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Airborne particulate matter & health hazards

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Abstract :Airborne suspended particulate matter (SPM) is a serious worldwide concern since it is linked with adverse health effects. Air pollution is on account of modern civilization linked with increasing number of vehicular traffic on the road, industries and aircraft in air. The exponential growth in the human population is also an indirect cause of air pollution. Particulate matter (PM) is also associated with automatic function of the heart, including increased heart-rate, decreased heart-rate variability and increase in cardiac arrhythmias. SPM is also associated with acute & chronic respiratory disorders, lung cancer, morbidity and mortality.

Key words: Air pollution, PM, human health.

INTRODUCTION

The present generation and the coming generations have to solve three grave problem, namely population, poverty and pollution, if they have to survive. Pollution being the most dangerous problem likes cancer in which death is sure but slow. Environmental pollution is assuming dangerous proportion all through the globe and India is not free from this poisonous disease. This is the gift of modern living, industrialization and urbanization. Unless, timely action is taken we have a forbid & bleak future for the world.

Air pollution can be defined as an imbalance in the quality of air so as to create health hazard on living beings either immediately or after some times.

Air pollution is unfavourable alteration of air composition due to industrialization. It is the deviation in any form in the composition of air due to population explosion, industrialization and urbanization so as to cause injurious effect on human health.

The primary sources which cause 9% of global air pollution are coal and oil combustion, refineries blast furnaces, fumigation explosives, fertilizer plants, transportation, solid waste disposal etc. Air pollution maybe gases mixed in the air or liquid or solid particle dispersed in air.

In India mobile or vehicular pollution is predominant and significantly contributes to air quality problems. Road traffic produce volatile organic compounds, suspended particulate matter (SPM), which makes adverse health effects on the exposed population. The particle emitted from the vehicular exhaust of more than 10 micron size (PM_{10}) gets accumulated in the lung and produces respiratory abnormalities.

Air borne particulate matter (PM_{10}) is the recent focus of the world community as it penetrates the respiratory system of human being and causes many disorders. In the case of PM it is believed that aerodynamic size, number and quantity of PM, in the atmosphere play a vital role in impacting human health.

Several time series and studies have shown that children, elderly and asthmatic people are at higher risk due to air pollution. This article is an overview of air

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particulates and their impact on human health effects.

Particulate matter: Suspended particulate matter (SPM) refers to the mixture of solid or liquid particles in air. In a broader sense the term applies to matter in the atmosphere classed into particles having a lower size limit of the order of $10^{-3}\mu\text{m}$ and upper limit of $100\mu\text{m}$. SPM is a complex mixture of organic and inorganic substances, is a ubiquitous air pollutant. It is arising from both natural and anthropogenic sources. PM that is $10\mu\text{m}$ or less in diameter is called as respirable suspended particulate matter (RSPM) or PM_{10} . It penetrates the respiratory system.

RSPM is generally grouped in to three modes:

- Ultra fine (size range less than $0.1\mu\text{m}$)
- Fine ($0.7 - 10\mu\text{m}$)
- And coarse ($10 - 100\mu\text{m}$)¹⁻³

Source of particulate matter:

The ultrafine particles of size range less than $0.1\mu\text{m}$ are formed by nucleation, that is condensation of low vapour pressure substances formed by high temperature vaporization or by chemical reactions in the atmosphere to form new particles. They are mainly of anthropogenic origin such as from automobile exhaust, wood smoke and emission from diesel engines and generators.⁴⁻⁶ Fine particles of size range $0.7 - 10\mu\text{m}$ are formed by accumulation or coagulation of ultra fine particles. In close vicinity of the road, contribution of traffic to fine particle concentration.

Biomass burning is another important source of fine organic aerosols. Coarse particles ranging from $10 - 100\mu\text{m}$ are predominantly rock or soil material of natural origin emitted in to atmosphere by mechanical grinding or spraying. These particles can include wind blown dust from agricultural processes, uncovered soil, unpaved road or mining operations. Traffic produces road dust and air turbulence that can re-entrain road dust.

Deposition of PM in respiratory system:

On achieving entry in to the respiratory system, particles of size range $4.6 - 9\mu\text{m}$ normally deposit in the region of tracheopharynx; $1.1 - 4.6\mu\text{m}$ in the bronchi and $0 - 1.1\mu\text{m}$ in the alveoli. Penetration of these particles in to the lung airways is determined primarily by convective flow i.e. motion of the air in which particles are suspended deposit within the respiratory tract by five mechanisms: Inertial impact, sedimentation, diffusion,

electrostatic precipitation, and interception.

Particles $<0.5\mu\text{m}$ are deposited in small airways. For particles $0.5 - 2\mu\text{m}$ deposition occurs in small to mid sized airways by sedimentation. For particles $>2\mu\text{m}$ inertia causes the particle motion to deviate from the flow stream lines resulting deposition by impaction in mid to large sized airways. Interception is deposition by physical contact with airway surfaces.

Particles deposited in the bronchi and bronchioles (ciliated airways) are captured on the layer of mucus lining and are carried out of the lungs on the mucociliary ladder for expulsion through coughing or they are swallowed.

Human health effect of air pollution:

Health impacts of air pollution are normally assessed by dose response studies in a given area, which link the concentration of air pollutants to the observed health effects. The adverse effects of air pollution on human health has remained the prime consideration in air pollution studies and research for obvious reasons. Although initially the specific pollutants generating the observed adverse health effects, certain pollutants as the significant contributors to those adverse effects and disease caused in human.

Airborne suspended particulate matter (SPM) is a serious worldwide concern since it is linked with adverse health effects. Several epidemiological studies have been made across the world revealing the association of SPM in air with acute and chronic respiratory disorders, lung cancer, morbidity and mortality. PM is also associated with autonomic function of the heart, including increased heart rate, decreased heart rate variability and increased cardiac arrhythmias. Such health disorders are widely seen in urban areas worldwide that suffer from serious air quality problem due to increasing population, combined with change in land use and vehicular traffic.

Effect of air pollutants on health are related to respiratory disease, that is bronchitis, lung cancer, asthma, high blood pressure, allergies.

Acute infections involving upper respiratory tract damages causing major morbidity from respiratory illness such as influenza, bronchitis (acute & chronic) pneumonia, all types of asthma. Sinusitis and other respiratory disorders.

CONCLUSION

Airborne PM is reportedly known to cause wide

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ranging health effects. PM (liquid or solid particles) dispersed in air is generally classified as ultrafine, fine & coarse. Apart from the natural sources such as forest fire, volcanic eruptions and wind blown anthropogenic emissions from industries, vehicles, incomplete combustion of fossil fuel, PM are linked with deleterious health problems including asthma, bronchitis, chronic obstructive pulmonary disease, pneumonia, upper respiratory tract & lower respiratory tract disorder.

Fine PM is a risk factor for premature mortality, cardiopulmonary and cancer mortality.

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