Editorial:
Air pollution and children

Vijay Kamale

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Pediatric Environmental Health is discipline that involves the identification, treatment, prevention and control of environmental exposures and associated adverse health effects in infants, children, adolescents, and young adults.

Problem Statement:

Globally in 2016, one in every eight deaths was attributable to the joint effects of ambient and household air pollution – a total of 7 million deaths. About 543000 deaths in children under 5 years and 52000 deaths in children aged 5–15 years were attributed to the joint effects of ambient and household air pollution in 2016. Together, household air pollution from cooking and ambient air pollution cause more than 50% of acute lower respiratory tract infection (ALRI) in children under 5 years in LMICs. Of the total number of deaths attributable to the joint effects of household and ambient air pollution worldwide in 2016, 9% were in children.

Air Pollution:

Air Pollution is the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

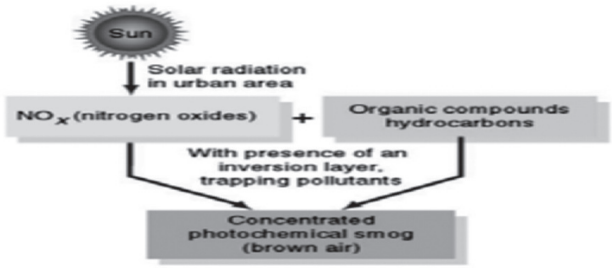
- *Primary pollutants are those which are emitted directly into the* air from pollution sources.
- *Secondary pollutants are formed when primary pollutants* undergo chemical changes in the atmosphere.

Ozone is an example of a secondary pollutant. It is formed when nitrogen oxides (NOx) and volatile organic compounds (VOCs) are mixed and warmed by sunlight. Ozone (O3) is a major component of what is often referred to as smog.

The ozone which is present in the troposphere, or the atmosphere that is close to the ground, should not be confused with beneficial ozone that is located in the stratosphere or upper atmosphere.

This beneficial ozone in the stratosphere helps protect the earth from harmful ultraviolet light from the sun.

Primary *pollutants are namely* Carbon monoxide, Sulphur dioxide, Hydrocarbon species, Dust & Soot (SPM) whereas Secondary *pollutants are* Nitrogen dioxide, Photochemical ozone, Aerosols important among them are **Polynuclear aromatic hydrocarbons (PAH)** which are organic compounds with two or more benzene rings and are



formed by incomplete combustion of organic materials.

Smog=Smoke+Fog

How Particulate Matter In Air Is Calculated By Government Bodies:

Particulate matter is the sum of all solid and liquid particles suspended in air many of which are hazardous. This complex mixture includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets. Particles with size 0f10 microns can have effect on nose and trachea,

2.5 microns on alveoli and 100 nanometers pass through capillaries. As far as density of particulate matter, 100 μg/m^3 is considered maximum safe limit of particulate matter in air.

An air quality index (AQI) is a number used by GOVERNMENT BODIES to communicate to the public how polluted the air currently is or how polluted it is forecast to become. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects. Different countries have their own air quality indices, corresponding to different national air quality standards.

Indices In India:

The National Air Quality in India was launched by The *Minister for Environment, Forests & Climate Change Shri Prakash Javadekar on 17th September 2014* under the SWACHH BHARAT ABHIYAN. The index constitutes part of the Government's mission to introduce the culture of cleanliness. Institutional and infrastructural measures are being undertaken in order to ensure that the mandate of cleanliness is fulfilled across the country

WHO Guideline Values:

The World Health Organization has air quality guidelines for air pollutants which are regarded as most harmful to health. These include ozone, oxides of nitrogen, sulfur dioxide, and carbon monoxide, as well as fine particulate matter. *Fine particulate matter (PM 2.5) is the key indicator used in making health estimates of air pollution impacts and is most commonly measured or monitored.*

The values in the WHO guidelines for PM 2.5 and PM 10 are as follows:

- Fine Particulate Matter ($PM_{2.5}$) -

  10 μg/m^3 annual mean

  25 μg/m^3 24-hour mean
- Coarse Particulate Matter (PM_{10}) -

  20 μg/m^3 annual mean

  50 μg/m^3 24-hour mean

Air quality expressed in terms of low, moderate, high and critical for various cities/towns monitored

Observed annual mean concentration of a criterion pollutant-

- Excedence Factor = Annual standard for the respective pollutant and area class
- Critical pollution (C): EF >1.5
- High pollution (H): EF :1.0 - 1.5
- Moderate pollution (M): EF: 0.5 - 1.0
- Low pollution (L): EF < 0.5

Wet deposition of air pollution has also been evaluated by analysing rain water samples at all monitoring stations.

Exposure-Disease Model:

There are variations in Susceptibility with Developmental Stages.Neonate and early infancy is a vulnerable time.Various reasons are cited like lack of full development of the blood brain barrier,neurons still proliferating, myelinating, pruning,Immature immune system,Increased skin surface area and absorbs agents more readily,increased respiratory rate,dependence on breast milk as sole source of nutrition,unable to move independently,toddlers and Young Children.The risk factors being nearer the ground, oral exploratory behavior,growth and development of lungs, dietary deficiencies and small intestine avidly absorbs lead.

Why are Children more Susceptible?

Children are especially vulnerable during fetal development and in their earliest years, while their lungs, organs and brains are still maturing. They breathe faster than adults, taking in more air and, with it, more pollutants. Children live closer to the ground, where some pollutants reach peak concentrations. They may spend much time outside, playing and engaging in physical activity in potentially polluted air. Newborn and infant children, meanwhile, spend most of their time indoors, where

they are more susceptible to household air pollution, as they are near their mothers while the latter cook with polluting fuels and devices. Children have a longer life expectancy than adults, so latent disease mechanisms have more time to emerge and affect their health. Their bodies, and especially their lungs, are rapidly developing and therefore more vulnerable to inflammation and other damage caused by pollutants.In the womb, they are vulnerable to their mothers' exposure to pollutants. Exposure before conception can also impose latent risks on the fetus.Even after birth, they often remain powerless to change their environment. Children's lungs may be more susceptible to pollutant-induced injury.Oxidant-induced injury may induce inflammation/repair mechanisms that could potentially result in permanent alterations in lung structure.Pollutant exposures may result in decreased lung growth

Acute Respiratory Effects on children are increased respiratory symptoms,**i**ncreased lower respiratory illness **,**asthma exacerbations **,**reversible lung function decrements**,** airway inflammation,altered host defense **and e**nhanced allergic responses

Chronic Respiratory Effects include decreased lung growth, altered lung structural development (e.g., airway remodeling, "bronchiolarization" of alveolar ducts), increased lifetime risk for asthma, chronic obstructive disease, and lung cancer

Adverse birth outcomes: Exposure to ambient PM is associated with low birth weight. Maternal exposure, especially to fine PM, increases the risk of preterm birth. Associations between exposure to air pollution and other outcomes, such as stillbirth and infants born small for gestational age. Childhood cancers like retinoblastomas and leukaemia can occur in children .

Cognitive development-Inhaled ultrafine particles, such as PM 2.5, are so small that they can enter the bloodstream and cause the degeneration of blood-brain barriers, leading to oxidative stress, neuroinflammation and damage of neural tissue. As these blood-brain barriers are still developing in children, studies show that their tissue could be less resistant and more vulnerable.Studies have shown that because these particles enter the blood-stream,they can also cross the placental barrier and affect the development of the foetus, including both physical and cognitive development.Several studies have shown that pregnant women's exposure to polycyclic aromatic hydrocarbons (PAHs) (a pollutant associated with fossil fuel combustion) affects the white matter of the unborn child's brain significantly.In consequence, studies have shown that PAHs can cause future developmental delays, lower verbal IQ, and increased signs of anxiety, depression, and problems with attention.

Lead in air pollution has long been known to have serious harmful effects on the development of the brain and nervous system.Lead is especially harmful to young children (They absorb about 4–5 times more lead compared with adults from a given source). Lead is distributed into the brain, liver, kidney and bones, where it accumulates over time. It can even transfer from the bones to blood, and affect the foetus during pregnancy – causing intergenerational effects.Lead has shown to reduce intelligence quotient, as well as cause behavioural issues such as reduced attention span, increased antisocial behaviour and reduced educational attainment.Cognitive impairment, high levels of exposure can cause coma, convulsions and even death.It has also been shown to cause anemia, hypertension, renal impairment, immunotoxicity and toxicity to the reproductive organs.

As A Health Care Professional Be informed:

All health professionals should consider air pollution a major risk factor for their patients and understand the sources of environmental exposure in the communities they serve. We should recognize exposure and related health conditions -Health professionals have an important role in identifying causative risk factors in order to prevent disease.A

health care provider can identify air pollution-related risk factors by asking pertinent questions about the child's or pregnant mother's environment.

Newer Initiatives:

WHO is developing tools such as AirQ+ for assessing the health impacts from various pollutants

- The Health Economic Assessment Tool (HEAT) to assess walking and cycling interventions,
- The Green+ tool to raise importance of green space and health, the Sustainable Transport Health Assessment Tool (STHAT)
- The Integrated Transport and Health Impact Modelling Tool (ITHIM).

Clean Household Energy Solutions Toolkit (CHEST)

The WHO is developing a Clean Household Energy Solutions Toolkit (CHEST) to promote clean and safe interventions in the home.

CHEST provides the tools for countries and programs to create or evaluate policies that expand clean household energy access and use.

CHEST facilitates the design of policies that promote the adoption of clean household energy at a local, programmatic, or national level.

Research, publish and disseminate knowledge:

Health professionals can conduct research on the effects of air pollution on children's health and publish the results of studies of the causes, mechanisms and effects of environmental exposure of children, as well as on potential treatment, prevention and management. They can use this evidence to inform social and behaviour change communication strategies. Health professionals can "prescribe" solutions to air pollution-related problems, such as switching to clean household fuels and devices. In contexts in which there are significant barriers to adopting clean household energy, health care professionals can recommend "transitional" solutions that offer some incremental health benefit, and they can provide resources and information on relevant government and non-profit programmes to help reduce exposure. Health care provider Educate colleagues and students by training others in the health and education fields, health professionals can increase the reach of their messages on the health risks of air pollution and strategies to reduce exposure. We need to advocate solutions to other sectors, policy- and decision-makers. Health professionals are well positioned to share their knowledge with decision-makers, including members of local governments and schools boards, and with other community leaders.

Health professionals can accurately convey the health burden of air pollution to decision-makers, conduct health-based assessments, support improved standards and policies to reduce harmful exposure, advocate for monitoring and emphasize the need to protect children at risk.

First WHO Global Conference on Air Pollution and Health, 30 October – 1 November 2018

- "Improving air quality, combating climate change – saving lives"
- The conference was organized in collaboration with UN Environment, the World Meteorological Organization (WMO), the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC), the UN Economic Commission for Europe (UNECE), the World Bank and the Secretariat of the UN Framework Convention on Climate Change (UNFCCC).
- Participants at the conference recognized the need for a world free of air pollution and an aspirational goal of reducing the number of deaths from air pollution by two thirds by 2030 was highlighted.