Air Pollution in India: Health and Economic Impact

ARTHA GLOBAL

Centre for Rapid Insights

Report

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Artha Centre for Rapid Insights

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About Us:

Artha Global

Artha Global is a globally networked policy consulting organisation that partners with governments, multilateral agencies, philanthropies, and the private sector to address systemic challenges that hinder people's aspirations for shared prosperity and opportunity.

Over the coming decades, developing nations will undergo critical transitions as they urbanise, digitise, and formalise their economies—all while striving to deliver jobs and reduce emissions. These transformations will create tremendous opportunities but also present complex, multidimensional policy challenges. Addressing these requires new paradigms and interdisciplinary solutions that are deeply rooted in local context and informed by a nuanced understanding of the political economy of execution.

At Artha Global, we work alongside leaders to navigate these transitions and the opportunities and disruptions they bring, in order to secure long-term prosperity, social stability and the opportunity for each individual to achieve their full potential. Our approach blends rigorous research with a relentless focus on execution. We believe deeply in the power of interdisciplinary networks and dialogue, and that collaboration across sectors and fields is essential to solving the most pressing challenges of our time.

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Executive Summary

Air pollution in India has reached a critical level, posing severe environmental, health, and economic risks. In November 2024, Delhi's Air Quality Index (AQI) hit an alarming 500, far exceeding the safe limit. The crisis is exacerbated by factors such as stubble burning, vehicular emissions, and industrial pollution. India is home to 12 of the world's 15 most polluted cities, with pollution levels exceeding WHO guidelines by more than ten times in nearly half of Indian cities. This pollution crisis costs Indian businesses an estimated $95 billion annually due to reduced productivity, worker illness, and premature mortality.

Beyond environmental concerns, air pollution has emerged as a major public health emergency. A rapid survey conducted across eight highly affected states in November 2024 found that 56% of respondents or their family members suffered from pollution-induced respiratory illnesses. Over 60% of individuals aged 18-30 reported experiencing these health issues. Among affected respondents, 70% missed at least one day of work or school. Further demonstrating the economic costs of poor air quality. Children and the elderly are particularly vulnerable, with pollution exposure affecting cognitive development and worsening chronic illnesses.

As air pollution worsens, people have adopted various coping mechanisms. Our survey found that around 40% of respondents wore masks to reduce exposure, while others relied on air purifiers or stayed indoors. However, nearly 24% of respondents did not use any protective measures, highlighting the disproportionate burden on low-income households who lack access to air purifiers or private transportation. While government interventions such as remote work policies and school closures help mitigate exposure, these measures primarily benefit urban and wealthier populations.

To combat air pollution effectively, policymakers must focus on prevention, mitigation, and adaptation. Preventive strategies should adopt a systems-thinking approach, fostering collaboration between urban planners, pollution control boards, and transportation authorities to implement holistic solutions. Expanding focus beyond administrative boundaries through an airshed-based strategy can improve pollution control across regions. Mitigation efforts must enhance air quality monitoring, predictive forecasting, and real-time AQI alerts to help citizens and businesses take preemptive action.

Adaptation measures should prioritise Clean Air Zones, particularly in vulnerable areas like schools and hospitals, to limit exposure. Strengthening healthcare access through mobile clinics in high-pollution zones can provide essential respiratory screenings and preventive care. Additionally, promoting flexible work and school arrangements, improving indoor air quality, and integrating green infrastructure in urban planning can help protect public health in the long term.

While India has made progress through policies like the Graded Response Action Plan (GRAP), further efforts are necessary. Enhanced coordination, stricter enforcement, and greater public engagement will be critical in reducing pollution, protecting public health, and minimising economic losses caused by deteriorating air quality.

1. Introduction

1.1 The air pollution crisis

In November 2024, Delhi's air quality index (AQI) reached an alarming 500, far above the satisfactory range of 50-100, putting it in the 'severe' category where pollution levels pose immediate health risks. Further, the air quality in other North Indian states—Haryana, Uttar Pradesh, Punjab, and Bihar—is poor, specifically due to stubble burning in these regions.[1] [2] General air pollution in India is linked to burning of coal to generate electricity, but the crisis deepens during colder temperatures with widespread crop burning from surrounding states.[3] A deadly combination of dropping temperatures, vehicle fumes, dust, cooking fuel emissions, smoke, and the extensive burning of crop residue comes together, leading to a sharp decline in air quality and smog .[4]

India has 12 of the most polluted 15 cities in the world. According to the IQAir World Air Quality Report 2021, no city in India met the World Health Organisation's (WHO) standards for safe air quality. Further, 48% of India's cities exceeded PM2.5 concentrations by more than 10 times the WHO guidelines, which poses a massive impact on human health.[5] Air pollution costs Indian businesses $95 billion every year, as it causes low productivity of workers, reduced consumer footfall, and premature mortality impacting India's workforce.[6]

1.2 Impact extends beyond an environmental crisis

Aside from being an environmental hazard, air pollution takes a heavy toll on health, well-being and productivity, and the full scope and impact of the damage it causes remain poorly understood. [7] [8] Therefore, it is important to understand the direct and indirect effect of air pollution. This is especially important as the effects of air pollution differ based on socio-economic and demographic factors, a detail that is often overlooked.[9] It impacts a broader section of the population, and its secondary consequences are often overlooked because they do not always appear as obvious health issues.

A health crisis

The impact of poor air quality is a public health emergency with 4 out of 10 families consulting a doctor in the first half of November 2024.[10] In 2019, India's annual average PM2.5 concentration, a dangerous fine particulate matter, was 91.7 µg/m^3, with Delhi recording a staggering 217.6 µg/m^3, the highest in the country, with Kerala, if one considers another state in South India as comparison, had a low concentration of just 15.8 µg/m^3. The health implications, ranging from chronic respiratory

[1] Delhi Air Pollution: AQI remains 'severe plus', inches closer to 500-mark as toxic haze envelops national capital (2024)
[2] Safar India: Air Quality Index
[3] Delhi air pollution: Why has India failed to clean up its toxic smog? (2024)
[4] 'Severe' air is coming. Here's the X-factor behind Delhi's winter poison (2024)
[5] World Air Quality Report (2021)
[6] Air Pollution and its Impact on Business (2021)
[7] Exposure and Health Impacts of Air Pollution
[8] The non-health impacts of Air pollution In India (2023)
[9] The environmental justice analysis of air pollution in India (2023)
[10] 4 in 10 families had someone consulting a doctor in last 3 weeks, finds new Delhi pollution survey (2024)

problems, cardiovascular diseases, to epigenetic changes that can affect future generations, are detrimental. Some studies also show that approximately 7.2% of all deaths in India can be attributed to daily exposure to air pollution.[11]

Additionally, the World Health Organisation (WHO) also recognises children and elderly people as particularly vulnerable, alongside those with underlying health conditions.[12] For children growing up in polluted cities, the risk of lung diseases and stunted growth is high.[13] This proves to be a glaring concern considering that the 10 most polluted cities in India host a sizable share of the population.[14] Poor air quality also impacts children's cognitive development and memory from an early age with prolonged exposure to increased pollution levels being linked to reduced capabilities in the long-run.[15] This can impede future growth and productivity of the younger population. For elderly people, chronic health issues and diminishing lung capacity due to increasing air pollution are a rising concern. This also poses a challenge to the health care system that needs to cater to a growing incidence of inter-related health issues, many of which are exacerbated by poor air quality.[16]

An economic crisis

The economic impact of air pollution is equally striking. Air pollution negatively impacts workers and several sectors in the economy, affecting economic growth. Key factors include reduced worker productivity, higher absenteeism due to illness, and decreased agricultural output. Over time, pollution also hampers human capital development and drives migration away from the most productive areas.[17] Studies also indicate a link between air pollution and reduced performance on various cognitive and academic tests, highlighting its effects on both students and office workers.[18] [19]

However, this effect is not uniform across sectors. Workers in specific industries/workspaces—agricultural labourers and others engaged in physically demanding, outdoor work—experience greater exposure to pollutants. A study published in The Lancet Planetary Health highlights that states like Uttar Pradesh, Bihar, and Rajasthan, with lower per-capita GDPs, face the largest economic losses due to poor air quality. [20] Since these states contribute significantly to the nation's economy through outdoor labour-intensive sectors, they are especially susceptible to climate shocks.

Air pollution, in turn, affects a country's GDP, as it leads to economic losses through illnesses, deaths and reduced productivity. The World Bank estimated that air pollution caused economic losses of $36.8 billion, or 1.36% of India's GDP, in 2019 due to premature deaths and morbidity alone. [21] Further, a study by the Reserve Bank of India also states that by 2030, as much as 4.5% of India's GDP

[11] Increase mortality risk from increased air pollution in India (2024)
[12] Vulnerability to air pollution: Health Effects (2008)
[13] Air pollution harms most vulnerable (2020)
[14] Top 10 polluted cities in India, Delhi ranks second (2024)
[15] Air Pollution: The invisible effects on health, productivity, and economic output (2022)
[16] Young and old, air pollution affects most vulnerable (2018)
[17] Air Pollution reduces economic activity: Evidence from India (2023)
[18] Does India's air pollution impact more than just health? (2023)
[19] Office air quality may affect employees' cognition, productivity (2021)
[20] Health and economic impact of air pollution in the states of India: the Global Burden of Disease Study (2019)
[21] How is India trying to Address Air Pollution (2024)

could be at risk due to lost labour hours as a result of climate change issues like excessive heat and air pollution.[22]

1.3 Current coping mechanisms adopted

As pollution levels continue to rise sharply, accompanied by escalating health issues, it becomes increasingly essential to understand how individuals are coping with these challenges. Understanding their coping mechanisms can inform strategies to facilitate adaptation, ensuring that vulnerable populations can mitigate the adverse effects.

Cities across Delhi and Haryana, for instance, have implemented measures such as online schooling, staggered office timings for government employees, and mask-wearing advisories for residents.[23] A higher percentage of work absences in Delhi may be linked to a combination of heightened awareness and government interventions, including work-from-home policies and flexible work hours. These measures are particularly prevalent in areas with high air pollution, aiming to mitigate the impacts on health and productivity.[24]

Another survey reveals that around 27% of families are turning to air purifiers, staying indoors, and consuming immunity-boosting foods to tackle escalating pollution. Interestingly, an equal percentage of respondents do not choose any of the coping strategies listed in the survey, opting to endure it.[25] Meanwhile, 16% of those surveyed plan to escape the toxic air by traveling to cleaner locations during the peak pollution month of November.

However, it's important to address the disproportionate burden on low-income households, who often lack the resources to implement such protective measures. While wealthier individuals can afford choices that minimise exposure—such as using clean fuel or driving personal cars—those from poorer backgrounds have fewer options.[26]

2. Rapid Survey Framework and Methodology

Our rapid survey approach allows us to gather large-scale data rapidly, while implementing statistical adjustments to balance non-response bias.

We used Interactive Voice Response (IVR) technology to gather large-scale survey data via mobile phones. We were able to conduct and complete the survey at a time when the impacts of air pollution were most noticeable.

Our framework ensures that there are no day-level or surveyor-level effects on survey response, and that we can gather recent, topical data at scale. Similar to in-person surveys, each person has a different propensity to answer a survey. We account for non-response bias by using new statistical tools in the analysis of public opinion to mitigate these biases. The relatively large sample size with

[22] How Climate change can impact GDP and jobs (2023)
[23] Air Pollution : After Delhi, Gurgaon temporarily shuts down schools, authorises online classes (2024)
[24] Delhi Pollution: Central govt employees body seek WFH, staggered working hours as air quality worsens (2024)
[25] Every Delhi-NCR family has one or more members with pollution-related health issues, claims survey (2024)
[26] Study: Poorer Indian households are bearing the brunt of global pollution (2021)

appropriate statistical adjustment, allowed us to make robust empirical claims from the survey data at a fraction of the cost and time that it would take to roll out a brick-and-mortar in-person survey.

We conducted our survey over November 12-13th, 2024, to assess the impact of air pollution on health and productivity, and the impacted respondents' coping mechanisms. We surveyed over 8000 respondents across eight of the most affected states—Bihar, Delhi, Haryana, Madhya Pradesh, Punjab, Rajasthan, Uttar Pradesh, and Uttarakhand. Since respondents on the phone typically have a short attention span, our survey had three questions to maximise the number of responses with complete data.

To understand the incidence of pollution-induced respiratory problems and the means of coping with such health issues, we asked the following questions:

1. Have you or anyone in your household developed a cough or difficulty breathing due to air pollution in the last 2 weeks?
    - Yes, this is a regular occurrence
    - Yes, but it is a rare occurrence
    - Not an issue

For those saying yes, we asked:

1. How many days of work or school was missed due to the illness?
    - Less than 3 days
    - More than 3 days
    - Did not miss work

2. What is your primary method of coping with air pollution?
    - Wearing mask
    - Have air purifiers
    - Not stepping outside
    - Keeping doors and windows closed
    - None of the above

3. Findings

4.1 Incidence of pollution-induced respiratory illness

4.1.1 Overall findings

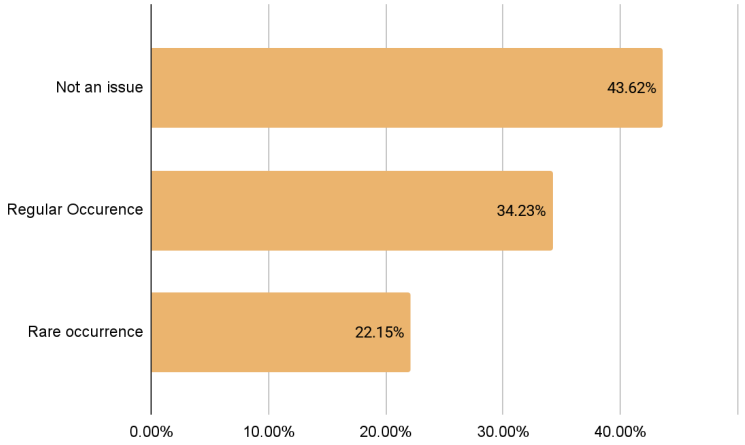


Figure: Prevalence of respiratory illness due to air pollution (Sample: 8688)

Over 55% of all those surveyed said they, or at least one family member, experienced pollution-induced respiratory illness.

4.1.2 Incidence of pollution-induced respiratory illness, by gender and age group

We aimed to examine the impact of pollution across gender and age groups, recognising that the impacts on health and productivity vary across demographics.

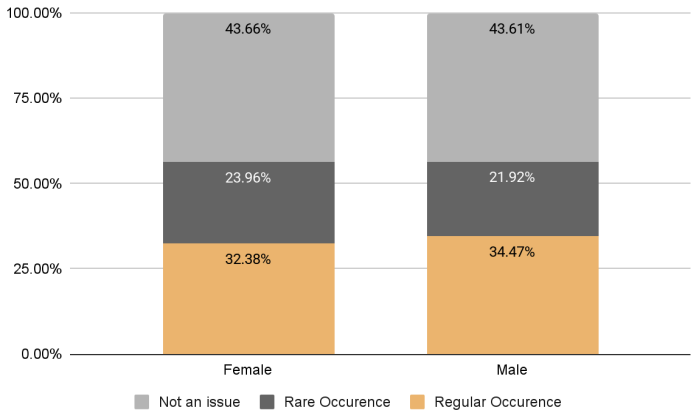


Figure: Prevalence of respiratory illness due to air pollution, by gender (Sample: 8688)

Over 55% of respondents across both genders report experiencing pollution-induced respiratory illness.

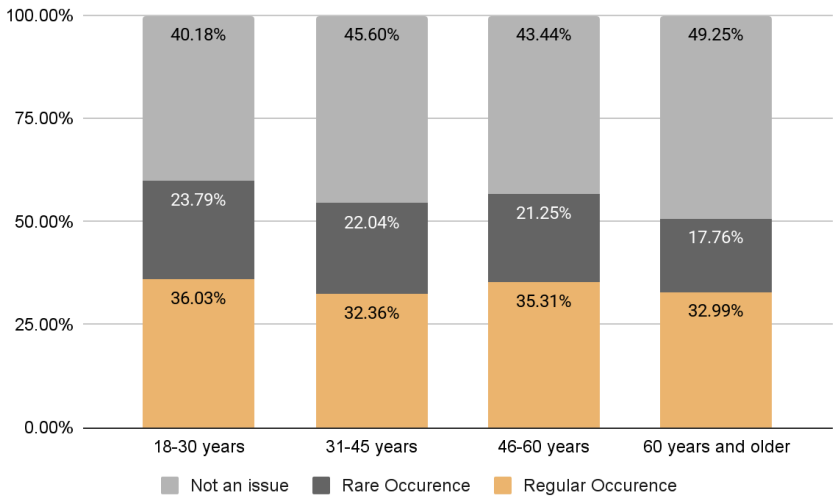


Figure: Prevalence of respiratory illness due to air pollution, by age (Sample: 8688)

More than 60% of respondents aged 18 to 30 have faced respiratory issues linked to pollution.

4.1.3 Incidence of pollution-induced respiratory illnesses, by state

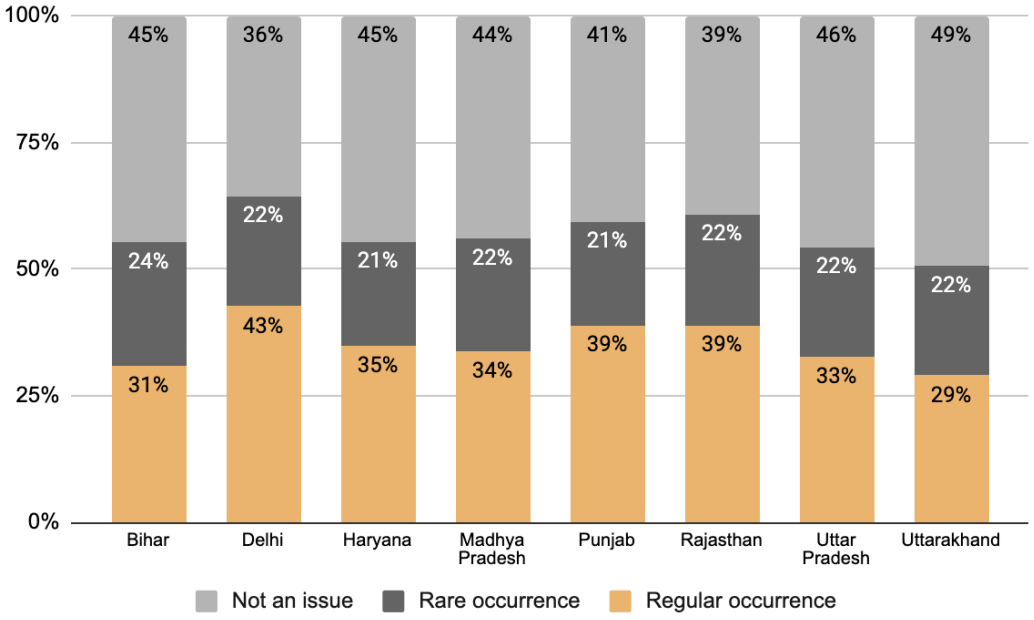


Figure: Prevalence of respiratory illness due to air pollution, by state (Sample: 8688)

In Delhi, Rajasthan, and Punjab, states that consistently experience deteriorating air quality, over 60% of respondents report pollution-induced respiratory issues.

4. 2 Impact on Attendance and Productivity

4.2.1 Overall findings

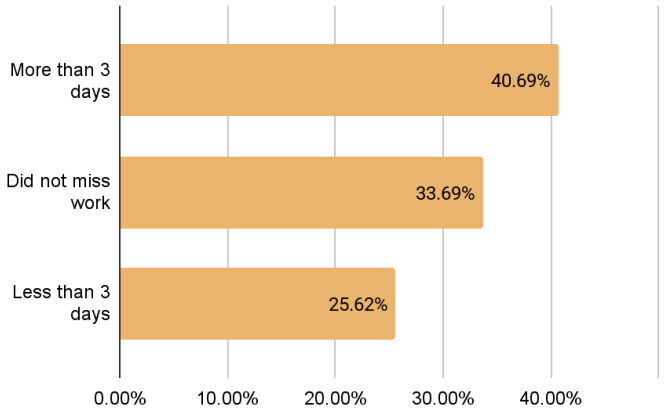
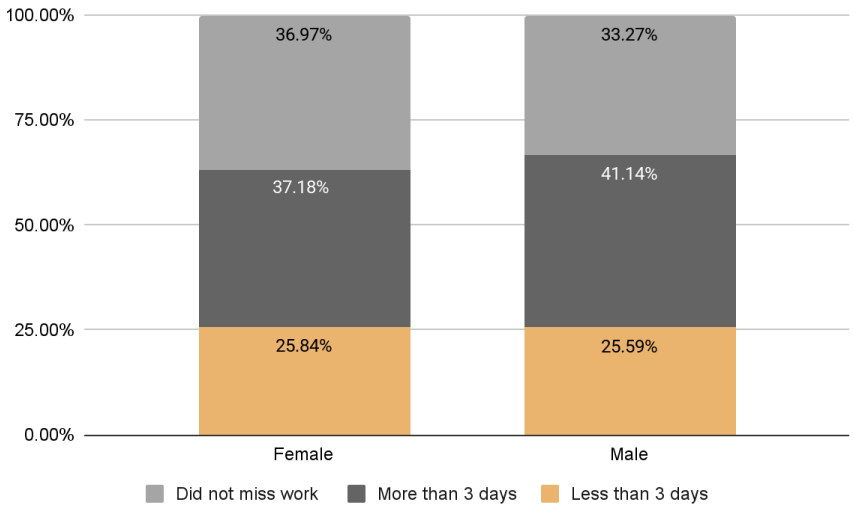


Figure: Days of work missed due to respiratory illness (Sample: 4188)

More than 65% of those affected by respiratory illness missed at least one day of work or school, underscoring the severe disruption pollution causes in people's lives.

4.2.2 Impact on Attendance and Productivity, by gender and age



Days of work missed due to respiratory illness, by gender (Sample: 4188)

Over 60% of respondents across genders missed at least one day of work or school in the past two weeks due to these health problems.

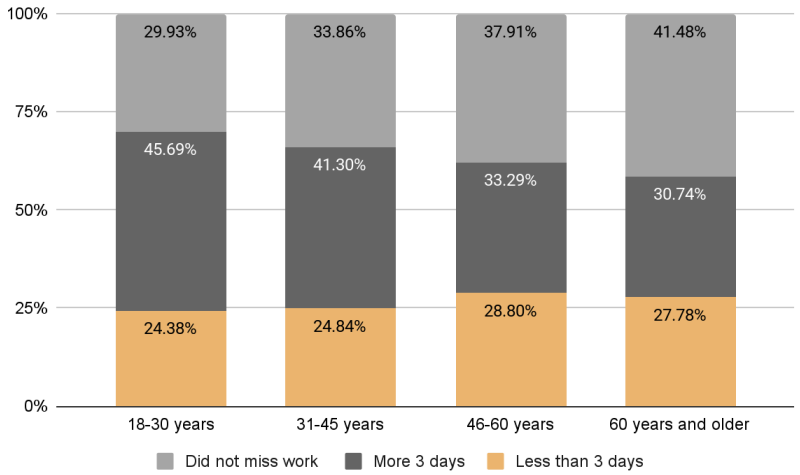


Figure: Days of work missed due to respiratory illness, by age (Sample: 4188)

About 70% of respondents who experienced respiratory issues, between the ages of 18 and 30, missed at least one day of work/school in the last two weeks due to this.

4.2.3 Impact on Attendance and Productivity, by state

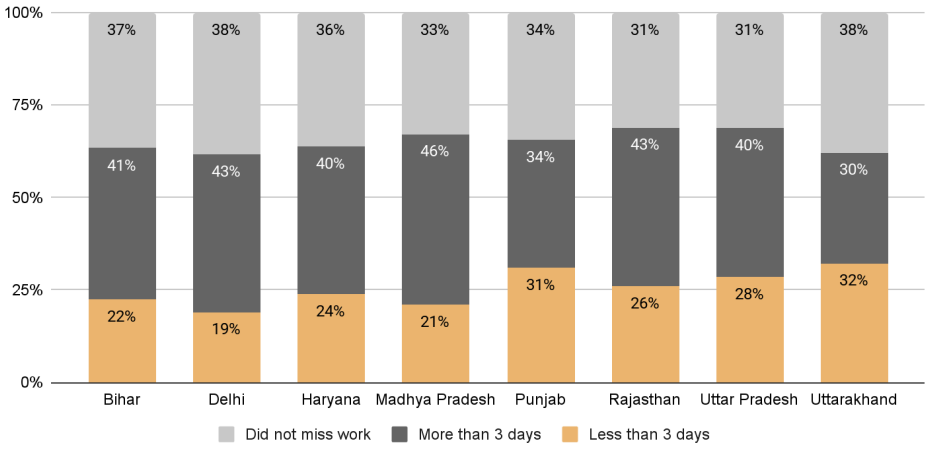


Figure: Days of work missed due to respiratory illness, by state (Sample: 4188)

Further, more than 60% of impacted respondents in all surveyed states have missed at least one workday in the past two weeks due to air quality-related health issues, indicating considerable productivity losses.

4.3 Coping Mechanisms

4.3.1 Overall findings

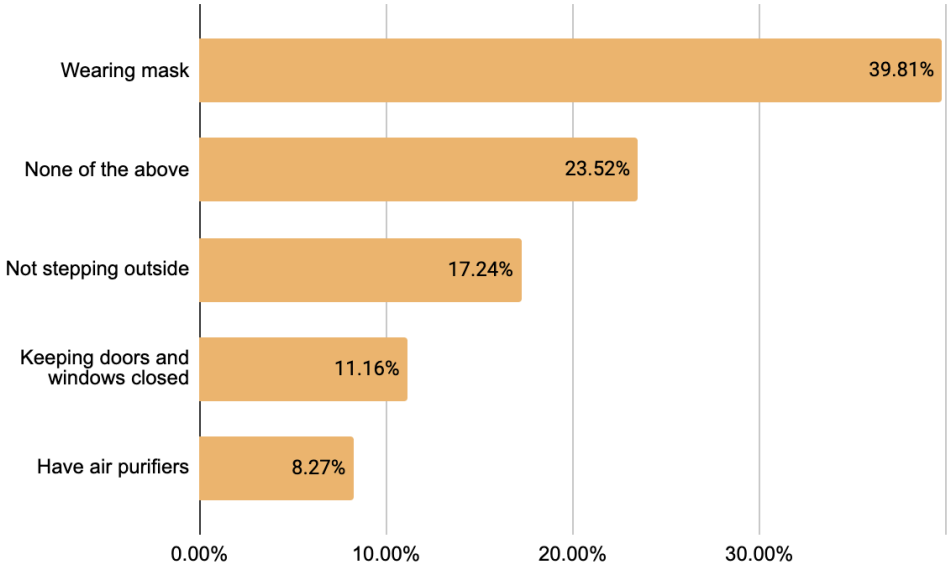


Figure: Strategies to cope with air pollution (Sample: 8688)

Approximately 40% of affected respondents prefer wearing a mask as their coping strategy. Further, nearly 24% of the respondents did not choose any of these coping strategies, necessitating further investigation into ways in which affected people cope with plummeting air quality.

4.3.2 Coping mechanisms, by gender and age group

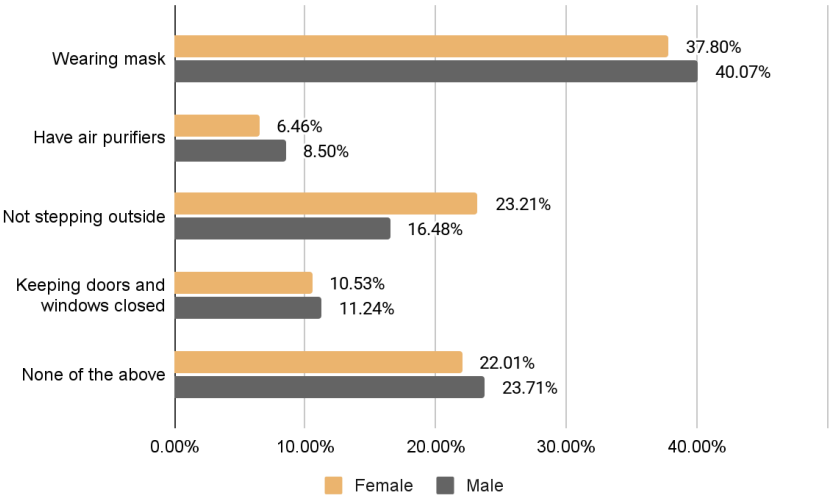


Figure: Strategies to cope with air pollution, by gender (Sample: 3665)

Over 37% of the men and women surveyed cope with air pollution by wearing masks. Further, over 22% of respondents across both these groups did not opt for any of the coping mechanisms listed in our survey.

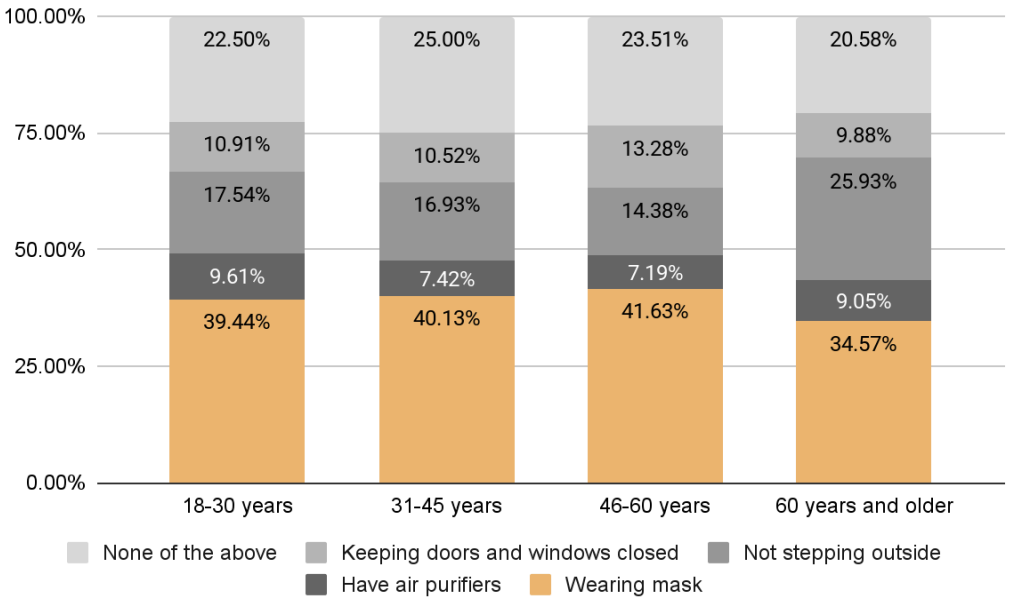


Figure: Strategies to cope with air pollution, by age (Sample: 3665)

Additionally, close to 18% of respondents in the age group 18-30, and approximately 15% of respondents in age groups 31-45 and 46-60, choose not to step outside as a coping strategy.

4.3.3 Coping mechanisms, by state

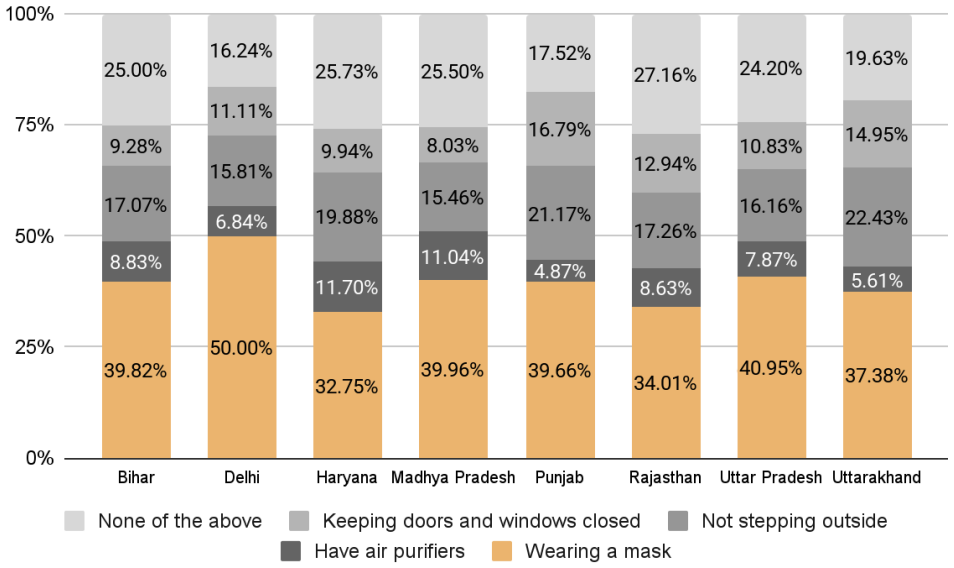


Figure: Strategies to cope with air pollution, by state (Sample: 3665)

Approximately 20% of respondents from all states reported not using any of the coping mechanisms mentioned in our survey, while more than 50% of respondents in Delhi chose wearing a mask as their primary coping strategy.

4. Policy Recommendations

Governments are taking important steps to combat air pollution, with initiatives such as drone monitoring to identify pollution hotspots, random vehicle emissions checks, and the establishment of a Graded Response Action Plan (GRAP) tailored to various levels of air quality. However, while these efforts are notable, more work remains to be done. Continued innovation, stronger enforcement of regulations, and broader public engagement will be essential to achieving long-term improvements in air quality and ensuring a sustainable environment for future generations. We have categorised several measures that can help reduce impacts into three main stages: prevention, mitigation, and adaptation:

A. *Prevention*

- **A systems-thinking approach:**
  Policymakers addressing air pollution often operate within departmental silos, limiting their ability to implement holistic solutions. A systems-thinking approach, which fosters coordination across multiple sectors and stakeholders, is essential for tackling the interconnected challenges of urban air pollution. Improved collaboration between state pollution control boards, transport and law enforcement agencies, urban local bodies, and local communities—enabled through shared data, clear objectives, and aligned policies—can lead to more effective and sustained pollution control measures. Integrating air quality considerations into urban planning, mobility strategies, and public health policies will help cities transition toward cleaner, healthier environments.

- **Expanding the focus beyond administrative boundaries:**
  Current air pollution control efforts, such as the National Clean Air Programme (NCAP), primarily target cities, yet much of their pollution originates beyond urban limits. Addressing air pollution requires a shift from a city-centric approach to an airshed-based strategy, acknowledging that pollution disperses across regions. This necessitates national and state-level coordination, cross-jurisdictional planning, and systemic investments in emission reduction efforts that extend beyond city boundaries.

B. Mitigation

- **Enhancing air pollution data systems:**
  While monitoring data remains crucial for regulation and management, air quality modeling should be given greater attention. Building the capacity for air quality modelling is a vital step towards mitigation. This exercise would allow insights on what exacerbates pollution levels, the extent of pollution, periods and locations where pollution is severe.

- **Developing predictive air quality alerts:**
  A proactive air pollution management strategy requires real-time AQI forecasting, similar to weather predictions, to help governments, businesses, and individuals take preemptive action. Platforms like Google Maps' AQI tracker already provide real-time updates, historical trends, and forecasts, but scaling and integrating such tools into government response systems is crucial. Enhancing hyperlocal air quality sensors, using AI-driven predictive models, and implementing automated graded response plans—such as traffic restrictions or remote work advisories—can significantly reduce exposure and health risks, especially in high-pollution regions.

C. Adaptation

- **Implementation of Clean Air Zones:**
  The implementation of Clean Air Zones (CAZs), also known as low-emission zones, can contribute to protecting public health, promoting sustainable modes of transportation and reducing congestion. Identifying these zones based on factors such as the presence of schools and hospitals can help reduce the health burden on vulnerable groups in urban areas. Some Indian cities are attempting to introduce CAZs, with commonly known examples being Delhi's Chandi Chowk and Bangalore's Church Street. However, municipalities and other stakeholders should develop more cohesive, regional strategies, tailored to local contexts. This is necessary to address the lack of direct funding, and disconnect from broader city planning frameworks which impede the implementation of CAZs.

- **Expanding health interventions**
  Strengthening healthcare access in high-pollution areas through mobile health clinics can help address pollution-related illnesses. These clinics could provide respiratory screenings, public health education, and preventive care, reducing the long-term health burden on vulnerable populations.

- **Encouraging flexible work and school arrangements**
  Workplace and school policies should be responsive to air quality conditions. Flexible work arrangements and remote learning options during high-pollution periods can significantly reduce exposure, particularly for children, who are more susceptible to long-term health impacts. Encouraging mask usage, shifting school timings to avoid peak pollution hours, and improving school infrastructure to minimise indoor pollution exposure can further protect vulnerable groups.

- **Improving built environment:**
  Housing and urban infrastructure influence indoor air quality and exacerbate health risks associated with pollution. Measures such as reducing reliance on biomass and coal-based stoves, improving ventilation standards, and using non-toxic construction materials can mitigate household air pollution. Urban planning efforts should integrate green infrastructure, such as tree cover and green roofs, to enhance natural air filtration and mitigate heat islands, which contribute to pollution retention.

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