Impact of Climate Change on Human Health: A Case Study on Neglected Tropical Diseases

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“The effects of climate change are…potentially catastrophic risk to human health….Tackling climate change could be the greatest global health opportunity of the 21st century”

Health impacts in the Arab region:

- Direct impacts
  - Heat-related illnesses
  - Extreme events

- Indirect impacts
  - Spread of disease vectors
  - Undernutrition
  - Mental health
CASE STUDY:
Impacts on Neglected Tropical Diseases (NTDs) in the Arab Region

Climate change

- Disease vectors are very sensitive to changes in climate conditions
- Rising $T_{\text{min}}$ and $T_{\text{max}}$ may result in range changes or expansions of exposure
- Disruptions to ecosystems indirectly impact disease cycle

Other environmental and social changes

- Displacement, desertification, conflict
• Water-associated disease index (WADI) used to provide an integrated view of environmental and social disease determinants

Conceptual framework and identification of thresholds for case studies (Leishmaniasis in Morocco; Schistosomiasis in Egypt)

Creation of indicator layers for case studies including RICCAR climate projections for RCP 4.5 and RCP 8.5

Integrated map output of exposure conditions

Methodology: Dickin et al., 2013 PloS One DOI: 10.1371/journal.pone.0063584
• 1.7 billion people at risk globally

• Endemic in Arab region (e.g. Algeria, Egypt, Iraq, Jordan, Libya, Morocco, Palestine, Saudi Arabia, Saudi Arabia, Somalia, Sudan, Tunisia, and Yemen)

• Two forms cutaneous leishmaniasis and visceral leishmaniasis transmitted by sandfly vector
  • Carried by both humans and animals

The P. papatas sandfly, vector of Leishmania parasites.
Source: Center for Disease Control and Prevention.
Leishmaniasis

Conceptual framework illustrating linkages between the human, vector, parasite and animal reservoir components of the leishmaniasis disease cycle.

<table>
<thead>
<tr>
<th>GLOBAL CHANGE PROCESSES</th>
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<tr>
<td><strong>SUSCEPTIBILITY</strong></td>
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<tr>
<td>- General health status and immunity</td>
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<td>- Municipal services (solid waste collection, sanitation)</td>
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<td>- Migration</td>
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<td>- Poor housing quality</td>
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<td><strong>ADAPTIVE CAPACITY</strong></td>
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<tr>
<td>- Education</td>
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<td>- Health care access</td>
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<td>- Surveillance and control measures</td>
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<tr>
<td><strong>EXPOSURE</strong></td>
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<tr>
<td>- Land use (Urban/rural environment)</td>
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<td>- Population density</td>
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<tr>
<td>- Climate (precipitation, temperature, humidity)</td>
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<td>- Vegetation</td>
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Note: Dashed lines indicate connections between exposure, susceptibility, adaptive capacity and components of the disease cycle.
Applying WADI in RICCAR: Leishmaniasis

November ZCL exposure

i. Historical (1986-2005)

ii. RCP 4.5 Mid-century (2046-2065)

iii. RCP 4.5 End of century (2081-2100)
Applying WADI in RICCAR: Leishmaniasis

June ZCL exposure

i. Historical (1986-2005)

ii. RCP 4.5 Mid-century (2046-2065)

iii. RCP 4.5 End of century (2081-2100)
• Climate change may have an important impact on the range of leishmaniasis transmission:
  • Increasing $T_{\text{min}}$ will increase length of exposure season and geographic range (including higher altitudes) (>10°C)
  • Increasing $T_{\text{max}}$ will reduce exposure (>40°C); however, generally occurring in uninhabited desert regions
  • Increasingly dry conditions less favourable for animal host, but projected changes in humidity are small
Schistosomiasis

- Water-related disease transmitted by parasites released from snails, resulting from contact with contaminated surface water

- Schistosomiasis is endemic in Egypt, Somalia, Sudan and Yemen, with an estimated 12.7 million cases

- Recent advances have been made in eliminating schistosomiasis, but climate change could impact elimination efforts

The Biomphalaria sp. aquatic snails, hosts for *S. haematobium* and *S. mansoni*. Source: Lewis et al., 2008.
Schistosomiasis

Conceptual framework illustrating linkages between the human, schistosome parasite and freshwater snail components of the schistosomiasis disease cycle.

**GLOBAL CHANGE PROCESSES**

**SUSCEPTIBILITY**
- Water access
- Livelihoods (water related and animal husbandry)
- Age
- Health status

**EXPOSURE**
- Sanitation access
- Water environment (vegetation, flow, quality)
- Proximity to water
- Climate (Temperature, sunlight, precipitation)

**ADAPTIVE CAPACITY**
- Education
- Health care access
- Surveillance and control measures

Note: Dashed lines indicate connections between exposure, susceptibility, adaptive capacity and components of the disease cycle.
Projected Climate Change Impacts

Schistosomiasis exposure in December

i. Historical (1986-2005)

ii. RCP 8.5 Mid-century (2046-2065)

iii. RCP 8.5 End of century (2081-2100)
Climate change may impact the seasonal range of schistosomiasis transmission:

- Projected warming will create suitable snail conditions during colder months (>12.5°C), when fewer cases currently occur.
- Projected warming during summer months may decrease exposure in Upper Egypt.

Impacts on public health control measures:

- Schistosomiasis control activities currently undertaken during warmer months when most people become infected.
Implications for Public Health

• Transmission seasons could increase in the Arab region due to rising temperatures (historically limited the range of disease vectors)

• Interventions must be sustained for 10-20 years to ensure elimination

• Better (adaptive) health promotion strategies

• Collaboration across water, health and environment sectors; improved surveillance, and reporting of incidence rates
Implications for Gender and Social Equity

• Leishmaniasis: a greater threat to health and socioeconomic status of women -> work in agriculture, animal care, and water collection;
  • Disfiguring scars can have a severe impact on women’s psychological wellbeing and quality of life due to social stigmatization.

• Schistosomiasis: women and girls who spend large amounts of time doing water, sanitation and hygiene-related tasks, and caring for sick members of their families.

• Women’s limited access to financial resources may reduce access to healthcare to receive treatment for disease.
THANK YOU!

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http://inweh.unu.edu
http://inweh.unu.edu/managing-water-related-health-risks/