

# Natural Disasters and Myocardial Infarction: The Six Years After Hurricane Katrina

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## Abstract

**Objective:** To determine the prolonged effect of Hurricane Katrina on the incidence and timing of acute myocardial infarction (AMI) in the city of New Orleans.

**Patients and Methods:** Our study population consisted of 1476 patients with AMI before (August 29, 1999, to August 28, 2005) and after (February 14, 2006, to February 13, 2012) Hurricane Katrina at Tulane University Health Sciences Center to determine post-Katrina alterations in the occurrence and timing of AMI.

**Results:** Compared with pre-Katrina values, there was a more than 3-fold increase in the percentage of admissions for AMI during the 6 years after Hurricane Katrina ( $P < .001$ ). The percentage of admissions for AMI after Hurricane Katrina increased significantly on nights ( $P < .001$ ) and weekends ( $P < .001$ ) and decreased significantly on mornings ( $P < .001$ ), Mondays ( $P < .001$ ), and weekdays ( $P < .001$ ). Patients with AMI after Hurricane Katrina also had significantly higher rates of psychiatric comorbidities ( $P = .01$ ), smoking ( $P < .001$ ), lack of health insurance ( $P < .05$ ), and unemployment ( $P < .001$ ).

**Conclusion:** These results indicate that the effect of natural disasters on the occurrence of AMI may persist for at least a 6-year period and may be related to various factors including population shifts, alterations in the health care system, and the effects of chronic stress and associated behaviors.

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In the past decade, the incidence of worldwide natural disasters has increased 6-fold compared with just 5 decades ago.<sup>1</sup> Ninety percent of these disasters are hydrometeorological (droughts, storms, and floods), and these events are expected to continue to increase in both frequency and intensity with persistent global climate change.<sup>1</sup> As a result of an increase in the number of people living in areas likely to be exposed to a natural disaster, the economic impact is expected to continue to rise dramatically (as evidenced by the recent havoc wrought by Hurricane Sandy on the greater New York City metropolitan area).<sup>1</sup> Because coronary artery disease is the number one killer worldwide, the effect of natural disasters on acute myocardial infarction (AMI) is an issue of paramount importance.

The short-term effect of natural disasters causing an increase in the incidence of AMI was first established after the 1994 Northridge

earthquake in Los Angeles, California, and the 1995 Hanshin-Awaji earthquake in Japan.<sup>2,3</sup> In 2005, analysis of data from Hurricane Katrina found that this effect can last beyond the first several weeks and still be evident at 2 and 3 years after the event.<sup>4,5</sup> Furthermore, after Hurricane Katrina, the increase in the percentage of admissions for AMI was accompanied by an alteration in the traditional chronobiological pattern of onset of AMI, suggesting possible changes in factors triggering the acute event.<sup>6</sup>

Because neither the occurrence nor the chronobiology of AMI presented any sign of returning to pre-Katrina levels in the first 3 years after the storm, the long-lasting effect of Hurricane Katrina is yet to be established. Consequently, the present study was designed to provide a long-term follow-up (4-6 years) on the effects of Hurricane Katrina on the pattern of AMI in New Orleans.

## PATIENTS AND METHODS

### Study Population

We retrospectively identified patients with AMI at Tulane University Health Sciences Center (TUHSC) by using *International Classification of Diseases, Ninth Revision*, codes 410.1-410.9. The institutional review board at the Tulane Office of Human Research Protection approved the study, waiving the requirement for informed consent. Pre-Katrina demographic, clinical, and chronobiological data were assessed over 6 years: from August 29, 1999, to August 28, 2005 (the day Hurricane Katrina struck New Orleans). The percentage of admission for AMI after Hurricane Katrina was assessed only over 2 years: from August 29, 2003, to August 29, 2005. Unfortunately, overall TUHSC hospital admission data were not available before 2003. Post-Katrina data for all variables were assessed over 6 years: from February 14, 2006 (the day TUHSC became the first downtown medical center to reopen), to February 13, 2012. All study participants had typical myocardial ischemic symptoms and troponin I levels exceeding the upper limits of normal (as defined by the TUHSC Biochemistry Laboratory). Excluded from all analyses were patients younger than 18 years, patient transfers from outside hospitals, non-New Orleans residents, those with symptom onset while hospitalized, and patients with elevated serum troponin levels in the setting of severe noncardiac illness without documentation of ischemic symptoms. Specifically excluded from chronobiological analysis were patients with inadequate documentation of timing of symptom onset. All clinical and demographic information (including psychiatric history) was obtained from admission nurse triage and physician history and physical reports reflecting both patient- and patient's family-reported information. Employment status included participation in both full- and part-time jobs.

### Study Design

Pre- and post-Katrina cohorts were compared with regard to the percentage of admissions for AMI, demographic characteristics, and timing of symptom onset. Additional subgroup analyses compared years 1 to 3 with years 4 to 6 after Hurricane Katrina. The percentage of admissions for AMI was calculated

by dividing the number of AMI admissions by the total number of TUHSC admissions.

### Statistical Analyses

Nonuniformity between cohorts and subgroups was performed using  $\chi^2$  statistical tests. Differences between group means were compared using unpaired Student *t* tests.

## RESULTS

A total of 1476 patients were analyzed for demographic and clinical historical data. The post-Katrina group was significantly younger ( $P=.007$ ), less likely to be white ( $P=.03$ ), and had significantly higher rates of previously diagnosed coronary artery disease ( $P=.004$ ), hyperlipidemia ( $P=.05$ ), psychiatric comorbidities ( $P=.01$ ), smoking ( $P<.001$ ), and lack of employment ( $P<.001$ ) (Table 1). Notable demographic differences between years 1 to 3 and years 4 to 6 after Hurricane Katrina included significantly lower rates of men ( $P=.01$ ), whites ( $P=.002$ ), and uninsured ( $P<.05$ ) and significantly higher rates of coronary artery disease ( $P=.001$ ), hyperlipidemia ( $P=.004$ ), diabetes ( $P=.04$ ), and psychiatric disease ( $P<.001$ ) in the latter period (Table 1).

The percentage of admissions for AMI (as measured by the number of AMI admissions divided by the total number of TUHSC admissions) increased from 150 of 21,079 (0.7%) to 1177 of 48,258 (2.4%) after Hurricane Katrina ( $P<.001$ ) (Table 2). Subgroup analyses of years 1 to 3 and years 4 to 6 after Hurricane Katrina revealed that the incidence of AMI admission increased from 418 of 21,092 (2.0%) to 759 of 27,166 (2.8%) total admissions between the 2 periods ( $P<.001$ ).

An assessment of chronobiology of AMI onset was possible in 1180 total patients and in 881 of 1177 patients with AMI after Hurricane Katrina (296 patients were excluded owing to inadequate documentation of symptom onset). A comparison of pre-Katrina and post-Katrina groups revealed significantly decreased AMI during mornings (from 6 to 11:59 AM;  $P=.001$ ), Mondays (from midnight to 11:59 PM;  $P<.001$ ), and weekdays (from 6 AM to 5:59 PM, Monday through Friday;  $P<.001$ ) and significantly increased AMI during nights (from 6 PM to 5:59 AM, all days of the week;  $P=.001$ ) and weekends (from midnight Saturday to 11:59 PM Sunday) after Hurricane

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