Airborne Environmental Threats to Health & Wellness-An Integrated Overview

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ABSTRACT
Background: The environmental pollution is a growing world problem specifically in developed & developing countries. In these areas G.I.T disorders & diarrheal diseases have replaced by airborne environmental disorders.

Methods: Literatures was reviewed on the subject to find out the knowledge regarding Environmental threats of air pollution & its effects on the health of human body. Data and details have been located, selected, extracted and synthesized from different national & international Journals, websites, Proceedings, books, google scholar etc.

Result & Conclusion: Changes are taking place in air regularly. Different pollutants are being created from different sources. Indoor air pollution is common among underdeveloped & developing nations. To improve health situation different professional, have to play their roles. Effects of air pollution are sometimes general in nature otherwise may be immediate or delayed. Leading causes of death is cardiovascular diseases like IHD are now being declared as airborne. Emergent airborne diseases are more than 30 like COVID 19 only result in 43.6 lakhs death so far. Toxic & hazardous chemicals are present in air in the form of allergens, neurotoxin, mutagen, carcinogen etc. Air pollutants are carbon monoxide, nitrogen oxides, Benzene, Ozone, Lead, sulphates, SPM etc. Meteorological effects on health are also related with air including season, atmospheric pressure, heat, cold etc. Indoor air pollutants have also specific health effects.

KEYWORDS: Environment, Health, Air Pollution

ARTICLE DETAILS
Published On: 05 January 2022
Available on: https://ijmscr.org

INTRODUCTION
The “environment” was originated from Latin word ‘Environner’ means “to surround / to encircle”. Environment defined as external condition which surrounds, act upon and influence around or its part. Components of Environment are as follows:
- Physical
- Chemical
- Biological - plants & animal
- Social – physic - social / psychosocial / bio-social

Air is one of the most important components of physical environment which may be polluted and effect the health of a person.

AIR POLLUTION
Definition: presence of 1 / > contaminants / combination of contaminants in such a quantity and duration which may prove injurious to human, plants, animal life or property and interfere with comfort and enjoyment of life, property and conduct of business

CHANGES IN AIR
The changes in air are of two types (i) normal i.e., seasonal or (ii) abnormal
Abnormal changes are of 2 types
1. Qualitative changes
Which is either extreme condition in a particular season or reverse condition
2. Elemental changes
In which composition of air disturbed and external material added and cause air pollution, infection, affect heart and humor and may result in death.

**AIR POLLUTANTS & SOURCES**

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxides of sulfur</td>
<td>burning combustion of fossil fuel, petroleum, coal, oil, use of chemicals in smelters refineries and power plant</td>
</tr>
<tr>
<td>Oxides of Nitrogen</td>
<td>power plants, motor vehicles, and other industrial &amp; commercial sources</td>
</tr>
<tr>
<td>Lead &amp; Manganese</td>
<td>automobiles &amp; smelter</td>
</tr>
<tr>
<td>Calcium, Chlorite,</td>
<td>soil particulate &amp; industrial emission</td>
</tr>
<tr>
<td>Silicone, Cadmium</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>automobiles, fuel burning appliances - gas water heater, fire places, wood stoves, gas stoves, yard equipment</td>
</tr>
<tr>
<td>CO₂</td>
<td>lung exhale, chemical industries, combustion of fossil fuel, deforestation, volcano eruption (40%)</td>
</tr>
<tr>
<td>H₂S</td>
<td>industries, coke production, rayon production wastewater treatment plant, wood pulp production, sulfur extraction process, oil refining, tanning industry, livestock, liquid manure</td>
</tr>
<tr>
<td>O₃</td>
<td>chemical reaction in air</td>
</tr>
<tr>
<td>HC &amp; PHC</td>
<td>incineration, combustion of coal, wood, processing &amp; use of petroleum, Combustion of fuel, automobile, jet planes, power plants, manufacturing unit, industries, marine vessel, burning of wood, aerosol spray, nuclear weapon, carbonization, biomass fuel, automobiles</td>
</tr>
<tr>
<td>Organic substances</td>
<td>petrochemical solvent &amp; vapors</td>
</tr>
<tr>
<td>Particulate matters</td>
<td>aerosol, combustion particles, metal vapour, crustal material, fugitive dust, dust storm, power plants, industrial process, vehicular traffic, domestic coal burning, industrial incinerator</td>
</tr>
</tbody>
</table>

**INDOOR AIR POLLUTANTS**

<table>
<thead>
<tr>
<th>Air pollutant</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radon</td>
<td>Building material, water &amp; soil</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Insulation, furnishing, tobacco smoke</td>
</tr>
<tr>
<td>Asbestos, mineral wool &amp; synthetic</td>
<td>Acoustic, thermal, electric insulation</td>
</tr>
<tr>
<td>Fiber</td>
<td></td>
</tr>
<tr>
<td>Organic substances</td>
<td>Adhesive, solvent, cooking &amp; cosmetics</td>
</tr>
<tr>
<td>Aerosol of nicotine &amp; other organic Substances</td>
<td>Tobacco smoke</td>
</tr>
<tr>
<td>Mercury</td>
<td>Fungicide, thermometer breakage &amp; dental care</td>
</tr>
<tr>
<td>Aerosol of various compositions</td>
<td>Consumer products</td>
</tr>
<tr>
<td>Viable organism</td>
<td>Infected organism</td>
</tr>
<tr>
<td>Allergen</td>
<td>House dust &amp; animal debris</td>
</tr>
<tr>
<td>Suspended particulate matter</td>
<td>Soot, condensed vapour from automobile, combustion, burning of waste, dust, smelting process</td>
</tr>
</tbody>
</table>

**ENVIRONMENTAL FACTORS AFFECTING HUMAN HEALTH**

Effects may be in both ways i.e. positive and negative.

**Positive** environmental factors sustain health, and promoting them is preventive medicine. They include:

- Air quality;
- Ozone layer (protection from UV, cancers, etc.); &
- Space for exercise and recreation;

**Negative** environmental factors are mostly human changes that create conditions favoring disease;

- disturb and release noxious levels of previously bound chemicals (e.g., mercury released)
The key players to numerous health related program are

- Medical universities and researchers- environmental factors affecting health, and exploring the space for better environmental monitoring efforts;
- Federal and provincial/territorial health agencies - exploring downstream health expenditure;
- World Health Organization - environmental factors are perceived and dealt with through public policy;
- Medical and hospital associations;
- Nutritionists;
- Emergency preparedness and response organizations
- NGOs; and
- Medical, environmental, and general media.

AIR & HEALTH
EFFECTS OF AIR POLLUTION ON HEALTH
General effects of air pollution on human health are as follows:

- Air pollution is top concern among environmentalist & conservationist
- More than 100 of laws have been framed or aimed.
- Unani (Greek) physician also invented numerous detoxifications and cleaning solution.
- Doctors, researchers uncovered several diseases caused by air pollution (like Asthma, COPD, Emphysema, Heart attacks, Lung CA, Bronchitis,
- Chronic Obstructive Pulmonary Disease (COPD) is the third leading cause of death worldwide, causing 3.23 million deaths in 2019.
- Over 80% of these deaths occurred in low- and middle-income countries (LMIC).
- Crude estimates suggest there are 30 million COPD patients in India. India contributes a significant and growing percentage of COPD mortality which is estimated to be amongst the highest in the world; i.e. more than 64.7 estimated age standardized death rate per 100,000 amongst both sexes.

IMMEDIATE effects are on respiratory system and even death by suffocation
DELAYED effects are Chronic bronchitis, Lung CA, Bronchial Asthma, Emphysema, Respiratory allergies
Social & Economic aspect of air pollution are like it destroy plants and animal life, corrosion of metal, damage building, cost of cleaning and maintenance and decrease visibility.

HEALTH HAZARDS OF AIR
The effects of polluted air are

- Infectious organism
- Morbidity & quality of life
- Emergent diseases and environmental changes
- Emergent ecological diseases
- Antibiotic / Pesticide resistant
- Toxic chemical
- Endocrine hormone disruptor
- Diet

Leading causes of death globally
At a global level, 7 of the 10 leading causes of deaths in 2019 were noncommunicable diseases. These seven causes accounted for 44% of all deaths or 80% of the top 10.
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However, all noncommunicable diseases together accounted for 74% of deaths globally in 2019.

<table>
<thead>
<tr>
<th>Disease or Group</th>
<th>Million/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Ischemic Heart Disease</td>
<td>8.4</td>
</tr>
<tr>
<td>ii. Stroke</td>
<td>6.1</td>
</tr>
<tr>
<td>iii. Chronic Obstructive Pulmonary Diseases</td>
<td>2.6</td>
</tr>
<tr>
<td>iv. Lower Respiratory Infections</td>
<td>2.4</td>
</tr>
<tr>
<td>v. Neonatal diseases</td>
<td>2.0</td>
</tr>
<tr>
<td>vi. Trachea, Bronchial &amp; lung Cancers</td>
<td>1.8</td>
</tr>
<tr>
<td>vii. Alzheimer’s disease &amp; other dementia</td>
<td>1.7</td>
</tr>
<tr>
<td>viii. Diarrheal diseases</td>
<td>1.6</td>
</tr>
<tr>
<td>ix. Diabetes mellitus</td>
<td>1.8</td>
</tr>
<tr>
<td>x. Kidney disease</td>
<td>1.3</td>
</tr>
</tbody>
</table>

The world’s biggest killer is ischaemic heart disease, responsible for 16% of the world’s total deaths and now considered as air borne by WHO.

AIR BORNE EMERGENT DISEASES
Definition: - Disease that is never known before / absent since last 20 years
- Air pollution result in approximately 30 infectious diseases
- Largest loss of life in 1981 - Influenza epidemic - war refugees and soldiers spread the virus
- 30 - 40 million suffered in a year
- 43.6 lakhs lost life in 2020 & 2021 by COVID-19
- 4.3 lakh in India

TOXIC / HAZARDOUS CHEMICAL
- Hazardous effects are - flammable, explosive, irritant, sensitizer
- Acid & Caustics - when diluted becomes harmless
- Toxic chemicals - kill cell and harmful even after dilution

Allergens
activated immune system, sometime act as antigen/allergens e.g., formaldehyde used in wood product, insulation, glue and fabrics

Sick building syndrome (indoor more severe)
Clinical features are
- headache, allergies & chronic fatigue
Indoor air contaminated by molds, CO, NO, formaldehyde which are released by carpet, insulation, plastic, building material
Poor indoor air quality cost 60 billion dollar for absenteeism, reduced productivity

Neurotoxin
Attack nerve cells
- Heavy metals like lead, mercury kill nerve cells and cause permanent neurological damage
- Anesthetics, chlorinated hydrocarbon (DDT, Dieldrin) - disrupt nerve cell membrane for nerve action

- Organophosphates (malathion), carbonates - inhibit acetylcholine - signal effected between nerve cells and tissue / organ
- a total of 850 compounds act as neurotoxin

Mutagens
- Chemicals and radiation damage DNA which mostly led birth defects

Carcinogen
- causes cancer
- Rate increased in industrialized countries
- Worldwide, ambient PM2.5 air pollution was estimated to have contributed to 265,267 lung cancer deaths (95% uncertainty interval [UI], 182,903-350.835 lung cancer deaths) in 2017, or 14.1% (95% UI, 9.8%-18.7%) of all lung cancer deaths.
- Environmental pollution is now a global phenomenon, and its impact is evident in several regions globally. Now, after more than quarter of a century, the environmental pollution will show its impact in the rising number of cancer cases in the country. In India, 1.6 million new cancer cases are detected each year.
- Lung cancer is the most commonly diagnosed cancer worldwide and is the leading cause of cancer death, with an estimated 2.1 million new cases and 1.8 million deaths occurring in 2018, representing 11.6% of all new cancer diagnoses and 18.4% of all cancer deaths. Rates of lung cancer incidence and mortality vary substantially within and between countries, depending largely on historical patterns of cigarette smoking, with long latency periods of up to approximately 30 years between the start of the smoking epidemic and the rise of lung cancer incidence. The highest incidence rates for lung cancer among men are currently observed in Micronesia/Palynesia, Eastern Asia, and Eastern Europe and, among women, in North America, Northern and Western Europe, and Australia/New Zealand. In several European countries, lung cancer incidence rates are beginning to converge in men and women as increasing rates in women are approaching declining rates in men.
- Other causes of cancer are - life style, - smoking, sunbathing, drinking alcohol
- Prostate CA in females
- Lung CA in females

AIR POLLUTANTS & HEALTH

Carbon monoxide
- Lethal at high dose
- In low dose (low concentration) causes Neurobehavioral dysfunction, exercise elated heart pain, headache, breathlessness
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- If combine with Hb - result in decrease O2 flow to brain - cause dizziness, headache & heart stress

Oxides of Nitrogen
- causes asthma, susceptibility to infections, damage lung, eye, skin irritation

Benzene – act as carcinogen

Ozone – causes eye & air passage irritation, increased susceptibility to infection, damage lung, cough, skin irritation, chest pain, fatigue

Lead - dangerous to children - effects brain & CNS – neuropsychological system, loss of IQ, poor school performance, behavioral difficulties, mental & physical impairment - decreased intelligence

 Sulphates, SO2 - damage lung & eye
 Fine particulate material – causes lung ailment

METEOROLOGICAL EFFECTS

SEASON & HEALTH
- During Spring - humor liquefy - activate chronic disorders
  - Diseases activated due to overeating and inadequate exercise in winter
  - General diseases are epistaxis, malaria, hemoptysis, paralysis, arthritis, melancholia
- During Summer - duration of diseases decreased, resolve matter particularly disease matter, weakening, early death in case of fatal diseases
  - if rain - duration of diseases increased, heat shock fever, conjunctivitis, erysipelas,
  - In biliary peoples, dry skin, measles, chicken pox, ascites, dysentery
- During Autumn – causes scabies, taenia, malignant ulcer, rheumatoid arthritis, incontinence, sciatica, tonsillitis, worms, chicken pox
- During Winter - phlegmatic diseases, common cold, coryza, pleurisy, pneumonia, pain, phlegmatic vomiting

ATMOSPHERIC PRESSURE & HEALTH
- Decrease at high altitude
  - Causes acute mountain sickness, pulmonary edema
  - Result in Cough, Cheyenne - stroke breathing, oliguria, mental confusion, hallucination, stupor, seizure, and coma
- Increase at low altitude
  - Increase Nitrogen oxides – causes loss of mental function, consciousness
  - Increase O2 – result in convulsion & death
  - Causes Caisson’s disease

HEAT & HEALTH
- Heat
- Causes heat stroke, hyperpyrexia, exhaustion, cramp & syncope
- Result in GLOBAL WARMING
  - Cold
- Causes Frost bite & immersion / trench foot

INDOOR AIR POLLUTION & HEALTH
- Result in acute respiratory tract infection in children
  (WHO)
  - Causes Pneumonia – Chief killing disease in developing countries – 4.5 million death / year – exceed diarrhea (in SEA – 1.4 million)
  - In Nepal, Zimbabwe, Gambia, Buines Aires, South Korea, New Delhi – Adverse pregnancy outcome – Low Birth Weight, Neonatal death, still birth cause is Carbon monoxide – from Biomass fuel
  - In Guatemala & India – found COPD & Car Pulmonale – cause is smoking a major risk factor
  - In Nepal & India – cooking on Biomass stove – causes Cor pulmonale
  - Smoking in females is common in India & Nepal
  - Cancer – Naso–pharyngeal CA with biomass smoke in Kenya
  - In Japan Lung CA is common
  - Lung CA associated with coal on open stove is common in China
  - Tuberculosis – 90000 cases /year– India – female is using bio fuel
  - Result in Blindness – Contact risk – 80 % were using bio-fuel
  - WHO – 2.7 – 3 million - premature death – out of 3 million, 2.8 million death from indoor pollution.
  - EFFECT is Illness as well as death – from respiratory causes & decrease lung function
  - SPECIFIC – If acid aerosol (sulphate and nitrate in presence of high level of SO2)

INDOOR POLLUTANTS & THEIR DISEASES

Asbestos - Lung cancer
Radon - Lung cancer
Particulate matter - Lung CA
Formaldehyde - Cough, eye irritation, fatigue, running nose, sore throat sinus irritation, skin rashes, vomiting & headache
Phenol/ solvents / herbicides - Liver & kidney diseases, respiratory problems, Microbes - Infections & allergies

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