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EDITORIAL

Air pollution climate change on lung health

Our lungs and eyes along with skin and gastrointestinal systems have direct contact with environmental pollution. Lungs bear the brunt either directly or indirectly through skin–lung and gut–lung axis. According to a report on burden of diseases compiled by National Commission of Macroeconomics and Health of the Government of India, 2005, chronic respiratory diseases affects 65 million people. A 2015 study across the country showed that 50.5% of diseases are due to respiratory symptoms in all age groups (Sundeep Salvi, *Res. Resp. Med.*, 2015, **V**(4)).

Allergic lung diseases represent the earliest onset of non-communicable environmental diseases with significant psycho-socio-economic healthcare burden. The welfare losses from pollution are US$ 4.6 trillion per year amounting 6.2% of the global economic output. The Lancet Commission on Pollution and Health (2017), emphasizes that adaptation to air pollution and climate change is essential for preventing lung diseases. The recent COVID-19 pandemic has shown higher morbidity and mortality in the polluted environment.

According to the National Health Profile of India Report, 2018, between 1990 and 2016 respiratory communicable diseases decreased and non-communicable diseases increased. The consensus statement from experts reveals that recurrent respiratory infections in India are 27–59% in children under five years of age (Paramesh *et al*., *Asian J. Pediatric Pract.*, 2017, **1**(3), 19–27). Air pollution and climate change are the major contributing factors. According to the report of UNICEF, India reduced mortality from acute lung infection (pneumonia) by 47% between 2000 and 2015.

Among the non-communicable lung diseases allergic rhinitis, asthma, chronic cough and comorbidities are the major healthcare burden arising from air pollution and climate change. The allergic rhinitis and sinusitis increased from 22.5% to 40% between 1994 and 2018, and its comorbidities – middle ear infection and sinusitis went up from 9% to 22.5% and 1% to 34.8% respectively. Asthma in children increased from 9% to 28% between 1979 to 2016, and chronic cough from 8% to 21.25% between 1999 and 2017. Sleep disorder breathing (snoring) is 8% in general but in children with chronic cough it is 27%, allergic conjunctivitis 27.5%, laryngeal dyskinesia 3.2% and bruxism (grinding of teeth) 17% (Paramesh *et al*., ADEX Next Cough Module, IAP allergy, Immunology Chapter, 2017).

Recent expert observations on air pollution, induced rhinitis and nasal health in India emphasize the impact of particulate matter-10 (PM-10) and water-soluble gases on nasal health in India causing significant morbidity and a decrease in the quality of life (Paramesh *et al*., *J. IMA*, 2021). Studies show chronic obstructive pulmonary disease affects nearly 65 million people. In New Mexico there was overall prevalence of 309/100,000/year of interstitial lung disease, 39% of lung cancer from air pollution and climate change (Marsha Antoine *et al*., Stat Pearls, updated August 2021).

The main sources and components of outdoor air pollution are emissions from traffic, industry, residential heating and solid-waste disposal, while indoor air pollution is from cooking, heating, cleaning, furniture and decoration. The components of pollutants are suspended particulate matter (SPM 10, 2.5), nitrous oxide, volatile organic compounds, carbon monoxide, sulphur dioxide, ozone (O_3), p-t-butyl styrene and radon. Among them the secondary pollutants are SPM, O_3 and diesel emission particles. Each one of the air pollutants individually or in combination affects lung health (Naclerio *et al*., *WAO J*., 2020). The impact of these pollutants on lung health depends on the size of the particles and water solubility of the gases. The particulate size 10 μm and above and water-soluble gases like aldehydes, ammonia, chlorine, sulphur dioxide affect the upper respiratory tract. Particles of the size 2–10 μm and medium water-soluble ozone impact the lower respiratory tract. The SPM 0.5 to 2 μm and low water soluble nitrogen dioxide and phosgene affect the lung parenchyma, where gas exchange occurs. Molecules below 2.5 μm can traverse the interstitium of the lung, enter the blood stream and produce platelet aggregation and small clots which interferes with the placenta (foetal thrombotic vasculopathy), leading to poor nutrition for the growing foetus, and causes still-births, prematurity and small for babies, depending upon the degree of exposure. The premature babies are born with narrow airways (fixed airway obstruction) causing more wheezing, bronchiolitis and persistent asthma after birth. Supportive epidemiological evidence for outdoor pollution comes from the fact that children studying in schools in heavy-traffic urban

environment suffer more than those in schools in the rural areas.

During the last 15 years asthma has increased in summer from 2% to 28.5%. It has been hypothesized due to O_3 production (Paramesh, *Int. J. Environ. Health*, 2008, **X**(XXXX)). It has also been observed that twice the number of traffic police suffer from asthma more than regular police. Asthma visit to the emergency room increases by 100% during Diwali festival due to burning of crackers. It is reported that exposure of pregnant mother to SPM from 35.5 to 53.4 μm resulted in four-fold increase of wheezing among children (Weislow and Chowski, *Int. J. Environ. Health*, 2021). L. Dandona (*Lancet*, 2020) observed that mortality from outdoor pollution increased by 115.3%, while indoor pollution decreased by 64.2%.

The indoor air pollution using non-commercial cooking fuel in ill-ventilated huts changed the sex ratio of asthma (female children affected more). Asthma in ill-ventilated houses was 42.7% in comparison to 8% in well-ventilated houses. Use of cow-dung cakes for cooking was associated with highest incidence of asthma (48.8%), in comparison to electricity (1.2%). Asthma incidence was 22.8% in homes with a single parent smoking. In the homes of non-smokers, it came down to 8%. There was a 10.5-fold increase in the incidence of pneumonia in people living in single rooms where biofuel was used for cooking (Paramesh, *Int. J. Pediatric*, 2018).

Hales *et al*. (WHO report, 2014) performed a quantitative risk assessment of the effects of climate change on selected causes of death, observed that climate change accounted for 23% deaths in 2014, but there would be an increase in deaths at the rate of 0.25 million per annum till 2030, increases the risk of air pollution, and worsens the lung diseases by increasing PM and O_3 production at troposphere. Global warming intensifies drought, which leads to forest fires, and enhanced dust and smoke, which can travel thousands of miles by wind, posing risk for those with lung diseases in the extremes of age group. Thawing of permafrost releases greenhouse gases, particles and entrapped new viruses, which contribute to new pandemics. It is extremely important to know that anthropogenic activities produce three times more greenhouse gases (carbon dioxide 9.5 billion tonnes) than what the Earth can manage, causing an emergency for survival of life, as pointed out by Houghton (*Annu. Rev. Earth Planet. Sci.*, 2007).

The climate change due to global warming increases respiratory allergic diseases by prolonging flowering season and growth of new weeds. Heat stress produces higher potency pollens when coated with diesel particle they are 50 times more potent. With increase in temperature, there will be an increase in vaporization of water causing more precipitation and thunderstorms leading to rupture of pollen grains from osmotic shock releasing cytoplasm content into atmosphere. For example, Didymella fungal spores are released during thunderstorms and increase the allergic lung diseases. O_3 in the troposphere is highly irritant to respiratory tract and increases asthma by 43% and has a cumulative effect. Increased humidity and temperature, enhance dust mite allergy. Decreased humidity and increased temperature increase pollen allergy. Decreased humidity and temperature increase fungal allergy. Wind velocity and air quality index and seasons have an impact on lung health. In winter, the air quality index shows high pollution arising from low wind velocity. In summer with high wind velocity and increased ozone production, pollution will be high. During monsoon, large precipitation, high wind velocity and change in wind direction reduce the pollution level. In the post-monsoon season, with decrease in wind velocity and burning of crop residue, there will be moderate to higher air quality index.

The 6th Intergovernmental Panel on Climate Change report of 2021 has stressed that air pollution, global warming and climate change have great impact on our environment, impacting our health and survival. The WHO–NGO Committee on Climate Change representing 46 million health professionals globally raised concerns on health issues and solutions based on the following principles: (1) align climate and health goals for recovery; (2) support fossil fuel free recovery; (3) be prepared for pandemics in future; (4) include health in all polices of each country. The action taken was presented at the COP 26, 2021 Conference, held in November 2021 at Glasgow, UK (WHO-NGO climate change report on Global Health 2021).

India has committed to enhance renewable energy from 40% to 50% and reduce emission by 30–35% by 2030 targeting zero CO_2 emission by 2070. It is targeting zero CO_2 emission by 2070 (Prime Minister's message, https://www.mea.gov.in).

While measures are being taken internationally and nationally, we should individually take major steps to reduce the carbon footprint to 2 tonnes per person per year and CO_2 level at 250 ppm by the end of the century to maintain the global temperature rise at 1.5°C. This should go along with the control of population, adoption of car-free living, using of electric vehicles, avoiding unnecessary air travel and using renewable energy. Use of public transport, walking, bicycles, building houses with cross-ventilation and enough sunlight, adopting vegan diet, use of LED bulbs, improving cooking equipment and using gobar gas energy for cooking can reduce the carbon footprint by 0.64–2 tonnes per year per person and improve human health.

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