

Impact of air pollution and global warming on human health: an urgent need to mitigate by stakeholders

Introduction

Air Pollution global warming and climate change are inter related and play a major role in causing increased Airway allergies which are the earliest onset non communicable disease with tremendous psycho-socio-economic health burden globally. They will be the defining issues for our health system in the 21st century. Nearly 8million people die from air pollution annually.¹

We need 420litre of oxygen per day and we exhale 350litre of Carbon Di Oxide. To get this we have to breathe 10,000litre of air per day and to carry the oxygen for every part of the body we need 10,000litres blood circulation every day. This gas exchange occurs in over 600million alveoli in lungs which are lined with thin membrane of 0.3micron. The air we breathe from atmosphere to reach alveoli for gas exchanges is carried by patent branching bronchial tubes over 100-200million. Our children suffer more from air pollution due to their anatomic and physiologic reasons (Table 1).

Table 1 The main source of air pollution²

Outdoor Air Pollution	Indoor Air Pollution	
	Aero- Biological	Irritants
<ul style="list-style-type: none"> • Automobile exhaust - Affect airways – Nox, SO₂, O₃, SPM, Photochemical oxidants - Toxic substances – CO, Lead - Carcinogenic – Benzene, PAH, Aldehydes. • Power plant emission • Open burning of solid waste • Construction related activities – dust • Mining activities • Pollens, fungi. 	<ul style="list-style-type: none"> • Dustmite- 60.00% • Cockroach -25.00%, • Fungi -07.50% • Pollens -07.50% • Pets- 05.00% 	<ul style="list-style-type: none"> • Tobacco Smoke • Mosquito Coil Burning • Cooking Fuel • Formaldehyde Voaltile compounds from furniture made from compressed wood, panel boards etc.

The main source of air pollution are²

The air pollution pyramid can depict the progress of ill effects

from silent airway obstructions without symptoms to hospital visits, to emergency visits, to hospitalizations, and death³ (Tables 2–4).

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H Paramesh

Pediatric Pulmonologist and Environmentalist, Lakeside Centre of Health Promotion and Lakeside Education Trust, Indian Institute of Science (I.I.Sc), India

Correspondence: H Paramesh, MD, Pediatric Pulmonologist and Environmentalist, Lakeside Centre of Health Promotion and Lakeside Education Trust, Distinguished Scientist/Professor Divecha Center for Climate Change, Indian Institute of Science (I.I.Sc) Bangalore, India, Email drhperamesh@gmail.com

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Table 2 Outdoor air pollutants ^{4,5}

Chemical	Source	III Effect
CO Carbon Mono Oxide	50% of all our air pollution motor vehicles	Low level of oxygen[<i>Hypoxia</i>] No effect of Lung Function
SO₂ Sulphur Di Oxide	Motor Vehicles, Power Plants, 75% from fossils fuels	· Airway Inflammation both upper and lower airways. · Decreases Mucus clearance · 10 fold sensitivity to asthma · Increase resistance to air flow
NO_x Oxides of Nitrogen	Motor Vehicles	· Increase resistance of flow of air · 60% increase in asthma attack · Increase sensitivity to dust mites.
O₃ Ozone	Motor Vehicles slow moving vehicles with higher emission in summer with bright sunlight and low wind velocity.	· Extreme irritant to respiratory tract · There is 43% increase in asthma. · Asthma increase in summer by 16 times in 15 years.
SPM 10 to 2.5 micron suspended particulate matter	Diesel Vehicle	· Airway Inflammation · Cardiovascular disease · Cancer
Lead	80% from Automobile Exhaust from leaded petrol, paint, battery, crystal glass, enamel jewelry	· Abdominal cramps · Anemia · Convulsions coma and death.

Table 3 Indoor air pollutants ^{4,5}

Agents	Source	III Effect
Aerobiological Dust mites 60%	Bed, blankets, pillows, stuff toys, carpets, upholstered furniture, heavy draperies	Allergic nose problem, sinusitis, adenoidal hyper trophy, asthma
Cockroach 25%	Kitchens, stores, drains, garbages, ill maintained houses	Allergic rhinosinusitis , asthma,
Fungus 7.50%	Wet humid, ill ventilated houses, basement, attics, Shower curtains, indoor plants not exposed to sun light	Allergy respiratory problems asthma.
Pollens 7.50%	Tree pollens- Jan-Apr Grass pollens-July-Nov Weed Pollens- Nov-Jan	Allergy respiratory disease, seasonal asthma.
Pets 5%	Cats are more allergic, skin scales, urine and saliva	Allergies respiratory problems. Improved cases. Dogs are stress busters

Table 4 Indoor Air Pollutants

Irritants	Source	III Effects
Tobacco Smoke	From Smoking	Fetus in mothers womb is affected by third hand Smoke. Prematurity, low lung capacity, more wheezing, blood pressure and heart problem and cancer
Mosquito coil	Burning of coils to prevent mosquito bite	One coil is equivalent to burning of 70-100 ciggrates and has ill effects of tobacco
Chulhas	Cooking in Chulhas with fire woods	Nearby 400 ciggrate smoking ill effect
Formaldehyde Volatile organic compounds(VOC)	Modern furniture made of compressed wood and panel boards etc.	Extremely irritant to respiratory tract and has cumulative effects.

Causes for climate change and global warming to increase airway allergies

It has been observed that during the preindustrial times before 1800; the carbon-di-oxide (CO₂) emission was from respiration of humans, animals, volcanic eruptions, decomposition of dead materials, burning and from forest fires. Now in addition to we are adding by rapid urbanisation,⁴ automobile emission and deforestation, intense animal's agriculture to meet the need of non-vegetarians.⁵ It is the burning of fossil fuel in large quantity contribute for the CO₂ concentration and global warming.⁶

The temperature of our planet earth is raising mainly due to increased concentration from greenhouse gases concentration, such as carbon-di-oxide, nitrous oxide and methane which will prolong the flowering season and increase the allergic season from pollens. In addition new plants with new pollens will emerge.

The global warming produces of potent pollens and the deisel particle coated pollens are 50times more potent and produce stronger and prolonged symptoms of allergy.⁷

Sudden change in the temperature causes increase sensitivity to develop respiratory and ocular symptoms, decrease in lung functions (FEF) and more pronounced inflammatory nasal response. Both early and late phase phenomenon are expected to occur.²

It takes 4 weeks for lungs to recover from the ill effects of inhaled of urban polluted for 30mins.

WHO reported that in the year 2014 that there are 1600 cities around the world which have dirty atmosphere. Thirteen for the top twenty most polluted cities in the world are situated in India Delhi

pollution level of PM 2.5micron is 153 that are 6times higher than recommended by WHO. The major cause of air pollution and global warming and climate change in our country are⁸

- Increase vehicular traffic: 66.28% of total consumption of diesel
- Coal powered thermal plants: Account for 60.72% of India's total power generation
- Use of biomass: 87% in rural 26% is urban households
- Use of Kerosene: 30% of rural households

It is also predicted that we can save \$105 billion by 2030 if we can reduce the particulate emission by 30%⁸

Health issues of Air pollution observed in our study

Air pollution both outdoor and indoor air pollution have impact from womb to tomb many occasion it is difficult to separate them distinctly.

There is significant increase in upper respiratory allergies and its comorbidities such as –

- Allergic rhinitis increased in general pediatric population from 22.5% to 27.5% between 1994-1999 and in asthmatic children it is gone up from 75% in 1999 to 99.6% in 2011.^{9,10}
- The comorbidities of allergic rhinitis like otitis media is 22.5%; sinusitis is 34.8% and conjunctivitis is 27.5%.^{9,10}

The lower respiratory airway allergy: Asthma is also increased 9% to 26.1% from 1979 to 2016 as shown in Figure 1.

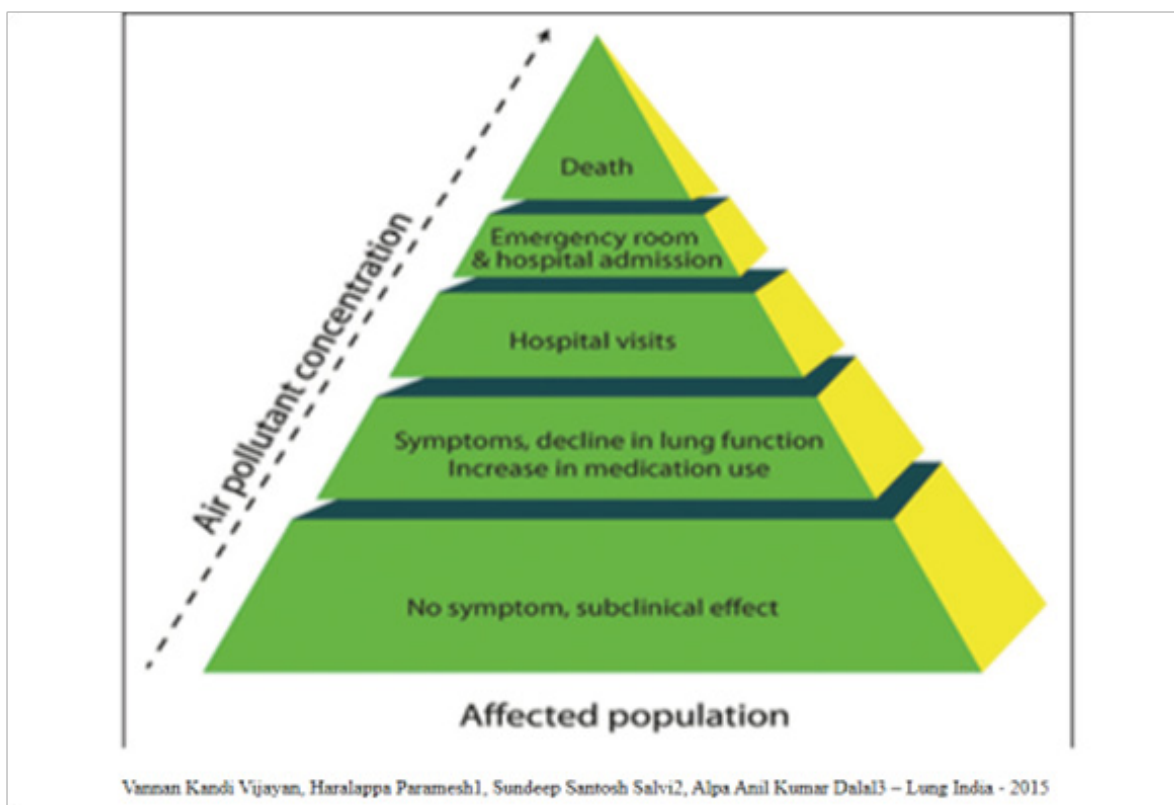


Figure 1 Pollution pyramid

Children from heavy traffic area school suffer more asthma and it further increase in low socioeconomic children.⁹ Urban children suffer more in asthma than rural children as shown in Figure 2.⁹ Emergency

room visit from asthma increased by 100% during Diwali festival where bursting of crackers happen by increasing the air pollution by sulphur-di-oxide as shown in Figure 3.¹⁰

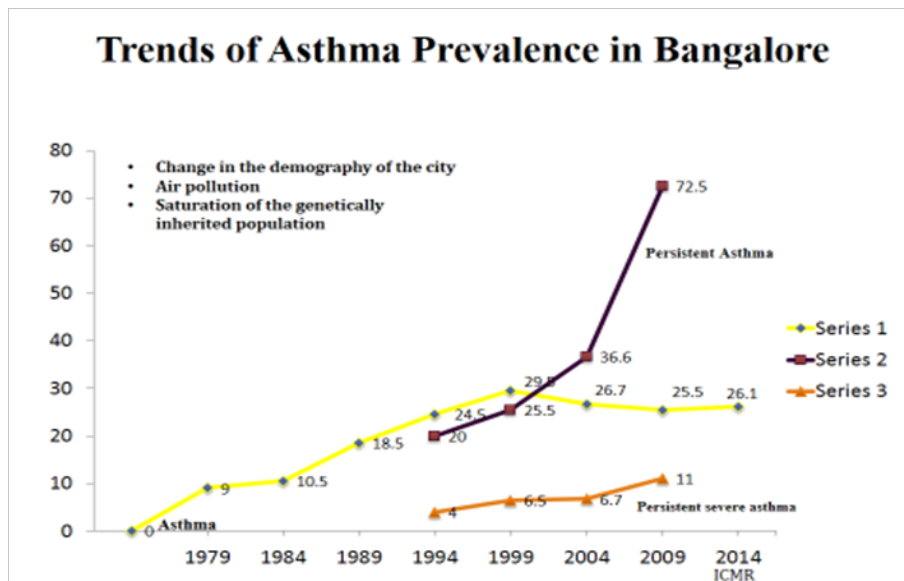


Figure 2 Asthma prevalence in Bangalore.

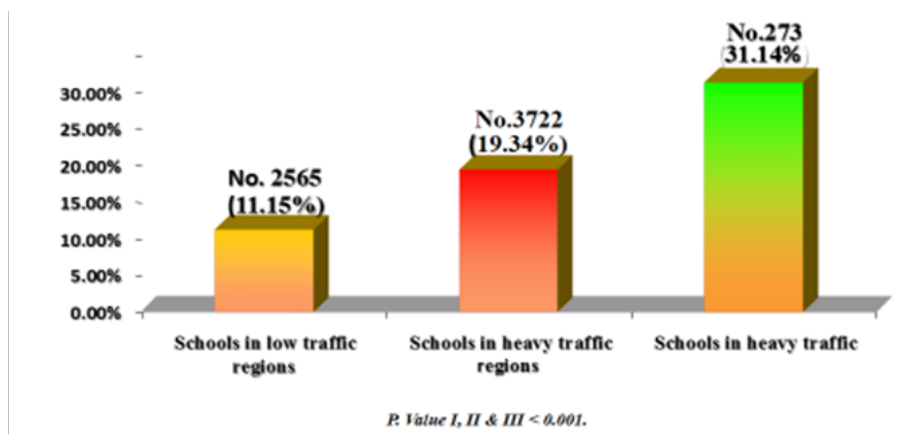


Figure 3 Children of heavy traffic school areas suffer more from asthma.

Asthma is increased in summer season from 2.8% to 28.8% between 1994-2009 and is hypothesised due to secondary production of increased ozone level Figure 4.¹¹ Double the number of traffic police personnel suffer from air pollution than non-traffic police personnel as shown in Figure 5.¹² Use of non-commercial cooking fuel has shown 6 times more prevalence of asthma Figure 6. Children living in single room, ill ventilated huts and use of non-commercial cooking fuel showed 10 ½ times more prevalence of Acute respiratory infection Figure 7.¹⁰ Single person smoking in the house increases the prevalence of asthma by 3 times Figure 8.¹⁰

Chronic cough over 2 weeks with comorbidities are increased from 8 to 21.25% between 1999-2017.^{12,13}

Wheeze in preschool children is a global phenomenon. Nearly 77.7% of our children under 5 yrs are wheezers in them 26.3% are below 1 year of age.¹⁴ Wheeze in preschool children is increased by 4 fold by prenatal exposure to SPM 2.5micron particles from 35.5µ to 53.5micron Figure 9.¹⁵

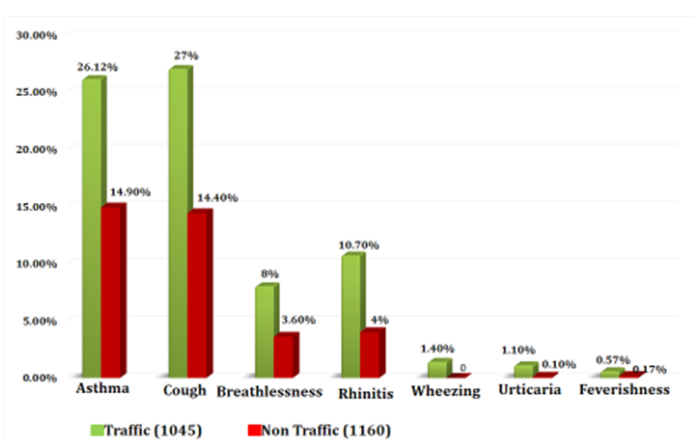


Figure 4 Traffic Police suffer more from Air Pollution than Non –Traffic Police.

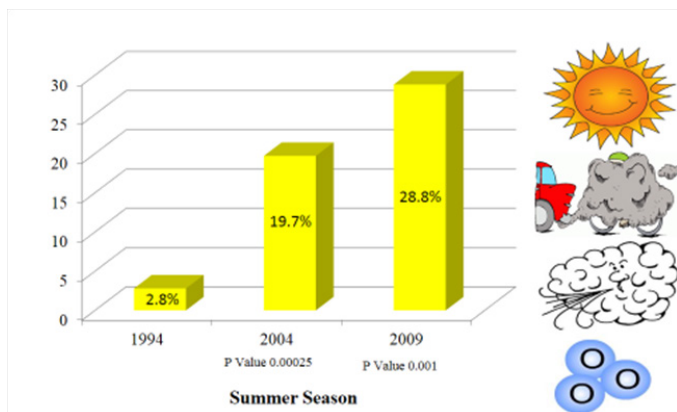


Figure 5 Changing Seasonal Pattern of Asthma Episodes

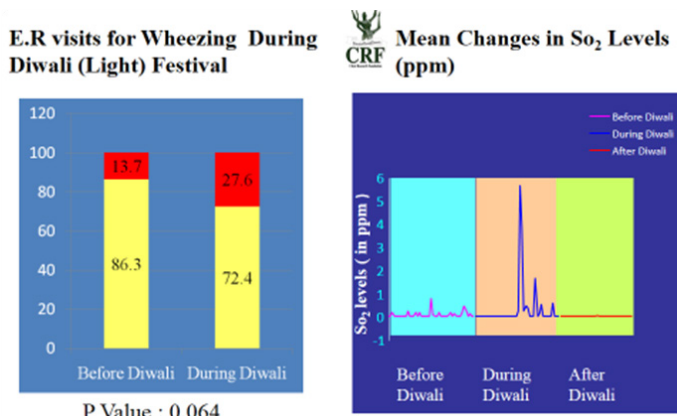


Figure 6 E.R visits for Wheezing during Diwali Festival and Mean Change in SO₂ Levels.

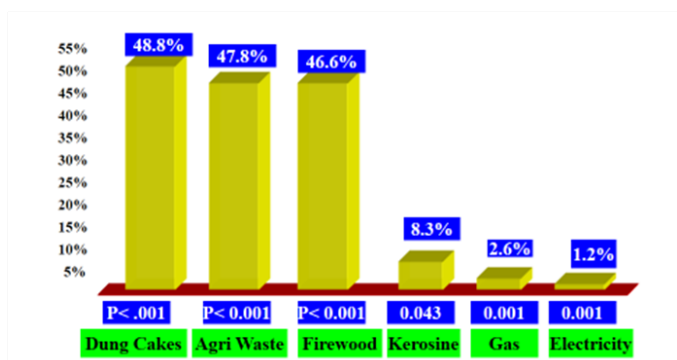
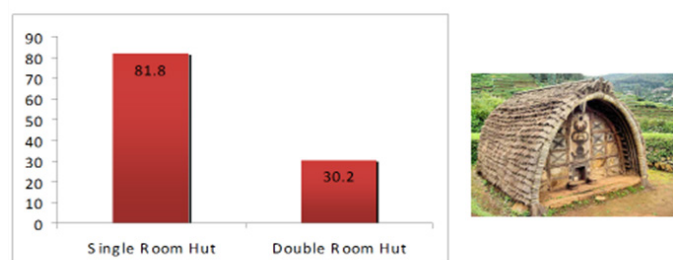


Figure 7 Cooking Fuel V/s Prevalence of Asthma in Children.

No. of houses 612, children <5 years 301



Children living in single room are 10.5 times more likely to develop respiratory infection when compared to children living in double rooms. P < 0.001**

Figure 8 Point Prevalence of respiratory infection/indoor pollution A Rural Study.



Figure 9 Cigarette Smoking Parents V/s Asthma Prevalence in children.

Measures to mitigate air pollution and global warming:¹⁶

- Quality education of stake holders on the magnitude of the disease burden on psycho socio economic front with convincing data.
- Reduce air pollution by setting guidelines on both outdoor and indoor air pollution.
- Reduce personal automobiles and encourage mass transport. Reduce usage of fossil fuel which is the major contributor for air pollution, global warming and climate change. Look out for electric motors vehicles in future
- Finding out new energy source – Preferably solar energy, atomic energy with strict safeguarding the waste management
- Increase greenery: Planting more trees to reduce Carbon dioxide and produce more oxygen. One full grown tree gives free oxygen for 4 people per year. Ocean agriculture can enhance carbon sequestration and enhances the fish population. However one has to observe for biological oxygen demand.

Indoor plants helps in absorbing the formaldehyde, volatile organic compounds which are highly irritants to respiratory tract emitted from furniture’s from compressed woods, panel boards carpet glue etc.

The recommended plants are – firm, anthurium, bamboo, chrysanthemum and money plants. Please note that these plants should be exposed to sunlight and tray of water should be removed weekly to avoid fungal growth and to mosquito breeding.

- For sustainability of the cities and communities one has to plan the cites to match the need and supply with good roads, clean drains, clean chimneys, good footpaths for children and senior citizen, maintain parks, playgrounds, plant trees and having bicycle paths are a must.
- We have to highlight the economic burden to policy makers and implementing strict guidelines to prevent air pollution how much we can gain economically over the years
- Social determinants dictate terms for sustainability. We should aim to reduce the population growth and encourage family planning. No government could able to match the needs of rapid growing demands.
- When authorities and policy makers fail to control air pollution the society should activate our legal system to achieve societal needs
- Air pollution produce inflammation of airways by oxidative stress hence we have to recommend our patients to use

foods with more oxidants like fresh fruits, vegetables, butter and encourage yogurt, curds to replenish protective germs in the gut, fish and other omega 3 fatty acid food to reduce inflammation. Always encourage local traditional food habits.¹⁷

Conclusion

- a) Airway allergic diseases are the earliest onset non communicable disease of environment origin with major psycho-socio-economic burdens.
- b) Society should involve and determine the health care management by the collective efforts of all stake holders for sustainability.
- c) Influence the policy makers with quality education in budgeting to promote research on traditional local values on care along with cure
- d) It demands think locally act locally and propagate the results globally
- e) LINK for progress of health science – include ethical participation of practitioner's academicians, researchers and pharma companies.
- f) With new technologies interventions and energy sources with urgent need to put all the efforts by all stake holders we can mitigate air pollution, global warming climate change by 2030.

Acknowledgments

None.

Conflicts of interest

The authors declare no conflicts of interest in this work.

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