Foundations of Global Health

Environmental Health: Part I

On Beautiful for smoggy skies, insecticided grain, For strip-mined mountain’s majesty above the asphalt plain. America, America, man sheds his waste on thee, and hides the pines with billboard signs, from sea to oily sea.

~George Carlin

Environmental Health Definition

Box 1. A definition of "environment" for measuring the environmental impact on health.

The environment is all the physical, chemical, and biological factors external to a person, and all the related behaviours.

This definition excludes behaviour not related to environment, as well as behaviour related to the social and cultural environment, and genetics.

Importance of Environmental Health

- Environmental concerns are major risk factors in global burden of disease
  - Unsafe water
  - Hygiene and excreta disposal
  - Indoor air pollution
  - Outdoor air pollution
  - Climate change

- Addressing environmental health is central to the achievement of the MDGs

Risk Factors

- Consequences of environmental health issues
  - Indoor air pollution is household issue, whereas climate change is a global issue

Learning Objectives

- Identify important environmental threats to health in low and middle-income countries
- Identify diseases related to environmental risk factors
- Identify human activities that contribute to climate change and major consequences from climate change
- Describe important energy trends
- Identify sources and health consequences of indoor and outdoor air pollution
- Describe pollution of land and sea, superfund sites
- Identify actions that we can take to limit pollution of the environment

Environmental concerns are major risk factors in global burden of disease

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- Outdoor air pollution
- Climate change

“Water and air, the two essential fluids on which all life depends, have become global garbage cans.”

- Jacques Cousteau

Risk Factors

- Outdoor air pollution
- Respiratory infections, selected cardiorespiratory diseases, lung cancer
- Indoor air pollution from solid fuel use
- COPD, lower respiratory infections, lung cancer
- Loud
- Mild mental retardation, cardiovascular diseases
- Water, sanitation and hygiene
- Diarrheal diseases, tuberculosis, schistosomiasis, onchocerciasis, trichuriasis, hookworm disease
- Climate change
- Diarrheal diseases, malnutrition, selected unintentional injuries, prostate-energy malnutrition

Selected occupational factors

- Interventions
- Metal
- Cancer
- Asthma
- COPD
- Low back pain

Note: Different combinations of stressors provide for human populations the various types of ecosystems represented here. There ability to alter the health of human populations and develop the physical and chemical interactions, which are then affected by human activities.
Global Climate Changes

- 2000s warmest decade on record
  - Human-induced climate change significantly increased likelihood of European summer heatwave (2003)
- Parts of Asia and Africa, frequency and intensity of droughts have increased
- Episodes of El Niño more frequent & intense since mid-1970s
- Global emissions of carbon dioxide still increasing

Source: Intergovernmental Panel on Climate Change (IPCC)

Global Warming

- Greenhouse gases
  - CO₂
  - Methane
  - N₂O
  - CFCs
- Global warming: natural occurrence
  - Collect gases (CO₂, H₂O, methane)
  - Trap heat
- Additional human contribution

Dark blue, purple areas denote high levels of ozone depletion
Source: NASA 2006

Goal 4—Reduce Child Mortality

Link—Addressing environmental risk factors can reduce the two leading causes of death in children—diarrheal diseases and pneumonia. Diarrheal disease is reduced through improved access to clean water and sanitation. Pneumonia can be reduced through improvements in indoor air quality.

Goal 5—Improve Maternal Health

Link—Diarrheal disease associated with poor sanitation and unsafe water can harm the nutritional status of the mother.

Goal 6—Combat HIV/AIDS, malaria, and other diseases

Link—Environmental improvements can reduce the breeding grounds for malarial mosquitoes and vectors of some other disease, such as diphtheria and dengue fever.

Goal 7—Ensure environmental sustainability

Link—Measures to improve water supply, sanitation, and personal hygiene promote sustainability, especially when they are carriedNEAR in community-based ways.


TABLE 7-1 Environmental Health and the MDGs

<table>
<thead>
<tr>
<th>Goal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal 1—Eradicate Poverty and Hunger</td>
<td>Link—Reducing environmental risk factors is central to eradicating poverty by reducing the burden, which falls largely on the poor, of environmentally-related morbidity and mortality.</td>
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<tr>
<td>Goal 2—Achieve Universal Primary Education</td>
<td>Link—Children that do not have access to clean water and sanitation are more likely to suffer from undernutrition due to a vicious cycle of diarrheal disease and malnutrition. There is a correlation between nutritional status and learning. Children with poor nutritional status are not as likely to stay in school or learn as much as healthy children.</td>
</tr>
<tr>
<td>Goal 3—Promote Gender Equality and Empower Women</td>
<td>Link—Improving access to water can improve the lives of poor women in the developing world by reducing the amount of time required to get water. Reducing indoor air pollution can also substantially improve the lives of women since they suffer a disproportionate burden when they are cooking.</td>
</tr>
</tbody>
</table>

Source: Intergovernmental Panel on Climate Change (IPCC)

Goal 3—Eradicate Poverty and Hunger

Link—Although environmental risk factors are central to eradicating poverty by reducing the burden, which falls largely on the poor, of environmentally-related morbidity and mortality.
**Carbon Counter: On the Rise**

**July 2003**

**July 2007**

Both images show the spreading of carbon dioxide around the globe. The color codes in these two pictures are different in order to account for the carbon dioxide increase from 2003 to 2007. If the color bar for 2003 were to be used for 2007, the resulting 2007 map would be saturated with red/dark colors, and the time structure of the distribution of carbon dioxide disclosed.

*Images that the absorption dataset (ADD) indicate carbon dioxide/sea surface* (Source: NASA/NOAA).

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**What Will Likely Happen...**

- Public health services and high living standards will protect some populations from specific impacts
- What may happen in other countries?
  - Drought, famine, civil war
  - Floods, waterborne diseases, loss of home/crops/livelihood
  - Malnutrition
  - Malaria (vectorborne diseases)

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**World carbon emissions**

- China
- U.S.
- India
- Japan
- Russia
- Brazil
- Germany

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**Polar Ice Caps Melting...**

Centre for Research on the Epidemiology of Disasters (CRED)

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Ways to Reduce Carbon Footprint

- **Government action**
  - Tougher emission standards
- **Hybrid/electric cars (40+ mpg)**
  - Drive better

- **Reduce. Reuse. Recycle.**
- Donate old electronics to charity
- Stop junk mail
- Eat less meat
- Turn off lights, computers

Earth By Night

- 1.5 billion people have no electricity
- Mostly in developing countries (Africa & South Asia) where 79% of people have no access to electricity

Global Energy Comparison: Consumption vs GDP

Little Energy Dependence

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Energy Sources

- Fossil fuels
- Renewable
- Nuclear

Countries with natural gas reserves > 1 trill. m³

Strategic ellipse
- with about 70 % of world oil reserves
- and about 65% of world natural gas reserves
Air Pollution

- 6 categories of pollutants (US EPA)
  - Suspended particulate matter (SPM)
  - CO
  - Lead
  - NO₂
  - SO₂
  - O₃

Air Pollution & Health

- Indoor and outdoor air pollution cause 5% of the global burden of disease
- Aggravates and may even cause asthma and other allergic respiratory diseases
- Adverse pregnancy outcomes, such as stillbirth and low birth weight
- In developing countries:
  - 1.5 million deaths/year due to exposure to high concentrations of SPM indoors in rural areas
  - 500,000 deaths/year excess mortality due to outdoor levels of SPM and SO₂ amounts

Smoking & Indoor Air Pollution

- Tobacco smoke pollution contains over 4,000 chemicals - 200 are poisons & 69 known to cause cancer
- Adverse health problems include cancer, respiratory infections, and asthma
- Classified by the EPA as Group A carcinogen
- In non-smokers:
  - Secondhand smoke causes ~3,000 lung cancer deaths
  - 37,000 heart disease deaths annually
- Very harmful to young children:
  - Increases # of asthma attacks and severity of symptoms in 200,000 to 1 million children with asthma
  - Causes up to 300,000 lower respiratory tract infections
  - Results in 7,500 to 15,000 hospitalizations annually
- Spending 30 minutes in a smoke filled room = non-smoker puffing one cigarette

Fuel and Indoor Air Pollution

- Is electricity necessary?
  - Economic development
- What are the health benefits of electricity?
  - Sanitation, refrigeration, empower women & save lives
- >25% of people have no electricity in their homes and must burn solid fuels
  - smoke released into home
  - high levels of indoor air pollution
  - increased risk of respiratory diseases (and burns), especially for women and children
- Limited ventilation increases exposure, especially for women and young children
- Exposed to very high levels of pollution between 3-7 hours/day over many years

Indoor Air Pollution

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- Exposed to very high levels of pollution between 3-7 hours/day over many years

**Kitchen Killer**

- >1.5 million deaths/year of respiratory infections due to environmental link
  - 36% lower respiratory infections
  - 24% upper respiratory infections
- Mothers most at risk of developing chronic respiratory disease


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**A Consequence of Poverty**

- Role of poverty (energy ladder)
- Widespread use of biomass fuels
  - Nearly half the world continues to cook with solid fuels
  - More than 75% in India, China and nearby countries
  - 50-75% in parts of South America & Africa

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**Reducing Indoor Air Pollution**

- Use improved cooking devices that divert smoke out of the home
- Use alternate energy sources like solar panels
- Increase ventilation or move kitchen outside of home or shelter
- Keep children away from smoke and boiling liquids

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**Outdoor Air Pollution**

- Major problem in modern, urban societies
- Many pollutants enter the air as a result of human behavior
- Smog is most recognizable sign of air pollution
- High air pollution impacts health:
  - Lowers lung function
  - Associated with increased # heart attacks
  - Increased # asthma attacks

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**Air Quality Index**

**United States Key Stats**

Comparison of Growth Areas and Emissions, 1980-2008
Land Pollution

- In 1970s, more attention was paid to disposal of garbage and solid wastes following Love Canal
- In 1980, Congress passed the Superfund Act
- Provide money for cleaning up most dangerous toxic waste sites
- Average cost to clean up a site has been $27 million

Garbage Stats: USA & World

- 4.39 pounds of trash per day and up to 56 tons of trash per year are created by average person (USA)
- Only about 1/10 of all solid garbage is recycled (USA)
- Each day we throw away enough trash to fill 63,000 garbage trucks (USA)
- 43,000 tons of food is thrown out each day (USA)
- Almost 1/3 of waste generated is packaging (USA)
- As of 1992, 14 billion pounds of trash were dumped into ocean annually (world)
- 65 billion aluminum soda cans used each year (world)
**Land Fills**

- As we begin to run out of space for garbage, this has become a major concern!
- Poor landfill design and construction may lead to further environmental degradation (e.g. leaky containment barriers contaminate groundwater)
- Serious health consequences in developing countries that lack adequate sanitation facilities

**Practice Questions**

- Define environment as it relates to health
- Name 5 services that ecosystems provide
- Match 5 environmental risk factors to disease
- What disease has the largest environmental burden?
- Identify recent trends of climate change, carbon emissions
- Identify 5 human activities and major threats of climate change
- Identify regions with little energy dependence
- Identify sources of energy and recent trends
- Name 6 criteria air pollutants
- Identify harmful health effects of tobacco smoke pollution
- Identify harmful health effects & ways to reduce indoor air pollution in developing countries
- What is a superfund site? What is found in the Great Pacific Garbage Patch?

**In Summary...**

- Environmental health issues have a large impact on the global burden of disease
- The impacts occur at various levels
- The risks of indoor air pollution are greatest for women and children
- The risks of environmental impacts on health are greatest in the low-income countries of Africa and South Asia