Design Engineering

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 9279- 9285

A Review on Association between Outdoor Air Pollutants and Adverse Health Effects

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Abstract: Abundant analysis into the harmful impact of airborne toxins on human health has been published. The review's aim is to briefly synopsize the research on the health consequences of different airborne pollutants. The contaminants in the air reviewed include particulates, Carbon monoxide and carbon dioxide are two forms of carbon compounds, Oxides of nitrogen, sulphur dioxide, formaldehyde and ozone. Various studies have linked outdoor air contaminants to different human health issues, such as respiratory disorders, cardiovascular diseases, neurological diseases, lung diseases, and COPD. Numerous research has discovered a stronger relation or link between hospital admissions or mortality due to respiratory and cardiovascular disease and levels of various outdoor air pollutants. The additional research should be helpful to government, health officials, physicians and general public.

Keyword: Outdoor air pollutants, cardiovascular disease, respiratory disease, mortality, hospital admission.

INTRODUCTION

Air pollution's negative health consequences are a hot topic in the world today. The published studies primarily focused on the health effects of various outdoor air contaminants. Every year, the WHO estimates that approximately 7 million people die around the world [1]. In addition, WHO collaborates with nations to track and enhance air quality [1]. More than 91 percent of the world's populace survives in areas where air quality surpasses WHO guidelines, with the highest levels of exposure are in low- and middle-income countries. , both indoors and outdoors [1]. Diseases of the respiratory system and the cardiovascular system are the most reported health effects associated with low air quality [2]. The key pollutants mentioned in a guideline from the World Health Organization on Air Quality are Particulate Matter(PM), Ozone(O3), Nitrogen Dioxide(NO2), Sulfur Dioxide(SO2) [2]. The key pollutants mentioned in Air Quality guideline from WHO are Particulate Matter (PM), Ozone (O3), Nitrogen Dioxide (NO2), Sulfur Dioxide (SO2) [2].As per the data available of the year 2016, In India, air pollution was second largest primary source of disease burden is which the Particulate Matter contamination was being top most reason for disease burden (deaths caused due to specific disease cause especially non communicable disease [13].

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- **Air Pollutants and their adverse effects on Human Health**

1. Particulate Matter (PM)

It is derived from plant and artificial solid and liquid particles that are released into the atmosphere [1].The thickness of the particle has been used to measure PM. According to scale, Particulate is categorized into two groups.

1) PM10 is a particle of a diameter 10 microns or less that can pierce the lungs [2].

2) A particle of a diameter of 2.5 microns or lesser is PM2.5. It is the most risky air pollutant because it quickly reaches the lungs and circulation.

Serious illnesses such as cardiovascular disease, respiratory disease, and lung cancer may be caused by it [2].There is a strong quantitative connection between high levels of small particles and increased deaths or morbidity.

When tiny and fine particulate matter concentrations are reduced, associated mortality or morbidity is reduced as well [2]. Tiny Particulates (PM2.5) should be 10/m3 yearly average and 25/m3 24-hour mean, whereas coarse Particulates (PM10) should be 20/m3 annual mean and 50/m3 24-hour mean, as per WHO Air Quality Guiding principle [2].

2. Ozone (O3)

Ozone causes severe health implications like breathing problem, asthma, reducing lung function, lung disease and the guideline value for Ozone is 10µ/m3 (8-hr) mean [2].

3. Sulphur Dioxide (SO2) and Nitrogen Dioxide (NO2)

NO2 and SO2cause health consequences such as bronchial symptoms, lung inflammation and reduced lung function [2]. The WHO recommends NO2 guideline values of 40/m3annual mean and 200/m31-hour mean, and SO2 guideline values of 20/m324-hour mean and 500/m310-minute mean [2].

In nations America, Europe, and some other Asian countries, analyze the negative impacts of air contamination on cardiac and respirational disease hospitalizations [3] or the correlation of air toxins with cardiovascular and respiratory disease mortality or morbidity rates [3] are performed. However, air pollution is increasingly growing in developing nations as India. As a result, exploration on the topic of the association or connection between the levels of concentration of various pollutants and chronic ailments that is respiratory and cardiovascular diseases is needed in order to decrease the mortality or morbidity rates associated with these ailments in various cities across India.

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LITERATURE SURVEY

There are some researchers who majorly focused on pollutants PM2.5 and NO2 as they found the link of long term health effects with PM2.5 and NO2 [5]. These health effects can be considered as losses or morbidity (i.e. hospital admissions) due to diseases like Cardiovascular Disease (CVD), lung cancer, Asthma, Bronchitis, Pneumonia. Cesaroni et al. 2013 approached to develop or implement single-pollutant system in which the consequence of a specific pollutant is recognized against cause specific mortality and multi-pollutant design where simultaneous effect of two (bi-pollutant model) or more

toxins have been checked against cause specific mortality and has found that PM2.5 is strongly correlated with Ischemic Heart Disease (IHD) then with Cardiovascular Disease and lung cancer in decreasing order of association [5]. European Study of Cohorts for Air Pollution Effects (ESCAPE) were established to discover that if there's a connection among air contamination and healthiness influences (natural reason of expiry and cause specific mortality) and also used some other covariates that is traffic intensity and over-all traffic burden for effect estimation of emissions in the air [6]. According to Beelen et al.2014 study, it has been discovered that a connection between mortality from natural causes and PM2.5 concentration even when PM2.5 has the concentration (annual mean) below the value of the upper limit defined by Europe [6]. Research studies related to the negative sound effects of air contamination on social well-being were performed majorly on large cohorts especially in countries like Europe, United State etc. in which they have selected the sample population to determine the connection amongst airborne contamination and disease cause mortality. The ambient air toxins PM2.5, NO2 and O3 are two forms of gases found to be positively correlated with all-cause, respiratory and circulatory disease mortality [7] in two pollutant likewise in multi-pollutant model.

Furthermost related research studies concentrated on the cohort based study which include the sample population containing the participants that are either adults or age having 20 years or elder [8]. Various models can be developed according to different predictors as demographic factors or indicators, lifestyle factors, health factors, occupational factors [8]. Guo et al.2018 focused on FEV1 (Forced Expiratory Volume in 1 s), FVC (Forced Vital Capacity), MMEF (Maximum Mid-Expiratory Flow) and FEV1: FVC ratio are the parameters of spirometry test which is a Lung function test used to determine exactly how a person's lungs are functioning [8]. These four factors actually reflects the decrease in lung function which may become a cause for development COPD (Chronic Obstructive Pulmonary Disease). This shows that to asses COPD we have to consider the factors related to lung function. This research concluded that rise in PM2.5 concentration by 5µg/m3 will reduce FVC by 1.18 %, FEV1 by1.46 %, MMEF by 1.65 % and 0.21 % for FEV1:

FVC ratio [8] which clearly shows that PM2.5 concentration is closely related to reduction in lung health and thereby development of COPD, this means PM2.5 is considered as the harmful

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air pollutant for human health. Research studies from foreign countries like America, China, and Europe etc. have been proven that Cardiovascular and respiratory problems are possible side effects with increase in Particulate Matter concentration in the atmosphere. For analysis of air pollution's influence on social well-being researchers have been selected the different characteristics such as age, sex, medical history (Hypertension, diabetes mellitus, etc.) and the pollutant PM2.5 had a positive relationship with Myocardial Infarction (MI) within few hours and 24 hours after PM2.5 exposure [9]. Cairncross et al. 2001 has developed Air Pollution Index (API) system that evaluates a connection between relative risk and short term exposure pollutants there in air and daily mortality [10]. They focused on relative mortality and morbidity risks and not on actual measures of mortality and morbidity. To make the API

system more consistent the researchers have taken DALY (Disability Adjusted Life Year) as a metric of health effect

[10] instead of mortality and morbidity. C.Arden Pope 2000 research study includes the combined death count of both heart and lung disease as cardiopulmonary mortality against criteria air pollutants [11]. This research has been intended to explore the connection amongst Particulate Matter air pollutant and admissions to hospitals with respiratory ailments visits for COPD and asthma etc. [11]. Benjamin Bowe et al.2019 discovered an association between PM2.5 and several sources of deaths such as CVD, Cerebrovascular Disease, type 2 diabetes, lung cancer, hypertension and dementia over the years 2006 and 2016 [12]. The participants for this analysis were veterans in US. This means that they focused only on older age group that’s why not getting generalized results.

Balakrishnan et al.2019 have done the research on air pollution (Both ambient and household air pollution) exposure and its influence on people's health [13] for every states in India for the year 2017.For this research they have chosen Particulate Matter as pollution risk in the air parameter and disease death burden and DALY as health impact parameters to discover the linking between these parameters state wise in the nation of India.The result of this study includes the findings that 1.24 million people were died as a result of Particulate Matter emissions along with

0.48 million deaths were for the household pollution [13].This study concluded that if we minimize degree of pollution in the air in India will automatically decrease the health outcomes and thereby increasing the life expectancy. COPD is also a kind disease of the lungs [4]. When research studies try to explore the link between COPD and PM exposure then it may give rise to biased results when data of COPD deaths collected from death certificates [14]. This is because, in such cases it could happen that the patients initially diagnosed with COPD may die due to either Pneumonia or Cardiovascular Disease. C. Arden Pope et al. had come up with the outcomes in which CVDs such as dyrhymia, heart failure, cardiac arrest has a positive correlation with PM2.5 exposure adjusting a smoking factor [14].

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Air pollution and its health impact study should include various subgroups of population such as sex (male/female), different age groups in mortality outcomes along with the other indicators like occupation, education and other life style factors [15]. The Naess et al. 2006 have got results that the population at age group 51-70 has greater Ratio of Risk (Hazard Ratio) for COPD deaths as compare to the COPD deaths for the age group 71-90 as an outcome of pollution [15]. Sunyer et al.2020 has taken the emergency admissions once and further than once for Asthma as health indicator in medical consequences of air pollution analysis. Along with gaseous and particulate pollutants, Pollen and spores are used as well in this analysis. According to this research Pollen and spores are two groups that can be present in the atmosphere not correlated with hospital admissions but O3 and NO2 (hourly) remained statistically significant for the association [16]. There exists a strong association of nitrogen dioxide (NO2) and ozone (O3) with cardiovascular cause mortality which is followed by respiratory disease mortality. Respiratory disease is now going to become the harmful effects of outside air pollution on one's well being as There occurs a strong positive correlation between respiratory disease mortality and air pollutants PM2.5 and SO2 in city Xian, China which is the most populous Northwest China's city [17].The problem of collinearity amongst PM2.5 and SO2 is resolved using PCA (Principal Component Analysis) but results remains unchanged even after removal of collinearity. Ozone had related to respiratory disease mortality only for female subgroup whereas the subgroup having age greater than or equal to 65 has no any correlation with PM2.5, SO2 and O3 [17]. This means age group less than 64 is at high risk for the respiratory disorders mortality with respect to all the three pollutants. In the research study by Meng et al. 2013 NO2 and SO2 are at high risk for COPD mortality than Particulates (PM10) but among these pollutants NO2 become more hazards as it was still statistically significant even after adjusting PM10 and SO2 in a model of multiple pollutants [18].

CONCLUSION

There are many air airborne pollutants that have an adverse influence on human well-being can cause the hospital admissions or death as a result cardiovascular diseases, respiratory diseases, Pneumonia, Bronchitis, COPD and Asthma. Many Studies found the substantial connection amongst count of hospitalizations or the total number of people die from chronic diseases and the levels of pollutant concentrations in the air or the excellence of the air data. Among all ambient air contaminants PM2.5 is more risky because it's related to the disease cause mortality in different countries. More exploration is required to study the medical attributes may be used to diagnose the chronic diseases that actually affected by increase or decrease in the volume of concentration levels of different air pollutants. Also it should be necessary to focus on negative consequences of airborne emissions on Non respiratory or non-cardiovascular diseases like allergy.

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Issue: 7 | Pages: 9279- 9285

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