards of air pollution and effective ways to protect oneself from it, i.e., using masks, staying indoor till the problem is tackled at the national level.

With the emerging data, where air pollution is clearly impacting the mental health of our nation in various capacities, we must acknowledge it as a psychiatric public health concern. In order to address this burden, intersectoral policy integration is needed. Public health systems and policy making

should be individualized to urban and rural problems with goal-directed measures in each sector. It is a multistage process starting with psychoeducation of the masses, followed by the development of adaptive coping mechanisms (such as stress management and cognitive restructuring), while incorporating regular screening for pollution-related discomfort and emergence of psychiatric illness, and providing early intervention. Psychiatrists and mental health professionals have an important role to play in this evolving landscape. In addition to clinical care, they can contribute to research, advocacy, and policy dialogue, helping to foreground the mental health consequences of environmental exposures. The teamwork of mental health professionals and policy makers is the cornerstone that will help close the gap between clinical practice and public health initiatives to combat this problem in the coming years.

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