Gyanshauryam, International Scientific Refereed Research Journal
Available online at : www.gisrrj.com
OPEN ACCESS
ISSN : 2582-0095
doi : https://doi.org/10.32628/GISRRJ

The Impacts of Air Pollution on Community Health : A Comprehensive Review

Shivam[1] / Dr. Prem Shankar Pandey[2]

[1]Research Scholar, Department of Geography, Bhartiya Mahavidyalaya , CSJMU Kanpur

[2]Assistant Professor, Department of Geography, Bhartiya Mahavidyalaya , CSJMU Kanpur

Article Info

Article History
Accepted : 20 Sep 2024
Published : 05 Oct 2024

Publication Issue :
Volume 7, Issue 5
September-October-2024

Page Number : 25-32

Abstract:

A major worldwide environmental issue, air pollution has a profound impact on people's health and well-being. An extensive analysis of air pollution, its various sources, and its harmful impacts on public and individual health are presented in this research paper. The study looks at the different kinds of pollutants that are present in the atmosphere, where they come from, and how they affect people's health. Furthermore, it explores the worldwide impact of air pollution, highlighting the startling magnitude of its effects and highlighting the pressing need for efficient mitigation measures to protect the environment and public health. Additionally, this paper will review and analyse the various existing literature on the subject. The study also pinpoints some of the major variables that moderate this relationship, including coping mechanisms, perceptions of health risks, and sociodemographic characteristics. The study's conclusions have significant ramifications for public health officials, urban planners, and legislators who must take into account how air pollution affects human health when developing policies and interventions to address this pressing problem.

Keywords :- Air Pollution , Environment and Community Health

Introduction:

Indoor and outdoor air pollution is a serious environmental health issue that affects people in both developed and developing nations. Particulate pollution (also known as particulate matter, or PM), ground-level ozone (O_3), carbon monoxide (CO), sulphur oxides (SOx), nitrogen oxides (NOx), lead (Pb), and ambient air pollutants (also referred to as "criteria pollutants") are the most significant air pollutants; indoor sources of PM, CO, SOx, NOx, environmental tobacco smoke (ETS), formaldehyde, and polycyclic organic matter are also present.

The type of pollutant, the amount of the pollutant exposed to, the length and frequency of exposure, and the associated toxicity of the particular pollutant all influence the health effects of exposure to air pollutants. From subclinical effects to early mortality, these exposures are linked to a wide range of acute

and long-term health effects. Although there are many ways to classify air pollutants, most of them typically occur in complex mixtures that have the potential to have synergistic effects rather than in isolation. The toxicity of air pollutants and their composition vary depending on the environment. Socioeconomic status, age, cultural customs, and lifestyle can all affect how much air pollution a person is exposed to. Pregnant and young children, the elderly, and people with a history of cardiovascular diseases are among the demographic groups that are more susceptible to the effects of air pollutants. Therefore, a population's demographics are also significant.

Source of Exposure:

One of the biggest threats to global environmental health is air pollution. The resources required for the planet's long-term sustainable development are being harmed by air pollution, according to the World Health Organization (WHO). The sources of air pollution can be divided into three main categories:

(1) mobile sources, which include combustion-engine vehicles like cars, trucks, motorcycles, and airplanes;

(2) stationary sources, which include rural sources like mining, quarrying, and agricultural production;

(3) indoor sources, which include combustion, tobacco smoking, and biological sources; and community sources, which include incinerators, municipal waste, and the heating of homes and buildings.

Air Pollutants:

The six main air pollutants that are reported by the World Health Organization (WHO) are lead, sulphur oxides, nitrogen oxides, carbon monoxide, ground-level ozone, and particle pollution. All elements of the environment, including soil, groundwater, and air, can suffer greatly from air pollution. It also presents a significant risk to living things. In keeping with this, we are primarily interested in these pollutants because they are linked to more serious and widespread issues with human health and the environment. Air pollution is significantly impacted ecologically by acid rain, global warming, the greenhouse effect, and climate change.

Primary pollutants are those that are released into the atmosphere directly, while secondary pollutants are those that are created as a result of chemical reactions with other pollutants or atmospheric gases

1)Ozone:

The most common issue among the twelve major air pollutants for which the Central Pollution Control Board (CPCB) has established National Ambient Air Quality Standards (NAAQS) is ozone, which is also the most common photochemical oxidant and a major contributor to "smog.". The most important component of this issue is the creation of ozone in and downwind of major cities where, in specific weather conditions, emissions of nitrogen dioxide and nitic oxide (collectively referred to as Nor. and volatile organic compounds (VOCs) have the potential to triple the amount of ozone in the atmosphere.

2)Particulate Matters:

The presence of tiny solid and liquid particles with a range of physical sizes and chemical characteristics in the air is referred to as particulate air pollution. Their sources, distribution, and effects can vary greatly, despite the fact that classifying them as particulates may be convenient. Biological particles (pollen, fungal spores, etc.), fine soil particles, fine marine salts, volcanic ash, and smoke particles from wildfires are a few examples of particles that can have a natural origin. Others may come from a variety of sources, such as vehicle

emissions, waste crop residues, industrial combustion processes, home heating and cooking, land clearing, and firefighting operations. Slow atmospheric reactions between gases (like some photochemical smog reactions or the oxidation of sulphur dioxide and nitrogen dioxide) released at far-off places and carried by atmospheric processes can result in the production of additional fine particles in the air.

3)Corbon Monoxide(CO):

The incomplete burning of fossil fuels produces carbon monoxide (CO). The topography, weather, and traffic density all affect concentrations in urban areas. Indoor and outdoor levels may be similar if indoor combustion devices are not present. Indoor CO production may be increased by unvented combustion devices. CO exposure's negative health effects are linked to the gas's binding to haemoglobin. Men with coronary artery disease who exercise experience electrocardiographic changes and a reduction in the time to angina when their carboxyhaemoglobin levels are 3–6% higher than baseline.

4)NITROGEN OXIDE (NO_2) :

Although nitrogen oxides come in a variety of chemical forms, nitrogen dioxide is the most important one in terms of human health. In urban areas, motor vehicle fuel combustion and stationary sources like industrial facilities are the primary sources of nitrogen oxides. Airborne nitrogen oxides are produced by other industrial processes, such as those in nitric acid manufacturing facilities. The locations of major industrial sources, buildings with unvented sources, and major roads are typically where urban concentrations are highest during periods of high traffic. The production of nitrogen oxides by home and commercial combustion appliances like stoves, ovens, and unflued gas fires makes them significant indoor air pollutants as well. One significant way of personal exposure is through cigarette smoking.

5)SULFER DIOXIDE (SO_2):

The colourless gas sulphur dioxide (SO2) dissolves easily in water. Volcanoes and other natural sources contribute to the amount of SO2 in the atmosphere. The use of fossil fuels containing sulphur for power generation and home heating is one example of man-made contributions. In a humid atmosphere, sulphur dioxide is converted to sulfuric acid. Major cities in Europe and America now have annual mean SO2 concentrations that are significantly lower than 100 pg/m3. The average concentrations per day are less than 500 pg/m3.

6)Cobon Dioxide (CO_2):

In the Earth's atmosphere, carbon dioxide (CO2) is a colourless, odourless gas that occurs naturally. It is created through respiration, the burning of fossil fuels, and volcanic eruptions. a toxic gas with deadly potential at high concentrations. Carbon dioxide is regarded as the world's worst climate pollutant and is a major pollutant due to the greenhouse effect (Vaidyanathan, 2014). It is the most vital gas and a naturally occurring part of air that is released by the human respiratory system and is necessary for plant life.

7) Lead :

Lead (Pb) is an unnecessary, extremely toxic heavy metal that is used in various industrial facilities and released from radiators, batteries, waste incinerators, and wastewaters. It is known to have detrimental effects on biological systems. Lead concentrations in soil and water are currently several orders of magnitude higher than those found naturally due to current anthropogenic lead emissions. Notably, lead seems to be the only hazardous chemical pollutant that has accumulated in humans to average levels that are close to the threshold for possible clinical poisoning.

Even though lead uses and emissions are subject to more stringent regulations, animals still suffer from a variety of health problems when exposed to lead in the environment, and certain lead sources continue to cause animal deaths.

8)Volatile organic compound (VOCs):

VOCs are defined as organic compounds that, at normal temperature (293–15 K) and pressure (101–325 kPa), have a Reid vapor pressure greater than 10.3 Pa. At room temperature, the VOCs—a broad category of carbon-based compounds—evaporate readily. One category of significant contributors to air pollution is. VOCs. They have a direct impact on the environment as pollutants and an indirect one as precursors to ozone and smog. The environment's increasing emissions of volatile organic compounds (VOCs) are a result of rapid industrialization and urbanization. VOCs can be released from a variety of indoor and outdoor sources. Petroleum refineries, automobile manufacturers, textile manufacturers, electronic component plants, solvents, cleaning supplies, food processing, paper manufacturing, paint drying, transportation, and chemical industries are just a few examples of outdoor sources. The following are examples of indoor sources: pressed woods, wood stoves, office supplies, printers, heat exchanger systems, insulating materials, and plumbing leaks.

Effect of Air Pollution on Health:

Human health is being severely impacted by air pollutants. These effects are caused by both indoor and outdoor pollution, such as that from cookstoves and automobile emissions. Of all the environmental health hazards, air pollution has the biggest effect on human health. Similar to smoking, it impairs health and increases the risk of lung cancer, respiratory conditions, and cardiovascular diseases. Air pollution exposure is thought to have contributed to 40.9 million premature deaths in 2017, according to the Global Burden of Disease project, while the World Health Organization estimates that 7 million premature deaths occurred in 2016. Exposure to air pollution not only causes premature death but also a host of other health problems, including low birth weight, preterm births, severe asthma attacks, childhood pneumonia, heart attacks, and strokes.

A recent epidemiological study from the Harvard School of Public Health found that exposure errors and the disparity in epidemiological approaches have left the relative magnitudes of the short- and long-term effects unclear, as previously stated in detail. New models are put forth to more effectively evaluate data on both short- and long-term human exposure. Since these effects are frequently influenced by environmental factors, dosage, and individual susceptibility, we discuss both the more common short-term and long-term health effects in this section, but we also raise general concerns about both types of effects.

Temporary in nature, short-term effects can range from mild discomfort (eye, nose, skin, throat, wheezing, coughing, chest tightness, and breathing difficulties) to more severe conditions (bronchitis, asthma, pneumonia, lung and heart issues). Headaches, nausea, and light-headedness can also result from brief exposure to air pollution. Extended long-term exposure to the pollutants can exacerbate these issues, as it damages the neurological, reproductive, and respiratory systems and can lead to cancer and, in rare cases, death.

Long-term exposure to O_3 has been linked to both a rapid decline in lung function and a lower level of lung function. Moreover, the interaction between O3 and acid sulfate might be

more significant than O3's effects alone. Children in Germany between the ages of 9 and 11 who lived in the most congested urban areas as opposed to those who lived in less congested areas had noticeably worse lung function.

Carcinogens that are known or suspected to cause cancer can be found in vehicle emissions, including benzene and other polycyclic aromatic hydrocarbons. There have been attempts to calculate the car emissions' cancer risk. An additional 1 to 2–6 cases of lung cancer per 100,000 people annually are thought to result from diesel particle levels in the atmosphere of 5–23 mg/m3 in Austria. A significant increase of about 20 mg/m3 sulphate particles has been linked to a mortality risk ratio for lung cancer of 1.36 (95 percent CI 1.11-1.66), according to other studies. It should be noted that it is challenging to quantify risks using only epidemiological data. Even quantitative risk assessments that are done well are predicated on assumptions. Confounding variables also include exposure to cigarette smoke and individual susceptibility to exposure. However, the fact that these studies have shown a link between cancer mortality and air pollution levels raises concerns that air pollution may raise the risk of lung cancer.

Long-term air pollution appears to be linked to retinopathy, low birth weight, foetal growth, psychological issues, and autism. Although the exact cause of the neurodegenerative diseases Parkinson's and Alzheimer's is unknown, prolonged exposure to air pollution is thought to play a role. In particular, diet and metals and pesticides are mentioned as etiological factors. Oxidative stress, protein aggregation, inflammation, and neuronal mitochondrial impairment are among the processes that lead to neurodegenerative disease.

Effects of air pollutants on different organs and systems:

Patients with underlying or pre-existing respiratory or cardiovascular conditions are more likely to have severe COVID-19 symptoms during the current pandemic. Given its effect on respiratory and cardiovascular conditions, this serves as a timely reminder of how important it is to address air quality.

Heavy metals like lead, mercury, and arsenic, as well as dioxins, primarily affect the nervous system. After exposure to arsenic, lead, and mercury, neurotoxicity has been found to cause neuropathies, which manifest as symptoms like slurred speech, anger, exhaustion, hand tremors, memory problems, sleep disorders, and blurred vision. Lead exposure specifically damages the N-methyl-D-Aspartate (NMDA) receptor complex, glutamate system, and dopamine system, all of which are critical for memory processes. Certain types of neurological cancer are also brought on by mercury. Dioxins impair children's mental development and reduce nerve conduction velocity.

Heavy metals can cause kidney damage, including tubular dysfunction that starts with an increase in low-molecular-weight protein excretion and leads to a decrease in glomerular filtration rate (GFR). Moreover, they raise the risk of renal cancer and stone formation or nephrocalcinosis.

The fact that air pollutants can also have an impact on the developing fetus should not be overlooked. Exposure of the mother to heavy metals, particularly lead, raises the risk of spontaneous abortion and stunted fetal growth (low birth weight, preterm delivery). It has also been suggested that parental exposure to lead causes congenital malformations and lesions of the developing nervous system, which significantly impair the motor and cognitive abilities of newborns. Likewise, dioxins were discovered to be passed from the mother through the placenta to the fetus. They impact fetal growth and development of the central nervous system and function as endocrine disruptors. Accordingly, in every species that has been studied, TCDD is regarded as a developmental toxin.

Conclusion:

The primary source of harmful health effects among the different elements that contribute to air pollution is PM2.5. The primary sources of air pollution include markets, temples, restaurants, gas stations, traffic (particularly at bus stops), and so on. When people are at home, their personal PM2.5 exposure contributions have been demonstrated to be higher. Air pollution has been linked in numerous studies to increased mortality from heart disease, stroke, lower respiratory tract infections, lung cancer, diabetes, and chronic obstructive pulmonary disease. Furthermore, air pollution has a negative economic impact on health. In order to reduce air pollution, it is therefore essential to reduce emissions and adjust to the effects of climate change. Individual actions to successfully lessen the negative health effects of air pollution also include encouraging the use of masks, using air purifiers, ventilating, picking low-exposure routes, and eating a healthy diet.

References

1. Schwela, D. (2000). Air pollution and health in urban areas. *Reviews on environmental health*, *15*(1-2), 13-42.
2. McGranahan, G., & Murray, F. (Eds.). (2012). *Air pollution and health in rapidly developing countries*. Routledge.
3. Bernstein, J. A., Alexis, N., Barnes, C., Bernstein, I. L., Nel, A., Peden, D., ... & Williams, P. B. (2004). Health effects of air pollution. *Journal of allergy and clinical immunology*, *114*(5), 1116-1123.
4. Kampa, M., & Castanas, E. (2008). Human health effects of air pollution. *Environmental pollution*, *151*(2), 362-367.
5. Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E. (2020). Environmental and health impacts of air pollution: a review. *Frontiers in public health*, *8*, 14.
6. Nandasena, Y. L., Wickremasinghe, A. R., & Sathiakumar, N. (2010). Air pollution and health in Sri Lanka: a review of epidemiologic studies. *BMC public health*, *10*, 300. https://doi.org/10.1186/1471-2458-10-300
7. Chan-Yeung M. N. (2000). Air pollution and health. *Hong Kong medical journal Xianggang yi xue za zhi*, *6*(4), 390–398.
8. Mcgranahan, G., & Murray, F.B. (2003). Air Pollution and Health in Rapidly Developing Countries. *Bulletin of The World Health Organization, (pp 33-37)*
9. Gul, H., & Das, B. K. (2023). The Impacts of Air Pollution on Human Health and Well-being: A Comprehensive Review . *Journal of Environmental Impact and Management Policy*.

10. Le, L., V. Quang, K., Vo, T., T. Nguyen, T., Dao, T., & Bui, X. (2024). Environmental and health impacts of air pollution: A mini-review. *Ministry of Science and Technology, Vietnam*.
11. Senevirathne, S. R. D. A. (2003). Air pollution: a case study of environmental pollution. Journal of the College of Community Physicians of Sri Lanka, 1-9. https://doi.org/10.4038/jccpsl.v8i1.8300
12. American Thoracic Society. What constitutes an adverse health effect of air pollution? Official statement of the American Thoracic Society. (2000). *American journal of respiratory and critical care medicine*, *161*(2 Pt 1), 665–673. https://doi.org/10.1164/ajrccm.161.2.ats4-00
13. World Health Organization. (2004). *Health aspects of air pollution: Results from the WHO project "Systematic review of health aspects of air pollution in Europe"*. Europe: World Health Organization
14. Health Effects Institute. (2004). *Special Report 15, Health effects of outdoor air pollution in developing countries of Asia: A literature review*. Health Effects Institute.
15. World Health Organization. (1999). *Guidelines for air quality*. Geneva: WHO. Retrieved from http://www.who.int/peh/air/airguides2.htm
16. Wilson, W. E., & Suh, H. H. (1997). Fine particles and coarse particles: Concentration relationships relevant to epidemiologic studies. *Journal of the Air & Waste Management Association, 47*(12), 1238-1249. https://doi.org/10.1080/10473289.1997.10464074
17. National Research Council. 1991. Rethinking the Ozone Problem in Urban and Regional Air Pollution. Washington, DC: The National Academies Press. https://doi.org/10.17226/1889.
18. Pattee, O. H., & Pain, D. J. (2002). Lead in the environment. In *Handbook of ecotoxicology* (pp. 374). CRC Press.
19. Kamal, M. S., Razzak, S. A., & Hossain, M. M. (2016). Catalytic oxidation of volatile organic compounds (VOCs)–A review. *Atmospheric Environment*, *140*, 117-134.
20. Malley, C. S., Henze, D.K., Kuylenstierna, J. C. I., Vallack, H.C., Davila, Y., Anenberg, S.C., Turner, M. C., and Ashmore, M. R. (2017) Updated Global Estimates of Respiratory Mortality in Adults ≥30Years of Age Attributable to Long-Term Ozone Exposure. Environmental Health Perspectives, 125(8). DOI: 10.1289/EHP1390
21. Mai, F., Pinto, R. D. and Ferri, C. (2020). COVID-19 and cardiovascular diseases. Journal of Cardiology. DOI: 10.1016/j. jjcc.2020.07.013
22. Kloog, I., Ridgway, B., Koutrakis, P., Coull, B. A., & Schwartz, J. D. (2013). Long- and short-term exposure to PM2.5 and mortality using novel exposure models. *Epidemiology, 24*(4), 555-561. https://doi.org/10.1097/EDE.0b013e318294beaa
23. ope, C. A. III. (1989). Respiratory disease associated with community air pollution and a steel mill, Utah Valley. *American Journal of Public Health, 79*(5), 623-628. https://doi.org/10.2105/AJPH.79.5.623
24. Pope, C. A. III, Thun, M. J., Namboodiri, M. M., Dockery, D. W., Evans, J. S., & Speizer, F. E. (1995). Particulate air pollution as a predictor of mortality in a retrospective study of US adults. *American Journal of Respiratory and Critical Care Medicine, 115*(5), 669-674. https://doi.org/10.1164/ajrccm.115.5.669
25. Kloog, I., Ridgway, B., Koutrakis, P., Coull, B. A., & Schwartz, J. D. (2013). Long- and short-term exposure to PM2.5 and mortality using novel exposure models. *Epidemiology, 24*(4), 555-561. https://doi.org/10.1097/EDE.0b013e318294beaa

26. Genc, S., Zadeoglulari, Z., Fuss, S. H., & Genc, K. (2012). The adverse effects of air pollution on the nervous system. *Journal of Toxicology, 2012*, Article 782462. https://doi.org/10.1155/2012/782462
27. Guarnieri, M., & Balmes, J. R. (2014). Outdoor air pollution and asthma. *The Lancet, 383*(9928), 1581-1592. https://doi.org/10.1016/S0140-6736(14)60617-6
28. Garza, A., Vega, R., & Soto, E. (2006). Cellular mechanisms of lead neurotoxicity. *Medical Science Monitor, 12*, RA57.
29. Wang, S. L., Lin, C. Y., Guo, Y. L., Lin, L. Y., Chou, W. L., & Chang, L. W. (2004). Infant exposure to polychlorinated dibenzo-p-dioxins, dibenzofurans, and biphenyls (PCDD/Fs, PCBs): Correlation between prenatal and postnatal exposure. *Chemosphere, 54*(10), 1459-1468. https://doi.org/10.1016/j.chemosphere.2003.09.052
30. Mandal, P. K. (2005). Dioxin: A review of its environmental effects and its aryl hydrocarbon receptor biology. *Journal of Comparative Physiology B, 175*(3), 221. https://doi.org/10.1007/s00360-005-0007-3
31. Damek-Poprawa, M., & Sawicka-Kapusta, K. (2003). Damage to the liver, kidney, and testis with reference to burden of heavy metals in yellow-necked mice from areas around steelworks and zinc smelters in Poland. *Toxicology, 186*(1), 1-10. https://doi.org/10.1016/S0300-483X(02)00409-0
32. Ewan, K. B., & Pamphlett, R. (1996). Increased inorganic mercury in spinal motor neurons following chelating agents. *Neurotoxicology, 17*(3), 343-356.