Air pollution and Health

Introduction – what is air pollution?

Air pollution refers to a complex, heterogeneous mixture of gases, liquids, and particulate matter, derived from natural or man-made causes, which has significant toxicological effects on human health and the environment. Examples of pollutants primarily include particles (such as dust, pollen, soot, smoke, etc.), sulphur dioxide, nitrogen dioxide, ground-level ozone, carbon monoxide, and volatile organic compounds such as Benzene.

Sources of exposure and extent of the problem in India

Exposure to these pollutants can be both ambient (outdoor) or household. Ambient air pollution can be caused by natural (windblown dust, forest fires, etc.) or anthropogenic (combustion of fossil fuels in industries, vehicles, etc. or dust from construction activities) sources. Household air pollution occurs primarily due to combustion of solid fuels such as coal, wood, dung or charcoal for cooking or heating, due to active/passive smoking, chemicals use, or the presence of mould. Over 700 million individuals in India use solid fuels for cooking or heating, with most living in rural areas. Figure 1 shows the regional distribution of kitchen $PM_{2.5}$ concentrations across India. Furthermore, WHO data suggests that 10 of the top 20 cities with the highest annual average $PM_{2.5}$ levels, were in India. Figure 2 represents regional variations in ambient $PM_{2.5}$ levels across India.

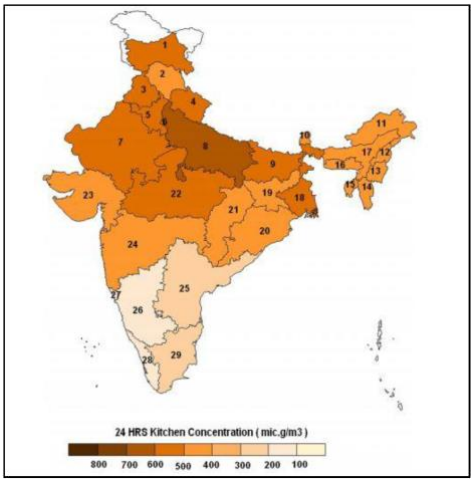

Figure 1: 24hr average kitchen $PM_{2.5}$ levels in India

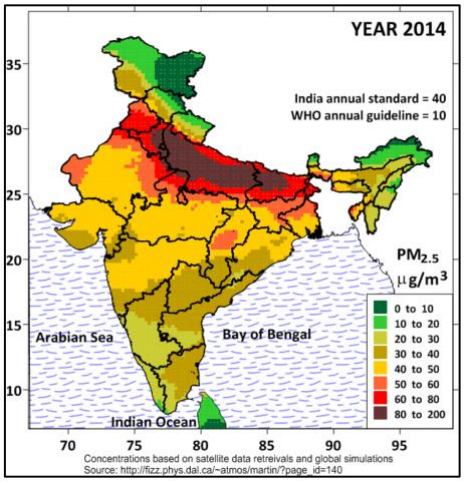

Figure 2: Regional variations in $PM_{2.5}$ across India

Impact on health and associated disease burden

Various health impact assessment studies have linked air pollution with lower respiratory tract disorders, chronic obstructive pulmonary disease (COPD), ischaemic heart disease (IHD), stroke and lung cancers. Further, long-term exposure to particulate matter, has also been associated with diabetes, neurodevelopment and cognitive disorders, adverse birth outcomes, amongst other conditions. Detrimental effects are exaggerated in vulnerable population groups, including children, elderly, pregnant women, and those with pre-existing medical conditions.

The scale of exposure to air pollutants in India raises significant concerns on the impact of air pollution as a risk factor. As per the Global Burden of Disease 2016 data, exposure to air pollution (household or ambient) in India is associated with more than 1.9 million deaths, and 54 million disability adjusted life-years (DALYs) lost (Fig. 3).

The increasing burden of diseases associated with this risk factor, has warranted global interest and research, as well as regulation and policy reform, government and private initiatives, and awareness efforts, to ameliorate the effects of air pollution

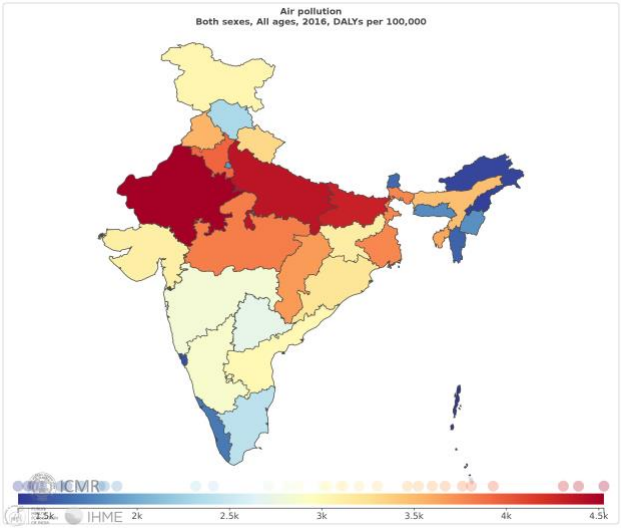

Figure 3: Disability Adjusted Life Years (DALYs) per 100,000 due to air pollution

Effect on cardiovascular disease (CVD) and Pathophysiology

While studies analysing the effects of air pollution on health have largely focused on respiratory illness, air pollution has been identified as a serious risk factor for CVD. Acute and chronic exposures to air pollution, and $PM_{2.5}$ in particular, have been associated (at varying degrees of certainty) with a range of cardiovascular effects including ischaemic heart disease, heart failure, stroke, thrombosis, arrhythmias, and hypertension. The pathophysiology is currently explained by three major hypotheses backed up in some cases with studies in mice. The strongest data-backed hypothesis states that entry of particulate matter into the lungs triggers inflammatory responses that promote systemic oxidative stress, thereby leading to increased risk of thrombosis, endothelial dysfunction, atherosclerosis progression, and dyslipidaemia.

The second hypothesis correlates pulmonary exposure to activation of the autonomous nervous system (ANS) in the lungs leading to ANS imbalance, consequentially causing vasoconstriction, endothelial dysfunction, hypertension, platelet aggregation, tachycardia, increased heart rate variability and increased arrhythmia potential. The third hypothesis states that inhalation and subsequent absorption of particulate matter into the blood stream causes tissue-level interactions resulting in platelet aggregation, vasoconstriction, endothelial dysfunction, and epigenetic changes in gene expression.

As observed in the GBD 2016 data, over a third of all cardiovascular mortality in India is attributable to air pollution, and over 60% of mortality due to air pollution is via cardio and cerebrovascular end-points.

This communique emphasizes the gravity of addressing air pollution as a risk factor, in routine management of CVD. The attached infographic summarizes key action points for awareness and mitigation of air pollution.