Indoor Air Quality Issues in South Africa

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Presentation outline

- Indoor air pollution from domestic fuel burning
  - Why is it important?
  - What are the health effects?
- International studies on IAP from domestic fuel burning
  - Kenya
  - Bangladesh
  - Pakistan
  - Sri Lanka
  - Guatemala
- Indoor air pollution issues in South Africa
- Current activities in SA regarding IAP
- Other sources of indoor air pollution
- What is the way forward?
Why is indoor air pollution (IAP) from domestic fuel burning so important

- Worldwide, more than 3 billion people depend on solid fuels including biomass (wood, dung and crop residues) and coal, for cooking and heating
- Acute respiratory infections are the most important cause of death among children under 5 years of age in developing countries
- Globally, reliance on solid fuels has emerged as one of the ten most important threats to public health
- In 2000, WHO found that globally IAP was responsible for more than 1.5 million deaths and 2.7% of the global burden of disease
- The MRC Burden of Disease Research Unit ranked IAP at number 15 for South Africa, higher than urban air pollution

<table>
<thead>
<tr>
<th>Rank</th>
<th>Risk factor</th>
<th>% total DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unsafe sex/STIs</td>
<td>31.5</td>
</tr>
<tr>
<td>2</td>
<td>Interpersonal violence</td>
<td>8.4</td>
</tr>
<tr>
<td>3</td>
<td>Alcohol harm</td>
<td>7.0</td>
</tr>
<tr>
<td>4</td>
<td>Tobacco smoking</td>
<td>4.0</td>
</tr>
<tr>
<td>5</td>
<td>High BMI</td>
<td>2.9</td>
</tr>
<tr>
<td>6</td>
<td>Childhood and maternal underweight</td>
<td>2.7</td>
</tr>
<tr>
<td>7</td>
<td>Unsafe water sanitation and hygiene</td>
<td>2.6</td>
</tr>
<tr>
<td>8</td>
<td>High blood pressure</td>
<td>2.4</td>
</tr>
<tr>
<td>9</td>
<td>Diabetes</td>
<td>1.6</td>
</tr>
<tr>
<td>10</td>
<td>High cholesterol</td>
<td>1.4</td>
</tr>
<tr>
<td>11</td>
<td>Low fruit and vegetable intake</td>
<td>1.1</td>
</tr>
<tr>
<td>12</td>
<td>Physical inactivity</td>
<td>1.1</td>
</tr>
<tr>
<td>13</td>
<td>Iron deficiency anaemia</td>
<td>1.1</td>
</tr>
<tr>
<td>14</td>
<td>Vitamin A deficiency</td>
<td>0.7</td>
</tr>
<tr>
<td>15</td>
<td>Indoor air pollution</td>
<td>0.4</td>
</tr>
<tr>
<td>16</td>
<td>Lead exposure</td>
<td>0.4</td>
</tr>
<tr>
<td>17</td>
<td>Urban air pollution</td>
<td>0.3</td>
</tr>
</tbody>
</table>
## Health Effects (IAP from domestic fuel burning)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Mechanism</th>
<th>Potential health effects</th>
</tr>
</thead>
</table>
| Particulate matters (PM10/2.5) | Bronchial irritation  
Reduced mucocilliary clearance | Respiratory infections  
Chronic obstructive pulmonary disease (COPD) and exacerbation  
Wheezing, asthma  
Excess mortality including cardiovascular disease (CVD) |
| Carbon monoxide (CO)    | Binding with Hb (reduced oxygen delivery)  | Low birth weight  
Increased perinatal deaths                                                             |
| Benzopyrene             | Carcinogenic                                | Lung cancer  
Cancer of mouth, pharynx, larynx                                                       |
| Formaldehyde            | Nasopharyngeal and airway irritation        | Increased infections (?)  
May lead to asthma (?)                                                                       |
| Nitrogen oxides (NOx)   | Acute: bronchial reactivity  
Chronic: infections | Wheezing  
Respiratory infection and reduced lung functions                                           |
| Sulphur oxides (SOx)    | Acute: bronchial reactivity  
Chronic: particulate effects | Wheezing, asthma  
COPD, CVD                                                                                 |
| Smoke                   | Absorption of toxin into lens              | Cataract                                                                                   |
Kenya (Practical Action Project 1998-2001)

• Aim of project was to contribute to reduction of exposure to indoor air pollution
• 50 rural households participated in study from two areas (Kajiado and West Kenya)
• Evaluation of changes in pollution levels and community views about the process and interventions was carried out
• Baseline monitoring showed unacceptably high levels (24 hr PM10 of 1713 µg/m³ to 5526 µg/m³)
• Daily levels are comparable to annual rates in these societies
• Interventions considered included: windows, eaves spaces, and smoke hoods

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Reduction in PM10 (%)</th>
<th>Reduction in CO (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows</td>
<td>No observable change</td>
<td></td>
</tr>
<tr>
<td>Smoke hoods</td>
<td>75</td>
<td>78</td>
</tr>
<tr>
<td>Eaves spaces</td>
<td>60</td>
<td>28</td>
</tr>
<tr>
<td>Stoves</td>
<td>54</td>
<td>42</td>
</tr>
</tbody>
</table>
Kenya (Practical Action Project 1998-2001) 
Findings

• Positive Impacts
  ▪ Reductions IAP
  ▪ Improvement general comfort
  ▪ More time, increased income
  ▪ Less time spent in hospitals
  ▪ Savings due to increased efficiency

• Negative Impacts
  ▪ Cooler houses, more draughts
  ▪ Lack privacy and security
  ▪ Difficulty lighting wick lamps
Kenya (Practical Action Project 1998-2001)

Findings

Problems encountered

- No universal protocol for measurement (e.g. height and distance from fire)
- Lack “real time” data (when are peak concentrations experienced?)
- Equipment issues (power, filters becoming full before 24 hr)
- Cultural issues (women move between houses, babies born)
- Loss of houses in study post interventions (e.g. divorce)
Bangladesh

- Analysed exposure to indoor air pollution at two levels
  - Differences within households attributable to family roles
  - Differences across households attributable to income and education
- Found high levels of exposure for children especially for children under 5
- Among prime-age adults they found that men have half the exposure of women
- Found the poorest, least educated households have twice the pollution levels of relatively high-income households with highly-educated adults
- They proposed the pollution exposure for children in a typical household can be halved by increasing children’s time spent outdoors to 5 to 6 hours per day, and concentrating outdoor time during peak cooking times
Pakistan

- In Pakistan, biomass meets about 86% of total domestic energy requirements
- Biomass burned in inefficient three-stone stoves
- A fuel-efficient cooking technology project funded by GTZ of Germany implemented throughout Pakistan
- In a pilot project, smoke-free stoves with smoke-hoods were built in northern areas of Pakistan
- Potential for using biogas as rural energy throughout the country by a network of community biogas plants
- Pakistan produces enough animal waste for the production of biogas
In a rural district of Sri Lanka, women used to spend hours collecting wood for cooking and heating.

Practical Action showed the women the waste from their cows could provide them with all the energy they need.

The construction of a biogas plant at their home has transformed their lives.

The plant produces methane gas from animal dung by adding water to the waste and letting it ferment.

This gas produced can then be used to provide energy for cooking and lighting.

More time is available to spend on activities that generate income for the family.

The organic waste from the plant improves the productivity of their vegetable garden.

In order to help make biogas a more widely used fuel, Practical Action is also now working on setting standards for biogas systems in Sri Lanka.
Guatemala

- New stoves (*planchas*) installed in 250 homes in community of San Lorenzo, while 250 control homes continued to cook on open fire.
- The *plancha* is a wood-burning stove constructed from bricks and concrete blocks, a steel top-plate with 3 pot holes, and a metal chimney.
- Children less than 18 months old were assessed over a 2-year period for pneumonia.
- Concluded PM inhalation will generate oxidative stress in developing airways of infant children exposed to high levels of biomass smoke and chronic exposure will result in increased respiratory symptoms, decreased somatic growth and abnormal structural development of the respiratory tract leading to a reduced rate of lung function growth.
South Africa Indoor Air Quality Issues

- Household fuel burning – most significant local air pollution problem
  - Range of fuels
  - Cost of fuels
  - Poor ventilation and bad thermal efficiencies

- Asbestos
  - Mining stopped in 2000/2001
  - Fibre stockpiles depleted 2003 (for export)
  - Despite mining ceased still have asbestos exposure
  - Asbestos materials used in affordable housing, and mixed with mud to plaster walls of traditional houses
  - Asbestos-containing ores used for road construction
  - Unrehabilitated asbestos mines and dumps
Activities in SA to alleviate IAP

• Minister of Mineral and Energy approved a three-phased approach to alleviation of air pollution caused by use coal in residential areas
  ▪ Dissemination of Basa njengo Magogo technology
  ▪ Production and distribution of low-smoke fuels
  ▪ Improving thermal efficiencies of homes

• Basa njengo Magogo Project
  ▪ Top-down ignition method
  ▪ Less smoke
  ▪ Saving fuel costs
  ▪ 87% less particulate emissions

• eThekwini municipality (Health Unit) creating awareness
  ▪ Brochures
  ▪ Presentations and workshops
  ▪ Newspaper articles
Activities in SA to alleviate IAP

- Behaviour changes in Mafikeng municipality
  - Promotion of outdoor cooking in segotlo (especially during winter) resulted in 88% lower levels of child exposure to CO

- CHANGE project (2000 to 2003)
  - Provided technical and financial assistance to MRC to identify and test feasible behavioural interventions
  - Interventions selected were: 1) more ventilation sources, 2) keeping younger children further from heat source, 3) fixing stoves and 4) burning fuels for a shorter duration
Other sources of Indoor Air Pollution

- Biological pollutants
  - Moulds and fungi
  - Animal dander
- Organic pollutants (e.g. formaldehyde and benzene)
  - Paints
  - Building construction materials
  - Furnishings
  - Cleaning agents
  - Air fresheners
- Environmental tobacco smoke
- Radon
- Infiltration of outdoor pollution
The way forward

- MRC Burden of Disease Research Unit recommend following interventions for IAP:
  - Technologies which aim at improved cooking/heating devices, improved fuels (e.g. low-smoke fuels) and reduced need for heating (e.g. improved thermal efficiency of homes)
  - Technologies aimed at improving the living environment
  - Behavioural change to reduce exposure and smoke generation

- WHO recommend:
  - Research on health effects of IAP
  - A systematic approach to the development and evaluation of interventions
  - Clearer recognition of interrelationships between poverty and dependence on polluting fuels
The way forward

- Development on an integrated strategy (should be available Feb 2010)
- Short term goals (behaviour change, interventions to reduce IAP)
- Long term goals (cleaner fuels, electrification, thermal efficient houses, alternative technologies such as biogas)
- Indoor air quality monitoring (making sure monitoring techniques follow protocol)
- Information, education and communication about effects of IAP
- Very important – community involvement
- Legislation prohibiting use of asbestos-containing building materials
Domestic biogas digesters range in size from six to 10m$^3$ and are buried underground to minimise their impact on your garden. If you know what you're doing, they should take about six weeks to build.
Thank you

Are we to decide the importance of issues by asking how fashionable or glamorous they are? Or by asking how seriously they affect how many? – Nelson Mandela