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BREATHING EASY: NAVIGATING LUNG HEALTH IN A CHANGING ATMOSPHERE

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Abstract: Air pollution is having a high concentration of pollutants in the air that can be harmful to people, animals, plants, or structures. It poses a significant risk to the health of people everywhere in the world. Individuals with chronic cardiovascular disorders, the elderly and small children are most vulnerable to the negative health impact due to dust, smoke, and polluted air. Exposure to dust has been linked to both infectious and non-infectious disorders. Influenza infectious disorders linked to dust include viruses, bacterial pneumonia, meningococcal meningitis, and pulmonary coccidioidomycosis. Contaminated air exposure has been linked to non-infectious disorders such as lung fibrosis, asthma, sarcoidosis, and chronic obstructive pulmonary disease. The present understanding of how ambient air pollution affects the respiratory system is investigated with relation to the health of the lung.

Keywords: Air pollution, Allergic symptoms, Lung health, Respiratory diseases, Smoke.

INTRODUCTION

The environment has seen a wide range of significant variations due to climate change (Verma, 2021). Pollution affects the overall web of life (Singh *et al.,* 2023). The changes in rainfall patterns, sea level rise and increase in extreme weather events like dust storms, floods, and droughts have an impact on human health (Mirsaeidi *et al.,* 2016). From birth to death, air pollution impacts everybody of the population. Significant portions of the European populace still reside in regions with poor air quality. In certain areas and for certain pollutants, the situation for biotic life is getting worse rather than better (Balwan and Saba, 2021). Furthermore, new fuel and combustion technologies, industrial production, the transportation of commodities, and urban design may have an impact on the components of air pollution and, therefore, the population's exposure to it (WHO, 2005). Several studies support the harmful consequences of air pollution that go beyond lung involvement and encompass a variety of cardiovascular outcomes, including atherogenic effects, is gradually increasing (Kunzli and Tager, 2005; Ghio *et al.,* 2014).

Air pollution is a complex mixture of thousands of pollutants. This mixture may consist of solid and liquid particlessuspended in air (particulate matter; PM) and differenttype of gases such as ozone (O_3), nitrogen oxides (NO_2 or NOx), volatile organic carbons (VOCs), and carbon monoxide (CO). Particles can differ in quantity, form, size, surface area, and chemical makeup, but gases can also differ in solubility and toxicity. The burning of fossil fuels used in automobiles, trucks, airplanes, marine vessels, and other engines, as well as in industry, power plants, and residential heating systems, is one of the primary processes responsible for air pollution. People and emissions are closely connected, therefore transportation-related activities especially those involving vehicles and trucks are a significant source of air pollution (Perez *et al.,* 2010; Hoque, 2023a).

Burning coal, gasoline, diesel fuel, and wood releases particulate matter into the atmosphere, which is a complex combination of solid and liquid particles floating in air. It is also created by the chemical interactions between organic substances found in the atmosphere and nitrogen oxides. PM is further derived by vegetation and cattle. Vehicles, lorries and coal-fired power plants are the main sources of PM pollution in big cities. The size and makeup of the particles, the amount and length of exposure, the exposed person's age, gender, and sensitivity are some of the variables that affect how PM affects their health. Exposure symptoms might include a chronic cough, painful throat, burning eyes, and heaviness in the chest. Additionally, PM can aggravate asthma or cause early mortality, especially in older people who already have medical conditions (Ostro *et al.,* 2011; Hoque and Rafi, 2023). This review article aims to explore measures for decreasing air pollution, as suggested by several clinical studies, and to give information on the effects of pollution on respiratory health. The community is mostly concerned about pollution from particulate matter and ozone.

Short-term respiratory impact of Air pollution
Numerous epidemiological studies have demonstrated a correlation between the daily variation in air pollution levels and the number of fatalities, primarily from cardiovascular and respiratory disorders (Samoli *et al.,* 2008). The ground breaking European multicity time series analysis, conducted in 29 research centers, including three cities in Switzerland, discovered that there was a 0.6% rise in illness-related mortality for every $10 \, \mu g \times m^{-3}$ increases in PM10 concentration. Similar findings were seen in data from hundreds of other cities worldwide (Samoli *et al.,* 2008). Research on short-term mortality revealed that on an average; respiratory outcomes had a greater relative risk associated with air pollution and health. However, the number of cardiovascular fatalities linked to air pollution is equal to or greater than the number of respiratory deaths linked to air pollution as more individuals pass away from cardiovascular disorders (Williams *et al.,* 2019).

Individuals with asthma have greater symptoms on or after days with higher pollution levels, particularly young children who do not get anti-inflammatory or bronchodilator medication. Daily changes in PM, NO_2, and/or O_3 have been linked to increased wheeze, coughing, and breathlessness episodes in the panel studies on asthma using appropriate exposure assignment techniques. These symptoms studied, are also accompanied by worsening lung function and the need for extra treatment (Teresa *et al.,* 2020).

Long term effect of Air pollution
Long-term or lifetime exposure to ambient pollutants may also contribute to pathologies that ultimately result in chronic respiratory diseases (Downs *et al.,* 2007). Research from Europe, the United States, and Canada demonstrates that the total impact of pollution on mortality is far greater than the portion attributable to acute exposures (Downs *et al.,* 2007). Cardiovascular problems often result in mortality more frequently than respiratory illnesses. As a result, the two are frequently included together when discussing cardiopulmonary mortality. In both the American Cancer Society (ACS) research and the Harvard Six Cities research, long-term variations in particle and sulphate concentrations between cities were linked to cardiopulmonary mortality (Pope *et al.,* 1995). Comparison of community-level concentrations of fine particles with death rates among more than 5, 00,000 participants in

the ACS study showed a 6% increase in cardiopulmonary deaths 16 years later per 10 μg × m⁻³ of PM2.5. In a reanalysis of 18 years of ACS follow-up from the Los Angelesarea, modelled PM2.5 concentrations were assigned to each residence. This improved exposure assignment resulted in larger estimates. Cardiopulmonary mortality increased by 20% per 10 μg × m⁻³ contrast in PM2.5 (Jerrett *et al.,* 2005).

Multiple studies have demonstrated that urban air pollution was positively correlated with overall mortality, mortality from ischemic heart disease, mortality from lung cancer and, to a lesser extent, mortality from cerebrovascular accidents. The correlation was measured individually for each participant by modeling traffic emissions of NO_2. A Dutch cohort study with exposure data over 20 years observed weak associations of traffic density on the nearest main road with cardiopulmonary death. Respiratory deaths were related to NO_2, black smoke, traffic density within a radius of 100 meter, and living near a main street (Huovinen *et al.,* 2003).

ALLERGIC DISEASES
Children and young people are more susceptible to allergy disorders including asthma and allergic reactions/rhinitis. Increased production of immunoglobulin E against common allergens is the hallmark of asthma in these patient groups in the majority of instances. When particular aeroallergens, such as pollens, are exposed to these people, their bodies go through a sequence of immunological changes that ultimately result in asthma symptoms. The relationship between elevated air pollution and pollen generation is now well known, and it is shown to have a detrimental effect on both the prevalence and severity of allergic asthma (Nielsen *et al.,* 2002).

Diesel exhaust contains numerous pollutants and polycyclic aromatic hydrocarbons, which enhance allergenicity and asthma symptoms by acting in synergy with allergens. Experimental studies showed that diesel exhaust particles act as an adjuvant for immunoglobulin E production in response to specific allergens (ovalbumin or Japanese Cedar pollen) (Muranaka *et al.,* 1986). Additionally, breathing in diesel exhaust

particles causes an asthmatic's characteristic phenotype, which includes hyperresponsive airways and pulmonary inflammation (Park *et al.,* 2011). According to certain theories, diesel exhaust particle engulfment by macrophages triggers a Th2-type inflammatory response, while particle entrapment results in a Th1-type inflammatory response. High carbon dioxide concentrations in the environment increase both pollen production and the allergenicity of pollen. Indeed, researches showed that a high concentration of carbon dioxide enhanced the production of Amb a 1, an allergenic protein in ragweed pollen (Singer *et al.,* 2005).

Respiratory diseases in Children
Adolescents have greater energy and engage in more outside activities. They breathe faster and have a higher metabolic rate than adults. Children's immune systems are still developing, thus respiratory infections are more common in them. Since the child's lung is still growing, any growth deficit will have an effect on it for the rest of their lives. Furthermore, it is easier to interpret epidemiological data since there are less potential confounding or moderating factors, such as active smoking, occupational exposure to smoke and dust, or medical treatments for illness. Studies on the development of children's lungs and the prevalence of asthma, the primary chronic illness in children, are particularly pertinent and interesting (Zu *et al.,* 2018; Manisalidis *et al.,* 2020).

Although there is a definite correlation between air quality and asthma flare-ups, differences in the geographic distribution of allergies or asthma prevalence do not correspond to variations in the background pollution levels in metropolitan areas. In order to characterize the local intracommunity distribution of traffic-related pollutants, novel methodologies currently incorporate spatial modeling techniques, land-use data, geographic information systems, and local measurements of pollutants related to traffic. Individuals residing near major highways are subjected to several times the amount of main pollutants associated to traffic compared to those living between 50 and 100 meters away. Even after controlling for confounding variables,

epidemiological studies examining the incidence of children asthma as a function of traffic proximity have clearly indicated that living near a busy road raises the risk of childhood asthma.

Significant cohort studies conducted in the US (such as the USC Children's Health Study) and Europe have recently corroborated this, despite the fact that the urban architecture, traffic patterns, and automobile fleets are somewhat different. The most significant finding was the confirmation of a greater prevalence of asthma related to ambient air pollution by a European birth cohort, whose children are now tracked up to the age of eight (Gehring *et al.,* 2010).

Chronic Respiratory Diseases in Adults
It is well established that smoking is the primary risk factor for adult chronic respiratory disorders, and there seems to be a significant overlap between the health consequences of smoking and ambient air pollution. In addition to individual characteristics like age, sex, and hereditary variables, studies assessing the effect of outdoor air pollution on illnesses like adult asthma and chronic obstructive pulmonary disorders (COPD) must include the association of these factors. Researches whose findings are based on nonsmokers are very useful (Escobedo *et al.,* 2011). Numerous researches found cross-sectional relationships between air pollution and lung function; nevertheless, some of these findings are rather contradictory, may be for methodological reasons. Most notably, the age-related loss in lung function in the Swiss SAPALDIA trial was mitigated by a reduction in pollution exposure (Götschi *et al.,* 2008).

Measures against air pollution
When the Air Quality Index (AQI) rises over a certain threshold, people can mitigate the negative impact of ambient air pollution by reducing the amount of time they spend outside and their level of activity. Since 2009, the U.S. Environmental Protection Agency has employed the AQI, an indicator for reporting daily air quality, to offer basic information on local air quality (Nishimura *et al.,* 2013). Ground level O_3, particle pollution, CO, and SO_2 are the four main air pollutants that are used to calculate it

(Nishimura *et al.,* 2013). The National Standard for Air Quality was implemented by the Chinese Ministry of Environmental Protection in March 2012, which saw the addition of PM 2.5 as a significant measure and the adoption of the AQI (Liu *et al.,* 2019).

The AQI warns individuals about the health risks linked with the air as well as how clean or unclean it is. The official website, local media, including television and newspapers, and client-end mobile applications is all current sources for the AQI. When the AQI hits a specific high point, individuals should spend less time outside and engage in physical activity in the polluted air (Liu *et al.,* 2019).

Subjects with chronic respiratory disease, such as COPD and asthma, should regulate their daily activity according to the local AQI report. People with asthma are more sensitive to SO_2. Children with asthma may respond less well to short-acting bronchial agonists due to the presence of NO_2 and perhaps O_3. Asthma patients should take appropriate precautions in addition to routinely utilizing inhaled bronchodilators when NO_2 levels are consistently higher than usual (Jiang *et al.,* 2016).

In order to enhance indoor air quality in homes and buildings more effectively, it was suggested to use combination systems that utilize several kinds of air filtration units. One study, for instance, described a complex air cleaner made up of four different types of air filter units: a photocatalyst filter connected to a parallel beam ultraviolet irradiation device; an activated charcoal filter (ACF); a unit for trapping agent for acidic gases; and a MnO_2 filter for formaldehyde oxidative decomposition (Sekine *et al.,* 2011; Hoque, 2023b). A newer model of air purifier that uses Nova technology may be more effective. For instance, the plasma cluster ion air purifier effectively purifies the air by combining an ion generator with a multilayer filter system that includes a prefilter, carbon filter, HEPA filter, and antimicrobial filter. Together with PM filtering and other gaseous chemical pollutant absorption, the plasma cluster ion air purifier also has the ability to neutralize airborne microbes through the creation of ions. This development is

particularly critical for those who suffer from long-term respiratory conditions.

Nutrition to relieve from air pollution based illness

Even while there doesn't seem to be a direct correlation between dietary nutrients and the various consequences of air pollution, they are nonetheless significant protective factors for respiratory health (He *et al.,* 2008). Consuming a lot of fresh fruit and certain veggies is good for the lungs. Antioxidant vitamins like C and E are among the many nutrients found in fruits and fresh vegetables. The oxidative process and inflammatory response linked to lung illnesses are protected against by the antioxidant vitamins. In order to counteract the harmful impact of air pollution, this protective effect may become increasingly significant.

According to a study, kids who ate a lot of green vegetables had healthier lungs and less respiratory ailments (He *et al.,* 2008; Hoque *et al.,* 2023). Sufficient intake of fruits and vegetables is advised in subjects who face additional oxidative stress challenges, such as exposure to high levels of air pollution, because nutrients such as vitamins and other mineral substances are involved in cell metabolism and the maintenance of the immune system. Nutrients are therefore crucial in defending against environmental threats, including air pollution (Romieu, 2005).

CONCLUSION

In conclusion, there is several serious negative impact of air pollution exposure on human health. The components and causes of pollution vary among countries, seasons, and occasions, and so does the health impact of air pollution. Individuals suffering from long-term respiratory conditions like asthma are particularly susceptible to the negative consequences of air pollution. People should be aware of the local air quality and take extra precautions, such limiting their time outside and using masks when needed, to lessen the negative impacts of ambient air pollution. With the improvement of air pollution exposure assessment technologies, other health outcomes are becoming of increasing interest due to plausible pathways connecting the lung with other organs and systemic effects.

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