Understanding ill-Effects of Air-Pollution on our Health

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Does Air Pollution Impact Health at all?

Yes  No
30 Years Of Chest Surgery: A Chest Surgeon’s Perspective

1988

- 90% Lung Cancers: Smokers
- 10% Non Smokers
- Average Age Of Lung Cancer: 50-60
- Almost No Women
- Colour of Lungs: Pink in non-smokers; Black In Smokers

2018

- 50% Lung Cancers Smokers – 50% Non Smokers
- Average Age Of Lung Cancer: 30-40
- 40% Women Patients
- Colour of Lungs: Black in non-smokers as well as Smokers

www.lcf.org.in
Healthy Pink Lungs

Diseased Black Lungs

Toxins deposited in our Lungs Cannot be Cleaned

We Believe Lung Health Care is A National Emergency
What is the health impact of Air Pollution?
One cigarette per day is the rough equivalent of a PM$_{2.5}$ level of 22 μg/m$^3$

Source: http://berkeleyearth.org/air-pollution-and-cigarette-equivalence/
‘THERE IS NO NON-SMOKER IN INDIA’.
The whole country, on an average, smokes 5-7 cigarettes a day, including NEWBORNS!
Newborn Smokers?
51 per minute: India
What is the magnitude of the health impact of Air Pollution?
We Are Sitting On A Time Bomb

• India ranks **FIRST** in lung disease related deaths in the world - according to a report by the World Health Organisation (WHO) in 2014

• **10% of Total Deaths in India** caused due to Lung Diseases

• **14 of the 20** most polluted cities are in **India** and over 50% of the sites studied across India had critical levels of PM10/PM 2.5 pollution.
Which organs of the body are affected?
At what age does the harmful effect of air pollution start?
The harmful effects of Air Pollution start even before you are born

Environmental Working Group, 2005, 2009

287 pollutants, chemicals, pesticides identified in the umbilical cord blood
(Lead, Mercury, Perfluorochemicals, Polybromoninated Biphenyls)

(http://www.ewg.org/reports/bodyburden2/execsumm.php
What age group?  
Which sex?
If you breathe, you are under the attack of air pollution.
Who are most vulnerable?

- Unborn babies
- Children
- Elderly
Colour of Lungs: At Birth & Later
Pink Lungs
As we are born with...
Colour of Lungs
Of a non smoker in Delhi
Colour of Lungs Of a Smoker
Pneumonia Deaths and Prevalence in Children < 5 years

(Rudan I et al, J Global Health 2013; 3: 1; WHO March, 2014)

120 million children under 5 suffer from Pneumonia / year
8 million require hospitalization
1.1 million children die every year

>50% of childhood pneumonia deaths are attributed to household air pollution from the burning of biomass
Children are more vulnerable to the harmful effects of air pollution

- Growing lungs sensitive to chemicals and pollutants present in the air
- More physically active and breathe relatively more air than adults - therefore inhale more pollutants in the lungs
- Breathing zone is lower than adults, hence are exposed to greater concentration of pollutants

- Respiratory tract infections (upper and lower)
- Asthma
- Poor lung growth
Lung Function values across different parts of the world

PURE STUDY
(Population Urban Rural Epidemiology)

153,996 enrolled
128,152 clean data

38,517 healthy,
Nonsmoker M and F

(Duong M et al, Lancet Respiratory Medicine 2014; 1: 599-609)
Healthy adult Indians had lung function values that were 35% lower than age- and gender-matched Caucasians.

(Duong M et al, Lancet Respiratory Medicine 2014; 1: 599)

India, 1977

-20%

India, 2014

-15%

over 35 yrs

? Environmental
? Nutritional
? Lifestyle

(Kamat SR et al, JAPI 1977; 25: 531)
Air Pollution and COPD

55% of COPD Deaths and DALYs is attributed to ambient and household Air Pollution in India

Global Burden of Disease Report, 2017
Salvi S, Barnes PJ, Lancet 2009; 374: 733-743
Salvi S, Barnes PJ, CHEST 2010; 138: 1-3
Salvi S. Respirology 2018;
Salvi S et al. Lancet Global Health 2018;

COPD is the 2nd leading cause of death and DALYS in India

55% of COPD Deaths and DALYs is attributed to ambient and household Air Pollution in India

Global Burden of Disease Report, 2017
Salvi S, Barnes PJ, Lancet 2009; 374: 733-743
Salvi S, Barnes PJ, CHEST 2010; 138: 1-3
Salvi S. Respirology 2018;
Salvi S et al. Lancet Global Health 2018;
Air Pollution & Heart

- Hypertension
- Arrhythmias
- Increased Serum Lipid Concentrations
- Accelerated Progress of Atherosclerosis
- Myocardial Infarction (Heart Attack)
- Congestive Heart Failure
- Cardiovascular Mortality

The Multi-Ethnic Study of Atherosclerosis Air Pollution Study (MESA Air), University of Washington, 2004

Long-term exposure to ambient concentrations of fine particles (PM2.5) and nitrogen oxides (NOx) is associated with the progression of atherosclerosis as indicated by the accumulation of coronary artery calcium. Increases in air pollution can accelerate the development of atherosclerosis. One way to describe this damage is the premature aging of blood vessels.

http://www.epa.gov/air-research/multi-ethnic-study-atherosclerosis-mesa-air-study-research
Odds of having a Heart Attack

(In susceptible subjects)

Air Pollution & Brain

• Stroke
  ➢ Inflammation and blockage of arteries leading to stroke

• Mercury
  ➢ potent neurotoxins
  ➢ damage to brain and neurological functioning especially in unborn children and infants

• Lead
  ➢ long term mental & Socio-emotional effects
  ➢ developmental delays (retardation) in cognitive functioning
Air Pollution & Cognitive Development

- Reduced Cognitive development in Children
- Accelerated ageing in Elderly
Leaded Petrol reduced Intelligence

Banning of leaded petrol

Air pollution and cognition
Another reason to cut air pollution and record the health benefits likely to follow

PM2.5 associated with reduced cognition, especially in the children and the elderly
Is exposure to particulate matter air pollution associated with reduced brain mass in elderly females?

**Women’s Health Initiative Memory Study**

USA

1403 community dwelling older women without dementia

>70 yrs

Performed MRI scans as part of their regular screening + Measured PM pollution levels

For a 3.5µg/m³ increase in PM2.5, white matter reduced by 6.2cm³.

This was equivalent to 1-2 years of brain ageing

(Chen JC et al, Annals Neurology June 2015; 78: 466-476)
Discussion
In this large population-based cohort, living near major roadways was associated with increased dementia incidence. The associations seemed stronger among urban residents, especially those living in major urban centres and those who never moved. Although the increase in risk might appear moderate (eg, HRs varied from 1.07–1.12 for living <50 m away from a major road, depending on the region), this translates to 7–11% of dementia cases in patients who live near major roads attributable to traffic exposure (appendix). The associations...
Air Pollution & Diabetes

• Long term exposure to air pollution increases the Risk of DM several times.
European Journal of Endocrinology

MECHANISMS IN ENDOCRINOLOGY

Effect of long-term exposure to air pollution on type 2 diabetes mellitus risk: a systemic review and meta-analysis of cohort studies

Bin Wang1,2, Donghua Xu3, Zhaohai Jing1, Dawei Liu4, Shengli Yan5 and Yangang Wang1

PM10: 15% ↑ ed risk (2 – 30)

PM2.5: 39% ↑ ed risk (14 – 68)
Air Pollution & Obesity

• Air Pollution is now recognised as a cause of Obesity.
Chronic exposure to air pollution particles increases the risk of obesity and metabolic syndrome: findings from a natural experiment in Beijing

Exposed to:
(1) Polluted Beijing air
(2) Filtered air from Beijing

Lab 2 km away from main road

15-20% heavier

*Significant difference (p<0.05) between the Filtered and Unfiltered groups
“Pollutants as Obesogens”

You are Fat not only because of

What you eat

But also, because of

What you breathe
Air Pollution & Reproductive / Neonatal Health

- Male & Female infertility
- Miscarriage
- Difficult pregnancies
- Premature & low birth weight infants
- Congenital abnormalities including Downs syndrome, mental & physical retardation, physical deformity, organ deformity etc.
Air Pollution & Eyes

- Redness
- Burning sensation
- Watering
- Ropy discharge

- Itching sensation
- Dry, gritty sensation
- Difficulty in vision due to watering and itching
- Dry Eye Syndrome

Allergic reaction: Severe itching, redness, discharge, eyelid swelling, inability to open eyes, vision problem and risk of infection (conjunctivitis, ulcers).
Air Pollution & Skin Hair

- hair fall, dandruff and poor hair texture
- decreased moisture and elasticity
- acne
- dull and dry skin
- eczema

- skin allergies
- rashes
- wrinkles and premature aging
- ozone depletion and ultraviolet radiation leading to Skin Cancer

According to the large scale survey by Journal of Investigative Dermatology, traffic air pollution is linked to the formation of dark spots, pigmentation and wrinkles.
HEALTH EFFECTS OF AIR POLLUTION

Growing fetus

Lungs
- Infections
  - Asthma
  - COPD
  - Lung Cancer

Heart
- Hypertension
- Ischemic Heart Disease
- Heart Failure

Vascular
- Stroke

Endocrine
- Obesity
- Diabetes
- Metabolic Syndrome

Brain
- Cognition
- Depression
- Alzheimers

Irritation of eyes, nose, and throat
Breathing Problems
- O₃, PM, NOₓ, SO₂, BaP

Impacts on the respiratory system: Irritation, inflammation, and infections.
Asthma and reduced lung function.
Chronic obstructive pulmonary disease (PM).
Lung Cancer (PM, BaP)

Headache and anxiety (SO₂)
Impacts on the central nervous system (PM)

Cardiovascular diseases
- PM, O₃, SO₂

Impacts on liver, spleen, and blood (NOₓ)

Impacts on the reproductive system (PM)
Does it shorten our life?
Air Pollution Kills 6.5 million people every year

Top 10 leading countries

Air Pollution kills 3-times more people than those due to HIV-AIDS, TB and Malaria all put together

(Landigam P et al, The Lancet Commission on Pollution and Health; Lancet Oct 2017; Pages 5-55)
Health Impact Surveys

Harvard T.H. Chan School of Public Health: Short Term Exposure – Health Impact

Objective  To estimate the association between short-term exposures to ambient fine particulate matter (PM$_{2.5}$)

- 10 Year Long Study
- During the study period, 22 million people in the study population died.
- The study found that, for each 10 µg/m$^3$ daily increase in PM$_{2.5}$, the daily mortality rate increased by 1.05%

For example, an increase of just 1 µg/m$^3$ in daily PM$_{2.5}$ over the course of one summer in the U.S. would lead to 550 extra deaths per year and 7,150 extra deaths over the course of the 13-year study period.

If We In India Can Believe International Studies For Medical Treatment We Follow, We Can Do So For The Health Impact Studies Too
Health Impact Surveys

Harvard T.H. Chan School of Public Health: Long Term Exposure – Health Impact

Objective  Effect of long-term exposure to airborne fine particulate matter (PM$_{2.5}$) and ozone in the risk of premature death,

• 60 million Americans 65+ over a seven-year period
• Representing 460 million person-years of follow-up
• Long-term exposure to airborne fine particulate matter (PM$_{2.5}$) and ozone increases the risk of premature death, even when that exposure is at levels below the National Ambient Air Quality Standards (NAAQS) currently established by the U.S. Environmental Protection Agency.

If the level of PM$_{2.5}$ could be lowered by just 1 microgram per cubic meter (ug/m$^3$) nationwide, about 12,000 lives could be saved every year.

If We In India Can Believe International Studies For Medical Treatment We Follow, We Can Do So For The Health Impact Studies Too
The Global Burden of Disease Study estimates that Air Pollution related disease was responsible for 6.5 million pre-mature deaths in 2015.

GDB study by Institute for Health Metrics and Evaluation, University of Washington
What is the magnitude of the health impact of Air Pollution?
Air Pollution and its effects

- Death
- ER visits, Hospital admissions
- Doctor visits, absence from work
- Respiratory symptoms, medication use, Asthma attacks
- Lung function decrements, Inflammation, Cardiac effects

Proportion of population affected

Magnitude of impact

Severity of effects

Thousands
Tens of Thousands
Millions
Air Pollution is a National Public Health Emergency
Life of 1.3 Billion People of India at risk