A Review on Effects of Air Pollution on Human Beings and Global Environmental Effects of Air Pollution

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Abstract

One of the greatest scourges of our time is air pollution, not only because of its effects on climate change, but also because of its increasing morbidity and mortality on public and individual health. Air pollution can have serious costs, penalties and consequences for the health of human beings and also ruthlessly distress the natural bio-network and ecosystems. The major air pollutants released into the atmosphere through a variety of natural processes and human activities include nitrogen oxides, volatile organic compounds, and particulate matter. There are many pollutants that contribute significantly to human disease. Among them, particulate matter (PM), enter the respiratory tract by inhalation, causing respiratory and cardiovascular diseases, central nervous and reproductive system disorders, and cancer. Carbon monoxide can even cause direct poisoning when inhaled in high concentrations. Heavy metals such as lead, if absorbed into the human body, can cause direct or chronic poisoning, based on Exposure. The diseases that occur as a result of the substances mentioned include mainly respiratory diseases such as chronic obstructive pulmonary disease (COPD), asthma, bronchiolitis, but also lung cancer, cardiovascular events, disorders of the central nervous system and diseases of the skin. The global consequences of air pollution are global warming, acid rain, photochemical smog, ozone depletion. The only way to address this problem is by sensitizing the public along with a multidisciplinary approach by scientific experts, National and international organizations must address the emergence of this threat and propose a sustainable.

Keywords: Particulate Matter, Sulphur Dioxide, Carbon Monoxide, Ground Level Ozone, Lead, Volatile Organic Compounds, Global Warming, Acid Rains, Photochemical Smog, Ozone Depletion

I. INTRODUCTION

Any change in the natural and normal composition of the air that affects the living system, especially human life, inevitably causes air pollution. The nature of air pollution changed thousands of years ago. No longer is air pollution predominantly smoke-related and sulfur-related but now it is associated with nitrogen oxides, volatile organic compounds, and PM connected with the growing traffic and industrial emissions (Morawska et al., 2008). Therefore, the number of deaths from air pollution in households in low-income countries is declining. Increased air pollution due to the rapid expansion of large cities, the globalization of industrial production, the proliferation of pesticides and toxic chemicals, and the increased use of motor vehicles. The number of deaths from ambient air pollution has increased worldwide since 1990, and the increase is most pronounced in the most rapidly industrializing countries (Pruss Ustun A et al., 2016).

In developing countries, the problem of air pollution is more serious because of overpopulation, uncontrolled urbanization and development of industrialization. In these developing countries, however, significant economic and social disparities coexist. People in rural areas exposed high concentrations of indoor air pollution because of the use of biomass fuels (coal, wood, and other solid fuels) as an energy resource. Three billion people around the world are using the above sources of energy for their daily cooking or heating purposes (Pier Mannuccio Mannucci et al., 2010). Air pollution is one of the most critical human and environmental health problems facing us today. A recently published WHO report entitled "Burden of disease from the joint effects of air pollution in the home and the environment for 2012" (WHO, 2014) attributes approximately 7 million deaths worldwide to the harmful effects of air pollutants..This amounts to 1 in 8 deaths across the globe, with 3.7 million deaths resulting from poor ambient air quality and 4.3 million deaths attributed to indoor air pollutants (Selahattin Incecik et al., 2014).

II. EFFECTS OF AIR POLLUTION ON HUMAN BEINGS

The World Health Organization (WHO) reports on six main air pollutants, namely particulate pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides and lead. Air pollution can have a detrimental impact on all components of the environment, including groundwater, soil and air (William E. Wilson et al., 1997).

A. Effects of Sulphur Dioixde (SO_2)

Sulfur oxides are generally four gas-phase compounds, namely, sulfur monoxide, sulfur dioxide, sulfur trioxide, and di Sulphur monoxide; but only sulfur dioxide (SO_2) occurs at sufficient concentrations in ambient atmospheres to be of public health concern (X Pan et al.,2011). It affects human, animal, and plant. When SO_2 inhaled, it affects the mucous membrane. The major health problem associated with SO_2 emissions are mucous membrane, bronchial- spasms, mucous membrane, and respiratory irritations. It affects breathing, lung defences, aggravation of existing respiratory and cardiovascular diseases, and death. Asthmatics and those suffering from chronic lung and cardiovascular diseases are sensitive to SO_2 exposure. Susceptible people as those with lung disease, old people, and children, who present a higher risk of damage (Chen TM et al. 2007).

B. Effects of Ground Level Ozone (GLO)

Ozone develops in the reaction of oxygen molecules with the singlet oxygen splitting off from nitrogen-oxides in the presence of UV-radiation. This reaction is fast and reversible, so ozone formation and depletion are in constant equilibrium. This happens when pollutants from automobiles, power plants, industrial boilers, refineries, chemical plants, and other sources chemically react in the presence of sunlight (Crutzen et al., 1994). Ozone shows short-term and long term effects on cultivated plants. Ozone can cause short-term effects in plants such as the development of visible injury (fine bronze or pale yellow specks on the upper surface of leaves) or reductions in photosynthesis. If episodes are frequent, longer-term effects such as reductions in growth and yield and early scenescence can occur (Harmens et al., 2006).

Daily ozone exposure increases mortality and respiratory morbidity. Short-term studies on lung function, pneumonia, lung permeability, respiratory problems, increased drug intake, morbidity and mortality, ozone appears to have independent effects of other air pollutants such as fine dust (PM).Regarding long-term exposure, new epidemiological evidence and experimental animal studies on the inflammatory response, lung damage, and persistent structural changes in the airways and lung tissue changes early in life also demonstrate the effects of long-term exposure of ozone. Inhaling ozone at ground level causes health problems such as chest pain, cough, sore throat, and constipation. It can exacerbate bronchitis, emphysema, and asthma. Repeated exposure can cause permanent scarring of the lung tissue (US EPA).Because of the low water-solubility of ozone, inhaled ozone can penetrate deeply into the lungs (Hatch GE et al., 1994).

C. Effects of Lead

Lead is a harmful xenobiotic, to humans and considered as one of the most hazards and cumulative environmental pollutants that affect all biological systems through exposure to air, water, and food sources (Patra, R.C et al., 2011). Due to its many uses (e.g., leaded gasoline, lead in paint, ceramics, canned foods, makeup, traditional remedies, batteries), lead is present to varying degrees in air, dust, soil, and water. Each of these media can act as a route of human exposure, through ingestion or inhalation Lead can assess directly to humans, through blood, teeth or bone and indirectly, in the environment (air, dust, food or water). (Annette Pruss Ustun et al., 2004).

Lead exposure to human population was relatively low before the industrial revolution, but has increased with industrialization and large-scale mining (A. Russell Flegal and Donald R. Smith (1992). Since microbial activity can't degrade lead, lead is an environmentally persistent toxin, which accumulated upward the food chain. Once taken into the body, lead can distribute in the blood throughout the body and accumulate in the bones and soft tissues, leading to chronic toxicity. Depending on the level of exposure, lead can cause neurological (Thomson and Parry 2006), liver (Singh et al. 1994), kidney, hematological, circulatory, immunological, reproductive, developmental (Davis and Svendsgaard, 1987), gastrointestinal diseases and cardiovascular. pathologies (Patrick 2006a, 2006b).Chronic occupational exposure to lead has been shown to increase the risk of Parkinson's disease (Gorell et al., 1999; Weisskopf et al., 2010). Chronic exposure to lead can also cause tooth loss and the damage of hard dental tissues (Cenic-Milosevic et al., 2013).

Lead pollution cause abortion and stillbirths. Contaminated ecosystems they have negative effects such as loss of biodiversity, change of community components, decreased pollen germination and seed viability, decreased growth and reproduction rates in plants and animals (Myra et al. 2012). High concentration of lead in children's blood is among the leading public health issues worldwide (Tong S et al., 2000). Ingestion of lead deposited on surfaces is the primary route of human exposure to lead originally released into the air. Once absorbed by the body, lead in the blood disperses throughout the body and accumulates in the bones Depending on the level of exposure, lead can damage the nervous system, kidney function, immune system, reproductive and developmental systems, as well as the cardiovascular system. Exposure to lead also affects the oxygen carrying capacity of the blood.

Children particularly under age of 5 are vulnerable to harm from lead. It affects the development of the brain and nervous system, causing reduced postnatal growth and lifelong neurological, cognitive, and physical damage (National Institute of Environmental Health Sciences). In adults, 5-10% of lead in contaminated food is absorbed through the digestive system; in children, this rate is about 40% higher (Liu X et al., 2002). Ingestion of lead contaminated food in children can cause a metallic taste sensation, abdominal pain, vomiting, diarrhea, colourless stool, loss of appetite, irritability, fatigue and shock (Centers for Disease Control and Prevention (Centers for Disease Control and Prevention).Neurological disorders, including headache, insomnia, somnolence, and seizures are also common.

D. Effects of Volatile Organic Compounds (VOCs)

Exposure to VOCs is related to allergies and adverse respiratory effects, often expressed as asthma or chronic obstructive pulmonary disease (COPD) (Lerner et al., 2012). Industrial and vehicle emissions, oil refineries, and solvent use are major sources of VOCs in ambient air (De Blas et al., 2012). Cause eye, nose and throat irritation, headache, nausea. Long-term exposure to VOCs causes kidney, liver, or central nervous system damage (Gibb T et al., 2013). The health effects of VOCs depend on the concentration and duration of exposure to the chemicals. Most people are not affected by short-term exposure to the low levels of VOCs.

E. Effects of Particulate Matter (PM)

Particulate matter comprises a heterogeneous mixture of tiny particles, and liquid droplets suspended in air. Particulates can be products of combustion, suspensions of soil materials, and suspensions of sea spray, and they can also be formed by chemical reactions in the atmosphere. Therefore, it can be concluded that particulate matter (PM) in air is a complex mixture of many different chemical species, derived from a variety of sources (Ian Colbeck and Mihalis Lazaridis, 2009).

The main natural sources of aerosols include volcanic emissions, sea spray and mineral dust emissions, while anthropogenic sources include emissions from industry and combustion processes. Aerosols have a variety of effects, ranging from human health to visibility to forcing the weather. Two important species of aerosols sulfate and organic particles, have large natural biogenic sources that depend in a very complex way on environmental and environmental parameters and are therefore susceptible to the effects of global change (Andreae MO & Crutzen PJ, 1997). The size of the particle and surface and chemical composition of the particulate material determine the risk that exposure to this agent represents for human health. Fine particles, owing to their smaller size, penetrate deeply into the respiratory system and may affect the alveoli (Bayram H et al, 2006). There is a strong correlation between particulate matter contamination and impaired lung function, growth deficits in lung function, worsening asthmatic symptoms, and increased visits to the emergency room for asthma and disease. chronic obstructive pulmonary disease. (Atkinson RW et al, 2001).

Particulate matter size is directly linked to their potential to cause health problems. Particles with diameter ≤ 10 μm are passing through the throat and nose and enter the lungs. They can affect various organs of the body, especially the heart and lungs, and have serious health consequences. The particle load is divided according to the size of the particles into: a) "coarse inhalable particles", which have a diameter of 2.5 μm to 10 μm and are found in the vicinity of roads and industries, and b)“ fine particles” < 2.5 μm in diameter such as those found in smoke and haze; they can for when gases emitted from power plants, industries, and automobiles react in the air (Kelishadi R et al., 2010).

Fine particles can travel long distances (over 100 km) with the potential for high background concentrations over a wide area. As a consequence, their composition may be extremely heterogeneous, depending on the meteorological conditions and human activities in a particular geographical area. Ultrafine particulates are fresh emissions from combustion-related sources, such as vehicle exhaust and atmospheric photochemical reactions, and are considered important markers of exposure to traffic fumes along major roads, as they they can reach the deepest parts of the respiratory tract or even the bloodstream directly (Franchini, M et al, 2015). Fine and ultrafine particles are the ones that have been linked to the worst health effects, as they can penetrate the deepest parts of the airways or even directly into the blood stream directly (Franchini, M et al, 2011). Particles size greater than 10 μ cab be trapped by hairs and sticky mucus in the lining of nose. Smaller particles of up to 10 μ can reach trachea- bronchial system, but get trapped in the mucus. Very fine suspended particles reach the lungs and damage the lung tissues, causing diseases like asthma, bronchitis, and lung cancer, when such particles bring with them toxic and carcinogenic pollutants attached to the surface of the pollutants.

III. GLOBAL EFFECTS OF AIR POLLUTION

Air pollution can have serious costs, penalties and consequences for human health and is also a merciless burden on the natural bio-network and ecosystems. The main effects of air pollution are global warming, acid rain, smog, ozone depletion, etc (Ashfaq A et al., 2012).

A. Global warming:

The term global warming is synonymous with an increase in the greenhouse effect, which implies an increase in the amount of greenhouse gases in the Earth's atmosphere, which leads to more and more solar radiation being trapped and, therefore, to the global temperature of the earth increases. When these fuels are burned, gases such as carbon dioxide, methane, and nitrogen oxides are produced, causing global warming. Deforestation is also leading to warmer temperatures (Marc Lallanila, 2015).

Global warming produces many negative effects such as floods and droughts in the regions where increased evaporation process is not compensated by increased precipitation. In some areas of the world, this will cause crop failure and famine, particularly in areas where the temperatures are already high. The warmer climate will probably cause more heat waves, more violent rainfall and also amplification in the severity of hailstorms and thunderstorms. Sea level rise is the deadliest effect of global warming. The rise in temperature causes ice and glaciers to melt rapidly. This will lead to the rise of water levels in oceans, rivers and lakes that can pilot devastation as floods.

Global warming can seriously affect the health of living things. Excessive heat can cause stress, which can lead to blood pressure and heart disease. Warmer oceans and other surface waters can cause severe cholera outbreaks and harmful infections in some shellfish. It is a fact that warmer temperatures lead to dehydration, which is one of the main causes of kidney stones. Valley fever infections have increased, likely due to the warmer weather and drought that is causing dust storms. Dry soil and wind can transmit spores that spread the virus. Warmer and drier climates are predicted to increase the amount of accumulated dust that transmits this disease. Increase in mosquito-borne diseases such as dengue and malaria due to warmer and longer summers (Umair Shahzad & Riphah, 2015). Unprecedented temperature spikes around the world subtly affect the conditions of daily life. People who live in poorly constructed, often unventilated houses and shacks, and old apartments in the city center are at increased risk of health problems due to heat stress, which can be fatal. These include dehydration, heat stroke and asthma. Where there is no direct access to clean water, your health is at even greater risk (Manderson L, 2019).

B. Formation of Photochemical Smog:

Photochemical smog causes eye irritation and reduce the visibility to human beings. This also effects the vegetation by retard its growth. An important economic effect of smog is deterioration of the side walls of automobile tyres. This is primarily due to the ozone constituents of photochemical smog.

C. Formation of Acid Rain:

Acid rain is a dangerous ecological factor that has an important impact on reducing the productivity and reproduction of forest ecosystems. Acid rain affects not only ecosystems but also human health. Sulfur dioxide and nitric oxide emissions from acid rain cause irritation of the eyes, nose, and throat, as well as lung diseases such as dry cough, asthma, headache, and bronchitis. Use of urea and animal manure causes ammonia (NH3) accumulation in the atmosphere and long-term addition may cause acid deposition (Zhao-hui Wang et al., 2004). Acid rain affects ponds, rivers, streams, lakes, gulfs, seas, oceans, etc. by increasing its acidity. Because of acid rains, fish and other aquatic creatures can no longer live (Haradhan Kumar Mohajan, 2018).

Acid rain affects on fishes directly or indirectly. Direct effects are the alteration of blood chemistry, retardation of egg development, etc. Indirect effects are the reduction in the kinds and supply of food available to fish, the creation of toxic to fishes, etc. Acid rain reduces plant growth and yield due to leaf damage. Decreases vital soil nutrients, in the presence of acid rain, they become toxic in the soil and cause damage or death to plants and trees (Xuejun Liu et al., 2011). Acid rain changes the chemistry of leaf surfaces, reduces pollen germination, fertilization and seed development, as well as fruit set. Some plants can survive in the effects of acid rain but, become very weak and unable to survive in natural calamities like heavy rainfall, strong winds, and drought. Herbaceous plants are more sensitive to direct injury by acid rain than trees. The waxy layer on the leaf surface, chlorophyll and other components of cells are destroyed by acid rain.

Acid rain with pH value 3 - 5 is known as ‘stone cancer’. It is observed that lots of buildings, historical monuments are harmed worldwide because of acid rain. At present both railway and airplane industries have to spend a lot of money to repair the corrosive damage done by acid rain..Metals, paints, textiles, and ceramic can readily be corroded due to acid rain. It can downgrade leather and rubber. In building and monuments, acidic water reacts with calcium carbonate (CaCO3) to form powder type calcium sulphate (gypsum), and calcium nitrate, and destroy the structures (Gene E. Likens and F. Herbert Bormann, 1974). Acid precipitation affected famous structures like Taj Mahal, Westminster Abbey in England, Paul’s Cathedral in London, Statue of Liberty in New York, Cathedral Cologne in Germany and Parthenon in Greece.(Okita, 1983).

D. Depletion of Ozone:

Ozone layer depletion occurs when the natural balance between stratospheric ozone production and destruction shifts in favor of destruction. Although natural phenomena can cause temporary ozone loss, chlorine and bromine released from man-made compounds such as CFCs are the main cause of this depletion (Angell, J. K., and J. Korshover, 2005). Increased penetration of solar UV-B radiation shows impact on human health with potential risks of eye diseases, skin cancer and infectious diseases (Peter M. Morrisette ,1995). UV radiation effects cornea and lens of the eye. Chronic UVB exposure can cause cataracts of the cortical and posterior sub capsular forms. UVB radiation can affect the immune system and cause a number of infectious diseases. In light skinned humans, it is likely to develop non melanoma skin cancer (NMSC).

Increased UV-B radiation affects the physiological and developmental processes of plants. In forests and grasslands, increased UVB radiation probably leads to a change in species composition (mutation) and thus a change in biodiversity in various ecosystems. UV-B could also affect the plant community indirectly resulting in changes in plant form, secondary metabolism, etc (D. H. Stedman et al., 1981). Increased levels of UV exposure can have adverse impacts on the productivity of aquatic systems. High exposure in the tropics and subtropics can influence the distribution of phytoplanktons.

IV. CONCLUSIONS

Air pollution is a global problem and has become a major public health, climate and environmental problem. The effects of air pollutants are of great concern to academia, government, and the public communities. Air pollution negatively impacts our lives in many ways. Children are more prone to air pollution. The effects of air pollutants on the respiratory tract are generally considered, but the importance of other health hazards should also be highlighted. In addition to short-term effects, exposure to

criteria-related air pollutants at a young age could have long-term risks, particularly for chronic non-communicable diseases such as cardiovascular disease and cancer. Air pollution-related illnesses not only have significant economic effects, but also social effects due to absenteeism from productive work and school. Climate change caused by pollution affects the geographic distribution of many infectious diseases, famines, floods, and many natural disasters.

Women and children living in extreme poverty are more exposed to indoor air pollution from solid fuel use, as they spend a lot of time near stoves. As a result, these vulnerable populations are at increased risk of developing short-term and long-term adverse effects related to air pollution and therefore require closer monitoring. The only way to tackle these problems is through public awareness coupled with a multidisciplinary approach by scientific experts; national and international organizations must address the emergence of this threat and propose sustainable solutions. A successful solution could be envisaged for anthropogenic environmental pollution, as a tight collaboration of authorities, government and private bodies, and doctors to regularize the situation.

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