Impact of Hurricanes Irma and Maria on Puerto Rico Maternal and Child Health Research Programs

Michael Welton, PhD, MA
University of Georgia
Department of Epidemiology and Biostatistics

ACES – December 5, 2018
Presenter Disclosure

Michael Welton

The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

No relationships to disclose
Outline

• Intro to our studies
• Hurricane Overview
• Immediate Responses
• Puerto Rico Ecosystems
Introduction

• Puerto Rico is a United States Territory (1898)
• Population about 3.4 M / 3,500 Square miles
• In 2006, Puerto Rico had the highest rate of preterm births of any US jurisdiction (19.9%) and third highest worldwide
• Puerto Rico has the highest density per square mile of toxic waste sites recognized by the US EPA.
Supported with funding from the NIEHS Superfund Research program, the PROTECT Center studies exposure to environmental contamination in Puerto Rico and its contribution birth outcomes.
Center for Research on Early Childhood Exposure and Development in Puerto Rico: Children’s Environmental Health Center program directed by the EPA and the NIEHS. Investigate mixtures of environmental exposures and other factors affect the health and development of infants and children living in the heavily-contaminated island of Puerto Rico.
Zika in Pregnancy Study (ZIP)

• Began recruitment in summer 2016
• A consortium of six countries and 10 sites
• Prospective Observational Cohort – 2 years
• Intend to recruit 10,000 pregnant women in two years in five countries: Brazil, Colombia, Guatemala, Nicaragua, Puerto Rico, and Peru

<table>
<thead>
<tr>
<th>Study Sites</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>(1) North Karst, Puerto Rico</td>
<td>(6) Lima, Peru</td>
</tr>
<tr>
<td>(2) San Juan, Puerto Rico</td>
<td>(7) Pernambuco, Brazil</td>
</tr>
<tr>
<td>(3) Amatitlan and Mazatenango, Guatemala</td>
<td>(8) Salvador, Brazil</td>
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<tr>
<td>(4) Managua, Nicaragua</td>
<td>(9) Rio de Janeiro</td>
</tr>
<tr>
<td>(5) Cali, Columbia</td>
<td>(10) São Paulo, Brazil</td>
</tr>
</tbody>
</table>
Environmental Influences on Child Health Outcomes (ECHO)

• Began in 2017
• 7 years (5 years of recruitment)
• Will recruit approx. 1000 mothers/infant
• 267 mothers & 293 infants currently
• Through pregnancy and up to 6 years old
September 20, 2017
Hurricane Maria hits Puerto Rico

- Followed IRMA on Sept 6 – 2 weeks prior
  - ~80,000 people still had not recovered electricity
- 175 mph winds (sustained)
- Collapse of the electric grid, water systems, telecommunications, roads, and many homes destroyed
- Recovery will cost $139 Billion
- Close to 3,000 fatalities
PROTECT/CRECE/ZIP/ECHO Study sites
Figure 1. Hurricane Maria’s Path and PROTECT/ZIP Study Clinic and Hospital Sites

1: Manatí Medical Center and PROTECT Clinic, 2: Ciales FQHC, 3: Morovis FQHC, 4: Camuy FQHC, 5: Arecibo Pavia Hospital
Immediate Response...

- 1st priority was our team
- Over 20 staff in Puerto Rico
  - Field Nurses
  - Lab technicians
  - Project managers
  - Data Managers
  - Trainees/students
- 2 team members lost their homes entirely
- ~350 Maternal and close to 300 infant participants
• Followed by meeting participants needs
• Water filtration systems set up in health centers, clinics
• Coordinating donations with local needs
  • Water filters for participants and clinics
  • Personal care items needs
  • Batteries, flashlights, and other needs
  • Diapers, baby food, wipes, etc.
Science scramble after storm

Public-health researchers in Puerto Rico are regrouping to study the aftermath of Hurricane Maria.

BY SARA REARDON

Nightfall sets a hard deadline for a team of public-health researchers in Puerto Rico. Since Hurricane Maria hit on 20 September, leaving large swaths of the island without a reliable power supply, the scientists have rushed home each night to avoid being in the streets after dark. Many of them had taken a plane trip organized by Jordy Núñez-Cordero, a neuroscientist at UPR Río Piedras. The devastation that Cordero saw on a recent visit to Puerto Rico, his birthplace, shocked him. “I thought I was prepared, but I wasn’t,” he says.

Even before the hurricane, the island’s 18 ‘Superfund’ sites — areas so polluted that the US Environmental Protection Agency deems them hazardous to human health or the environment — posed a potential risk to the health of the population.
Resuming research activities...

• Strong rapport with community
  ~96% retention in studies

• Team eager to get back to work

• PROTECT/CRECE/ZIP a resource for participants
  • Information and support

• Continue to identify of major challenges to families and children
  • Mental health and finances

• Transportation and communication were major challenges to research
Research Projects

• Our team was awarded NIH grants:
  • Environmental Exposures and stress (Spring 2017)
  • Traumatic experiences (Fall 2017)
• Participants from PROTECT, ZIP, and CRECE
• Birth outcomes (Preterm birth, birth weight, and pregnancy loss)
• Included women who were pregnant who were pregnant during the Hurricanes or became pregnant during 6 months after
• Phone surveys, in person questioners, and biologic samples
Hurricane Damage to Puerto Rico Ecosystem

• Ecosystems
  • Sandy Beaches and Rocky Shores
  • Rain forest
  • Coral Reefs and seagrass beds
  • Mangroves and lagoons
  • Dry Forests

• 3000 Plant species
• 5300 insects and arthropods
• 1300 mollusks and echinoderm
• 1500 birds, reptiles, amphibians, fish, and mammals
Sandy Beaches
Rain Forests
Reefs and Seagrass Beds
Mangroves and Lagoons
Water is everywhere.

Puerto Rico After

Mosquitoes.

The disastrous hurricane spread ash from landfills into the air and groundwater of the island, giving new momentum to groups fighting for a future without coal.

V.I. Bats Struggle for Survival After Hurricane

Huntington, W.V. - Bats are struggling to recover from Hurricane Harvey. The storms have thrown the ecosystem out of balance, making it difficult for the species to adapt.

Monitor air pollution after Hurricane Maria

Rico’s Fight Against Coal Ash

The disas...
Puerto Rico: Monthly Sales Tax Revenue

Note: The Puerto Rican fiscal year runs July through June.
Sources: Government Development Bank for Puerto Rico.
Conclusions

• Climate models predict more extreme weather events to come and we need to work now to be prepared.

• The drastic lifestyle changes following a natural disaster constitute a dramatic departure from normality.

• Research on the impact of natural disasters on health and environment is needed.

• Disentangle the effects of hurricane on health outcomes - stress, trauma, and chemical exposures.

• Has implications for populations in all hurricane prone areas in the United States the Atlantic and Pacific regions.
Questions?

Email: mdwelton@uga.edu
Looking forward...
Natural Disasters and Health Outcomes

Research based on Hurricanes Andrew, Katrina, Sandy, etc.

- Long-term physical and psychological health consequences
- Evidence that pregnant women may be at higher risk of preterm birth, low birth weight, and other adverse birth outcomes
- Are associations due to post-traumatic stress, hurricane-related exposure to hazardous substances, or a combination of factors?

Maria is unique...

- Prolong recovery
- Geographic isolation
Research Projects

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• Phone surveys, in person questioners, and biologic samples
## Environmental Exposures and Stress

### Urinary Phthalate Metabolite Concentrations (ng/mL)

#### PRE-MARIA

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<th>GM</th>
<th>25th</th>
<th>50th</th>
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<th>MAX</th>
<th></th>
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<td>323</td>
<td>689</td>
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</table>

p-values from mixed models accounting for within person correlation across samples
### Part 5. Hurricane Experiences

This section asks about your experience during the hurricanes and the time immediately after. Please answer YES or NO to the following questions about your experience during hurricane Irma or Maria or during the recovery period following the hurricanes:

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Did you feel your life was in danger?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Were you injured or did you get sick?</td>
<td></td>
<td></td>
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<tr>
<td>24</td>
<td>Was a member of your family injured or did they get sick?</td>
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<tr>
<td>25</td>
<td>Did you walk through flood waters?</td>
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<tr>
<td>26</td>
<td>Did your home or residence have severe damage?</td>
<td></td>
<td></td>
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<tr>
<td>27</td>
<td>Were you without electricity for more than one week?</td>
<td></td>
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<tr>
<td>28</td>
<td>Did you experience the death of a family member or loved one?</td>
<td></td>
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</tr>
<tr>
<td>29</td>
<td>Did you witness the death of anyone?</td>
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</table>
### Traumatic exposure Severity Scale (TESS)

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>During the hurricanes did you have to spend the night somewhere other than in your home?</td>
<td></td>
<td></td>
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<tr>
<td>Did you need food and water aid after the hurricanes?</td>
<td></td>
<td></td>
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<tr>
<td>Did you need clothes after the hurricanes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did you need shelter outside of your home after the hurricanes?</td>
<td></td>
<td></td>
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<tr>
<td>Did you suffer financial difficulties because of the hurricanes?</td>
<td></td>
<td></td>
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<tr>
<td>Did you need financial assistance from others because of hardships caused by the hurricanes?</td>
<td></td>
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<tr>
<td>Was your home damaged in the hurricanes?</td>
<td></td>
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<tr>
<td>Did you have to relocate because your house became structurally unsafe to live in?</td>
<td></td>
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<tr>
<td>Did you lose possessions in the hurricanes?</td>
<td></td>
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<tr>
<td>Were you physically injured during the hurricanes?</td>
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<tr>
<td>Did you seek medical attention for any injury or illness as a result of the hurricanes?</td>
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<tr>
<td>Did you become dependent on others because of the physical injuries/losses you suffered?</td>
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<tr>
<td>Were you stranded for period of time during or after the hurricanes?</td>
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<tr>
<td>Did any members of your immediate family die during or soon after the hurricanes?</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were any members of your family or your loved ones physically injured in the hurricanes?</td>
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<td></td>
</tr>
<tr>
<td>Did any of your loved ones become dependent on you for physical care because of their injuries?</td>
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<td></td>
</tr>
<tr>
<td>Were a member of your family or someone close to you stranded or lost during or after the hurricanes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was there a period when you knew your family or someone close to you was stranded or lost during or after the hurricanes?</td>
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<tr>
<td>Was there a period when you were uncertain about the welfare of loved ones, when you were unable to establish contact or unable to locate them?</td>
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<tr>
<td>Did you lose any relatives (e.g., aunts, uncles, cousins, grandparents) in the hurricanes?</td>
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<td></td>
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<tr>
<td>Were you involved in rescue work?</td>
<td></td>
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<tr>
<td>Did you see any dead bodies or body parts during the rescue and clearing up work period during or soon after the hurricanes?</td>
<td></td>
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</tr>
<tr>
<td>Did you hear sounds and cries for help from individuals during or soon after the hurricanes?</td>
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<td></td>
</tr>
<tr>
<td>Did you experience the odor of dead bodies in the days following the hurricanes?</td>
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</table>