

All-Cause Hospital Admissions Among Older Adults After a Natural Disaster

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Study objective: We characterize hospital admissions among older adults for any cause in the 30 days after a significant natural disaster in the United States. The main outcome was all-cause hospital admissions in the 30 days after natural disaster. Separate analyses were conducted to examine all-cause hospital admissions excluding the 72 hours after the disaster, ICU admissions, all-cause inhospital mortality, and admissions by state.

Methods: A self-controlled case series analysis using the 2011 Medicare Provider and Analysis Review was conducted to examine exposure to natural disaster by elderly adults located in zip codes affected by tornadoes during the 2011 southeastern superstorm. Spatial data of tornado events were obtained from the National Oceanic and Atmospheric Administration's Severe Report database, and zip code data were obtained from the US Census Bureau.

Results: All-cause hospital admissions increased by 4% for older adults in the 30 days after the April 27, 2011, tornadoes (incidence rate ratio 1.04; 95% confidence interval 1.01 to 1.07). When the first 3 days after the disaster that may have been attributed to immediate injuries were excluded, hospitalizations for any cause also remained higher than when compared with the other 11 months of the year (incidence rate ratio 1.04; 95% confidence interval 1.01 to 1.07). There was no increase in ICU admissions or inhospital mortality associated with the natural disaster. When data were examined by individual states, Alabama, which had the highest number of persons affected, had a 9% increase in both hospitalizations and ICU admissions.

Conclusion: When all time-invariant characteristics were controlled for, this natural disaster was associated with a significant increase in all-cause hospitalizations. This analysis quantifies acute care use after disasters through examining all-cause hospitalizations and represents an important contribution to building models of resilience—the ability to recover from a disaster—and hospital surge capacity. [Ann Emerg Med. 2017;■:1-9.]

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INTRODUCTION

A recent National Academy of Medicine report on disaster-resilient communities called for identifying gaps in both patient and health care system disaster response¹ to support the development of models of recovery that will promote health outcomes in the aftermath of disasters. However, measuring health outcomes—including acute care use such as hospitalizations—after disasters remains difficult largely because of challenges surrounding data collection during and in the immediate aftermath of such incidents. Disaster-related hospitalizations are rarely documented as such, although increased health care use related to a disaster contributes to an already strained health care system. Collecting data during a disaster response therefore requires a unique combination of foresight, planning, and coordination that has proven difficult to implement.²

Nonetheless, there have been attempts to characterize service delivery after disasters. Most studies describe expected increases in emergency department (ED) and primary care visits for disaster-associated injuries and illnesses after a disaster. One study found an increase in hospital length of stay and total charges incurred for noncasualty hospitalized patients in the weeks after a large mass casualty incident in the United States at the 2 main receiving hospitals.³ Psychiatric ED visits remained higher than baseline in the 6 months after Hurricane Sandy in 2012.⁴ ED use varied at individual hospitals after Hurricane Sandy, with visits the day of the disaster consistently lower than normal across all studies,⁵⁻⁷ whereas 30% of dialysis centers experienced some degree of weather-related influence on operations in the aftermath of the June 2012 mid-Atlantic storms in the United States.⁸ An increase in all-cause admissions was found in the 30

Editor's Capsule Summary*What is already known on this topic*

Disasters can cause injuries resulting in a short-term increase in the demand for emergency care. The medium-term effect of natural disasters on the demand for hospital inpatient resources has not been well characterized.

What question this study addressed

Among individuals aged 65 years and older and living in zip codes directly affected by the southeastern US tornado outbreak on April 27, 2011, were there more hospital admissions during the 30 days after the event compared with other times of year?

What this study adds to our knowledge

Among 27,157 older adults living in affected areas who were hospitalized in 2011, all-cause hospitalizations were more common during the month after the tornado outbreak than during the rest of the year (incident rate ratio 1.04; 95% confidence interval 1.01 to 1.07). The effect remained after exclusion of the first 3 days after the tornado.

How this is relevant to clinical practice

The results provide evidence of a small but measurable increase in hospitalizations after a natural disaster, which may assist in planning responses for these types of events.

days after Hurricane Katrina among dialysis patients.⁹ Yet evaluating hospitalizations for any cause on a "whole disaster" scale has remained limited in the disaster health literature.

In this study, we pivot from examining the direct sequelae of disasters, including disaster-induced injuries and the immediate surge capacity that accompanies this, to a broader view of the effect of disasters on acute care use. We sought to determine whether hospital admissions among older adults for any cause increased in an extended recovery period after disasters. Using the April 27, 2011, southeastern US tornado outbreak as a model system, we characterized all-cause hospital admissions in the 30 days after a significant natural disaster in the United States. As secondary analyses, we sought to examine the association with all-cause ICU admissions, all-cause mortality, and excluding the initial 3 days of the disaster, when admissions for injury may have been more likely.^{10,11}

MATERIALS AND METHODS

We conducted a self-controlled case series analysis to determine the change in all-cause hospital admissions in the 30 days after a natural disaster. The 2011 superoutbreak was one of the largest tornado-related natural disasters in US history. During a 24-hour period on April 27, 2011, a reported 218 tornadoes touched down across the Southeast and Midwest in the United States, resulting in approximately 317 deaths and an estimated \$5 billion in damages.¹² In Alabama alone, 46 hospitals reported patients with tornado-related injuries.¹¹ Federal Emergency Management Agency disaster declarations were made in 10 states.¹³ Figure 1 depicts a map of Enhanced Fujita level 4 and 5 (EF-4 and -5) tornadic events across the southeastern United States. This study was approved by our institution's institutional review board.

Data Collection and Processing

The 2011 Medicare Provider and Analysis Review and Medicare beneficiary claims data were used to conduct this analysis. The Medicare Provider and Analysis Review contains final action stay records for acute inpatient hospitalizations for individuals aged 65 years or older, in which we examined one claim per hospitalization to avoid double counting hospitalizations. Spatial data of US tornado events were downloaded from the National Oceanic and Atmospheric Administration's Severe Report database,¹⁴ and zip code data were obtained from the US Census Bureau.¹⁵ Affected areas were identified (Figure 1) with ARC-GIS (version 10.5; Environmental Research Systems, Inc., Redlands, CA). The affected zip code areas with EF-4 and -5 tornado paths during the April 2011 superoutbreak were included in the sample for our primary analysis.¹⁶ Fifteen total EF-4 or -5 tornadoes were recorded: 11 in Alabama, 4 in Georgia, 4 in Tennessee, and 3 in Mississippi. In some instances, the same tornado crossed state lines.

Selection of Participants

Our sample included individuals in the 2011 Medicare Provider and Analysis Review database who were hospitalized in areas with zip codes that had a confirmed EF-4 or -5 touchdown on April 27, 2011. A population within the same broader geographic area that was confirmed to be unaffected by tornadoes was examined as a negative control.

Outcome Measures

All-cause hospital admissions in 2011 were examined as the primary outcome. Secondary analyses examined all-cause ICU admissions, all-cause in-hospital mortality, and all hospital admissions by state.

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