

Air pollution effects on health

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Abstract: Air pollution is responsible for several health hazards and diseases in man and other living organisms. Industrial and vehicular emissions, domestic fuel combustion, plastics and aquaculture, tobacco, aeroallergens, mosquito repellants, industrial gas leakages, agriculture waste burning, nuclear explosions, cell tower/phone and personal computer (PC)laptop/TV screen radiation, solar radiation, natural disasters like volcanic eruptions, forest fires causes air pollution. Genetically modified crops (GM, crops) impact on man and environment are yet to be assessed.

Keywords: Air pollution, Health effects, Environment, Emissions, Radiation, Natural disasters

Introduction

Air, food and water are essential for life. However air is more important than the other two because life is possible for weeks without food, few days without water but only few minutes without air. Good air quality is essential for public health and environment. National air quality standards are given below in Table.1. Good health of humans depends on purity of air consumed. Continuation of human race, longevity and disease free life of man depends how clean or pure or safe he maintains air or environment [1]. Rapid industrialization, over exploitation of natural resources to meet ever increasing demand, life style changes are contributing to environmental pollution. Presence of any undesirable substances or elements in air threatens survival of man and other species and disturbs environment. The word pollution refers to presence of pollutant in air or environment. Pollutant may be substance or element which is usually absent in environment.

Table.1 National air quality standards

Pollutant	Time	Concentration in air ($\mu\text{g}/\text{m}^3$) in residential areas
Sulfur dioxide (SO_2)	Annual	60
	24 hour	80
Nitrogen oxide (NO_x)	Annual	60
	24 hour	80
Suspended particulate matter (SPM)	Annual	140
	24 hour	200
Respirable suspended particulate matter (RSPM)	Annual	60
	24 hour	100

Air pollution affects human health and health of other life forms. Presence of air pollutants, over prescribed limit in the lower atmosphere is not only injurious to health of humans but also to animals, foliage, fruits, vegetables and microbes. Auto exhausts, gaseous and particulate emissions from industries and agricultural activities are responsible for most of the air pollution. Air pollutants consist of natural contaminants, aerosols, gases and vapours. The gas pollutants are Sulfur dioxide (SO_2), Nitrogen oxide (NO_x), Suspended particulate matter (SPM) and Respirable suspended particulate matter (RSPM) and dioxins [2]. Air pollutants are responsible for the air born allergic disorders like bronchial asthma, chronic rhinitis etc. In Table.2 air pollutants sources and their effects on health are presented.

Table .2
Air pollutants sources and their effects on human health

Air pollutant	Sources	Health effects
Sulfur dioxide (SO ₂)	Coal burning , fossil fuel use, petro chemical manufacture ,metal smelting	Eyes irritation, respiratory discomfort, aggravates heart disease, increases asthma, chronic bronchitis and cancer.
Nitrogen oxide (NO _x)	High temperature fuel combustion	Increase respiratory infections, chest tightness, air ways resistance, eyes burning.
Suspended particulate matter (SPM)	Motor vehicles , cigarette smoke ,home heating ,fossil fuels, bio mass combustion	Reduced visibility , respiratory problems
Respirable suspended particulate matter (RSPM)	Diesel vehicles ,construction activities , road laying, open air burning of wastage ,forest fires	Asthma ,emphysema ,chronic bronchitis
Dioxins	Burning of household fuel and trash , chemical processes of pesticides and herbicide production, electronic products dismantling and recycling, Paper and pulp chlorine bleaching, cigarette smoke, volcanic eruptions , forest fires	Reproductive problems, hormonal disturbances, developmental and immune system problems , cancer

Air chemicals

Industrial emissions and automobile vehicle emissions largely contribute to chemicals in air. Efforts to reduce lead content in gasoline led to increase in aromatic hydro carbons such as benzene. Use of gasoline dramatically increases their concentration in air. Through inhalation benzene in air enter into lungs of human body. From there it is absorbed by other body organs. Because it is aromatic substance it is more soluble in fat (lipid) than in water. Among fat tissues benzene is distributed .Brain and bone marrow are some of the tissues where benzene is concentrated [3].

Lead poisoning

Excessive lead present in atmosphere enters human body through natural food chain. Symptoms of lead poisoning are decreased liver and kidney function, sperm count and mental performance. Lead concentration in the air of most of cities is beyond normal permissible limit [4].

Arsenic pollution

Arsenic in the air occurs in mining areas, coal based thermal power plants, arsenic based industrial units. The arsenic present in the air around such places enters water through down winds and causes drinking water pollution. In Thailand arsenic poisoning around mining areas is reported. In Kolkata arsenic based pesticide paris green manufacturing factory contaminated drinking water with arsenic affecting several thousand people of the region with arsenism [5].

Domestic fuel combustion

In rural and semi urban areas wood, coal, crop residues, kerosine and dung are used as fuel for cooking, lighting, bathing etc. Combustion of these releases particulate matter, gases and heavy metals polluting air. They seriously affect health of children and adults. Acute respiratory disease in children below five years , chronic pulmonary obstructive disease (CPOD) , lung cancer , pneumonia , cataract in adults are due to air pollution by domestic fuel combustion [6].

Air pollution due to Aquaculture and plastics

Many parts of coastal zones of Asian countries facing depletion of mangroves due to aquaculture. This leads to rise in green house gases in environment and which in turn contributes to global warming [7]. Plastic making involves use of several petrochemicals emitting toxic gases into air. Further plastics enters soil when garbage containing plastics is dumped . This is common practice in most of rural and urban areas and one can see piles of garbage with all types plastics at outer skirts of towns and villages. When rains toxic chemicals leaches from plastics and enter soil along with plastics. Soil bacteria may partially convert these plastics into methane gas that enters environment. Since methane is one of the green house gases release of methane gas lead to global warming [8].

Tobacco

Environmental tobacco smoke from smokers and tobacco based agricultural activities, industrial activities like bidi and cigarette making companies causes pollution of environment with tobacco. Breathing of smoke by non-smokers, children and women which known as passive smoking (second hand smoke) can affect their health several ways.

Second hand smoke causes about 3000 lung cancer deaths a year compared to less than 100 lung cancer deaths per year from normal outdoor air pollution. Cardiovascular diseases also occur in passive smokers. In pregnant women second hand smoke affects baby health before and after birth. Exposure of children to environmental tobacco smoke contributes to neurological impairment, allergic diseases like asthma, ear diseases, respiratory infections and cardiovascular diseases [9].

Working with tobacco has adverse health effects. Bidi rollers are exposed to tobacco also contain high levels of nicotine in blood. High rate of tuberculosis and asthma are reported from bidi workers of Bihar and Tamilnadu. Young girls engaged in bidi making suffers from growth impairment, menstrual disorders and body pains etc. Tobacco smoke toxic chemicals such as Benzene, cyanide, lead, cadmium, radioactive polonium, benza(O) pyrenes, carbon monoxide, nicotine etc are implicated in these diseases. Nicotine is rapidly absorbed through skin and causes green tobacco sickness (GTS) in agricultural workers of tobacco [10].

Aeroallergens and human health

About 20% of population in our country suffers from allergic disorders like bronchial asthma, allergic rhinitis, dermatitis etc. Fungi are ubiquitous air pollutants in outdoor and indoor environment. Children and women are more exposed to indoor environment where as men are exposed to outdoor environment. Fungal spores in outdoor environment mainly comes from vegetation, cereal crops, garbage storage etc. In indoor environment sources for fungi are mattresses, carpets, dustbins, decaying vegetation, indoor plants, damp walls and organic waste[11]

Mosquito repellents

Mosquito borne diseases are spreading rapidly in developing countries due to favorable environment. So several types of mosquito repellents are widely used in South Asian countries including India to combat mosquito menace. Repellents are available in the form of lotions, vapourizers, creams, mats, coils etc. Marketing of repellents in India is highly organized and many brands can be found through out the country. A recent study shows that these repellents are harmful to human health [12]. So their use should be limited and avoided. Acute toxic symptoms are breathing problems, allergy, asthma etc [13]. Prolonged exposure to these repellents may be neurological hazard [14].

Bhopal gas leakage

Bhopal gas leak is worst environmental disaster that occurred on the night of 3rd December, 1984. It took heavy toll of human lives. More than 2000 dead in first few days. Gas that leaked contained methyl isocyanate (MIC) and possibly hydrogencyanide (HCN). Initial clinical symptoms are irritation of eye, throat, cough and drowsiness. These are followed by severe pulmonary edema leading to cardiovascular distress. Finally convulsions and death due to cardiovascular arrest. Intense fatigue and muscular weakness are other common symptoms. Cherry red discoloration of lungs is another characteristic observed in autopsy specimens [15].

Vizag gas leakage

Recent corona pandemic led to lockdowns world over. During lock down period all industrial establishments are closed. Lack of proper supervision caused accidents in industries. Vizag gas leakage occurred on the night of 7 th May 2020. Styrene gas leaked from the storage tank of L G Polymers and it spread over five kilometers covering several villages. Several people sleeping inside and outside of houses, animals, reptiles, plants etc are affected by the gas. Styrene gas if inhaled causes headache, fatigue, irritation of eyes, head reeling, fainting and death. Many of its effects on animals, plants, water etc. are yet to be known [16].

Agriculture waste or crop residue burning

Pollution of air due to the burning of agriculture waste by farmers in fields in some of the states in india where paddy is cultivated twice in year become a great concern in recent years. It is not only effecting air quality but also causing transport problems in india [17].

Air pollution due to nuclear explosions or fallouts

Nuclear detonations or test places of nuclear weapons like Pokharan of Rajasthan in India, Bikini atolls, Nevada and Marshal Islands in U.S.A and nuclear accidents are mainly responsible for radiation in environment. Animals, birds and plants are exposed to radiation [18].

By two ways living organisms are exposed to radiation.

1. *Radiation from external sources* : Radiation coming from source falls on the body and absorbed . This ceases with removal of radiation source and when the source is shielded.

2. *Radiation exposure from internal sources* : It can occur when the air contaminated with radio activity is inhaled . Part of the activity thus entering the body gets deposited in different organs depending on the nature of chemical substance.

Radiation exposure increases incidence of cancer due to DNA damage. DNA damage leads to mutations. Mutagenic effect of radiation is maximum public health concern. Decreased red cell count, blistering and reddening of skin and induction of sterility are some of other effects of radiation in humans [19].

Nuclear accidents that released radiation into air are Chernobyl nuclear reactor accident, Three mile island and Brown Ferry in USA, Saint Laurent in France, Fukushima Daiichi nuclear disaster in Japan, Vandellòs in Spain and Soviet nuclear submarine reactor accidents [20].

Cell Tower/ phone and Personal computers (PCs),Lap top / TV screen Radiation

Use of cell phones, personal computers (PCs), laptops and TVs in day to day life for communications, official works, e-commerce and for entertainment increasing dramatically globally. Further to provide uninterrupted cell services more cell towers are installed throughout world. Recent Covid-19 pandemic changed our lives dramatically. Most of daily activities are switched over to on line from offline. Educational activities from nursery to doctoral programmes, shopping, official meetings, political meetings, government procedures, marriages, movies, social activities etc. are now carried out online due to Covid-19 restrictions [21]. As a result worldwide more people of all ages are exposed for longer time to these manmade gadgets that emit radiation. Radiation from cell phones is recognized by WHO as harmful. Prolonged exposure to cell phone radiation increases incidence of brain tumors and sleep disorders. Pregnant women and children are also effected by cell phone radiation [22]. Cell towers radiation is more intense than cell phone and its deleterious effects on man and other life forms are reported. Population living within 300 meters of cell towers are at higher risk of radiation. Cell tower radiation is also dangerous to other animals, birds and plants. Health effects of cell tower radiation are increased cancer risk, DNA damage, neurological, immune system and reproductive disorders [23]. In animals cell tower radiation causes reproductive, developmental problems and overall health is affected. In birds and bees navigation and reproductive problems and in plants low crop yield occurs on exposure to cell tower radiation [24].

Personal computers (PCs), laptops, I pads, tablets are used by people of all ages to carry out official, educational, business and e-commerce works. Different types of TVs are used for entertainment and videogames etc. by people of all ages in our society. Due to Covid-19 pandemic use of these electronic gadgets increased several folds with simultaneous increase in exposure time. Radiation is produced continuously from these gadgets. It is dangerous pollutant of air and its harmful effects on health depends on proximity. It directly falls on the face and other body parts of users or viewers [25]. Prolonged exposure to this radiation is responsible for health problems like dry eyes, with irritation, sleep disturbance, headache, burning sensation, redness, cardiac problems, allergy, Alzheimers disease, fatigue and cancer. [26,27].

Solar radiation

A small portion of solar light (radiation) lies in ultraviolet region which is harmful to humans and causes sun burning and skin cancer [28]. However most of this incoming radiation is absorbed by Ozone layer thereby protecting us. However due to increased levels of chloro fluoro carbons (CFCs) in atmosphere Ozone layer is depleted in certain pockets and holes are formed. The most immediate effect is increase in UV radiation on human skin. Hence elimination of CFC utilization by man and regeneration of Ozone layer is important. However it may take decades to full Ozone layer recovery [29].

Air pollution by volcanic eruptions and forest (wild)fires

Volcanic eruptions eject ash, magma, steam, gases, pollutants and heavy metals. They pollute environment and affect human health. Gases are sulphur dioxide, carbon dioxide, carbon monoxide, carbon sulfide, methane, hydrogen, hydrogen sulfide, hydrogen chloride, hydrogen bromide, hydrogen fluoride etc. Heavy metals are lead, gold and arsenic. Ash and magma causes maximum loss of environment. All types life get terminated in the areas where magma spreads. Ash can block sun rays or alternatively may cause warming. Further ash causes cardiac, respiratory, skin and eye problems. Gases causes irritation of skin, mucous membranes of upper respiratory tract, and eyes. Acid rains due to sulfur dioxide in air also occurs around volcanic eruptions [30,31]. Forest fires emit particulate matter, carbon dioxide and green house gases. They affect air quality and human health. Many health effects such as simple wheezing, sore throat, eye irritation to serious conditions like asthma, cardio respiratory problems are due to particulate matter emitted by forest fires [32].

Air pollution due to marine phyto plankton

In 2004 an unusual and strong stench was reported from Kerala Malabar Coast. The stench was felt up to 5 Km inland from coast. Children below 15 years were hospitalized due to breathlessness, chest pain and nausea. It is due to fish kills by phyto plankton bloom [33].

Genetically modified (GM) crops

Genetically modified crops have entered in 21st century due to advances in biotechnology all over the world. They are not part of nature and produced by using genetic engineering or gene revolution (gene manipulation). Safety of environment and ecosystem due to their prolonged (extensive) use is considered by many as threat and many people believe that mankind is being exposed to unknown genes or diseases [34].

Conclusion

Longevity, disease free life of man and survival of other life forms depends on air quality. Human activities to meet ever increasing energy and life style demands and natural disasters are polluting air and environment causing several health problems in man and posing threat to other species.

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