BEYOND BREATH: UNVEILING THE ECOLOGICAL AND HUMAN HEALTH IMPACTS OF ANTHROPOGENIC AIR POLLUTION

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Abstract-
Natural disasters and a variety of human activities lead to air pollution. The atmosphere has not been as substantially impacted by natural events as it is currently by human activity, however throughout time, a variety of natural events like volcanoes, forest fires, and lightning may have released different toxins into the environment. Particulate matter (PM10, PM2.5), gases (such as carbon monoxide (CO), nitrogen dioxides (NOx), ground level ozone (O3), sulfur dioxide (SO2), organic compounds (such as polycyclic aromatic hydrocarbon [PAH]), and metals at higher concentrations that permeate the environment are among the harmful substances that contribute to air pollution. In addition to its effects on plants and animals, air pollution is the primary cause of respiratory, neurological, and cardiovascular diseases in humans. Furthermore, it contributes to acid rain, global warming, ozone layer thinning, and other factors that contribute to climate change. The effects of air pollution on the ecosystem and public health are covered in this essay.

Keywords: Acid Rain, Global Warming, Pollution, Environment, Neurological Disorders.

Introduction

Natural disasters and a variety of human activities lead to air pollution. The atmosphere has not been as substantially impacted by natural events as it is currently by human activity, however throughout time, a variety of natural events like volcanoes, forest fires, and lightning may have released different toxins into the environment. Thus, environmental contamination resulting from human activity is the primary cause of environmental stress, which in turn causes climate change and a host of other health impacts (Kampa & Castanas, 2018). It is evident that carbon dioxide, dust, and other gases are released into the atmosphere at the appropriate rates due to human activity. Rapid development of Indian cities has resulted in increased environmental pollution from industry, urbanization, and a rise in the number of cars. A significant portion of the population is also moving to cities in search of work or other necessities. According to Khandar and Kosankar (2019), as a consequence, the population of cities is becoming unsustainable every day, increasing the need for automobiles and causing traffic to get out of control. Anthropogenic activities, such as car emissions, industrial power plants, agricultural practices, garbage disposal, dust-producing building construction, tobacco usage, smelters, and metal-based businesses, are the primary causes of environmental deterioration. According to Gheorghe and Ion (2019), air pollution is caused by the introduction of harmful substances such as particulate matter (PM10, PM2.5), gases (like carbon monoxide [CO] and nitrogen dioxide (NOx), ground level ozone (O3), sulfur dioxide (SO2), organic compounds (like polycyclic aromatic hydrocarbon [PAH]), and metals in higher concentrations that permeate the environment and lower quality of life. Thus, air pollution is accountable for the gradual alteration in the atmospheric composition of gases.

Certain gases are released into the atmosphere directly, while others arise from the chemical interaction of other atmospheric pollutants, referred to as primary and secondary pollutants, respectively. Carbon monoxide, lead, nitrogen dioxide, ground level ozone, particulate matter, and sulfur dioxide are among the six pollutants for which the US EPA has established ambient air quality guidelines, sometimes referred to as criterion pollutants (Huang et al., 2019). The health of people, animals, and plants is negatively impacted by exposure to both high and low levels of air pollution, since air pollution is a worldwide problem and a multifaceted

public health issue (Ghorani-Azam et al., 2020). Both indoor and outdoor air pollutants are released via several means, such as combustion processes from motor vehicles, solid fuel burning, industry, smoke from bushfires, and dust particles (Kankaria et al., 2020). Indoor air pollutants are produced by burning kerosines, firewood, crop wastes, manure, and other materials. SO2, CO, NO2, Benzene, particulate matter, polycyclic aromatic hydrocarbons (PAHs), chlorofluorocarbons, and heavy metals including lead, mercury, copper, nickel, and cadmium are the main contributors of pollutants that directly contribute to air pollution. According to Chen et al. (2020), air pollution is the cause of both acute and chronic diseases. As stated by Lee et al. (2020), it is well known that both short-term and long-term exposure to air pollution increases the risk of a number of illnesses, including lung cancer, asthma, cardiovascular disease, respiratory disorders, wheezing, and pulmonary disease. In addition to listing the main air pollutants and their sources, this article estimates the impact of toxicological air pollutants on human health and related illnesses.

2. Air pollution's effects on the environment
2.1 Warming of the planet
Global warming is defined as an increase in the earth's average temperature caused by an excessive increase in the amount of greenhouse gases already in the atmosphere, such as carbon dioxide, methane, nitrous oxide, chlorofluorocarbons (CFCs), ozone, and water vapor. It is primarily caused by human activity (Venkataramanan, 2018). For life to continue on Earth, naturally occurring greenhouse gasses are vitally necessary. The earth's mean temperature would have been lower in the absence of very little greenhouse gas emissions. However, when GHG concentrations rise, temperatures also rise (Anderson et al., 2019). According to Al-Ghussain (2018), there might be major effects of global warming on human health, agriculture, water supplies, forests, animals, and the melting of snowcaps, which would raise the sea level. Furthermore, the severity of weather events including droughts, storms, heat waves, and floods also increases with rising global temperatures (Dosio et al., 2018).

2.2 The Acid Rain
When contaminants or chemical acids found in the environment combine with atmospheric water, acid rain is released onto the planet. The sulfur and nitrogen oxides released when coal is used in power plants and autos are what cause rainfall to be acidic (Singh & Agarwal 2007). Nitric acid, sulfuric acid, and weak carbonic acid make up the majority of acid rain (Ashfaq et al., 2012). Acid rain has a negative impact on the morphological structure of plants in a natural environment. It also disrupts physiological processes and plant production, which ultimately results in plant mortality. Acid rain may lead to soil acidification, which can harm plants and render water unsafe for humans to drink or for fish or other aquatic life. Additionally, it causes monuments and structures to corrode (Pathak et al., 2019).

2.3 Depletion of Ozone
Ozone, which is present in the stratosphere, shields humans from the sun's damaging rays by absorbing their UV rays. Tropospheric ozone, on the other hand, is harmful to both people and other living things, making it a pollutant. Unfortunately, ozone depleting substances like hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs) have harmed the stratosphere's ozone layer, causing it to become thin. As a result, the sun's dangerous radiation reaches the earth's surface, where it damages crops and plants and poses a health risk to people like skin cancer. Ozone gas inhibits CO2 transfer and lowers photosynthetic activity in plants by penetrating the whole plant via stomata (Madronich et al., 1993, Teramura, 2006, Singh et al., 2019).

3. Wildlife's impact
Increases in the world's population lead to the emission of harmful chemicals into the atmosphere, which may then settle on land or in aquatic environments and have a variety of effects on animals. Similar to humans, animals who are exposed to high enough concentrations of air pollution may have a variety of health issues (Williams et al., 2014). Animals exhibit birth defects and reproductive failure as a result of exposure to high levels of air pollution.

4. Danger to Human Heal
The human body may be exposed to a variety of air pollutants, which pose a health risk and may interfere with the regular functioning of live organs. Based on epidemiological research, the primary toxicological

effects of air pollution are related to the cardiovascular system, respiratory organs, immune system, and neurological problems. Nevertheless, prolonged exposure causes cellular and molecular damage, which may result in a variety of cancers in people (Nakano et al., 2015; Kampa et al., 2018). However, sensitive individuals—children, the elderly, and those with respiratory and cardiovascular conditions—are more vulnerable to exposure to air pollution, even at low levels (Makri et al., 2018).

4.1 Dysfunctional Heart Conditions

Direct exposure to air pollution has been linked to a number of cardiac-related dysfunctions, according to several experimental and epidemiologic investigations (Nogueira, 2019, Snow et al., 2014, Brook et al., 2018, Anderson et al., 2019). Numerous studies have shown that long-term exposure to air pollution from traffic emissions is linked to alterations in blood cells that impact coronary arteriosclerosis and heart disease (Hoffmann et al., 2017).

An 11% increase in cardiac mortality has been linked to long-term exposure to PM2.5 at a level of 10μg/m3, according to epidemiological research. An increase in cardiac mortality may also be attributed to both short- and long-term exposure to nitrogen dioxide. Both right and left ventricular hypertrophy are linked to high levels of NO2 exposure (Bourdrel et al., 2017, Steenhof et al., 2018). According to Katholi et al. (2019), short-term exposure is linked to an increased risk of hypertension, stroke, myocardial infarctions, and abrupt heart failure. Mixing carbon monoxide with other byproducts from automotive exhaust may cause cardiovascular dysfunction. Patients may also develop "atherosclerotic heart disease" when their hemoglobin content is high (Sule et al., 2019).

4.2 Conditions of the respiratory system

Research on the effects of air pollution on human health indicates that breathing in air pollution may lead to respiratory infections and allergic illnesses such pneumonia, asthma, and perhaps TB.

Air pollution may seriously impair lung development and increase the risk of developing chronic illnesses such as lung cancer, emphysema, and chronic obstructive pulmonary disease (COPD) (Laumbach et al., 2019, PSR, 2020). Depending on their size and chemical makeup, air pollutants may either pass through or infiltrate the lung tissue despite the respiratory tract's many defensive systems, including the air-blood barrier and mucosal cilia (D'Amato et al., 2010). The amount and quantity of the pollutants that are breathed may affect the respiratory tract to varying degrees and can affect both the upper and lower respiratory systems (Brunekreef et al., 2009). According to Valavanidis et al. (2020) and Tam et al. (2022), air pollutants, in particular particulate matters, dust particles, benzene, and other respirable compounds, may seriously harm the respiratory system.

4.3 Conditions relating to the nervous system

The high incidence of nervous system problems, including adult neurodegenerative diseases and childhood neurodevelopmental disorders, is mostly attributable to air pollution (Brown et al., 2015, Fombonne, 2019). According to recent research, inhaling PM2.5 and ultrafine particles (PM 0.1) can have a negative effect on the respiratory system and even reach the central nervous system and brain. This can lead to neurological diseases in humans, including Alzheimer's disease, Parkinson's disease, migraines, headaches, cerebro-cardiac strokes, and other types of dementia (Bandyopadhyay, 2016; Haynes et al., 2021, Newman et al., 2021, Calderón-Garcidueñas et al., 2018).

5. Conclusion

One of the main categories of pollution that has grown in recent years is air pollution. Many different types of contaminants are the source of air pollution. Depending on how prevalent they are in the environment, these pollutants might be classified as main or secondary pollutants. These contaminants might come from natural or man-made sources. When these contaminants are present in the environment in excess of what is desired, it may cause a variety of illnesses in both humans and wildlife as well as plants. In addition, acid rain, global warming, and other issues are caused by air pollution. Management of air pollutants is thus desperately needed in order to enhance air quality and hence reduce related risk.

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