

## Air Pollutants: Threats to Human Health in Nepal

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Nepal is a geographically diversified and land-locked nation, bordered to the north by China and to the east, west, and south by India. The nation is 147,516 km<sup>2</sup> in size, with the highest point in the high mountainous region being 8848.86 meter above sea level, while the lowest point is 59 meter above sea level in Terai. Topographically, the topography of the nation can be divided into three ecological regions: Terai, Hills, and Mountains, depending on the change in altitude.

The low-lying Terai region is ranked as the most vulnerable to air pollution among various geographical regions, followed by the middle hills and high mountains. Beyond their physical proximity to the South's exceptionally plain land, the industrial zones and the region's largest population density are the elements contributing to the highest susceptible pollution in the Terai region. In Nepal's Himalayan region, household air pollution (HAP) is the primary source of pollution, whereas in densely populated cities, automobiles and industries that burn fossil fuels are the primary sources of air pollutants.

Nepal was rated eighth in the world for PM 2.5 emissions, with an average annual emission of 44.46 µg/m<sup>3</sup>.<sup>1</sup> According to the data of the World Health Organization (WHO), Kathmandu ranks 96<sup>th</sup> among the most polluted cities in the world. Madhesh Province and Lumbini Province experience higher air pollution levels than the Kathmandu valley itself.<sup>2</sup>

In Nepal, the annual death toll from air pollution-related illnesses is about 42,100. According to the statistics of 2019, as many as 5,080 people die every year due to air pollution-related diseases in the Kathmandu Valley. It is estimated that 50 percent of lung cancer in the world is caused by pollution in non-smokers.<sup>3</sup>

According to a study, air pollution affects the brain and causes dementia, stroke, Parkinson's, poor mental health, autism, neurodegeneration, and Alzheimer's disease. Similarly, cardiac diseases include ischemic heart disease, high blood pressure, congestive heart, cardiac arrest, arrhythmia, cardiac arrest, lung cancer, respiratory diseases, chronic obstructive pulmonary disease (COPD) and asthma

are on the rise due to air pollution.<sup>4</sup> The effect of pollution is more on pregnant women and newborn babies. Women may suffer from anemia, infertility, miscarriage, gestational diabetes, low birth weight or stillbirth, premature menopause, mental illness, postpartum depression and other problems due to pollution.<sup>5</sup>

The average life expectancy of Nepalese has decreased by 4.6 years due to non-communicable diseases that are increasing due to the effects of air pollution. Due to the high level of air pollution in Madhesh Province, life expectancy has decreased by seven years, while in the Kathmandu valley; it has decreased by 3.5 years.<sup>6</sup>

According to information from the Nepal government, there are currently 27 air quality monitoring stations in the country that track PM<sub>1</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, TSP, air temperature, wind speed, wind direction and relative humidity.<sup>7,8</sup>

"Air pollution" is actually a mixture of small particles (pollutants). The air pollutants can be emitted from various sources, including industrial processes, transportation, agriculture, constructions and natural sources. Emitted air pollutants are called as Particulate matter or PM. Particulate matter come in a wide range of sizes. Particles are less than or equal to 10 micrometers in diameter. Particulate matters sizes ranging from 2.5 to 10 micrometers in diameter are called coarse dust particles (PM<sub>10</sub>). Sources include dust, pollen, and mold. Coarse particulate matter (PM<sub>10</sub>) is known to cause nasal and upper respiratory tract health problems.

Particulate matters size range from 2.5 micrometers in diameter or smaller, and can only be seen with an electron microscope are called as Fine particles (PM<sub>2.5</sub>). Fine particles are produced from all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning and some industrial processes. Fine particles (PM<sub>2.5</sub>) penetrate deeper into the lungs and cause heart attacks, strokes, asthma, and bronchitis as well as premature death from heart ailments, lung disease and cancer. Studies show that higher PM<sub>2.5</sub> exposure can impair brain development in children.

## Components of particulate matter

1. **Carbon Monoxide (CO):** A colorless, odorless gas produced by incomplete combustion of fossil fuels. High levels can be lethal, as CO binds to hemoglobin, reducing oxygen transport in the bloodstream.
2. **Nitrogen oxides (NO and NO<sub>2</sub>):** The transportation industry is the main producer of nitrogen oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). Under sunlight, NO is quickly transformed into NO<sub>2</sub>. High concentrations of NO<sub>x</sub> (a mix of NO and NO<sub>2</sub>) are created near roadsides, where they can aggravate pre-existing bronchitis and asthma as well as increase the risk of heart disease.
3. **Ground-level Ozone (O<sub>3</sub>):** A secondary pollutant formed through chemical reactions between nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOCs) in the presence of sunlight. Common sources include vehicle emissions and industrial activities.
4. **Sulfur Dioxide (SO<sub>2</sub>):** A gas released from burning fossil fuels containing sulfur, such as coal and oil. Sulfur dioxide causes eye irritation, worsens asthma, increases susceptibility to respiratory infections and impacts the cardiovascular system. When SO<sub>2</sub> combines with water, it forms sulfuric acid; this is the main component of acid rain, a known contributor to deforestation.
5. **Volatile Organic Compounds (VOCs):** Organic chemicals that can evaporate into the air. Sources include vehicle exhaust, industrial processes, and household products. VOCs contribute to the formation of ground-level ozone.
6. **Lead (Pb):** A heavy metal that can be released into the air from industrial processes, leaded gasoline, and lead-based paints. Exposure to lead can lead to neurological and developmental issues, especially in children.
7. **Mercury (Hg):** Released into the air primarily from coal-burning power plants. Mercury can accumulate in aquatic ecosystems and pose health risks, particularly through the consumption of contaminated fish.

8. **Ammonia (NH<sub>3</sub>):** Released from agricultural activities, such as fertilizer application and animal waste. It can contribute to particulate matter formation and nitrogen deposition.
9. **Radon (Rn):** A naturally occurring radioactive gas that can seep into buildings from the ground. Prolonged exposure can increase the risk of lung cancer.

## REFERENCES

1. IQAir.AirVisual.World air quality report: Region and city PM2.5 Ranking. IQAir Group; 2019.
2. World Health Organization: Chronic obstructive pulmonary disease (COPD). WHO, accessed 1 September 2022, [https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-\(copd\)](https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)).
3. Shrestha, S. Assessment of Ambient Particulate Air Pollution and Its Attribution to Environmental Burden of Disease in Kathmandu Valley, Nepal: A Review. *Environ. Anal. Ecol. Stud*; 2018, 4, 1–3.
4. Department of Environment. Air quality monitoring, Ministry of Forests and Environment, Nepal Government, Kathmandu; 2021. Available: <https://pollution.gov.np/portal/#/home?k=0mq3ft>. Accessed June 2021.
5. CBS. Environment Statistics of Nepal. Central Bureau of Statistics, Kathmandu; 2019.
6. WHO. Ambient air pollution: A global assessment of exposure and Burden of Disease. World Health Organization; 2016.
7. Shrestha SL. Particulate air pollution and daily mortality in Kathmandu valley, Nepal: Associations and distributed lag. *The Open Atmospheric Science Journal*; 2012.6:62-70. Available:<http://doi.org/10.2174/1874282301206010062>
8. Government of Nepal: Air quality monitoring. Ministry of Forests and Environment Department of Environment Air Quality Monitoring, accessed 20 May 2022.