Role of El Niño Southern Oscillation in Extreme Event Related Adverse Health Outcomes in Maryland, USA

Soneja S., Jiang CJ., Fisher J., Blythe D., Mitchell C., Sapkota AR., Sapkota A.

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Background

• Extreme weather events are becoming more frequent, more intense and longer lasting, in response to changing climate. (Field et al 2012)

• Previous studies have linked exposures to extreme heat and extreme precipitation events with host of adverse health outcome (Jiang et al 2015, Sonja et al 2016)
El Niño

Warmer than normal SST located across the central and eastern Pacific

La Niña

Warmer than normal SST located across the central and eastern Pacific

http://climate.ncsu.edu/climate/patterns/ENSO.html

https://www.ncdc.noaa.gov/teleconnections/enso/indicators/sst.php
Spatial Pattern of Extreme Events by Phases of ENSO

Extreme Heat

Extreme Precipitation

El Niño

La Niña

Jiang et al 2016 (In Prep)
Difference in Extreme Heat Events Across State

El Niño – ENSO Neutral

La Niña – ENSO Neutral
Difference in Extreme Precip Events Across State

Climate Region:
- Central
- East North Central
- Northeast
- Northwest
- South
- Southeast
- Southwest
- West
- West North Central
ENSO’s impact on health?
Methods: Extreme Heat Events in MD

- County and calendar day specific “climate” information derived using 30 year of daily weather observations (1960-1989).

- 95th percentile of this distribution used as a threshold to identify extreme heat events for the study period (2001-2013).

Example: ETT95 values on July 15th (Range: 30-36 C)
Methods: Extreme Heat Events in MD

- County and calendar day specific “climate” information derived using 30 year of daily weather observations (1960-1989).

- 95th percentile of this distribution used as a threshold to identify extreme heat events for the study period (2001-2013).

- Threshold used to define extreme heat varies by county and by day.
Methods

Sources of Data

• Hospitalization Data (2000-2012)
  • Maryland Department of Health and Mental Hygiene
    • Asthma, N= 116,470
    • Myocardial Infarction, N = 138,343

• Foodborne Illness (2002-2012)
  • Maryland Foodborne Diseases Active Surveillance Network (FoodNet)
    • Culture confirmed Campylobacter infections, N=4,804
    • Culture confirmed Salmonella infections, N=9,527

• Statistical Analysis
  • Hospitalization for asthma and AMI:
    Time-stratified case-crossover, with 3 control periods (7,14, 21 days before/after).
  • Salmonella infection: Negative binomial generalized estimating equations.
# Case distribution by ENSO Events

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Time of Year</th>
<th>Phases of ENSO</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>El Niño</td>
<td>La Niña</td>
</tr>
<tr>
<td><strong>Asthma</strong></td>
<td>Summer Only</td>
<td>3,483</td>
<td>4,214</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>26,754</td>
<td>33,441</td>
</tr>
<tr>
<td><strong>Myocardial Infarction</strong></td>
<td>Summer Only</td>
<td>6,257</td>
<td>6,737</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30,997</td>
<td>38,643</td>
</tr>
<tr>
<td><strong>Campylobacteriosis</strong></td>
<td>Summer Only</td>
<td>370</td>
<td>315</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>1,112</td>
<td>1,060</td>
</tr>
<tr>
<td><strong>Salmonellosis</strong></td>
<td>Summer Only</td>
<td>870</td>
<td>761</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>2,432</td>
<td>2,291</td>
</tr>
</tbody>
</table>
## Case distribution by ENSO Events

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Extreme Heat Events</th>
<th>Extreme Precipitation Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI Hospitalization</td>
<td>1.11 (1.05-1.17)</td>
<td>0.99 (0.97-1.02)</td>
</tr>
<tr>
<td>Asthma Hospitalization</td>
<td>1.23 (1.15-1.33)</td>
<td>1.11 (1.06-1.17)</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>1.04 (1.01-1.07)</td>
<td>1.06 (1.03-1.08)</td>
</tr>
<tr>
<td>Campylobacteriosis</td>
<td>1.00 (0.98-1.02)</td>
<td>0.98 (0.96-1.02)</td>
</tr>
</tbody>
</table>
Results

Extreme Heat Events

Extreme Precipitation Events

MI

Asthma

Extreme Heat: Summer Odds Ratio (95% CI)

Extreme Precipitation: Summer Odds Ratio (95% CI)

ENSO Period
- La Nina
- El Nino
- ENSO Neutral
Results: Foodborne Illness

Extreme Heat Events

- Salmonellosis

Extreme Precipitation Events

- Campylobacteriosis

Graph showing the overall odds ratio (95% CI) for extreme heat and precipitation events.
Recap

• Suggestive evidence that the association between extreme events and the selected 4 health outcomes in Maryland vary by phases of ENSO.

Looking ahead

• Inclusion of additional states with stronger ENSO-Extreme Event signal.
• Inclusion of additional health outcomes including stroke and injuries
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