

ASSESSING THE HEALTH IMPACTS OF FLOODING IN FLORIDA



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BACKGROUND

- Globally, flood is the most common cause of natural disaster.
- major cause of economic loss and infrastructure damage
- under future climate change scenarios, an expected increase in the frequency and intensity of floods
- limited insight into the factors that determine impacts to health

The impact on human health can be assessed by exploring

- deaths
- injuries
- other flood-related health outcomes

This study focused on the impact of floods in Florida from 2005-2015.

The impact on human health can be categorized as:

- direct effects
- indirect effects

Direct effects: include increased risk of

- drowning
- injury

Indirect effects: include increased risk of

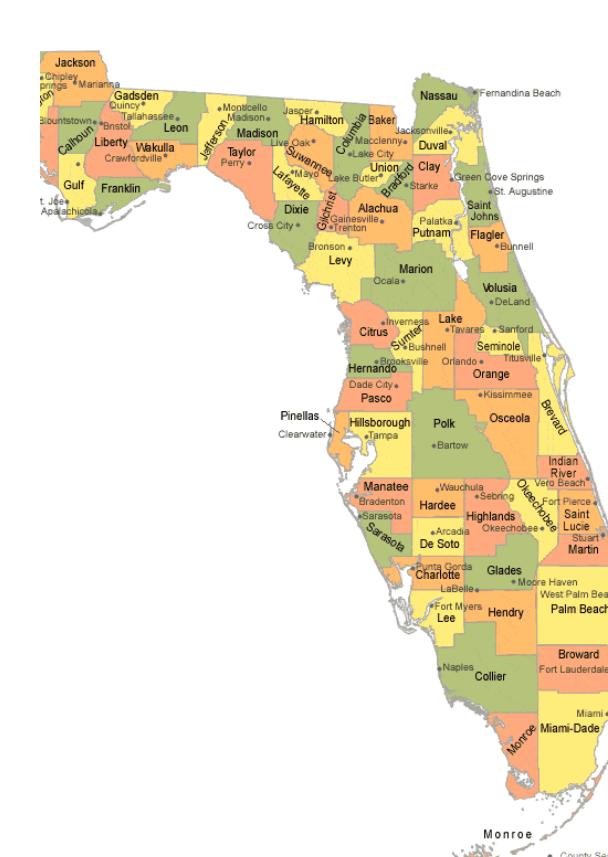
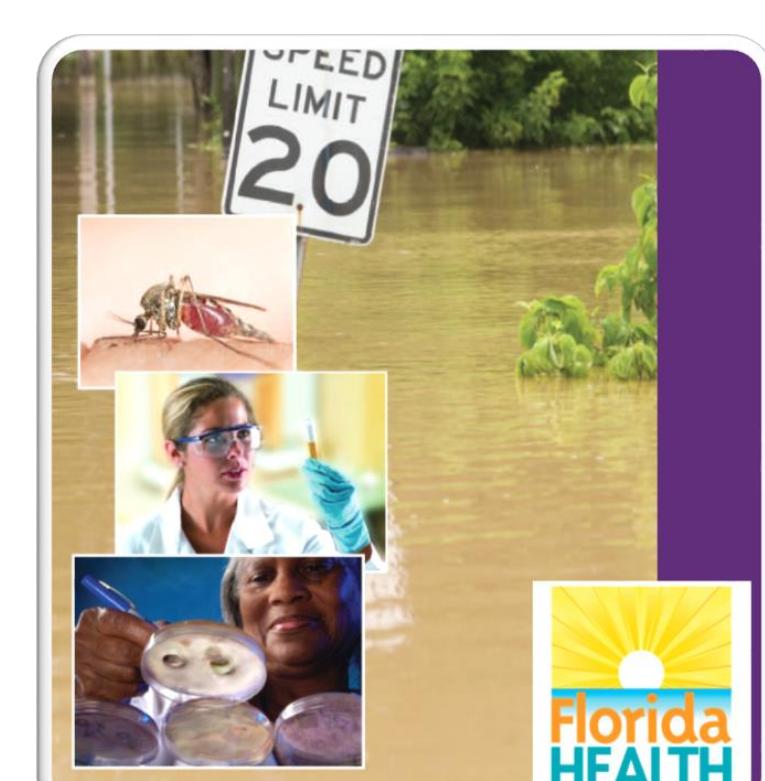
- food-, water-, and vector-borne diseases
- adverse mental health outcomes

Injury is a significant cause of morbidity and mortality during flood.

- over 360,000 flood-related injuries reported globally

Reasons for injury risk:

- evacuation of person or vehicle caught in floodwaters
- clean-up activities

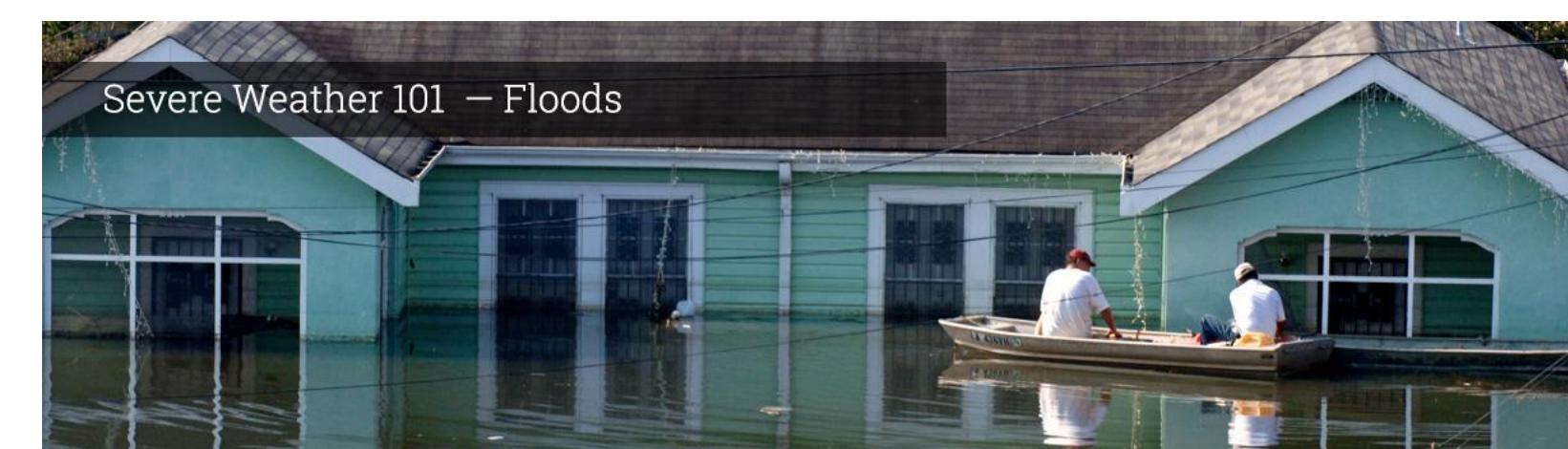


Selection of geographical location, i.e., Florida

- second wettest state in the United States
- an average annual precipitation of 54 inches
- geographic vulnerability to tropical storms, hurricanes, and floods
- frequent occurrence of heavy rainfall and flooding
- availability of flood and health events data

OBJECTIVE

The aim of the study is to estimate the association of flood events with healthcare utilization due to unintentional, all-cause injury in Florida between 2005-2015.



METHODS

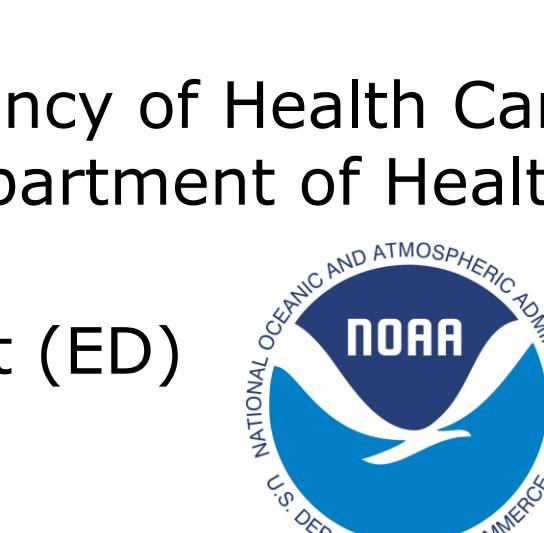
Study design: Ecological study

Data Sources and Variables



AHCA data:

- health event data from the Florida Agency of Health Care Administration (AHCA), the Florida Department of Health (FDOH)
- individual-level emergency department (ED) data collected since 2005



NOAA data:

- flood events data from the Storm database of the National Oceanic and Atmospheric Administration (NOAA)
- data available from January 1950 to January 2018

Exposure variable:

- primary exposure - flood events
- floods are "any high flow, overflow, or inundation by water which causes damage".
- Types of flood events considered were:

Flash flood:

- a life threatening, rapid rise of water into a normally dry area within minutes to multiple hours of the events

Coastal flood:

- coastal areas are portion of coastal land zones adjacent to waters, bays, & estuaries
- the vertical rise in water level due to strong onshore wind, high astronomical tide, and/or low atmospheric pressure

Lakeshore flood:

- lakeshore areas are portion of land zone adjacent to waters of Great Lakes & other assigned Marine Zones
- flooding of lakeshore area caused by strong, persistent onshore wind and/or low atmospheric pressure

Outcome variable:

- used primary diagnoses codes to define injury-related visits
- used International Classification of Diseases, Ninth Revision (ICD-9)

Definition of injury:

- unintentional injury from any cause
- excluded poisoning and toxic effects

Analysis

- Unit: daily count of ED visits in the 67 counties
- compared impact to control periods (Figure 1)
- used conditional Poisson regression, adjusting for year, month, day of week, and matched on county

Impact period:

- time interval between flooding event and elevated ED visits
- 14-day impact period

Washout period:

- two washout periods of 14 days each, before and after the impact period

Control period:

- time interval without flood events
- 14-day control period

RESULTS

There were 285 unique flood events impacting 67 counties of Florida.

- coastal floods – 11.9%
- floods – 45.5%
- flash floods – 42.6%
- lakeshore floods – 0.0%

The most affected areas included:

- Northwest coastal areas
- Panhandle

Table 1. Impacts of floods from NOAA data, Florida (2005-2015)

Variables	No. reported by NOAA database
Direct & Indirect Deaths	7
Crop Damage	\$63.26 million
Direct & Indirect Injury	2
Property Damage	\$593.73 million

Initial analysis:

- two control periods for every impact period
- combined all types of injury

Final Analysis:

- overlapping periods deleted such that a few impacts have only one control period
- significant increased rates of injury-related ED visits found for all storms combined and coastal flood impacts (Table 2)

Next Steps:

- sub-group analyses for specific types of injuries are to be conducted

Table 2. Associations of flood with all-cause, unintentional injury, Florida (2005-2015)

Storm category	Unadjusted		Adjusted	
	RR	95%CI	RR	95%CI
All Storms	1.007	1.003-1.012	1.005	1.0002-1.01
Flood only	.9995	.993-1.006	1.003	.996-1.0095
Coastal Flood	1.013	1.006-1.02	1.01	1.003-1.02
Flash Flood	1.015	.998-1.03	.991	.974-1.008

The values are adjusted for year, month & day of week.

CONCLUSIONS

- Florida is vulnerable to frequent flooding and its associated impacts
- The nature of this hazard varies.
- Final analyses showed increased rates of ED visits for injury during impact periods.
- We expect higher rates of specific types of injuries during impact periods in subsequent analyses.
- Such information will be key to planning public health prevention messages during and after major flooding events and will assist in resource planning and allocation during response activities.
- Thus, it is necessary to understand the impacts of flood events on human health for public health planning, preparedness, and mitigation activities.

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Figure 1. Impact and Control Periods Used in the Analysis of Floods between 2005-2015

