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Effects of air pollution on human health in Bihar

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Abstract

Air pollution can harm human health, the environment, and cause property damage. Various research have proven the connection of air quality and human health. The epidemiology and laboratory studies demonstrated that ambient air pollutants (for example PM, O3, SO2 and NO2) contributed to various respiratory problems including bronchitis, emphysema and asthma. The objective of this paper is to discuss the relationship between the human health and air quality. This conceptual paper is focussing on the findings from air quality literature review and the significant health effects related to it.

Air pollution is a major concern of new civilized world, which has a serious toxicological impact on human health and the environment. It has a number of different emission sources, but motor vehicles and industrial processes contribute the major part of air pollution. According to the World Health Organization, six major air pollutants include particle pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. Long and short term exposure to air suspended toxicants has a different toxicological impact on human including respiratory and cardiovascular diseases, neuropsychiatric complications, the eyes irritation, skin diseases, and long-term chronic diseases such as cancer. Several reports have revealed the direct association between exposure to the poor air quality and increasing rate of morbidity and mortality mostly due to cardiovascular and respiratory diseases. Air pollution is considered as the major environmental risk factor in the incidence and progression of some diseases such as asthma, lung cancer, ventricular hypertrophy, Alzheimer's and Parkinson's diseases, psychological complications, autism, retinopathy, fetal growth, and low birth weight. we aimed to discuss toxicology of major air pollutants, sources of emission, and their impact on human health. We have also proposed practical measures to reduce air pollution in Gaya.

KEYWORDS- Pollution, Diseases, Human Health And Air quality.

Introduction

Air pollution is a major problem of recent decades, which has a serious toxicological impact on human health and the environment. The sources of pollution vary from small unit of cigarettes and natural sources such as volcanic activities to large volume of emission from motor engines of automobiles and industrial activities. Long-term effects of air pollution on the onset of diseases such as respiratory infections and inflammations, cardiovascular dysfunctions, and cancer is widely accepted. hence, air pollution is linked with millions of death globally each year. A recent study has revealed the association between male infertility and air pollution.

Air pollution has now emerged in developing countries as a result of industrial activities and also increase the quantity of emission sources such as inappropriate vehicles. About 4.3 million people die from household air pollution and 3.7 million from ambient air pollution, most of whom (3.3 and 2.6 million, respectively) live in Asia. In India, as a developing country, the level of air pollutants has increased gradually since the beginning of industrialization in the 1970s, but it has reached a very harmful level in some mega cities such as Gaya, Nawada, Biharsharif and Patna over the past two decades. Gaya is the city of main polluted country in the india, In fact, four of the top ten air-polluted cities are in India. Micro dust blowing in from neighboring countries, and particulate levels three times that of Beijing, and nearly 13 times that of London. Air pollution caused almost many deaths in every year. Therefore, it is of great importance to describe

the problem, particularly its toxic effects on human health and provide recommendations as a basis for environmental guidelines and standard protocols in the field of air pollution.

Clean air is what all living humans and animals needs for good health and well-being. However, due to unstoppable urban development, the air is continuously polluted. Urban ambient air is more polluted than overall atmosphere, due to high density of human population and their activities in urban areas; it produces air pollutants with a higher rate as compared to less-developed areas and natural environment. As for the example, urban conurbation like Gaya with high volume of traffic and high density of developments contribute to the decrease of urban air quality.

but most cities in developing countries are facing increasing environmental pollution from vehicle emissions, and from industries and domestic heating sources at a level that exceeds the capacity to disperse and dilute emissions to non-harmful exposure levels (UN, 2001). The World Health Organization (WHO) stated that urban air pollution as a critical public health problem, and more than 2 million premature deaths each year can be attributed to the effects of urban outdoor air pollutant and indoor air pollutant (WHO, 2006).

However, the consequences of air pollution on public health are measured not only in terms of sickness and death, but also in terms of lost productivity and missed educational and other human development opportunities. The adverse health effects, such as respiratory morbidity, cardiovascular diseases and mortality, have created a public awareness to the urban air pollution. Evaluations and assessments on health have become more important since they serve as a basis to carry out a reformulation or review on the current air quality standards. The Clean Air Act regarded pollutants, such as sulphur dioxide, carbon monoxide, particulates, volatile hydrocarbons, photochemical oxidants, and lead, to be the greatest threats to human health. No doubt, these pollutants have the capabilities to threat the human health and environment, and could cause significant damages to properties. As stated by numerous scholars, particle pollution and ground level ozone are at the pinnacle among six other pollutants as the most threatening factors to the human health. The epidemiology and laboratory studies also demonstrated that ambient air pollutants (for example, PM, O3, SO2 and NO2) contributed to various respiratory problems including bronchitis, emphysema and asthma.

Environmental health

Environmental health has a very strong connection between the human health and healthy environment and it's often due to an imbalance resulting from poor adjustment between the individual and the environment. It focuses on the external factors that cause disease, including elements of the natural, social, cultural, and technological worlds in which we live (Cunnigham & Saigo, 2005). A disease is an abnormal change in the body's condition that impairs with physical or psychological. According to Ahluwalia and Malhotra (2008), air, water and soil represent the environment as a whole. There are two types of environment: natural and man-made. Natural environment composes of everything that affects an organism during the course of its lifetime, such as air, water, soil, radiation, land, forest, wildlife, flora and fauna etc. From a human perspective, environmental issues involve concerns regarding science, nature, health, employment, profits, politics, ethics and economics. Most social and political decisions are usually made with respect to the political jurisdictions. Environmental problems are not necessarily bound to these artificial, political worlds. Air pollution may simply involve from as low as governmental units to as serious as international states.

Environmental damages

Ecologically, air pollution can cause serious environmental damages to the groundwater, soil, and air. It is also a serious threat to the diversity of life. Studies on the relationship between air pollution and reducing species diversity clearly show the detrimental effects of environmental contaminants on the extinction of animals and plants species. Air suspended toxicants may also cause reproductive effects in animals. Acid rain, temperature inversion, and global climate changes due to the emissions of greenhouse gasses to the atmosphere are other major ecological impacts of air pollution.

Air

The atmosphere, or air, is normally composed of 79-percent nitrogen, 20-percent oxygen, and one percent mixture of carbon dioxide, water vapour, and small quantities of several other gases. Most of the atmosphere is held close to the Earth by the gravitational pull. Therefore, the composition of its closest point to the surface of the Earth is thinner (Enger & Smith, 2000). The atmosphere consists of the troposphere, a relatively dense layer of gases closest to the surface of the Earth; stratosphere, more distant with similar but less dense gases, and the ionosphere, composed of

ionized gases (Enger & Smith, 2000). Just as it contains gaseous components, the atmosphere also holds non-gaseous materials present in the form of solid or liquid particles dispersed into the air, such as aerosols or particulate matter.

Air pollutants and their toxicities

Every material in the air which could affect human health or have a profound impact on the environment is defined as air pollutants. According to the World Health Organization (WHO), particle pollution, ground-level O3, CO, sulfur oxides, nitrogen oxides, and lead (Pb) are the six major air pollutants which harm human health and also the ecosystem. There are many pollutants of suspended materials such as dust, fumes, smokes, mists, gaseous pollutants, hydrocarbons, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and halogen derivatives in the air which at the high concentrations cause vulnerability to many diseases including different types of cancers. The most important air pollutants and their toxic effects on different human body organs and related diseases.

Particle pollutants

Particle pollutants are major parts of air pollutants. In a simple definition, they are a mixture of particles found in the air. Particle pollution which is more known as PM is linked with most of pulmonary and cardiac-associated morbidity and mortality. They have varied in size ranging mostly from 2.5 to 10 µm (PM 2.5 to PM 10).

The size of particle pollutants is directly associated with the onset and progression of the lungs and heart diseases. Particles of smaller size reach the lower respiratory tract and thus have greater potential for causing the lungs and heart diseases. Moreover, numerous scientific data have demonstrated that fine particle pollutants cause premature death in people with heart and/or lung disease including cardiac dysrhythmias, nonfatal heart attacks, aggravated asthma, and decreased lung functions. Depending on the level of exposure, particulate pollutants may cause mild to severe illnesses. Wheezing, cough, dry mouth, and limitation in activities due to breathing problems are the most prevalent clinical symptoms of respiratory disease resulted from air pollution.

Long-term exposure to current ambient PM concentrations may lead to a marked reduction in life expectancy. The increase of cardiopulmonary and lung cancer mortality are the main reasons for the reduction in life expectancy. Reduced lung functions in children and adults leading to asthmatic bronchitis and chronic obstructive pulmonary disease (COPD) are also serious diseases which induce lower quality of life and reduced life expectancy. Strong evidence on the effect of long-term exposure to PM on cardiovascular and cardiopulmonary mortality come from cohort studies.

Ground-level ozone

O3 with the chemical formula of O3 is a colorless gas which is the major constituent of the atmosphere. It is found both at the ground level and in the upper regions of the atmosphere which is called troposphere. Ground-level ozone is produced as a result of chemical reaction between oxides of nitrogen and VOCs emitted from natural sources and due to human activities. Ground-level ozone is believed to have a plausible association with increased risk of respiratory diseases, particularly asthma.

As a powerful oxidant, O3 accepts electrons from other molecules. There is a high level of polyunsaturated fatty acids in the surface fluid lining of the respiratory tract and cell membranes that underlie the lining fluid. The double bonds available in these fatty acids are unstable. O3 attacks unpaired electron to form ozonides and progress through an unstable zwitterion or trioxolane (depending on the presence of water). These ultimately recombine or decompose to lipohydroperoxides, aldehydes, and hydrogen peroxide. These pathways are thought to initiate propagation of lipid radicals and auto-oxidation of cell membranes and macromolecules. It also increases the risk of DNA damage in epidermal keratinocytes, which leads to impaired cellular function.

O3 induces a variety of toxic effects in humans and experimental animals at concentrations that occur in many urban areas. These effects include morphologic, functional, immunologic, and biochemical alterations. Because of its low water solubility, a substantial portion of inhaled O3 penetrates deep into the lungs but its reactivity is scrubbed by the nasopharynx of resting rats and humans in around 17% and 40%, respectively. On ecological aspect, O3 can reduce carbon assimilation in trees leading to deforestation which may affect global food security in long-term exposure.

Carbon monoxide

CO is a colorless and odorless gas, which is produced by fossil fuel, particularly when combustion is not appropriate, as in burning coal and wood. The affinity of CO to hemoglobin (as an oxygen carrier in the body) is about 250 times greater than that of oxygen. Depending on CO concentration and length of exposure, mild to severe poisoning may occur. Symptoms of CO poisoning may include headache, dizziness, weakness, nausea, vomiting, and finally loss of consciousness. The symptoms are very similar to those of other illnesses, such as food poisoning or viral infections.

No human health effects have been showed for carboxyhemoglobin (COHb) levels lower than 2%, while levels above 40% may be fatal. Hypoxia, apoptosis, and ischemia are known mechanisms of underlying CO toxicity. The mechanism of such toxicity is the loss of oxygen due to competitive binding of CO to the hemoglobin heme groups. Cardiovascular changes also may be observed by CO exposures that create COHb in excess of 5%. In the early 1990s, Health Effects Institute performed a series of studies associated with cardiovascular disease to determine the potential for angina pectoris with COHb levels in the range of 2-6%. The results showed that premature angina can occur under these situations but that the potential for the occurrence of ventricular arrhythmias remains uncertain. Thus, the reduction in ambient CO can reduce the risk of myocardial infarction in predisposed persons.

Sulfur dioxide

SO2 is a colorless, highly reactive gas, which is considered as an important air pollutant. It is mostly emitted from fossil fuel consumption, natural volcanic activities, and industrial processes. SO2 is very harmful for plant life, animal, and human health. People with lung disease, children, older people, and those who are more exposed to SO2 are at higher risk of the skin and lung diseases.

The major health concerns associated with exposure to high concentrations of SO2 include respiratory irritation and dysfunction, and also aggravation of existing cardiovascular disease. SO2 is predominantly absorbed in the upper airways. As a sensory irritant, it can cause bronchospasm and mucus secretion in humans. Residents of industrialized regions encountered with SO2 even at lower concentrations (<1 ppm) in the polluted ambient air might experience a high level of bronchitis.

The penetration of SO2 into the lungs is greater during mouth breathing compared to nose breathing. An increase in the airflow in deep, rapid breathing enhances penetration of the gas into the deeper lung. Therefore, people who exercise in the polluted air would inhale more SO2 and are likely to suffer from greater irritation. When SO2 deposits along the airway, it dissolves into surface lining fluid as sulfite or bisulfite and is easily distributed throughout the body. It seems that the sulfite interacts with sensory receptors in the airways to cause local and centrally mediated bronchoconstriction.

The level of annual standard for SO2 is 0.03 ppm. Due to its solubility in water, SO2 is responsible for acid rain formation and acidification of soils. SO2 reduces the amount of oxygen in the water causing the death of marine species including both animals and plants. Exposure to SO2 can cause damages to the eyes (lacrimation and corneal opacity), mucous membranes, the skin (redness, and blisters), and respiratory tracts. Bronchospasm, pulmonary edema, pneumonitis, and acute airway obstruction are the most common clinical findings associated with exposure to SO2.

Nitrogen oxide

Nitrogen oxides are important ambient air pollutants which may increase the risk of respiratory infections. They are mainly emitted from motor engines and thus are traffic-related air pollutants. They are deep lung irritants that can induce pulmonary edema if been inhaled at high levels. They are generally less toxic than O3 , but NO2 can pose clear toxicological problems. Exposures at 2.0-5.0 ppm have been shown to affect T-lymphocytes, particularly CD8 + cells and natural killer cells that play an important role in host defenses against viruses. Although these levels may be high, epidemiologic studies demonstrate effects of NO 2 on respiratory infection rates in children.

Coughing and wheezing are the most common complication of nitrogen oxides toxicity, but the eyes, nose or throat irritations, headache, dyspnea, chest pain, diaphoresis, fever, bronchospasm, and pulmonary edema may also occur. In another report, it is suggested that the level of nitrogen oxide between 0.2 and 0.6 ppm is harmless for the human population.

Lead

Pb is a toxic heavy metal that is widely used in different industries. Pb pollution may result from both indoor and outdoor sources. It is emitted from motor engines, particularly with those using petrol containing Pb tetraethyl. Smelters and battery plants, as well as irrigation water wells and wastewaters, are other emission sources of the Pb into the environment. Evaluation of the blood Pb level in traffic police officers shows that environmental pollution may be considered as a source of Pb exposure. Fetuses and children are highly susceptible to even low doses of Pb. Pb accumulates in the body in blood, bone, and soft tissue. Because it is not readily excreted, Pb can also affect the kidneys, liver, nervous system, and the other organs.

Pb absorption by the lungs depends on the particle size and concentration. Around 90% of Pb particles in the ambient air that are inhaled are small enough to be retained. Retained Pb absorption through alveoli is absorbed and induces toxicity. Pb is a powerful neurotoxicant, especially for infants and children as the high-risk groups. Mental retardation, learning disabilities, impairment of memory, hyperactivity, and antisocial behaviors are of adverse effects of Pb in childhood. Therefore, it is very important to reduce the Pb level of ambient air.

Pb exposure is often chronic, without obvious symptoms. It can affect the different parts of the body including cardiovascular, renal, and reproductive systems, but the main target for Pb toxicity is the nervous system. Pb disrupts the normal function of intracellular second messenger systems through the inhibition of N-methyl-D-aspartate receptors. Pb may also replace calcium as a second messenger resulting in protein modification through various cellular processes including protein kinase activation or deactivation.

Abdominal pain, anemia, aggression, constipation, headaches, irritability, loss of concentration and memory, reduced sensations, and sleep disorders are the most common symptoms of Pb poisoning. Exposure to Pb is manifested with numerous problems, such as high blood pressure, infertility, digestive and renal dysfunctions, and muscle and joint pain.

Other air pollutants

Other major air pollutants that are classified as carcinogen and mutagen compounds and are thought to be responsible for incidence and progression of cancer in human include VOCs such as benzene, toluene, ethylbenzene, and xylene, PAHs such as acenaphthene, acenaphthylene, anthracene, and benzopyrene, and other organic pollutants such as dioxins, which are unwanted chemical pollutants that almost totally produced by industrial processes and human activity.

As it can be easily understood, fossil fuel consumption shares the largest part of air contamination. Air pollutants can also be classified into anthropogenic and natural according to their source of emission. From anthropogenic aspect, air contamination occurs from industrial and agricultural activities, transportation, and energy acquisition. While from natural contaminant has different sources of emission such as volcanic activities, forest fire, sea water, and so on.

Health hazards

In terms of health hazards, every unusual suspended material in the air, which causes difficulties in normal function of the human organs, is defined as air toxicants. According to available data, the main toxic effects of exposure to air pollutants are mainly on the respiratory, cardiovascular, ophthalmologic, dermatologic, neuropsychiatric, hematologic, immunologic, and reproductive systems. However, the molecular and cell toxicity may also induce a variety of cancers in the long term. On the other hand, even small amount of air toxicants is shown to be dangerous for susceptible groups including children and elderly people as well as patients suffering from respiratory and cardiovascular diseases.

Respiratory disorders

Because most of the pollutants enter the body through the airways, the respiratory system is in the first line of battle in the onset and progression of diseases resulted from air pollutants. Depending on the dose of inhaled pollutants, and deposition in target cells, they cause a different level of damages in the respiratory system. In the upper respiratory tract, the first effect is irritation, especially in trachea which induces voice disturbances. Air pollution is also considered as the major environmental risk factor for some respiratory diseases such as asthma and lung cancer. Air pollutants, especially PMs and other respirable chemicals such as dust, O3 , and benzene cause serious damage to the respiratory tract. Asthma is a respiratory disease which may be developed as a result of exposure to air toxicants. Some studies

have validated associations between both traffic-related and/or industrial air pollution and increasing the risk of COPD. Treatment of respiratory diseases due to air pollution is similar to the other toxic chemical induce respiratory disorders.

Cardiovascular dysfunctions

Many experimental and epidemiologic studies have shown the direct association of air pollutant exposure and cardiac-related illnesses. Air pollution is also associated with changes in white blood cell counts which also may affect the cardiovascular functions. On the other hand, a study on animal models suggested the close relationship between hypertension and air pollution exposure. The traffic-related air pollution, especially exposure to high levels of NO2 , is associated with right and left ventricular hypertrophy. In addition to the antidote therapy that exists only for a few cardiotoxic substances like CO, usual treatment of cardiovascular diseases should be carried out.

Conclusions

Human must understand the chain of causality in urban environmental health, because the chain of causality in environmental health begins with the impact of human factors (urbanisation) on the environment and human health. Human factors are the driving force to the destruction of environment and air quality especially, such as urban development, traffic, etc. This driving force of human activities will result in the effects of human health. In conclusion, human are responsible with the waste emitted to the air and society must take necessary actions to overcome the air pollution matter. Air pollution not just will harm human health but also other aspects of the environment such as visual qualities, vegetation, animals, soils and water quality.

Air pollutions have major impacts on human health, triggering, and inducing many diseases leading to high morbidities and mortalities, particularly in the developing countries. Therefore, air pollutions control is vital and should be on the top of priority list of the governments. The policy makers and legislators in these countries must update all laws and regulations related to air pollutions. Coordination between different departments involving in air pollutions must be leaded by a powerful environmental protection organization. An effective environmental protection organization should have enough budgets for administration, research, development, monitoring, and full control of the environment including air pollution.

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