Save the Mind-Air Pollution and Brain Health

"Our lives begin to end the day we become silent about things that matter."

- Martin Luther King Jr.

Air is the immediate environment of all living beings and is responsible for the continuous supply of life-giving oxygen and congenial atmospheric conditions to sustain life on earth. However, human activities are directly responsible for polluting indoor and outdoor air with dust, smoke, toxic gases, and chemical vapors, leading to adverse health effects. Indirectly, human exposure to air pollutants occurs when polluted air enters the food chain via animals and vegetation. The health effects of air pollution are both early and delayed. The urban population is more vulnerable to adverse effects, especially children, the elderly, smokers, and those with chronic respiratory diseases.

The World Health Organization (WHO) data in 2019 showed that around 99% of the global population, especially in low- and middle-income countries, live in places with very poor air quality. Each year, around 4.2 and 3.8 million people die prematurely from illness attributable to ambient and household air pollution, respectively.[1] If no measures are taken to contain the adverse effects of air pollution, it is expected that the number of deaths will more than double by 2050.[2]

Though cardiovascular and respiratory system involvement is known for air pollution, the brain has also been proposed to be a target organ for the ill effects of airborne pollutants.[3] There is growing evidence that indicates an association between exposure to a cocktail of air pollutants (such as carbon monoxide, carbon dioxide, sulfur dioxide, lead, ozone, and particulate matter [PM]) and increased incidence of neurological and psychiatric disorders. The components that appear most concerning for the central nervous system are ozone and PM (2.5, 10, ultrafine particles [UFPs]).[4] Proposed mechanisms by which these pollutants affect brain health include cellular, molecular, and inflammatory processes causing direct damage to the brain or indirect neurodegeneration by activating the systemic inflammatory cascade.

There are no exact global data on the neurological side effects of air pollution. In the analysis of stroke and risk factors from the Global Burden of Diseases Study 2013, it was highlighted that household air pollution is responsible for 30% of all strokes[2] and the WHO data showed that air pollution is responsible for 18% of all deaths from stroke globally.[5] This could be because of cardiovascular oxidative stress and inflammation along with autonomic dysfunction due to PM in the inhaled air. There is emerging medical evidence based on epidemiological studies, suggesting a strong association between air pollution and Alzheimer's disease and Parkinson's disease. The environmental risk factors such as exposure to airborne pollutants (nitrogen dioxide, nitrous oxide, manganese, and PM), metals, and pesticides play an important role in their manifestation.[6] Also, ambient air pollutants (lipopolysaccharides, nitrogen dioxide, nitrous oxide, sulfur dioxide, PM10, and exposure to second-hand smoking) have been found to be associated with the development of demyelinating plaques in multiple sclerosis. The association of neuropsychiatric manifestations (depression, anxiety disorders, schizophrenia, psychosis, childhood cognitive development, and suicide) with long-term and short-term air pollution exposure (nitrogen dioxide, nitrous oxide, and PM10) does exist but epidemiological evidence is scarce.[7]

Children are the most affected due to air pollution. According to the WHO, environmental risks like indoor and outdoor air pollution are responsible for nearly 1.7 million deaths in children under 5 years, every year.[5] Indoor and outdoor smoke along with PM, nitrogen dioxide, lead, methyl mercury, arsenic, polychlorinated biphenyls, and toluene are the most important neurotoxic air pollutants responsible for neuropsychiatric manifestations (e.g., headache, fatigue, lack of concentration, low IQ, and aggression), autism spectrum disorders, and birth defects in children.[6,8]

Air pollution and its negative impact on brain health have become a topic of great concern in recent times. The WHO and United Nations acknowledge this fact and have developed indoor and outdoor air quality guidelines, and the United Nations' 2030 Agenda for Sustainable Development, containing a set of 17 goals established to achieve global sustainable development by 2030, respectively, to achieve good effects on the brain.[9,10]

Although air pollution has several adverse effects on the brain, the good news is that it is a modifiable risk factor for neurodegenerative and psychiatric disorders. The best solution is to switch to renewable energy sources such as wind and solar energy, maximizing fuel efficiency in our vehicles and replacing gasoline-driven vehicles with electric vehicles. Figure 1 shows certain interventions to reduce the impact of pollution when the air pollutant levels are high.

The causal relationship for deleterious effects of air pollution on neurodegenerative disorders is inconsistent as various studies conducted so far have a limited sample size and have no definite method to ascertain and quantify exposure to air pollutants along with their duration of exposure.[11] In the present global scenario, the need of the hour is to design both population and toxicological studies that can more reliably investigate, identify, and estimate its possible negative effects on brain health so that prompt remedial measures can be taken to curb its adverse effects on the neurological health of mankind.

Abbreviations

WHO- World Health Organization; PM- particulate matter; UFP- ultrafine particles; IQ- intelligence quotient

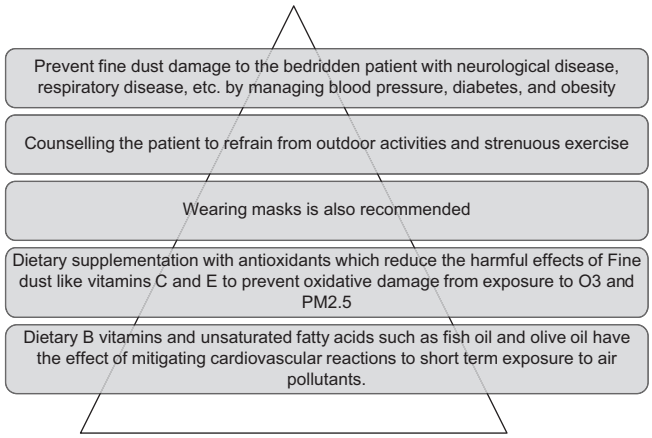

Figure 1: Interventions to reduce the impact of pollution when the air pollutants levels are high

Man Mohan Mehndiratta, Vasundhara Aggarwal[1], Divyani Garg[2]

Department of Neurology, BLK Hospital, Rajendra Place, [1]Department of Neurology, Janakpuri Super Speciality Hospital, C-2B, Janakpuri, [2]Department of Neurology, VMMC and Safdarjung Hospital, Mahatma Gandhi Marg, Safdarjung, Campus, Ansari Nagar West, New Delhi, India

Address for correspondence: Dr. Man Mohan Mehndiratta, BL Kapoor Memorial (BLK-MAX), Hospital, MAX Healthcare, Pusa Road, Radha Swami Satsang, Rajendra Place, New Delhi - 110 005, India.
E-mail: mmehndi@hotmail.com

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