

## The Effect of Climate Change on Respiratory Diseases

Simoni Shah<sup>1</sup> and Alok S Shah<sup>2\*</sup>

<sup>1</sup>Cathedral and John Connon School, India

<sup>2</sup>Pulmonary Department, University of Chicago, USA

**\*Corresponding Author:** Alok S Shah, Department of Medicine, University of Chicago, University of Chicago, Chicago, IL, USA.

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### Abstract

Information on the effects of climate change on respiratory allergy is still lacking and the relationship between various factors such as respiratory diseases, environmental factors, air pollution and asthma is being researched by the medium of experimental studies [1,2].

Even after years of research it is not easy to form a correlation between the impact of climate changed and air pollution with the existence of asthma in the general population, but there is a high possibility that the rise in the cases and severity of asthma in individuals could be impacted by pollution and climate change [1,2].

There is also a correlation between pollen allergies, air pollution and respiratory diseases. Data shows that living in large cities and being exposed to particulate emissions from cars etc. can increase the occurrence of respiratory diseases. Changes in temperature and humidity affect the components of this interaction.

**Keywords:** *Climate Change; Respiratory Diseases; Air Pollution*

### Introduction

Through years of research it was found that changes in the climate and the earth's atmosphere have an effect on the Earth's environment and biosphere. An increase in the quantity of greenhouse gases in the atmosphere has already affected the climate, causing severe heat waves, fluctuations in temperature conditions, longer pollen seasons, pollution, forest fires, droughts and heavy precipitation, all of which increase the chance of respiratory diseases [24,25]. The diseases a large part of the population suffer from are asthma, rhinosinusitis, Chronic Obstructive Pulmonary Disease and respiratory tract infections [1,2].

Climate change poses more of a threat to people who are already suffering from cardiopulmonary diseases. It will also be more dangerous for people living in areas with poverty, as they have limited access to medical care.

In developing countries, people who live in urban areas tend to be negatively impacted by allergic respiratory diseases more than people who live in small villages and towns. Traffic plays a role in contributing to air pollution due to its gaseous and particulate emissions. There is a positive correlation between respiratory health issues and living near high traffic roads. An increase in frequency of Asthma

attacks are caused by an increase in air pollution. Respiratory diseases are extremely prevalent and harmful and are the third largest cause of deaths in India (Table 1 and figure 1).

Country	India
Cardiovascular diseases	13.57%
Cancers	5.52%
Diabetes, blood, and endocrine diseases	0%
Mental and substance use disorders	4.66%
Respiratory diseases	7.03%
Other NCDs	4.59%
Liver disease	1.54%
Diarrhea and common infectious diseases	0%
Neonatal disorders	9.25%
Maternal disorders	0.52%
Musculoskeletal disorders	4.52%
Unintentional injuries	4.83%
Neurological disorders	3.66%
HIV/AIDS and tuberculosis	0%
Transport injuries	2.72%
Self-harm	2.18%
Interpersonal violence	0.57%
Conflict and terrorism	0.02%
Natural disasters	0.04%
Malaria and neglected tropical diseases	1.42%
Nutritional deficiencies	4.00%
Digestive diseases	3.22%
Other Communicable disease	0%

**Table 1:** Burden of disease by cause- India, 2017.

*Respiratory diseases are the third largest cause of death in India after cardiovascular diseases and neonatal disorders. 7.03% of deaths due to diseases are caused due to respiratory diseases alone.*

Climate Change negatively impacts the growth of plants and crops which affects natural animal and human habitats. This change has negative economic consequences and can affect the welfare of a country [26].

Through research the impacts of climate change on the mortality and morbidity of human health have been found. The effects on the habitat of plants and animals could not be quantified.

The global economic cost of air pollution from fossil fuels are estimated at US\$2.9 trillion in 2018, or 3.3% of the world GDP. An estimated 4.5 million people died in 2018 due to exposure to air pollution from fossil fuels [27].

**Outdoor and indoor air pollution effects on respiratory health**

Air pollution and its elements have a direct impact on climate change. Data shows that exposure to particulate matter can cause respiratory diseases.

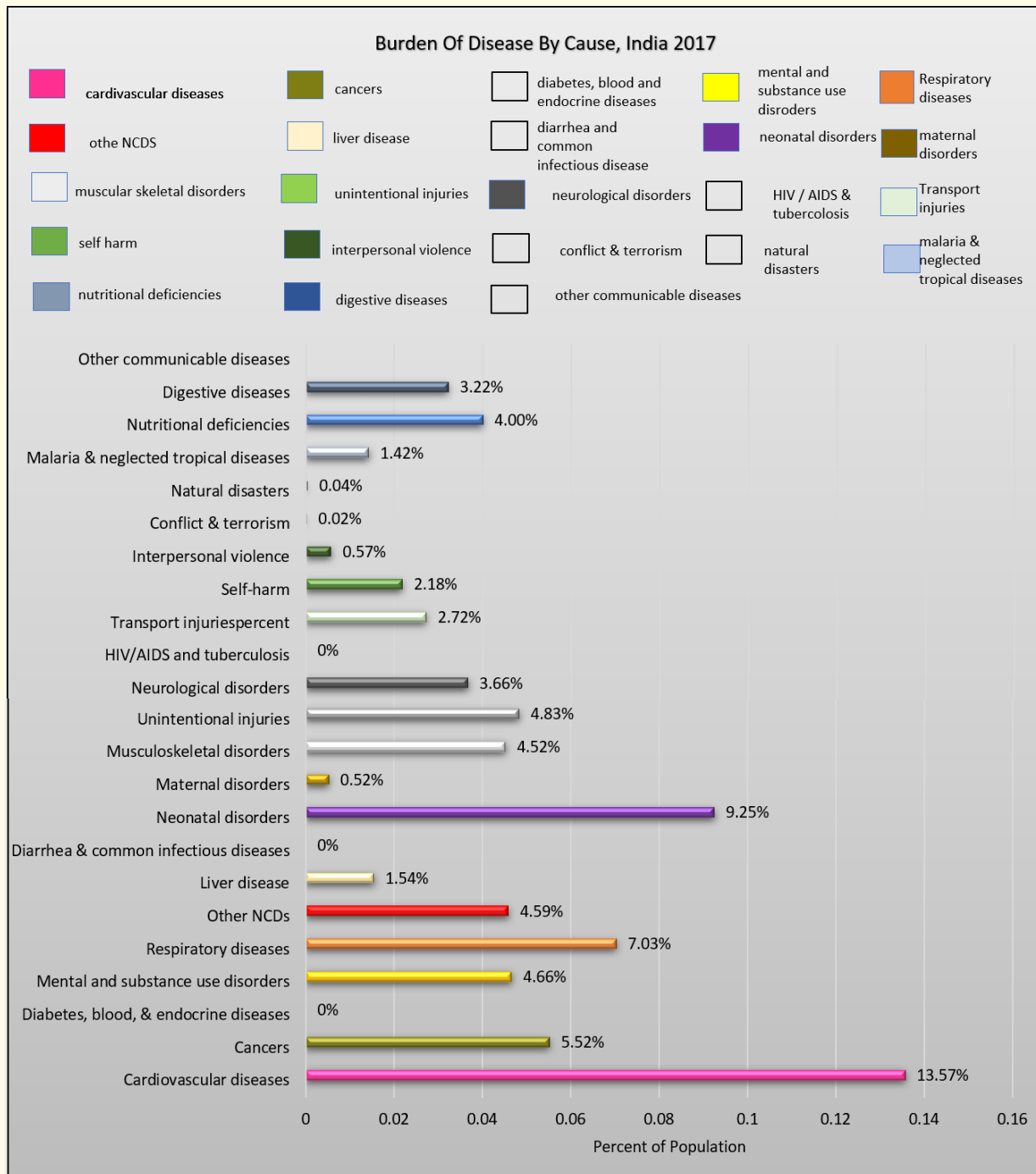


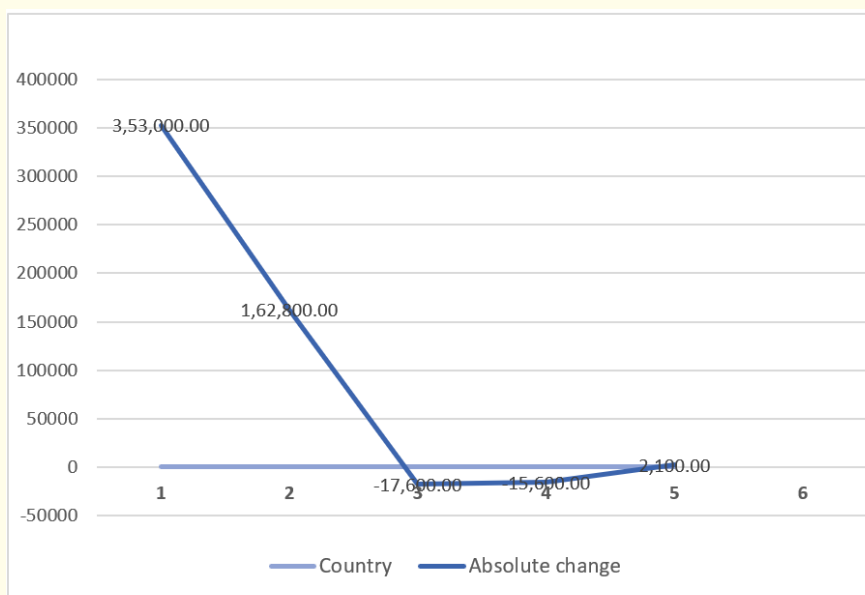
Figure 1: Burden of disease by cause-India, 2017.

1. The amount of pollen produced increases when the concentration of carbon dioxide increases.
2. People living in larger cities have a higher chance of contracting respiratory diseases and allergies due to pollen as compared to people who live in small towns with lesser air pollution and particulate emissions.
3. Particulate matter in air pollution impacts individuals by having an inflammatory effect which causes easier transmission of allergens into the membranes which can weaken the immune system [1,3].

Air pollution is abundant in almost every developed/developing country in the world and each year, a large number of deaths are caused due to air pollution. This number is increasing year by year and India has one of the largest number of deaths caused by air pollution (Table 2 and figure 2 and 3).

Country	Start 1990	End 2015	Absolute change	Relative change
1. India	737,400.00	1.09 million	3,53,000.00	48%
2. China	945,300.00	1.11 million	1,62,800.00	17%
3. United States	106,000.00	88,400.00	-17,600.00	-17%
4. United Kingdom	42,800.00	27,200.00	-15,600.00	-36%
5. United Arab Emirates	500.00	2,600.00	2,100.00	420%

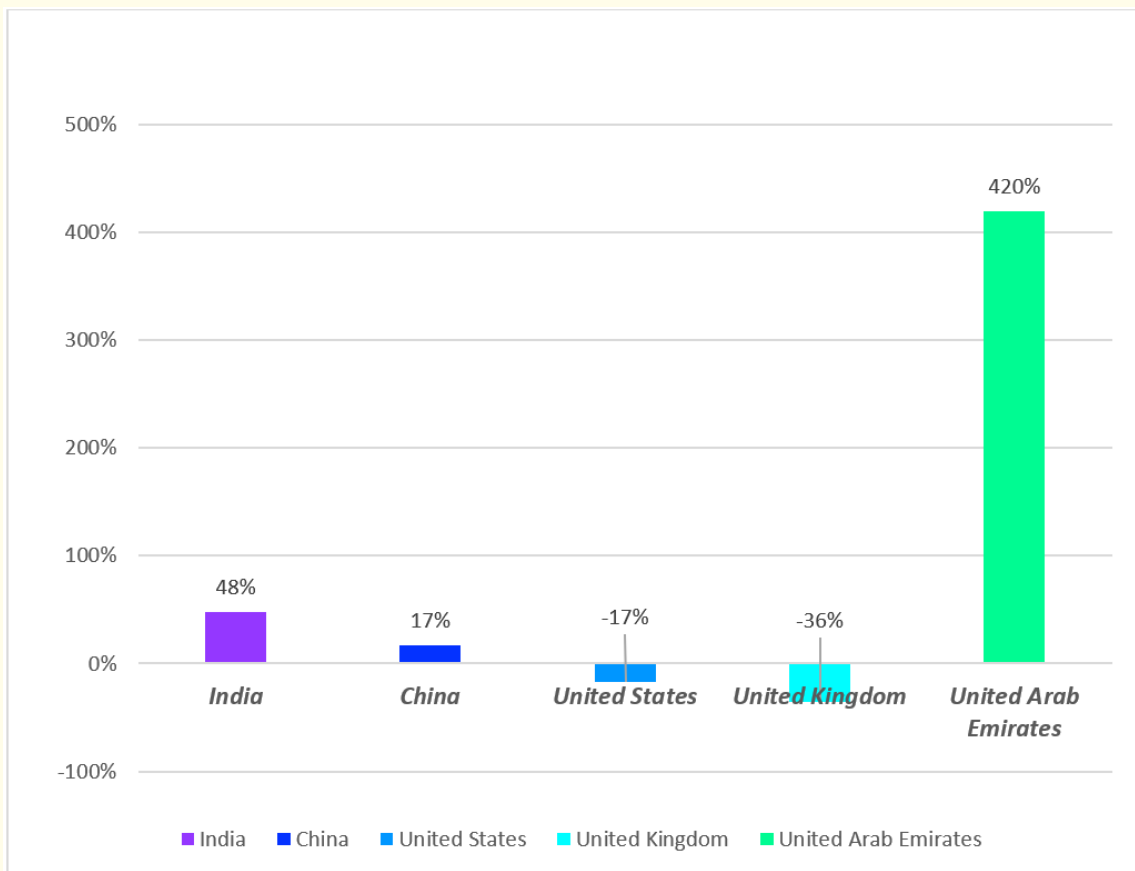
**Table 2:** Absolute deaths from ambient Pm2.5 air pollution- state of global air.



1.	Indian
2.	China
3.	United States
4.	United Kingdom
5.	United Arab Emirates

**Figure 2:** Absolute change in the number of deaths from 1990 to 2015.

Even though China has a larger number of deaths than India with a lead of 1.11 million deaths occurring, however India still had the largest change in the number of deaths (3,53,000.00). This data shows us that Air pollution in India is also increasing at an alarming rate and potentially harmful for the country.



**Figure 3:** Relative change in the number of deaths from 1990 to 2015. Dubai has the largest relative change in deaths due to air pollution with a lead of 420%. Even though it has the smallest number of deaths (2100).

**Elements of air pollution in urban areas**

The increasing number of emissions of pollutants in the air due to industrial growth in the last few decades has made it an environmental problem.

Nitrogen dioxide, ozone, and particulate matter are the most abundant components of air pollution in large cities [1].

**Particulate matter**

It is a mixture of solid and liquid particles that are organic or inorganic and of varying origins, size, and composition [5]. A large amount of particulate matter is present in the air and has negative impacts on human health. Entrance through the bronchial tract depends on how big the particle is and how efficient airway defence mechanisms are [6].

Through research it has been found that,  $PM_{2.5}$  appears to be more harmful for the development of respiratory and cardiovascular disease compared with  $PM_{10}$  [20-22].

$PM_{10}$  can pass through the lower airways and  $PM_{2.5}$  is thought to be more dangerous since it can be inhaled more deeply into the lungs at the alveoli level [23].

### Diesel exhaust particles

A significant amount of urban particulate matter originates from diesel and these particles are extensively being researched on. This is an important correlation as a larger number of cars have started using diesel engines in industrialised countries.

Being exposed to diesel exhaust results in headaches, lung function abnormalities, fatigue and nausea, while continuous exposure is associated with cough, mucus production, and decrease in lung function, data shows that these can modify the immune response in animals and humans harm the inflammatory process in the airway [7].

The effects are extreme in patients with moderate asthma.

### Nitrogen dioxide

Exhaust from automobiles is a major source of nitrogen dioxide. Nitrogen dioxide, being similar to ozone is an oxidant pollutant. However, it has a lower chance of inducing airway inflammation as it is less chemically reactive.

### Ozone

It is the element of air pollution that causes bronchial inflammation. Inhaling this can induce epithelial damage and causes the upper and lower airways to become inflammatory due to an increase in levels of neutrophils, eosinophils, mononuclear cells, fibronectin and bronchoalveolar lavage fluids [8].

High ozone levels in the atmosphere seem to be inducing asthma in individuals.

Negative impacts of ozone include lung problems, airway inflammation, asthma, and increase in severity of respiratory diseases [9]. Research has reported that long-term exposure to ozone may increase asthmatic tendencies in both adults and children [10].

### Weather and climate-related effects on respiratory health

Changes in weather and climate significantly increase the risk of respiratory morbidity in adults with common chronic lung diseases, such as asthma and Chronic Obstructive Pulmonary disease, and other serious lung diseases [11,12]. The risk of respiratory diseases in children has a direct correlation with high temperatures and this can trigger asthma symptoms. Cyclones have also been related to asthma and so do low temperatures by increasing cold exposure, which will negatively impact with COPD [13].

The correlation between weather (pressure, temperature, humidity) and respiratory diseases in individuals is poorly understood.

In recent times the extreme weather events, such as heat waves, heavy rainfall, and thunderstorms have started occurring more frequently which has led to an increase in the number of people affected and hospitalised due to respiratory diseases.

### Pollen and mould allergy

One of the most important components of air in its natural state is pollen. Pollen causes many airborne allergic diseases that are very common in developing countries.

There is a very complex correlation between pollen and climate change [1,2].

The amount of pollen could increase due to mechanisms such as an increase in carbon dioxide or high temperatures. Research shows that extensions to the flowering season due to climate human exposure and increase the risk of allergy. Data suggests that allergic respiratory diseases caused by and related to pollen such as rhinitis and asthma have increased in the past few years.

Thunderstorms taking during the pollen season are dangerous for people with pollinosis as they can induce asthma. associations have been identified in multiple locations around the world [14,15]. Climate change will increase occurrence of floods and cyclones which increases fungal spore production which is a powerful asthma and rhinitis trigger [16]. Causes of natural disasters such as floods and cyclones increase depression, anxiety and stress which risk factors for asthma.

### Conclusion

The need of the hour is to decrease the effect of climate change on respiratory diseases. To do this we must be more mindful of our actions so as to try and curb climate change.

The action we can take against climate change is:

1. Industries should use non-polluting factors of production.
2. Encouraging people to use public transport and carpools instead of their own private vehicles in order to lessen air pollution.
3. Schemes to plant trees in places around the city.

All of these measures can benefit human health.

In conclusion, citizens must be aware of just how serious this climate change problem is and it is the job of the educated people everywhere, including professionals and respiratory doctors to make others aware not only of the severity of the problem but also of how irreversible the damage we are doing is.

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