Editorial

Atmospheric Pollution and Lung Health

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Atmospheric pollution has long been recognized as a major health hazard. Atmospheric pollution indicates the presence of contaminants or substances in the air that interfere with human health and welfare or produce other harmful environmental effects. Breathing clean air is considered to be a basic requirement of human health and well being. In spite of the continued efforts at loco regional and global levels, air pollution continues to pose a major challenge to human health and well being.

WHO reports that in 2012 around 7 million people died as a result of air pollution. Air pollution has now become the world's largest single environmental health risk. Reducicng air pollution can save millions of lives. In April 2014, WHO has issued new information estimating that outdoor air pollution was responsible for about 3.7 million deaths of people under the age of 60 years in 2012. It is disheartening to note that half of the burden of air pollution is borne by the developing countries[1]. Both indoor and outdoor pollutions are equally harmful from a public health perspective. Indoor air pollution occurs mainly due to the burning of solid fuels in poorly ventilated dwellings. Indoor smoke can be 100 times more than the permissible levels for small particles. Exposure is particularly high among women and children who spend most of their times indoor.

Outdoor air pollution may be consequent to natural disasters and anthropogenic activities. Man made activities involve rapid urbanization, industrialization, wide spread construction activities, open burning of garbage and plastic materials, uncontrolled combustion of shredded tires and vehicular traffic related emissions. Hazardous chemicals and particles escape into the atmosphere by the aforementioned ways and may cause several adverse effects on human health and environment. Increased combustion of fossil fuels in the last century is responsible for the progressive change in the atmospheric composition. Air pollutants such as carbon monoxide, sulfur dioxide, oxides of Nitrogen (NOX), volatile organic compounds (VOCS), Ozone (O_3), heavy metals like zinc, iron, copper and Nickel and respirable particulate matter (PM 2.5 and PM10) may differ in their chemical composition, reaction properties, emissions, disintegration time and ability to diffuse to short or long distances.

Particulate matter (PM) represents a major family of air pollutants. Fine particulate matter with an aero dynamic diameter of 2.5 μm. (PM 2.5) and perhaps to a greater extent ultrafine particles (PM < 0.1 μm.) can penetrate into the innermost regions of the lung. These fine particles are composed of non organic compounds (sulphate, ammonium and hydrogen ions) certain metals, elemental carbon (black carbon), organic species including polycyclic aromatic hydrocarbons (PAH) and many other families. Black carbon (BC) is an incomplete combustion byproduct considered to be a proxy for all traffic related particles[2].

Vehicular traffic related pollutants are the major contributors to unhealthy air quality. Common transportation related air pollutants include carbon monoxide, oxides of Nitrogen (NOX), particulate matter and Ozone (O_3) that is formed when NO_2 interacts with volatile organic compounds in the presence of sunlight. PM 2.5 concentration and PM 2.5 absorbance are possible markers of traffic related pollution. More specifically PM 2.5 absorbance is a measure of the blackness of PM 2.5 which depends on the presence of elemental carbon in PM 2.5. Because elemental carbon represents a major fraction of diesel motor exhausts PM 2.5 absorbance is considered to be a sensitive index of air pollution due to diesel engines and truck traffic. PM 2.5 absorbance is considered to be a sensitive marker of traffic related pollution than PM 2.5 per se.

Petroleum refining products consist mainly of cyclo alkanes, straight and branched chain alkenes. They are continuous sources of air pollution in various occupational settings[3]. Benzene and Toluene are major monocyclic hydro carbons in petrol with nitropyrene in diesel exhaust emissions. Benzene is highly volatile and the most usual mode of exposure is inhalation of vapor[4]. In India, the percentage of benzene in automobile gasoline is only about 3 % whereas in other countries it may be as high as 30 %.

Air pollution has both acute and chronic effects on human health, affecting various organ systems of the body, but the brunt is borne by the cardiopulmonary system. The respiratory system is particularly vulnerable to air pollution because the lungs must move in large quantities of ambient air (over 400 million liters in a lifetime) in order to oxygenate the circulating blood efficiently. Air pollutants like ozone and PM can injure the lungs directly. They may trigger an inflammatory response in the lungs which may spill into the systemic circulation to affect the cardiovascular system and other organs of the body. The pulmonary consequences of air pollution may range from minor upper respiratory irritation to chronic respiratory and cardiovascular diseases, lung cancer, acute respiratory infections in children and chronic airway diseases in adults. Asthma is triggered by exposure to dust, smoke, pollens, volatile organic compounds, ozone, carbon monoxide, sulphur dioxide and oxides of Nitrogen. Ozone is a lung irritant, can aggravate preexisting asthma and COPD. Both short term and long term exposures to air pollution have also been linked to premature mortality and morbidity.

Numerous epidemiological and laboratory studies have documented a reduction in pulmonary function with both short and long term exposures to air pollution[5].Petroleum products and its exhaust can lead to significant respiratory symptoms like chronic cough, breathlessness and wheezing[6]. In high concentrations they cause significant systemic inflammatory response. The particles generated from petrol exhaust are extremely small and are present in the nuclei or accumulation modes with diameters of 0.02 nm and 0.2 nm respectively. Since their surface area being larger they are capable of carrying much larger fractions of toxic components such as hydrocarbons and metals in their surface. They can remain suspended in air for longer periods and deposit deep in the lungs in large numbers compared to larger particles. Transport of oxygen to the tissues is hindered by methHb, a byproduct of benzene metabolism in the body leading to functional anemia. As the levels of methHb rises, symptoms like dyspnoea, palpitation, anxiety and confusion occurs[7,8]. Carbon monoxide also has a stronger affinity for hemoglobin compared to oxygen (230 times more) leading to tissue hypoxia.

Effects of Sulphur dioxide in the respiratory system ranges from a reversible reduction in pulmonary function to constriction of bronchioles, severe airway obstruction, hypoxemia, pulmonary edema and death[9].

Nitric oxide impairs the lung's immune defense mechanisms thereby increasing the susceptibility to various infections and asthma attacks. It has also the potential to induce inflammatory response.

Solid particulate matter (PM) generated from emissions gets adsorbed onto soot particles which can penetrate the lungs thereby increasing the risk for pneumoconiosis and lung cancer[10].

Quality of breathing air plays a pivotal role in the growth and development of lungs during childhood and adolescence. This has been firmly demonstrated by the children's health study[11]. This has shown that lung growth as measured by the rise in FVC, FEV_1 and MMEF from the ages of 10-18 years exhibited a declining trend among the children exposed to ambient air pollution. The study concluded that most children are susceptible to the chronic respiratory effects of breathing polluted air[11]. Thus impaired lung growth and development during childhood and adolescence creates an additional risk factor for lung diseases in adult life.

Children are particularly vulnerable to the deleterious effects of air pollution. Children predominantly breath through their mouth there by bypassing the usual filtering effects of nasal passages and allow the pollutants to travel deeper into the lungs. More over children have a large surface area of the lungs relative to their weight and inhale relatively more air than the adult. They also spend more time outdoors.

There is a strong association between ambient fine particulate air pollution and elevated risk of both cardio pulmonary and lung cancer mortality[12]. Each 10 $\mu m/m^3$ elevation in long time average PM2.5 ambient concentrations was associated with approximately a 4%, 6 % and 8% increased risk of all cause, cardio pulmonary and lung cancer mortality respectively[12].

The detrimental effects are not uniformly seen among all individuals exposed to air pollution. Some individuals are genetically prone for the exaggerated harmful effects of air pollution. Recent results from the normative aging study (NAS) among a population of elderly men, linked long term exposure to black carbon (BC) with the rate of lung function decline. It is seen that oxidative stress is associated with lung function decline[13]. Traffic pollution including black carbon induce oxidative stress systemically and in the lungs[14,15]. There exists a strong association between long term black carbon exposure and rate of lung function decline among elderly men with relatively high oxidative stress risk profiles compared with men with a lower risk[16].

In this issue of Pulmon, Gayathri etal has looked at the occupational hazard of petrol pump workers in Trivandrum city. In their cross sectional study comprising of 30 petrol pump workers with age and sex matched control, they have measured FEV_1 and FEV_6. The study concluded that there is a significant reduction in pulmonary function among petrol pump workers compared with the control group. The observed lung function impairment is restrictive in nature. Though there are several studies of similar nature conducted at certain centers in India and abroad, this seems to be the first of its kind being published from the state of

Kerala. The authors certainly merit appreciation in this respect. In spite of certain limitations of the study it has clearly shown a link between the occupational exposure to fuel related pollutants and the declining lung function among the petrol pump workers. The petrol pump workers are actually exposed to the twin effects of the fuel related pollutants and traffic vehicular particulate matter. So the differential effects of these two exposures are worth studying. One possible way is to have a comparative study involving the petrol pump workers and the traffic police personals, who are constantly exposed predominantly to vehicular traffic pollutants. Equally important would be to do a study involving the residents in and around the petrol pumps who are constantly exposed to both traffic pollutants and fuel related exposure. A multi centric Cohort study can shed more light on these details.

The study results are in agreement with similar studies conducted elsewhere. Now it has become clear that the petrol pump workers are occupationally vulnerable to declining lung function which may increase with the duration of exposure. This should call for implementation of preventive measures including pre placement lung function screening and periodic surveillance. Control measures to reduce the benzene concentrations in the ambient air, evaporation controls, use of catalytic converters and reducing the benzene content of the fuel are to be adopted. Use of protective masks at work place, improvement in engine design, soot filters and fuel modification such as biodiesel are other measures which may minimize the exposure risk.

Clean ambient air is an essential pre-requisite for healthy living. To accomplish this an orchestrated and sustained effort should come from all concerned, the government, policy makers, NGOS, professional bodies and all responsible individuals at large. Attempts to minimize atmospheric pollution should ideally start at home by taking steps to reduce indoor air pollution and then participating in various activities to reduce outdoor pollution. Since motor vehicles contribute to more than 50 % of urban air pollution, attempts to reduce this alone can pay rich dividends. This may involve the designing of communities and transportation systems which may impact how often automobiles are used, how many automobile trips are taken, and how long these trips are. Reducing auto trips by increasing mass transit use, car pooling, walking and bicycling may help mitigate air pollution. During the 1994 summer Olympics in Atlanta, USA when peak morning traffic decreased by 23% and peak ozone level decreased by 28%, emergency visits for asthma events in children decreased by 42%. This observational study clearly suggests that efforts to reduce traffic congestion and thereby improving the air quality can improve the respiratory health of the community. Other measures to reduce vehicular emission may include reduction of lead and sulphur contents of fuels, retirement of older commercial vehicles, conversion of diesel and petrol run public transport vehicles to compressed natural gas. Changes in vehicular technology in autorickshaws and motorized two wheelers- change from two stroke to 4 strokes may also be beneficial. But the rising trend of NOX along with the presence of volatile organic compounds indicates an ever increasing tendency to form ground level ozone and as a result smog in that region. It is predicted that the current regimen of vehicle technology, fuel standards and high growth of private vehicles will nullify all the past emission reduction by the end of 2020. Our country is now in the “Swatch Bharath” movement initiated by the honorable Prime Minister of India Sri. Narendra Modi. This movement calls for an earnest and concerted effort by each one of us towards accomplishing a clean environment. Many respiratory organisations in the world are already engaging themselves to accomplish clean air environment in their respective regions. With this prime objective in mind, APCCM had launched the “LUNG HEALTH DAY” , about seven years back. It is being observed on 2nd of December every year commomerating the

Bhopal gas tragedy of 1984. It is planned to observe the lung health day every year highlighting a particular theme about lung health.

We can win the fight against air pollution and reduce the number of people suffering from cardio respiratory diseases including lung cancer , said Dr. Maria Neira ,WHO director for public health, Environmental and social determinants of health. A good quality air can go hand in hand with economic development and over all prosperity of a nation. We cannot buy clean air in a bottle, but countries, states and regions can adopt stringent ,sustained and broad based measures that will clean the air and helps save lives of their people.

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