The Ill Health Effects of Pollution

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Abstract :

Air pollution is the global problem that affects each and every organism on the earth. Air pollution is caused by human activities or by natural processes, which increases gases like carbon dioxide (CO2), carbon monoxide (CO), Nitrogen oxide (NO), nitrogen dioxide (NO2), particulate matter (PM), ozone(O3) and sulfur dioxide (SO2) in the environment. According to world health organization (WHO) 29% of lung cancer, 17% of Acute lower respiratory infections, 43% of Chronic obstructive pulmonary diseases, 24% of deaths due to stroke and 25% of Ischemic heart disease are due to ambient air pollution

Keywords: Air pollution, Air quality monitoring, Health effects, climate change

Introduction:

The term "pollution" refers to any substance that negatively impacts the environment or organisms that live within that environment.[1] These harmful substances are called as pollutants. The seven major forms of pollutions are water pollution, air pollution, soil pollution, thermal pollution, radioactive pollution, noise pollution and light pollution.[2] Pollution can be natural or as a result of human activity.

Air pollution: Air usually comprises of 78% nitrogen, 21% oxygen, 0.9% oxide gases and 0.1% inert gases. When the air becomes contaminated with other elements, poisonous gases or particles, it can cause serious problems to human health. The most common causes of air pollution include partially combusted exhaust gases, poisonous gases which are a by-product of industry like sulphur dioxide and carbon monoxide, and carcinogenic gases released through the burning of plastic, rubber and wood. Air pollution poisons living organisms which breathe it in, or disturb the atmosphere and mix with air and clouds to cause acid rain.

Sources of air pollution: The main sources of air pollution are vehicles, industries, thermal plants, construction, road dust and anthropological sources include agricultural waste burning, combustion of oil, coal and biomass in the households.[3,4] Across the major cities of country, 800 to 1000 tons of pollutants are released into air daily out of which 50 percent come from vehicle exhaust. Overall 15 percent of total CO2 that is released into air is through transport sector. It has been found that 6 percent increase in quantity of CO2 emissions occurs per year.[4] Rapid industrialization causes release of chief pollutant gases like SO2 and NO2. In thermal power plants, coal consumption is in millions of tonnes and pollutant release includes fly ash, hydrocarbons, SO2 along with other gases. Other activities like burning up of crop wastes by farmers, use of stoves and incinerators, refrigeration activities and sprays of aerosol add to pollution. Methane generation due to waste deposition in landfills, dust particles generated from natural sources, uncertain volcanic activities producing high content of fumes, ash and other gases, forest fires and decomposition of animals lead to production of methane.[4]

Air quality monitoring in India: The air quality in India is monitored collectively by Central Pollution Control Board (CPCB), State Pollution Control Boards (SPCBs), Pollution Control Committees (PCCs) and National Environmental Engineering Research Institute (NEERI) in 240 cities.[5,6] The CPCB is executing a nation-wide programme of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP).[7]

The NAMP monitors 12 pollutants, including SO2, NO2, PM10 (particulate matter up to 10 micron), PM 2.5 (particulate matter up to 2.5 micron), Ozone, Lead, Arsenic, Nickel, CO, NH3, Benzene and Benzo[a]pyrene (BaP).[5] The particulate matter (PM) is a complex mixture of solid and liquid particles suspended in air which are released in the atmosphere when coal, gasoline, diesel fuels and wood are burned.[8] National Air Quality Index (AQI) indicates the air quality by measuring the eight pollutants and display by number and color for the common man to judge the air quality. The AQI has six categories of air quality. These are good (0 - 50), satisfactory (51-100), moderately polluted (101 - 200), poor (201- 300), very poor (301- 400) and severely poor (401-500).[9]

AQI	Associated Health Impacts
Good (0–50)	Minimal impact
Satisfactory (51–100)	May cause minor breathing discomfort to sensitive people.
Moderately polluted (101–200)	May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.
Poor (201–300)	May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease
Very Poor (301–400)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
Severely poor (401-500)	May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.

Source: Central Pollution Control Board. National Air Quality Index. Available at https://app.cpcbccr.com/AQI_India/. Accessed on 1 Feb 2020.

Impact of pollution on human health: Ambient (outdoor air pollution) is a major cause of death and disease globally. The health effects range from increased hospital admissions to increased risk of premature death. An estimated 4.2 million premature deaths globally are linked to ambient air pollution. Pollutants with the strong evidence for public health concern include particulate matter, ozone, nitrogen dioxide and sulfur dioxide.[10]

Worldwide ambient air pollution accounts for:[10]

- 29% of all deaths and disease from lung cancer
- 17% of all deaths and disease from acute lower respiratory infection
- 24% of all deaths from stroke
- 25% of all deaths and disease from ischemic heart disease
- 43% of all deaths and diseases from chronic obstructive pulmonary disease

Particulate matter: The health effects of PM depend on several factors, including the size and composition of the particles, the level and duration of exposure, and the gender, age and sensitivity of the exposed individual.[8] The PM10 is known to cause nasal and upper respiratory tract health problems. PM2.5 fine particles penetrate deeper into the lungs and cause heart attack, stroke, asthma, bronchitis as well as premature death from heart ailment, lung disease and cancer in elderly individuals with preexisting disease and impair brain development in children. Studies show that higher PM exposure can impair brain development in children.[11] Human macrophages exposed to particles, release a range of cytokines, including tumour necrosis factor-a, interleukin-6, interleukin1b, macrophage inflammatory protein-1-a and granulocyte macrophage-colony stimulating factor. Metals contained in PM can induce a series of redox reactions causing oxidative DNA damage.[8]

Black carbon: It is the sooty black material emitted from gas and diesel engines, coal-fired power plants and other sources that burn fossil fuel.[12] Exposure to black carbon over a long period are at a higher risk for heart attack and stroke.[11]

Carbon monoxide and carbon dioxide: These are produced on burning of coal, oil, gasoline, fuel or other carbon-based materials. Inhalation of CO causes headache, dizziness, vomiting and nausea. A high level of CO over long period is linked with increased risk of heart disease. Very high level of CO causes unconscious or death.[13] The CO2 inhalation causes suffocation, incapacitation, unconsciousness, headache, vertigo, tinnitus, and seizures.

Breathing high amounts of CO2 may be life-threatening. Prolonged exposure to CO2 may cause changes in bone calcium and body metabolism.[14] Studies show that diesel exhaust particles act as an adjuvant for immunoglobulin E production in response to specific allergens.[15] High concentrations of CO2 enhanced the production of Ambrosia artemisiifolia allergen I (Amb a1), which is an allergic protein in pollen and increased allergenicity [16]

Nitrogen oxide and nitrogen dioxide: Primarily produced by vehicles, acute effects on exposure to these are irritation of the eyes, respiratory system, aggravation of respiratory diseases, coughing, choking, nausea, headache, and abdominal pain. Long term exposure at high levels causes genetic mutation, harm to developing fetus, swelling of throat, spasms, decreased female fertility, dilated heart and death.[17]

Ozone: It at ground level is a part of smog and a respiratory irritant.[11] Ozone can cause the respiratory muscles constriction, trapping air in alveoli which leads to wheezing and shortness of breath. It can aggravate lung diseases such as asthma, emphysema and chronic bronchitis. Long-term exposure to higher concentrations of ozone may be linked to permanent lung damage, such as abnormal lung development in children. [18]

Sulfur dioxide: About 99% of the sulfur dioxide in air comes from human sources.[19] It irritates the nose, throat and airways to cause coughing, wheezing, shortness of breath or a tight feeling around the chest. High concentration of SO2 can affect lung function, worsen asthma attacks and worsen existing heart disease in sensitive groups.[20]

Impact of air pollution on climate changes: Greenhouse effect is a natural process that warms the earth's surface and maintains the earth's temperature allowing life on earth to exist. Greenhouse gases include water vapors, carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons (artificial chemicals).[21] The problem arises when the greenhouse gas levels get too high, trapping too much of the sun's energy as heat, which is called as global warming. Global warming causes not only rise in average temperatures, but also extreme weather events, shifting wildlife populations and habitats and rising seas. All these changes are human activities, continuing to add heat-trapping greenhouse gases to the atmosphere, changing the rhythms of climate.[22]

Measures to decrease air pollution: Measures that are taken for control of air pollution in India are by relocation of polluting industries, closure of hazardous air polluting industries, phasing out older polluting vehicles and introduction of mass rapid transportation. Use of alternate fuels like CNG, LPG, Ethanol and Bio-diesel. Use of beneficiated coal (having ash 34%) made mandatory in thermal plants.[23] Measures that need to be taken to reduce air pollution at individual level are conservation of energy at home and at work, avoiding low energy star labelled equipment at house and office, carpool, use of public transportation, using LPG instead of wood for cooking, compost of the leaves and left out farm waste.[24] The environment belongs to all of us. We all have to strive together to protect our environment. Let not our apathy and indifference affect our healthy survival.

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