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Air Pollution: An Environmental Factor Contributing to Chronic Diseases

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Abstract—*Chronic diseases such as cancer, cardiovascular disease and respiratory diseases are the main cause of the morbidity and mortality worldwide. Today, Air pollution is one of the biggest environmental problem and main cause of these chronic diseases. Air pollution problem is more severe in Asian countries due to high pollution level and high pollution densities. Research studies conducted in asian cities showed that exposure to particulate matter (PM), sulfur dioxide (SO2), nitrogen dioxide (NO2) and O3 are highly associated with pulmonary and cardiovascular diseases. The results from various studies showed that the main sources of air pollution are industries, domestic fuel burning and vehicles, emission of particulate matter are closely associated with the emissions of SO2 and NO2. There is also a strong correlation between visits to hospital due to respiratory disorder and emission strength in the area of residence. So, we need to implement appropriate health and environmental monitoring actions to reduce emissions of toxic gases and harmful substances in the air.*

Keywords: *Air Pollution, Respiratory illness, cardiovascular illness, Gastroenteritis, Skin irritation.*

1. INTRODUCTION

Chronic diseases, especially cancer, cardiovascular disease, and respiratory diseases, are the leading causes of morbidity and mortality worldwide. Chronic diseases develop typically over long periods of time and have multiple risk factors [1]. The major causes of cardiovascular disease include high cholesterol, high blood pressure, and obesity [2-6]. For lung cancer and respiratory disease, tobacco smoking and exposure to toxic chemicals are important risk factors [7-15]. More recently, ambient air pollution has been implicated in increasing the incidence and mortality from lung cancer and from cardio-pulmonary diseases [16-18]. According to new estimates WHO reports that in 2012 around 7 million people died - one in eight of total global deaths–as a result of air pollution exposure. This finding more than doubles previous estimates and confirms that air pollution is now the world's largest single environmental health risk. In particular, the new data reveal a stronger link between both indoor and outdoor air pollution exposure and cardiovascular diseases, such as strokes and ischaemic heart disease, as well as between air pollution and cancer. This is in addition to air pollution's role in the development of respiratory diseases, including acute respiratory infections and chronic obstructive pulmonary diseases. The new estimates are not only based on more knowledge about the diseases caused by air pollution, but also upon better assessment of human exposure to air pollutants through the use of improved measurements and technology [19].

Table: 1 The table shows that outdoor air pollution-caused deaths–breakdown by disease (Adapted from http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/. Accessed on dated 18/04/2014).

Outdoor air pollution caused death	Diseases due to air pollution
40%	ischaemic heart disease
40%	Stroke
11%	chronic obstructive pulmonary disease (COPD)
6%	lung cancer
3%	acute lower respiratory infections in children

Table: 2 The table shows that indoor air pollution-caused deaths–breakdown by disease (Adapted from http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/. Accessed on dated 18/04/2014).

Indoor air pollution caused death	Diseases due to air pollution
34%	Stroke
26%	ischaemic heart disease
22%	chronic obstructive pulmonary disease (COPD)
12%	acute lower respiratory infections in children
6%	lung cancer

Diseases Caused by Air Pollution

There are the numerous diseases that may be caused by the air pollution.

Asthma

In recent years, scientists have shown that air pollution from cars, factories and power plants is a major cause of asthma attacks. And more than 131 million Americans -- over 40 percent of the nation's population -- live in areas with bad air. Roughly 30 percent of childhood asthma is due to environmental exposures, costing the nation $2 billion per year. Air pollutant that triggers Asthma are particulate matter, Ground level ozone, Sulfur dioxide (SO_2), Nitrogen oxide (NO_2) [20]. The NRDC states that the following air pollutants are common triggers of asthma: ground level ozone, sulfur dioxide, fine particulate matter and nitrogen oxide. The Centers for Disease Control and Prevention or CDC states that another important trigger for asthma attacks is environmental or secondhand tobacco smoke. The CDC suggests that parents, friends and relatives of children with asthma should attempt to quit smoking and should never smoke in proximity to a child or person with asthma, as this could cause an asthma attack [21].

COPD

Chronic obstructive pulmonary disorder or COPD is a disease that may be caused by air pollution. The U.S. National Library of Medicine and the National Institutes of Health or NIH state that, with COPD, a person airways and air sacs lose their shape and become distended or floppy, and that chronic bronchitis and emphysema are common COPDs. According to the American Lung Association or ALA, long-term exposure to air pollution especially automobile exhaust ;boosts women risk for lower lung function, COPD and dying prematurely, and truck drivers, dockworkers and railroad workers may be more susceptible to lung cancer-, heart- and COPD-related death due to chronic exposure to diesel emissions while on the job. The ALA also notes that even low levels of ozone and fine particulate matter increase a person risk of hospitalization for pneumonia and COPD [22].

2. LUNG CANCER

Lung cancer is a disease that may be caused by air pollution. According to LungCancer.org, lung cancer is characterized by the uncontrolled growth of abnormal cells in one or both lungs. Over time, the abnormal cells can develop into tumors and impair the lung primary function: to supply the blood, and therefore the body, with oxygen. LungCancer.org states that there are two principle types of lung cancer: non-small cell lung cancer or NSCLC and small cell lung cancer or SCLC. According to a 2002 study by C. A 2000 study by Fredrik Nyberg and colleagues published in the journal "Epidemiology" concludes that urban air pollution boosts lung cancer risk, and that motor vehicle emissions may be particularly problematic [23]. Cancers of the trachea, bronchus, or lung represent approximately 7% of total mortality attributable to PM2.5 in 2010. The Group I classification raises questions regarding individual components in the air pollution mixture, such as the carcinogenic potential of each component as well as through what pathways they may contribute to cancer risk [21].

3. RESPIRATORY ILLNESS

Public awareness of the impact of air quality on health is increasing worldwide. Indoor and outdoor air pollutants impair children's growing lungs, and increase the risk of respiratory infections. In many cities, children face indoor air pollution from fuels used for cooking and heating, as well as outdoor pollution from vehicle exhausts. Research identifies at-risk groups and seeks to establish biological plausibility for the associations already observed; and looks towards identifying the harmful pollutants that are responsible for respiratory morbidity and mortality. These findings may then serve to influence public debate and future policy at national and international level to improve air quality in cities, and improve children's health [25]. Chronic lung diseases, including chronic obstructive pulmonary disease and bronchiectasis in women, are associated with solid fuel use for cooking, and the damaging effects of exposure to household air pollution in early life on lung development [26].

4. IMPACT ON BRAIN HEALTH

Accumulating evidence suggests that outdoor air pollution may have a significant impact on central nervous system (CNS) health and disease. To address this issue, the National Institute of Environmental Health Sciences/National Institute of Health convened a panel of research scientists that was assigned the task of identifying research gaps and priority goals essential for advancing this growing field and addressing an emerging human health concern. Here, we review recent findings that have established the effects of inhaled air pollutants in the brain, explore the potential mechanisms driving these phenomena, and discuss the recommended research priorities/approaches that were identified by the panel [27].

5. CARDIOVASCULAR ILLNESS

Children with asthma involved in the study had relatively good pulmonary function test results (mean FEV_1 compared to standard values: 89.8%, mean FVC: 97.6%, mean $FEF_{25–75}$: 76.3%). Median diastolic, systolic blood pressures and oxygen saturation were 60/94 mm Hg and 99%, respectively. Median personal concentrations of pollutants were NO_2, 5.5 ppb; benzene, 2.1 $\mu g/m^3$; $PM_{2.5}$, 5.7 $\mu g/m^3$; and total PAH, 130 $\mu g/m^3$. Most personal concentrations of SO_2 were below the level of detection. No consistent associations were

observed between cardio-pulmonary indices and personal exposure to $PM_{2.5}$, NO_2 and benzene, although there was a suggestion for a small decrease in respiratory function with total concentrations of PAHs (e.g., adjusted association with FVC: −9.9 ml per interquartile range 95%CI: −23.4, 3.7) [28].

6. GASTROENTERITIS

The health impacts of air pollution have received much attention and have recently been subject to extensive study. Exposure to air pollutants such as particulate matter (PM) has been linked to lung and cardiovascular disease and increases in both hospital admissions and mortality. However, little attention has been given to the effects of air pollution on the intestine. Gaseous pollutants may also induce systemic effects. Plausible mechanisms mediating the effects of air pollutants on the bowel could include direct effects on epithelial cells, systemic inflammation and immune activation, and modulation of the intestinal microbiota.

7. SKIN IRRITATION

Concentrations of volatile organic compounds (VOCs) in office environments are generally too low to cause sensory irritation in the eyes and airways on the basis of estimated thresholds for sensory irritation. There is neither clear indication that office dust particles may cause sensory effects, even not particles spiked with glucans, aldehydes or phthalates, nor lung effects; some inflammatory effects may be observed among asthmatics. Ozone-initiated terpene reaction products may be of concern in ozone-enriched environments ($\geq$0.1 mg/m^3) and elevated limonene concentrations, partly due to the production of formaldehyde. Ambient particles may cause cardio-pulmonary effects, especially in susceptible people (e.g. elderly and sick people); even, short-term effects, e.g. from traffic emission and candle smoke may possibly have modulating and delayed effects on the heart, but otherwise adverse effects in the airways and lung functions have not been observed. Combined exposure to particles and ozone may evoke effects in subgroups of asthmatics [29].

8. CANCER RISK

A number of studies have linked exposure to long-term outdoor air pollution with cardiopulmonary disease. A total of 14,001 elderly residents completed questionnaires and were followed from December 1999 to January 2009. The positive associations of NO_2 levels with all-cause was found during various studies (HR = 1.12, 95% CI: 1.07–1.18), cardiopulmonary disease (HR = 1.22, 95% CI: 1.15–1.30), and LC mortality (HR = 1.20, 95% CI: 1.03–1.40). Among cardiopulmonary disease mortality, not only the risk for ischemic heart disease (HR = 1.27, 95% CI: 1.11–1.47) but also the risks for stroke were elevated: intracerebral hemorrhage (HR = 1.28, 95% CI: 1.05–1.57) and ischemic stroke (HR = 1.20, 95% CI: 1.04–1.39) [30].

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