Public Health Challenges Of Air Pollution
KSPCB and CSE Workshop. Bangaluru:22-03-2013

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- Panelist. Macroeconomics and Health G.O.I
- Chairman, State of Environment and action plan G.O.K and World Bank
- Past Chairman TAC. K.S.P.C.B
- Founder Chairman of Environment Child Health/Allergy Appl Immul. Chapters of I.A.P
- W.H.O Faculty for Environmental Health
Our Bangaluru – Environmental Profile

• 920m above sea level. Fastest growing city in the world (Forbes – 2010)

• Daily temperature – Max:28.9°C Min:18.9°C (07)

• Average Rainfall – 80.8cm per year

• Growth of Bangalore: 69km² – 1949 741km² – 2007 800 km² – 2011

• We add 20km of built up area per year and loose 20% of green area per year

• Was named as air conditioned city, garden city, pensioners’ paradise What is now?

• Sneezing city, wheezing city and pensioners nightmare city
Bangaluru Urban Agglomeration Zone (BUAZ)

- **Population:**
  - 0.1m (1880); 1.6m (1971); 8.678m (2008)

- **Vehicles:**
  - 3.7 million (2011)
  - 10 fold increase in the last decade
  - 10% increase 1 year
  - 70% are 2-wheelers (2011)

- **Fuel Consumption:**
  - 3-3 ½ fold increase in consumption of automobile fuel

- **Slow traffic emit (10 km/hr) 5 ½ times more CO.**

- **Congestion costs `3000-4000 Cr/yr.**
  - Apart from Health cost

*Source: IOCL - 2008.; Dept of Transport, GoK, 2011*
LUNGS: THE AMAZING ORGAN

Children Suffer more from air pollution due to anatomic & physiological reasons

- 100-200 million branching tubes
- Should remain patent all the time

- 600 million alveoli
- Very thin membrane (0.3 micron)

- 10,000 liters air every day
- 10,000 liters blood every day

- 420 Lts of Oxygen
- 350 Lts of Carbon Dioxide
LIFETIME EXPOSURES OF POLLUTANTS

- Air
- Drinking Water
- Domestic Environments
  - Soil: Dermal
  - Soil: Ingestion
  - "Normal" Food
- Breast-feeding
- Intra-uterine
- Occupational Exposure

Birth  6mths  1yr  5yrs  16yrs  45yrs  65
Residential Proximity to main roads during Pregnancy and Risk of Asthma

- Japanese Birth Cohort Study, 756 pregnant mothers, Babies followed for 2 yrs after birth

  <50 mts versus >200 mts

  - Doctor diagnosed asthma: 4.0 (1.4-11.2)
  - Doctor diagnosed eczema: 2.3 (1.1-4.6)

  Maternal exposure to vehicular pollutants during pregnancy is strongly associated with early childhood asthma

- Air Pollution increases the risk of premature birth by 30%

(Miyake Y et al, Pediatr Allergy Immunol 2010; 21: 22-28)
AAP Smart Brief October 10, 2011
Prenatal exposure to air pollutants and risk of allergic respiratory symptoms at 1 year

- Mothers (n = 333, from Poland) underwent personal monitoring for air pollutants during the second trimester
- Prenatal ambient air exposure to polyaromatic hydrocarbons associated with increased risk of babies (followed over 1 year) developing:
  - Cough 4.80-fold
  - Wheezing 3.83-fold
  - Sore throat 2.56-fold
  - Ear infections 1.82-fold

(Jedrychowski et al, Eur J Epidemiol 2006; 20(9): 775-782)
Pollen become more allergenic when these trees grow in an urban environment.

Diesel exhaust particles increase allergen-specific IgE levels by up to 50-fold.

(Knox et al, Clin Exp Allergy 1997)
(Bryce M et al., Int Arch Allergy Immunol 2010; 151: 45-65)
ESTIMATED MORBIDITY FOR NON COMMUNICABLE DISEASES BURDEN IN INDIA

National Commission of Macroeconomics and Health GOI-2005
ESTIMATED MORTALITY FOR NON COMMUNICABLE DISEASES BURDEN IN INDIA

Number in lacs

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>2.92</td>
</tr>
<tr>
<td>IHD</td>
<td>1.20</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.02</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.21</td>
</tr>
<tr>
<td>Chronic Resp</td>
<td>5.77</td>
</tr>
<tr>
<td>Injuries</td>
<td>7.49</td>
</tr>
</tbody>
</table>

(Nongkynrih B et al, JAPI 2004 Feb; 52: 118-123) WHO, 2002 data
Under-five mortality by social groups in India

<table>
<thead>
<tr>
<th>Social groups</th>
<th>Rate per 1000 live-births</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC</td>
<td>119.3</td>
</tr>
<tr>
<td>ST</td>
<td>126.6</td>
</tr>
<tr>
<td>OBC</td>
<td>103.1</td>
</tr>
<tr>
<td>Other</td>
<td>82.6</td>
</tr>
<tr>
<td>All NCMH 2005</td>
<td>101.4</td>
</tr>
</tbody>
</table>
Ultrastructural nasal pathology in children chronically and sequentially exposed to air pollutants

**Electron microscopy of nasal mucosa**

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>Veracruz (n = 11)</th>
<th>Mexico city (n = 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epithelial shedding</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Necrotic cells</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td><strong>Goblet hyperplasia</strong></td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><strong>Patchy absent cilia</strong></td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Squamous metaplasia</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Intraepithelial PMN</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Intraepithelial monocyte</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Particulate matter in intercellular spaces</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

Calderon-Garciduenas L et al, AJRCMB 2001; 24: 132-138
IMPACT OF PARTICULATE MATTER POLLUTION ON LUNG FUNCTION IN CHILDREN

(64 children in Leicester city, UK)

8-15 yrs old
Excluded children with chronic respiratory infection

Sputum induction for alveolar macrophages

Alveolar macrophages showing different amounts of intracellular carbon particles

Each increase of 1μm² in carbon content in the alveolar macrophage –
17% ↓ in FEV1
12.9% ↓ in FVC
34.7% ↓ in FEF25-75%

Passage of Inhaled Particles into the Blood Circulation in Humans

Radio-labeled Tc$^{99}$ particles <100nm

Found in blood within 1 minute and peak after 10-20 mins

(Nemmar et al, Circulation 2002; 105: 411)
Allergic Rhinitis: Magnitude

<table>
<thead>
<tr>
<th>Year</th>
<th>General Population</th>
<th>Asthmatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>22.5</td>
<td>1999</td>
</tr>
<tr>
<td>1999</td>
<td>27.5</td>
<td>75</td>
</tr>
<tr>
<td>2004</td>
<td>81.7</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>99.6</td>
<td></td>
</tr>
</tbody>
</table>

H Paramesh I.A.P Text book Pediatric - 2013
Prevalence of Snoring/OSAS

No = 950
Age = 2-17yrs

Primary Snoring: 8%
76

OSAS: 1.05%
10

H Paramesh, Pankaj Sharma OSAS and DNB thesis Study 2010
Sleep disorder breathing (SDB) & Causes

- Allergic Rhinitis = 58%
- Adenoid Hypertrophy = 50%
- Asthma = 35%
- Adenoid Hypertrophy = 7.9% & Asthma
- Adenoid Hypertrophy, AR & Asthma = 5.2%

8% of children had SDB

H Paramesh, Pankaj Sharma OSAS and DNB thesis Study 2010
Trends in Asthma Prevalence in Bangalore

- 1979: 9%
- 1984: 10.50%
- 1989: 18.50%
- 1994: 24.50%
- 1999: 29.50%
- 2004: 26.70%
- 2009: 25.60%

H. Paramesh; Indian Journal of Pediatrics; Special Issue 2002, 2006
• H Paramesh International Conf on Environment and health 2010
Prevalence of Persistent Asthma

Indian Journal of Paediatrics: Special issue 2006
* H.Paramesh International Conf on Environment and health 2010
Persistent Asthma Grades and Prevalence

H. Paramesh . Ind. J. Ped 2006
* H. Paramesh International Conf on Environment and health 2010
Changing Seasonal Pattern of Asthma Episodes

Dr. H. Paramesh: International Journal on Env Health 2008 Vol 12, nos ¾
IMPACT OF AMBIENT AIR POLLUTION ON ALLERGIC DISEASES

- Worsening of pre-existing asthma
- Increased emergency room visits for asthma exacerbations
- Increased hospitalization for asthma
- Increased use of anti-asthma medication
- Increased prevalence of Allergic Rhinitis, Otitis Media and Sinusitis.

Children of heavy traffic school suffer more from asthma; it further increases in low socioeconomic children

Asthma prevalence

- Low traffic: 11.15%
- Heavy traffic: 19.35%
- Heavy traffic + low socioeconomic: 31.14%

Dr. H. Paramesh; Indian Journal of Paediatrics, 2002; 69(4): 309-312

Traffic Police Suffer More from Air Pollution than Non-Traffic Police

<table>
<thead>
<tr>
<th>Condition</th>
<th>Traffic (1045)</th>
<th>Non Traffic (1160)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>26.12%</td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Breathlessness</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Rhinitis</td>
<td>10.70%</td>
<td>4%</td>
</tr>
<tr>
<td>Wheezing</td>
<td>1.40%</td>
<td>0</td>
</tr>
<tr>
<td>Urticaria</td>
<td>1.10%</td>
<td>0.10%</td>
</tr>
<tr>
<td>Feverishness</td>
<td>0.57%</td>
<td>0.17%</td>
</tr>
</tbody>
</table>

H. Paramesh, XI National Symposium on Environment, BARC, 2002
H. Paramesh State of Env& action plan - 2005
Distance of living away from the center of the city / asthma

Nearly 2 ½ times less suffering of they live 20Km away from the center of the city

Traffic Police
Non Traffic Police

Source - H. Paramesh, XI National Symposium on Environment 2002
H. Paramesh State of Environment & action plan - 2005
BARC
E.R visits for Wheezing During Diwali (Light) Festival increased by 100%

Mean Changes in So$_2$ Levels (ppm)

Ambient SO2 levels reached values 200 times above the safety limits recommended by WHO

P Value : 0.064

H Paramesh 5th Intnl confi env & health - 2010
H Paramesh . I.A.P Text book of Pediatric - 2013
Lead Poisoning

• Ingested, inhaled or absorbed through skin
• **Source:**
  - 86% of atmospheric lead – auto exhaust, leaded petrol, water pipes, paint, battery storage, crystal glass, ceramic glaze, enamel jewelry, etc.
  - Lead concentration in dust is directly proportional to the volume of traffic
  - Children absorb 50% and adults 10-20% of ingested lead.
  - Lead in tissue, cord blood correlate with air levels.
  - Global burden 0.6% (WHO – 2010).
• **Effect:**
  - GIT, peripheral nerve, central nervous system, decreased IQ, convulsions, coma, death. 1 microgrm / dl decreases I.Q by 0.25 points
  - Saudi Arabia study – 5000 children – 1989 – using 0.8 G/L of lead in petrol showed no alarming lead poisoning.
  - Bangalore study – 863 children – using 0.59 G/L of lead in petrol showed – 4.6% of increased lead level over 10µg/dl*.
• **Trend:**
  - Use of unleaded petrol will reduce lead pollution. No cause for fear psychosis, however there should not be any complacency in preventive measures.

**AVOID MEDIAGENIC DISEASE**

## Indoor Air Pollution

<table>
<thead>
<tr>
<th>Aero-biologicals</th>
<th>Irritants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>❖ Dust mite</td>
<td>❖ Cigarette smoke</td>
</tr>
<tr>
<td></td>
<td>o 1994 - 6.0%</td>
</tr>
<tr>
<td></td>
<td>o 1999 - 7.5%</td>
</tr>
<tr>
<td></td>
<td>o 2004 - 7.9%</td>
</tr>
<tr>
<td>❖ Cockroach</td>
<td>❖ Mosquito Coil</td>
</tr>
<tr>
<td></td>
<td>o 2002 - 5.0%</td>
</tr>
<tr>
<td></td>
<td>o 2010 - 7.9%</td>
</tr>
<tr>
<td>❖ Fungi Pollens</td>
<td>❖ Other smokes</td>
</tr>
<tr>
<td></td>
<td>❖ Formaldehyde</td>
</tr>
<tr>
<td></td>
<td>❖ Volatile organic compounds</td>
</tr>
<tr>
<td>❖ Pets</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>❖ Viruses</td>
<td></td>
</tr>
<tr>
<td>❖ Food</td>
<td></td>
</tr>
</tbody>
</table>

- Dust mite: 50% 5000/g
- Cockroach: 25.00%
- Fungi Pollens: 07.50%
- Pets: 05.00% (2002) 05.7% (2010)
- Viruses: 40.00%
- Food: 19.90%
- RSV
- Para influenza
- Corona
- Adeno
- Rhino

Childhood Pets Linked to Lower Allergy Risk

Family pets, in particular dogs, need not be removed to prevent allergies and in fact may protect against allergies.

Pets are not the cause for increased prevalence of asthma. They are stress busters.

Mclance Matheson et al. Journal of Allergy and Clinical Immunology online July 13, 2011

H. Paramesh Indian Journal of Pediatrics - 2002
The prevalence of asthma in ill ventilated houses is nearly 3 times more.

- WELL Ventilated: 8% (P:<0.001)
- ILL Ventilated: 22% (P:<0.001)

Paramesh H Cherian E 5th International Conference on Environment and Childrens health 2010
Paramesh I.A.P text book of Ped - 2013
Cigarette Smoking Parents V/s Asthma Prevalence in Children no - 418

Nearly 3 fold increase in asthma in a home with tobacco smoking parent

Paramesh H Cherian E 5th International Conference on Environment and Children's health 201
Paramesh H. I.A.P Text book of Ped - 2013
Cooking Fuel V/s Prevalence of Asthma in Children

There is nearly 20 times more asthma with the use of non-commercial cooking fuel.

Dung Cakes: P < .001
Agri Waste: P < 0.001
Firewood: P < 0.001
Kerosine: 0.043
Gas: 0.001
Electricity: 0.001

No – 418

Paramesh H Cherian E 5th International Conference on Environment and Childrens health 201
Paramesh H. I.A.P Text of Ped - 2013
Asthma v/s Dietary Habits

Vegetarians suffer nearly 4% less Asthma than Non vegetarians

- Vegetarians: 14.3%, 161 cases, P<0.482
- Non Vegetarians: 17.9%, 269 cases, P<0.545

H. Paramesh I.A.P text book of Ped - 2013
Incidence of Chronic Cough

- 1999: 8%
- 2010: 10.5%

Paramesh H Ped today 1999
Paramesh H Cherian E 5th Intnl Conf Env child health 2010
Point Prevalence of respiratory infection/indoor pollution
A Rural Study

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**

Dr. H. Paramesh, Elizabeth Cherian; International Conference on Environment and Child Health, Vienna, Austria 2007.
Take home message

- Air Pollution increases the non communicable respiratory diseases significantly.
- The economic and social burden is horrendous.
- The environmental degradation is unimaginable.
- We all have to pay thru our nose, lungs and heart.
- It is time that the preventive measures are taken at the earliest, while we are moving forward with less air pollution which can be sustained.
The Impact of Our Research Work

• Utilized by **Supreme Court of India**
  - In appointing Bhurelal Committee to **clean up the cities in a time-bound fashion**
  - Instructions to builders to follow strict **guidelines at school environment**

• Police personnel study **discussed in the Parliament** for remedial measures of the air pollution

• Brining **legislation to ban tobacco smoke in public places in Karnataka**

• Our work been cited in various peer reviewed journals and text books

• Instituted **lung functions, pulse oximetry and audiometry** to all the employees and public who have been affected by all industries in Karnataka

• Instituted measurement of **ozone, ultra-fine-particles(2.5microns) and sulphate** particles by Bangalore Metro Rail system
What Comes out:
Clean up the mess.
We hold our future in our hands and it is our children

I end with this beautiful reminder to us from a child in India. We must recognize the environmental risks to our Politically powerless children and assume our responsibilities for preventing them, because we hold our future in our hands — and it is our children.
“A Healthy Breath will always bring Healthy life”

“Each one Teach one and plant one tree”