



Heatwaves and Air Pollution: A Deadly Combination for Human Health in South Asia

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Heatwaves and air pollution have become global public health concerns. These environmental hazards are estimated to cause 250,000 annual and 4.2 million total deaths from 2030 through 2050,^{1,2} respectively. South Asia is particularly vulnerable to these impacts. This region has experienced prolonged heatwaves and high annual temperatures, as well as the worst air quality in the world, for several consecutive years. The combination of high temperatures and air pollution can also increase the concentration of toxic pollutants, such as ground-level ozone, which can cause respiratory issues in vulnerable populations. Such individual and synergistic effects of heatwaves and air pollution are expected to have severe consequences for the health of millions of people in South Asia.

The South Asian region is a hotspot for heatwaves. Heatwaves in South Asia are expected to become more intense, more frequent, and longer due to the influence of the El Niño/La Niña Southern Oscillation (ENSO) and factors such as industrialization, vehicle emissions, urbanization, and limited greenspace. India and Pakistan have already seen record-breaking temperatures of 44°C (111°F) and 49°C (120°F) in March–April 2022.³ Climate scientists warn that if global warming continues, this region will experience two- to 20-times more heatwaves than in 2022.³

Heatwaves in South Asia have already led to increased morbidity and mortality due to their negative effects on respiratory and cardiovascular health. The region has experienced an increase in heatwave-related deaths in recent years, with projections of a 4.5%–5.0% GDP decrease by 2030 due to lost labor.⁴ The severe heatwave in India and Pakistan in 2015 resulted in around 3,500 deaths,⁵ and from 1992 through 2016, India experienced 25,716 heat-related fatalities while Bangladesh experienced a 22% increase in heatwave-related mortality over the same period.⁶ Approximately 100 thousand previously displaced people in Afghanistan suffered from shelter and water scarcity during a recent heatwave in 2022.⁷

Concurrently, air pollution in South Asia has been at alarming levels in recent years, with nine of the world's ten most polluted cities located in the region. The main source of this pollution is carbon emissions from vehicles and industrial emissions. The concentrations of air pollutants in South Asia, such as PM_{2.5}, exceed World Health Organization (WHO; Geneva, Switzerland) standards, and nearly 99.9% of the region's residents are exposed to poor air quality.⁸ The consequences of this pollution are severe. Exposure to PM_{2.5} is the third leading cause of mortality and Disability-Adjusted Life Years (DALYs) in South Asia.⁹ The Global Burden of Disease (GBD) 2015 Study estimated that air pollution contributed to 1.4 million deaths and 5.8% of DALYs in South Asia.⁹ Air pollution has also been linked to 349,681 pregnancy losses annually in this region.¹⁰

Abbreviation:

DALY: Disability-Adjusted Life Year

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- Implementing air quality monitoring systems in various cities to provide real-time data on air pollution levels, enabling authorities to take immediate action in case of high pollution levels.
- Developing and implementing policies and regulations to reduce air pollution, such as stricter emission standards for vehicles and industries, incentives for the use of renewable energy, and promotion of cleaner modes of transportation.
- Developing early warning systems for heatwaves to help alert authorities and the public in advance, allowing them to take necessary precautions to protect themselves from heat-related illnesses.
- Conducting systematic risk assessment studies to understand exposure scenarios and establish dose-response relationships between these exposures and health outcomes in South Asia.
- Supporting more research on the underlying mechanisms of the interactive effects between heatwaves and air pollution on human health in South Asia. This may involve identifying specific pollutants and temperature thresholds that pose the greatest risk to human health and understanding how these impacts may differ by age, sex, and underlying health status.
- Implementing heat action plans such as setting up cooling centers, distributing heat-related information to the public, and providing emergency care to those affected by heatwaves.
- Investing in infrastructure that promotes the use of greenspaces and natural shade in urban areas. This can include planting trees and other vegetation, building green roofs and walls, and developing public parks and gardens.
- Raising awareness and educating the public on the risks of air pollution and heatwaves and the measures they can take to protect themselves from health impacts.

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Box 1. Recommendation for Mitigating Synergistic Effects of Heatwaves and Air Pollution in South Asia.

Extreme heat and air pollution are significantly more lethal when occurring simultaneously. Exposure to high heat levels and PM_{2.5} air pollution can increase mortality risk three-fold compared to exposure to either factor alone.¹¹ This is because both heat and air pollution can cause systemic inflammation and oxidative stress in the body and decrease antioxidant activity, leading to a synergistic impact on health.¹² Scientists have warned that the frequency of such joint events in South Asia may increase by 175% by 2050, translating to an average of 78 days per year of such extreme circumstances across the seven countries in this region. By 2050, the proportion of this region's land vulnerable to heat and air pollution co-exposures may increase ten-fold, exposing more than 52% of the population to these double hazards.¹³

Since urbanization and climate change impacts are accelerating in the South Asian region, it is important for scientists to

understand and mitigate the consequences of exposure to varying degrees of air pollution and temperature on human health. The recommendations to avoid further damages in this region are explained in Box 1.

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