Climate Change & Health in Inherently Hot Regions

THE CASE OF KUWAIT

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Climate Change & Health

Impact of Climate Change on Human Health

- Heat stress, cardiovascular failure
- Malnutrition, diarrhea, harmful algal blooms
- Anxiety, despair, depression, post-traumatic stress
- Environmental Refugees
- Forced migration, civil conflict
- Vector-borne Diseases
- Respiratory allergies, poison ivy
- Cholera, cryptosporidiosis, campylobacter, leptospirosis

- Injuries, fatalities
- Asthma, cardiovascular disease
- Malaria, dengue, encephalitis, hantavirus, Rift Valley fever
- Heat
- Air Pollution
- Water-borne Diseases
- Allergies

Adapted from J. Pata

https://www.cdc.gov/climateandhealth/effects/default.htm
Climate Change & Health

5th Assessment Report (AR5) 2014

Direct Impacts → Heat
Indirect Impacts → Ecosystem Mediated

Human Health
Heat Effects

Increase in Temperature
Mean and Variance

Folland et al, 2001
Heat Effects

The Middle East

“Under the business-as-usual scenario, our results expose a specific regional hotspot where climate change, is likely to severely impact human habitability in the future.” - Pal & Eltahir, 2015

“Results show that the mortality risk will increase in distant future to 8-20 times higher than that of the historical period” - Ahmadlipour & Mordkhani, 2018
Heat Stroke?

ICD-10 Code:
- T67: Effects of heat and light
- T67.0: Heatstroke and sunstroke

Problems?
(1) Chronic underestimation
(2) Heat can exacerbate existing conditions and be a ‘contributing’ factor to death
Why Kuwait?

“... they are the highest, officially recognized temperatures to have been recorded in the last 76 years.”
Heat Effects

The Effects of Temperature on Short-term Mortality Risk in Kuwait: A Time-series Analysis

Barrak Alahmad, Ahmed Shakarchi, Mohammad Alseaidan, & Mary Fox.

Environmental Research, 2019
Heat Effects

Kuwait

Comparing the 99th percentile vs. the optimum, the relative risk of total death = 1.65 (1.09 – 2.46)
Comparing the 97.5th percentile vs. the optimum, the relative risk of total death = 1.42 (1.03 – 1.95)

Alahmad et al, 2019
Heat Effects

Kuwait

Cardiovascular Mortality and Exposure to Heat in an Inherently Hot Region: Implications for Climate Change

Barrak Alahmad, Haitham Khraishah, Ahmed F. Shakarchi, Mazen Albaghdadi, Sanjay Rajagopalan, Petros Koutrakis & Farouc A. Jaffer

Circulation, 2020
Cardiovascular Mortality

Kuwait

Comparing the 99th percentile vs. the optimum temperature, the relative risk of cardiovascular death = 3.09 (95% CI: 1.72 – 5.55)

“... doubling to tripling risks.”
Heat Effects

Vulnerability to Temperature-Related Mortality in Kuwait


Science of the Total Environment, 2020
Heat Effects

Kuwait

In the Middle East we may have different vulnerable subpopulations:

- Men
- Elderly
- Non-Kuwaitis
- People with cardiovascular diseases

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Estimate (RR)</th>
<th>CI (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>3.09</td>
<td>1.72 – 5.55</td>
</tr>
<tr>
<td>Respiratory</td>
<td>1.50</td>
<td>0.36 – 6.30</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>2.08</td>
<td>1.23 – 3.52</td>
</tr>
<tr>
<td>Females</td>
<td>1.14</td>
<td>0.60 – 2.18</td>
</tr>
<tr>
<td><strong>Nationality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kuwaiti</td>
<td>1.38</td>
<td>0.80 – 2.41</td>
</tr>
<tr>
<td>Non-Kuwaiti</td>
<td>1.96</td>
<td>1.10 – 3.52</td>
</tr>
<tr>
<td><strong>Age Groups</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14</td>
<td>0.29</td>
<td>0.09 – 0.97</td>
</tr>
<tr>
<td>15-64</td>
<td>2.28</td>
<td>1.24 – 4.20</td>
</tr>
<tr>
<td>65+</td>
<td>1.86</td>
<td>1.02 – 3.39</td>
</tr>
</tbody>
</table>

Alahmad et al, [Manuscript in Preparation]
Susceptibility: Males

The risk of death from heat exposure was significantly high among males.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Heat effect (99th vs. Optimum)</th>
<th>Estimate (RR)</th>
<th>CI (95%)</th>
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- Previous studies have shown risk patterns to be similar between males and females, higher among males, and higher among females.
- Susceptibility by gender could be contextual within geographic and socioeconomic factors.
- Cultural norms can play a role in determining outdoor exposure (including choice of clothes, staying indoors, etc.)
Susceptibility: Non-Kuwaitis

The risk of death from heat exposure was significantly high among non-Kuwaitis

- The non-Kuwaiti population comprises of male laborers who are usually in working age group.
- They are more likely to take more demanding labor work and hence get higher exposure to heat.
- This is not a unique finding, a previous study on poor air quality effects and dust storms showed that non-Kuwaiti males are at higher risk of death (Achilleos et al. 2019).
Susceptibility: Non-Kuwaitis

Kuwaitis

Non-Kuwaitis

Total

PACI, 2018 - [Link to document](http://stat.paci.gov.kw/englishreports/#DataTabPlace:PopulationPyramid)
Projections?

Projected Atmospheric Greenhouse Gas Concentrations

- Highest Emissions Pathway (RCP 8.5)
- Higher Emissions Pathway (RCP 6.0)
- Lower Emissions Pathway (RCP 4.5)
- Lowest Emissions Pathway (RCP 2.6)

Parts per million, CO₂ equivalent

Year

2000 2020 2040 2060 2080 2100
Future Directions: Projections

Kuwait

Temperature Mortality Projections in Kuwait: The Immediate Future 2021 2060

Barrak Alahmad, Wan-Chen Lee, Walid Bouhamra, & Petros Koutrakis.

Manuscript In Preparation
Future Directions: Projections

Kuwait

The average increase in mean temperature under RCP4.5 by 2060 is:

1.84°C

Alahmad et al., [Manuscript in preparation]
Projections

Kuwait

2051-2060 future period (Under RCP4.5)

vs.

2006-2016 historical period

Excess mortality from Heat = 2.95% (eCI: 0.15-9.41%)

Alahmad et al., [Manuscript in preparation]
The case for: Middle East collaboration

1. Unique Contribution: Which subpopulations are more vulnerable?
2. Information for Decision-Makers: Interventions to protect public health
3. Potential for Broader Impacts: Growing the literature in the Middle Eastern Region
4. Fulfilling a Commitment: Climate adaptation plans for Paris Climate Accord
Take Home Messages

- In this hot, hyper-arid part of the world, population health data is not abundantly available while temperatures soar to unprecedented record high levels.
- We now uncover vulnerabilities to temperature extremes from a region that is overshadowed by the question of human inhabitability by the end of the century.
- Serious environmental justice questions need to be addressed by policy-makers.
- Alarming evidence is emerging on cardiovascular mortality from heat exposure.
- More research is needed in this region.
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