



ANNOTATED BIBLIOGRAPHY

The Human Dimensions of Sheltering



University of Colorado
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Overview

This annotated bibliography includes 118 resources focused on the human dimensions of sheltering—psychology of shelter use, shelter decision-making, experiences in shelters, mental health impacts of disasters/sheltering, specific population needs for sheltering—as they relate to hurricane, tornado, and extreme wind hazard events. This bibliography only includes references focused on the United States, U.S. Territories, and Tribal Nations. This bibliography is meant to provide a resource for publications available after 1999 focused on this topic. These references were compiled through searching Web of Science, EBSCOhost, ProQuest database and agency websites. It includes academic journal articles, articles published online, and agency reports. This bibliography is categorized into theme areas listed below. Abstracts were included when available. This effort was funded by the Federal Emergency Management Agency through an award to the Applied Technology Council.



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Socially Vulnerable Populations and Special Needs

Articles addressing the vulnerability of specific populations, such as the elderly, disabled, or those with medical needs; Studies on the challenges and recommendations for evacuating and sheltering vulnerable groups during disasters.

Citation

Adelman, D.S. & Legg, T.J. (2010). Caring for older adults with dementia when disaster strikes. *Journal of Gerontological Nursing*, 36(8), 13–17. <https://doi.org/10.3928/00989134-20100701-01>

Abstract

Disaster emergencies are occurring with seemingly increased frequency. The likelihood that gerontological nurse will be involved in a disaster scenario, regardless of practices setting, is real. Instead of recoiling from this likelihood, the best approach is preparedness. In this article we examine what constitutes a disaster and how it differs from an emergency, as well as the potential impact of disaster on older adults in general and those with dementia in particular. Concepts of sheltering in plac, caring for older adults with dementia in a temporary shelter, and partnering with nurses in acute care settings are discussed.

Citation

Ash, K. D., Egnoto, M. J., Strader, S. M., Ashley, W. S., Roueche, D. B., Klockow-McClain, K. E., Caplen, D., & Dickerson, M. (2020). Structural forces: Perception and vulnerability factors for tornado sheltering within mobile and manufactured housing in Alabama and Mississippi. *Weather, Climate & Society*, 12(3), 453–472. <https://doi.org/10.1175/WCAS-D-19-0088.1>

Abstract

Southeastern U.S. mobile and manufactured housing (MH) residents are the most tornado-vulnerable subset of the population because of both physical and socioeconomic factors. This study builds upon prior MH resident tornado vulnerability research by statistically and geographically analyzing responses from a survey administered to these residents in the Southeast. Specifically, 257 Alabama and Mississippi MH residents were administered a survey with questions pertaining to their perceived tornado risk and vulnerability, protective action and decision-making, and beliefs about the structural integrity of their homes. Results indicate that, despite the weather and emergency management enterprises consistently suggesting that MH residents evacuate their homes for sturdier shelter during tornado events, more than 50% of MH residents believe their homes are safe sheltering locations. The prevalence of larger MHs in northern Alabama partially influences willingness to shelter within one's MH, while higher levels of negative affectivity stemming from recent impactful tornadoes in northern Alabama influences people to evacuate their MHs for safety. Study findings also uncovered a perception and vulnerability paradox for these residents: Those who have the means to evacuate their MH often feel they have no need to do so, whereas those who recognize the potential peril of sheltering in their home and want to evacuate often lack the resources and/or self-efficacy to carry out more desirable sheltering plans. Overall, study results provide valuable information for National Weather Service forecasters, emergency managers, and media partners so that they may use it for public outreach and MH resident education.

Citation

Behr, J.G. & Diaz, R. (2013). Disparate health implications stemming from the propensity of elderly and medically fragile populations to shelter in place during severe storm events. *Journal of Public Health Management and Practice*, 19, S55-62. <https://doi.org/10.1097/PHH.0b013e318297226a>

Abstract

Chronic conditions, disability limitations (mobility, cognitive, and sensory), and the need for assistance with activities of daily living are characteristics of elderly and medically fragile populations. Theory suggests that households with these vulnerability attributes are more likely to suffer storm-induced adverse and prolonged health consequences and, therefore, ought to evidence an increased propensity to evacuate prior to a severe storm event. Yet despite being more sensitive to storm disruption, the elderly and medically fragile populations are only slightly more likely to evacuate in the face of impending storms. This suggests, for these groups, there may be other factors such as income, transportation, and social and familial networks that may be attenuating the propensity to evacuate. The public health significance is found in that the propensity to shelter in place, rather than evacuate, may contribute to disparate health outcomes. Data illustrating the prevalence of these conditions and the propensity to shelter in place are derived from a sampling of Hampton Roads households following the 2011 Hurricane Irene.

Citation

Brown, L., Christensen, J., Ialynytchev, A., Thomas, K., Frahm, K., & Hyer, K. (2015). Experiences of assisted living facility staff in evacuating and sheltering residents during hurricanes. *Current Psychology*, 34(3), 506–514. <https://doi.org/10.1007/s12144-015-9361-7>

Abstract

The study examined Florida assisted living facility staff perspectives of disaster preparedness, response, and recovery after the 2004 and 2005 hurricanes. A descriptive study using qualitative and quantitative approaches. One hundred seventy Florida assisted living facility staff who worked in areas under hurricane threat and provided care to residents during a hurricane. A questionnaire that was mailed or administered to staff attending a regional planning conference with quantitative and qualitative items. Of the 143 facilities that were affected by a hurricane, 77 % reported that they sheltered residents in place, while 23 % indicated that they evacuated for one or more of the hurricanes. Almost one-third of facilities lost telephone service and almost half lost electrical power during one or more of the hurricanes. Key topics noted by both evacuating facilities and those that sheltered in place were 1) decision-making, 2) planning, support, and supplies, 3) communication, and 4) electricity. Unique to assisted living facilities is the role of residents' family in assuming responsibility for evacuation and shelter during hurricanes. Facility staff at both evacuating and sheltering facilities indicated that the decision to evacuate or to shelter in place was difficult and the electrical power was critical to resident well-being. Assisted living facilities should develop disaster preparedness plans in conjunction with local and state emergency offices. Adequate disaster preparedness has implications for residents' safety as well as assisted living facility staff during disasters.

Citation

Buckley, J. W. (2002). After the storm: Building a safe shelter for the school children of Mulhall, Oklahoma. *Weather and Forecasting*, 17(3), 626–634.

Abstract

When the elementary school in Mulhall, Oklahoma, was destroyed during the tornado outbreak of 3 May 1999, a great loss of young life was prevented by chance alone. The tornado hit after school was out of session. The weather scientists and researchers who read this journal attempt to save lives by improving forecasting and public warning systems. The author has attempted to save lives for more than two decades by designing storm shelters to serve students who do not have the option of fleeing an approaching storm. The reasons why so few of Oklahoma's schools provide storm protection are defined as a lack of adequate construction and maintenance funding and a widespread low-risk perception. The estimated cost to provide all Oklahoma school children with protection from a direct hit by an F5 tornado is about \$1.3 billion. A plain-language discussion of the aboveground shelter that was designed for the rebuilt school includes site planning principles, structural design options, the importance of including a brick veneer, shelter door design options and criteria, strategies to resolve fire code violations, and the importance of designing for a rescue after the storm has passed. A call is made for a national storm shelter rating system based upon differing occupant safety levels. A call is also made for a partnership among the professionals who are designing large-scale shelters, scientists and researchers studying tornados, and building code officials similar to the partnership that has vastly improved earthquake-resistant building design.

Citation

Burger, J., Gochfeld, M., & Lacy, C. (2019). Concerns and future preparedness plans of a vulnerable population in New Jersey following Hurricane Sandy. *Disasters*, 43(3), 658–685.
<https://doi.org/10.1111/disa.12350>

Abstract

Knowing how people prepare for disasters is essential to developing resiliency strategies. This study examined recalled concerns, evacuation experiences, and the future preparedness plans of a vulnerable population in New Jersey, United States, following Hurricane Sandy in 2012. Understanding the responses of minority communities is key to protecting them during forthcoming disasters. Overall, 35 per cent of respondents were not going to prepare for an event. Intended future preparedness actions were unrelated to respondents' ratings of personal impact. More Blacks and Hispanics planned on preparing than Whites (68 versus 55 per cent), and more Hispanics planned on evacuating than did others who were interviewed. A higher percentage of respondents who had trouble getting to health centres were going to prepare than others. Respondents' concerns were connected to safety and survival, protecting family and friends, and having enough food and medicine, whereas future actions included evacuating earlier and buying sufficient supplies to shelter in place.

Citation

Cain, D.S., & Barthelemy, J. (2008). Tangible and spiritual relief after the storm: The religious community responds to Katrina. *Impact of Natural Disasters: Implications for Human and Social Services*, 34(3), 29–42.

Abstract

This study assessed the types of social services and spiritual messages that were provided by Baton Rouge area churches following Hurricane Katrina. Church representatives (n = 157) completed a 26-item survey which consisted of open and closed ended questions. The most common resources provided by churches included food, clothing, and financial assistance. Nearly 75% of churches attempted to connect evacuees with outside state and federal resources. The greatest unmet needs reported by churches included evacuee shelter and housing, and on-site computer and internet access. Churches recommend preparedness, triage care, and leadership for other churches that find themselves the first responders following a disaster. Because of their responsiveness to the needs of communities, clergy need to be trained in disaster management. Moreover, government monies could be well-spent in supporting faith-based disaster initiatives.

Citation

Christensen, J.J., Richey, E.D., & Castañeda, H. (2013). Seeking safety: Predictors of hurricane evacuation of community-dwelling families affected by Alzheimer's disease or a related disorder in South Florida. *American Journal of Alzheimer's Disease and Other Dementias*, 28(7), 682–692. <https://doi.org/10.1177/1533317513500837>

Abstract

This article explores how dyads of 186 community-dwelling individuals with a diagnosis of Alzheimer's disease or a related disorder (ADRD) and their caregivers (dyads) plan to respond to hurricane evacuation warnings in South Florida. Predictors of dyad evacuation for a category 1-3 storm include (1) a younger age of the person with an ADRD diagnosis, (2) the caregiver living in a different residence than the person with ADRD, (3) lack of hurricane shutters, and (4) lower income. A dyad is more likely to evacuate in a category 4 or 5 hurricane if there is (1) a younger age person with an ADRD diagnosis, (2) a more recent diagnosis of ADRD, (3) a residence in an evacuation zone, and if (4) they report needing a shelter. Emergency management teams, especially those who assist with special needs shelters or other outreach programs for people with cognitive disabilities, can use these guidelines to estimate service usage and needs.

Citation

Claver, M., Dobalian, A., Fickel, J.J., Ricci, K.A., & Mallers, M.H. (2013). Comprehensive care for vulnerable elderly veterans during disasters. *Archives of Gerontology and Geriatrics*, 56(1), 205–213. <https://doi.org/10.1016/j.archger.2012.07.010>

Abstract

Despite problematic evacuation and sheltering of nursing home residents during Hurricanes Katrina and Rita, an exploration of the experiences of Veterans Health Administration (VHA) nursing homes (VANHs) is necessary for a comprehensive examination of the healthcare community's response to these disasters. VANH evacuations during these hurricanes have not been widely studied. This exploratory project aimed to provide information about the evacuation experiences and characteristics of vulnerable nursing home residents. Interviews with key informants from VHA facilities with nursing home staff and representatives revealed that physical harm, psychological distress, cognitive decline and increased social isolation were areas that deserved special attention for this vulnerable population. Moreover, physical, psychological and social needs were

interconnected in that each influenced the others. Findings contribute to the general conversation about meeting the biopsychosocial needs of nursing home residents in an integrated healthcare delivery system and more broadly, the role of long-term care facilities in general in planning for future disasters.

Citation

Deal, B., Alfred, D., Fountain, R., Ford, T., & Chilton, J. (2010). Educational opportunities: A nursing school model for medical special-needs sheltering. *Nurse Educator*, 35(3), 122–126.

<https://doi.org/10.1097/NNE.0b013e3181d950a4>

Abstract

The devastation of New Orleans after Hurricane Katrina increased the awareness of persons who were unable to self-evacuate because of physical and/or mental disabilities. From that awareness, plans emerged to provide a safe haven for those who had special needs. In this article, we describe our efforts as a school of nursing to shelter medical special needs (MSN) evacuees in the wake of a hurricane. After the shelter closed, faculty and students involved in the shelter answered a short survey that included both open- and close-ended questions. The responses are summarized to encourage other schools of nursing to consider caring for MSN evacuees and to share our successes, our failures, and our plans for the future.

Citation

Deal, B.J., Fountain, R.A., Russell-Broadus, C.A., & Stanley-Hermanns, M. (2006). Challenges and opportunities of nursing care in special-needs shelters. *Disaster Management & Response*, 4(4), 100–105. <https://doi.org/10.1016/j.dmr.2006.08.001>

Abstract

Hurricanes Katrina and Rita forced many individuals along the coast of Texas and Louisiana to seek shelter inland. Among the evacuees were residents with special needs and residents of nursing homes and group homes caring for mentally retarded and physically disabled persons. Many nurses volunteered to provide health care for those in need. This article discusses challenges and opportunities that were encountered by nurses volunteering in special-needs shelters. Issues related to human and physical resources, patient care, and confidentiality are discussed including lessons learned. As nurses who cared for evacuees in the shelter, it is hoped some of the lessons learned can be utilized in future disasters.

Citation

DeYoung, S. (2020). Safe spaces: Creating a culture to support infant feeding in shelters. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters*, Natural Hazards Center, University of Colorado Boulder. <https://hazards.colorado.edu/news/research-counts/special-collection/safe-spaces-creating-a-culture-to-support-infant-feeding-in-shelters-1>

Citation

Dostal, P.J. (2015). Vulnerability of urban homebound older adults in disasters: A survey of evacuation preparedness. *Disaster Medicine and Public Health Preparedness*, 9(3), 301–306. <https://doi.org/10.1017/dmp.2015.50>

Abstract

OBJECTIVE: Recent disasters within the United States, such as Hurricanes Katrina and Sandy, have highlighted the vulnerability of older adults, and recent litigation has upheld the responsibility of government in assisting the public during mandatory evacuations. Older adults designated as homebound due to their disabilities are at greatest risk of poor outcomes in disasters. This study aimed at assessing the willingness and ability of homebound older adults to evacuate, as well as categorizing their medical needs in the event they are relocated to an emergency shelter.

METHODS: Fifty-six homebound older adults and medical decision surrogates from 1 homebound primary care practice in Philadelphia were assessed with a novel structured interview. **RESULTS:** Respondents reported limitations in both their ability and their willingness to evacuate their neighborhoods. Medical needs of homebound older adults were on par with those of nursing home residents. **CONCLUSIONS:** Many homebound older adults are unable or unwilling to evacuate in a mandatory evacuation situation, highlighting a need for public assistance. Their complex medical needs will require significant preparation by special needs shelters.

Citation

Eisenman, D.P., Cordasco, K.M., Asch, S., Golden, J.F., & Glik, D. (2007). Disaster planning and risk communication with vulnerable communities: Lessons from Hurricane Katrina. *American Journal of Public Health*, 97, S109-15. <https://doi.org/10.2105/AJPH.2005.084335>

Abstract

OBJECTIVES: We studied the experience of Hurricane Katrina evacuees to better understand factors influencing evacuation decisions in impoverished, mainly minority communities that were most severely affected by the disaster. **METHODS:** We performed qualitative interviews with 58 randomly selected evacuees living in Houston’s major evacuation centers from September 9 to 12, 2005. Transcripts were content analyzed using grounded theory methodology. **RESULTS:** Participants were mainly African American, had low incomes, and were from New Orleans. Participants’ strong ties to extended family, friends, and community groups influenced other factors affecting evacuation, including transportation, access to shelter, and perception of evacuation messages. These social connections cut both ways, which facilitated and hindered evacuation decisions. **CONCLUSIONS:** Effective disaster plans must account for the specific obstacles encountered by vulnerable and minority communities. Removing the more apparent obstacles of shelter and transportation will likely be insufficient for improving disaster plans for impoverished, minority communities. The important influence of extended families and social networks demand better community-based communication and preparation strategies.

Citation

Gin, J. (2020). Preparing the whole community: Including individuals experiencing homelessness in disaster planning. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters*, Natural Hazards Center, University of Colorado Boulder. <https://hazards.colorado.edu/news/research-counts/special-collection/preparing-the-whole-community-including-individuals-experiencing-homelessness-in-disaster-planning>

Citation

Holmes, T.J., Williams, P.C., Wong, S., Smith, K., Bandzuh, J.T., & Uejio, C.K. (2022). Assessment of an evacuation shelter program for people with access and functional needs in Monroe County, Florida during Hurricane Irma. *Social Science & Medicine*, 306, 115108.

<https://doi.org/10.1016/j.socscimed.2022.115108>

Abstract

This case study presents an evaluation framework to assess the facilitating and constraining factors that influenced the emergency response, operation, and management of a Special Needs Shelter Program in Monroe County, Florida during Hurricane Irma in 2017. A qualitative analysis of key documents and discussions with agencies directly involved in the Monroe County Special Needs Shelter Program was used to assess four major emergency response processes: notifications and communications, evacuation and transportation, sheltering, and interagency coordination. A critical cross-cutting theme emerged, which was a lack of a common definition for populations with “special needs” across different agencies resulting in uncertainties about who should be admitted to the Special Needs Shelter and have access to their services. We generate public health and emergency management lessons to inform future adaptation, preparedness, and response plans to extreme weather events for populations with access and functional needs in Monroe County and Florida’s coastal communities more broadly.

Citation

Horner, M.W., Ozguven, E.E., Marcelin, J.M., & Kocatepe, A. (2018). Special needs hurricane shelters and the ageing population: Development of a methodology and a case study application. *Disasters*, 42(1), 169–186.

<https://doi.org/10.1111/disa.12233>

Abstract

Recent experience of hurricanes, particularly in the southeast United States, has heightened awareness of the multifaceted nature of and the challenges to effective disaster relief planning. One key element of this planning is providing adequate shelter at secure locations for people who evacuate. Some of these individuals will have “special needs”, yet there is little research on the relationship with shelter space. This study designed a geographic information systems-based network optimisation methodology for the siting of special needs hurricane relief shelters, with a focus on the transportation component. It sought to find new locations for shelters that maximise accessibility by vulnerable populations, given capacity constraints, concentrating on the ageing population. The framework was implemented in a medium-sized metropolitan statistical area in the state of Florida where data suggest a possible deficit in special needs shelter space. The study analysed options for increasing special needs shelter capacity, while considering potential uncertainties in transportation network availability.

Citation

Laditka, S.B., Laditka, J.N., Xirasagar, S., Cornman, C.B., Davis, C.B., & Richter, J.V. (2008). Providing shelter to nursing home evacuees in disasters: Lessons from Hurricane Katrina.

American Journal of Public Health, 98(7), 1288–1293. <https://doi.org/10.2105/AJPH.2006.107748>

Abstract

OBJECTIVES: We examined nursing home preparedness needs by studying the experiences of nursing homes that sheltered evacuees from Hurricane Katrina. **METHODS:** Five weeks after Hurricane Katrina, and again 15 weeks later, we conducted interviews with administrators of 14 nursing homes that sheltered 458 evacuees in 4 states. Nine weeks after Katrina, we conducted site visits to 4 nursing homes and interviewed 4 administrators and 38 staff members. We used grounded theory analysis to identify major themes and thematic analysis to organize content. **RESULTS:** Although most sheltering facilities were well prepared for emergency triage and treatment, we identified some major preparedness shortcomings. Nursing homes were not included in community planning or recognized as community health care resources. Supplies and medications were inadequate, and there was insufficient communication and information about evacuees provided by evacuating nursing homes to sheltering nursing homes. Residents and staff had notable mental health-related needs after 5 months, and maintaining adequate staffing was a challenge. **CONCLUSIONS:** Nursing homes should develop and practice procedures to shelter and provide long-term access to mental health services following a disaster. Nursing homes should be integrated into community disaster planning and be classified in an emergency priority category similar to hospitals.

Citation

Mando, A.M., Peek, L., Brown, L., & King-Kallimanis, B. (2011). Hurricane preparedness and sheltering preferences of Muslims living in Florida. *Journal of Emergency Management*, 9(1). <https://doi.org/10.5055/jem.2011.0046>

Abstract

Objectives: Given the increasing diversity of the US population and the continued threat of hurricane devastation along the heavily populated Gulf Coast region, the lack of research on preparedness and sheltering activities across religious or cultural groups represents a significant gap in the field of hazards and disaster research. To address this void, a questionnaire examining hurricane preparedness attitudes and sheltering preferences was administered to Muslims living in Tampa, Florida. **Design:** An exploratory study using a cross-sectional survey of Muslim adults who were attending a religious or cultural event. **Setting:** The Islamic Society of Tampa Bay Area and the Muslim American Society located in Tampa, Florida. **Participants:** The final convenience sample of 139 adults had a mean age of 38.87 years (± 11.8) with males and females equally represented. **Results:** Significant differences were found in disaster planning activities and confidence in hurricane preparedness. Notably, 70.2 percent of the respondents were unsure about having a plan or were without a plan. Of the 29.7 percent who actually had a plan, 85.4 percent of those individuals were confident in their hurricane preparedness. This study also revealed that safety, cleanliness, access to a prayer room, and privacy were concerns related to using a public shelter during hurricanes. Nearly half of the respondents (47.4 percent) noted that the events of 9/11 influenced their comfort level about staying in a public shelter during a hurricane disaster. **Conclusions:** Disaster planners should be aware of the religious practices of the Islamic community, encourage disaster planning among diverse groups, and address safety and privacy concerns associated with using public shelters.

Citation

Missildine, K., Varnell, G., Williams, J., Grover, K.H., Ballard, N., & Stanley-Hermanns, M. (2009). Comfort in the eye of the storm: A survey of evacuees with special medical needs. *Journal of Emergency Nursing*, 35(6), 515–520. <https://doi.org/10.1016/j.jen.2009.07.007>

Abstract

INTRODUCTION: This article reports on a descriptive study conducted in a Medical Special Needs Shelter with evacuees from Hurricane Gustav in 2008. This shelter was operated by the faculty, students and staff of the University of Texas at Tyler in Tyler, TX. **METHODS:** A descriptive survey approach was used to determine the perception of the shelter experience of evacuees with special medical needs. Evacuees were interviewed by baccalaureate nursing students to assess experiences with the admission process, rest and sleep, food activities, medications and treatments and feelings of safety. **RESULTS:** Most evacuees were ambulatory, but 48% required human or mechanical assistance. Most had chronic health problems. Overall, the evacuees were pleased with the shelter experience. **DISCUSSION:** The admission process was expedient and the evacuees felt welcomed and safe in the shelter. Most slept without difficulty, and boredom was not a problem. Assistance with medications or management of medical conditions was provided for 63%. Areas of dissatisfaction were toilet and shower facilities and quality/quantity of food.

Citation

Patton-Levine, J.K., Vest, J.R., & Valadez, A.M. (2007). Caregivers and families in medical special needs shelters: An experience during Hurricane Rita. *American Journal of Disaster Medicine*, 2(2), 81–86.

Abstract

INTRODUCTION: Local public health departments may assume responsibility for sheltering and providing care for medically needy populations displaced by disasters. In addition, medical special needs shelters will inevitably house persons not requiring medical assistance. The presence of nonpatients may help or hinder shelter operations. This analysis examines the composition, demographics, and medical requirements of a population in a special needs shelter. **METHODS:** Frequencies and ratios were used to describe persons residing in a medical special needs shelter. All data were obtained from registration records from the city of Austin's medical special needs shelter, established in response to Hurricane Rita in 2005. **RESULTS:** The medically needy accounted for 58.4 percent of the shelter population. For every 100 patients, the shelter housed 71.2 nonpatients. The most common nonpatients in the shelter were family caregivers (13.1 percent), followed by dependent children (8.0 percent). Most professional caregivers were associated with some type of group facility. **CONCLUSIONS:** Sheltering a medically needy population means caring not only for patients but also for their accompanying caregivers, family, and dependents. Non-medically needy persons utilize shelter capacity and require different resources. Shelter staffing plans should not rely heavily on assistance from accompanying caregivers; instead, they should assume a substantial proportion of shelter capacity will be dedicated to non-medically needy persons.

Citation

Peek, L. (2020). Keeping the faith: Shelter preparedness, mass care, and Muslim Americans. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/keeping-the-faith-shelter-preparedness-mass-care-and-muslim-americans>

Citation

Saunders, J.M. (2007). Vulnerable populations in an American Red Cross shelter after Hurricane Katrina. *Perspectives in Psychiatric Care, 43*(1), 30–37. <https://doi.org/10.1111/j.1744-6163.2007.00103.x>

Abstract

TOPIC: During Katrina, people suddenly encountered multiple losses, including homes, finances, medications, and death of loved ones. The Model of Vulnerable Populations illustrates how reduced resources placed individuals at greater risk for harm. PURPOSE: Using vignettes and the Model of Vulnerable Populations, a psychiatric nurse discusses her experiences as an American Red Cross psychiatric/mental health nurse volunteer after the Katrina disaster at a Mississippi shelter. CONCLUSIONS: The role of the mental health nurse volunteer was demonstrated by assessment and interventions of advocacy, referral, crisis intervention, and general support and education. PRACTICE IMPLICATIONS: Using the Model of Vulnerable Populations, psychiatric nurses can improve mental health assessment and services by counseling, advocacy, triage, and teaching disease prevention strategies such as hand washing.

Citation

Schmidlin, T.W., Hammer, B.O., Ono, Y., & King, P.S. (2009). Tornado shelter-seeking behavior and tornado shelter options among mobile home residents in the United States. *Natural Hazards, 48*(2), 191–201.

Abstract

Residents of 401 mobile homes in Georgia, Mississippi, Illinois, and Oklahoma were surveyed after they heard a tornado warning. Most residents (69%) did not seek shelter during the warning. Half of those who sought shelter went to the frame house of a friend, neighbor, or relative, and 25% of those sought shelter in a basement or underground shelter. Some of the places where residents sought shelter were of dubious quality, such as their own mobile home, another mobile home, or in an out-building. Twenty-one percent of mobile home residents believed that they had a basement or underground shelter available as shelter during a tornado warning, and about half of those said they would drive to the shelter. Residents said they would drive if the shelter was more than 200 m away. Fifteen percent actually had a basement or underground shelter suitable as shelter within 200 m of their mobile home, but only 43% of the residents would use those shelters. The most common reason cited for not using the shelters was that they did not know the people who lived there. Likewise, a frame house or other sturdy building was within 200 m of 58% of the mobile homes, but only 35% of the residents stated they would use those houses for shelter. Thirty-one percent of mobile home residents had a ditch that was at least 0.5 m deep within 200 m of the mobile home. However, 44% of these ditches had utility lines overhead, 23% had water in them,

and 20% had trees overhead. The limited tornado shelter options among mobile home residents in the United States needs to be incorporated into safety instructions so that residents without nearby shelter are allowed to drive to safer shelter.

Citation

Simmons, K.M., & Sutter, D. (2007). Tornado shelters and the manufactured home parks market. *Natural Hazards*, 43(3), 365–378.

Abstract

Manufactured or mobile homes represent a fast growing portion of the housing market but are particularly vulnerable to tornadoes. In the US over 40% of tornado fatalities occur in mobile homes even though they comprise about 8% of US housing units. We examine the market for tornado shelters in manufactured home parks in Oklahoma. Almost 60% of parks in the state have shelters, with 90% of the shelters underground. Parks with shelters are not concentrated in urban areas but spread across the state, with parks with shelters in 32 counties. We find that rents for lots in parks with shelters are 5-8% higher, which generates sufficient revenue to approximately pay for shelters, but the point estimate is statistically significant in only one specification.

Citation

Springer, J., & Casey-Lockyer, M. (2016). Evolution of a nursing model for identifying client needs in a disaster shelter: A case study with the American Red Cross. *The Nursing Clinics of North America*, 51(4), 647–662. <https://doi.org/10.1016/j.cnur.2016.07.009>

Abstract

From the time of Clara Barton, Red Cross nursing has had a key role in the care and support of persons affected by disasters in the United States. Hurricane Katrina and other events brought to light the need for a shelter model that was inclusive of the whole community, including persons with disabilities, at-risk and vulnerable populations, and children. From an intake process to a nursing model for assessment, an evidence-guided process informed a systematic approach for a registered nurse-led model of care.

Citation

Stough, L. (2021). What came after Hurricane Harvey for people with disabilities? Restoring, recovering, and rebuilding. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters*, Natural Hazards Center, University of Colorado Boulder. <https://hazards.colorado.edu/news/research-counts/special-collection/what-strike-comes-strike-came-after-hurricane-harvey-for-people-with-disabilities-restoring-recovering-and-rebuilding>

Citation

Sullivan, D., & Nagel, J. (2020). Code red: Addressing menstrual needs during emergencies. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters*, Natural Hazards Center, University of Colorado Boulder. <https://hazards.colorado.edu/news/research-counts/special-collection/code-red-addressing-menstrual-needs-during-emergencies>

Citation

Twigg, J. (2020). Equalizing access: Ensuring people with disabilities don't lose out in emergency shelters. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/equalizing-access-ensuring-people-with-disabilities-dont-lose-out-in-emergency-shelters>

Citation

Twigg, J., Kett, M., Bottomley, H., Tan, L.T., & Nasreddin, H. (2011). Disability and public shelter in emergencies. *Environmental Hazards, 10*(3–4), 248–261. <https://doi.org/10.1080/17477891.2011.594492>

Abstract

This paper reviews current practice regarding people with disabilities in public (or communal) emergency shelter management. It shows that provision for disabled people generally fails to meet their needs and describes the main problem areas. These problems are set in the context of management and staff failings as well as underlying weaknesses in disaster management structures as a whole. The latter include outdated attitudes towards disability, the invisibility of people with disabilities to emergency officials and relief workers and misguided assumptions about the capacities of disabled people and their organizations to manage and respond to crises. The paper concludes with suggestions about how these challenges might be overcome.

Citation

Van Willigen, M., Edwards, T., Edwards, B., & Hesse, S. (2002). Riding out the storm: Experiences of the physically disabled during Hurricanes Bonnie, Dennis, and Floyd. *Natural Hazards Review, 3*(3), 98. [https://doi.org/10.1061/\(ASCE\)1527-6988\(2002\)3:3\(98\)](https://doi.org/10.1061/(ASCE)1527-6988(2002)3:3(98))

Abstract

The writers examined the experiences during Hurricanes Bonnie, Dennis, and Floyd of households in eastern North Carolina that included a member with a physical disability and contrasted them with those of other households. The writers utilized data from two phone surveys—one of households after Hurricanes Bonnie and Floyd, the second of households after Floyd. The writers also draw from interviews with physically disabled persons, family members, and informants from county and emergency management agencies. It was found that households with physically disabled members were less likely to evacuate than others. Reasons for not evacuating were directly attributable to a lack of or perceived lack of access to services and assistance. Households with a disabled member were more likely to have experienced damages to their homes in both seasons and to see their homes condemned after Floyd. Damage costs represented a greater proportion of the incomes of households with a disabled member. These data underscore the need for attention by emergency management personnel to three issues: communication and coordination of services, evacuation planning and assistance, and the provision of accessible shelter.

Citation

Yang, J., Vijayan, L., Ghorbanzadeh, M., Alisan, O., Ozguven, E. E., Huang, W., & Burns, S. (2023). Integrating storm surge modeling and accessibility analysis for planning of special-needs hurricane shelters in Panama City, Florida. *Transportation Planning & Technology*, 46(2), 241–261. <https://doi.org/10.1080/03081060.2022.2162053>

Abstract

We investigated the transportation accessibility of special needs populations to Special Needs Shelters (SpNS) by incorporating storm surge modeling into hurricane shelter planning in Panama City, a medium-sized city located close to the landfall location of Hurricane Michael. The storm surge model validated for Hurricane Michael was used to predict the coastal inundation. Using this model, A Geographical Information Systems (GIS)-based optimization methodology was developed for evaluating the accessibility to special needs shelters and repurposing existing regular hurricane shelters for special needs populations. With the proposed optimization approach, the average travel time per person-trip decreased from 28.5 minutes to 7.4 minutes after repurposing one regular shelter and to 4.3 minutes when three regular shelters converted to SpNS. Emergency plans can be improved by the proposed methodology, which can estimate the inundation zones by storm surge modeling and allocate the emerging shelter demand by accessibility analysis and location modeling.

Psychological and Emotional Impacts

Articles examining the psychological, mental, and emotional impacts of disasters during evacuation and sheltering; Studies on the experiences of individuals during and after disasters as they relate to evacuating and sheltering.

Citation

Beaudoin, C.E. (2007). News, social capital and health in the context of Katrina. *Journal of Health Care for the Poor and Underserved*, 18(2), 418–430. <https://doi.org/10.1353/hpu.2007.0024>

Abstract

This study assesses the public health functions played by news information and social capital in the context of Hurricane Katrina. In-depth interviews were conducted with 57 hurricane shelter residents between 4 and 6 weeks after the hurricane. Depression was more common for participants who relied more on news information than for other participants after the hurricane (adjusted odds ratio [AOR], 5.49; 95% CI, 1.29 to 23.35; $p=.021$). Depression was more common for participants with relatively low levels of pre-hurricane positive social interactions (AOR, .16; 95% CI, .02 to 1.83; $p=.046$) and post-hurricane positive social interactions (AOR, .02; 95% CI, .00 to .74; $p=.033$) and high levels of post-hurricane negative social interactions (AOR, 17.05; 95% CI, .92 to 315.64; $p=.047$). Illness and injury were more common for participants who had relied more on news information than for other participants after the hurricane (AOR, 1.13; 95% CI, 1.02 to 2.77; $p=.046$).

Citation

Coker, A.L., Hanks, J.S., Eggleston, K.S., Risser, J., Tee, P.G., Chronister, K.J., Troisi, C.L., Arafat, R., & Franzini, L. (2006). Social and mental health needs assessment of Katrina evacuees. *Disaster Management & Response*, 4(3), 88–94. <https://doi.org/10.1016/j.dmr.2006.06.001>

Abstract

Hurricane Katrina made landfall along the Gulf Coast as a Category 3 storm on August 29, 2005. Many residents were evacuated to neighboring cities owing to massive destruction. Working with the City of Houston Health Department, researchers conducted a medical and psychological needs assessment of 124 Hurricane Katrina evacuees in Houston shelters from September 4-12, 2005. Among those willing to talk about their experiences, 41% were afraid they would die, 16% saw someone close to them injured or die, 17% saw violence, and 6% directly experienced physical violence. When using a version of the Impact of Stress Experiences scale, the majority of evacuees scored as experiencing moderate (38.6%) to severe (23.9%) post-traumatic stress disorder (PTSD) symptoms. These data suggest that in addition to challenges in finding loved ones, housing, and jobs, many Katrina survivors have experienced significant psychological trauma that may lead to future PTSD.

Citation

Farmer, A.K. (2020). Safe shelter: Overcoming fear of crime in public shelters. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/safe-shelter-overcoming-fear-of-crime-in-public-shelters>

Citation

Farmer, A.K., DeYoung, S.E., & Wachtendorf, T. (2016). Pets and evacuation: An ongoing challenge in disasters. *Journal of Homeland Security & Emergency Management*, 13(4), 1. <https://doi.org/10.1515/jhsem-2016-0051>

Abstract

Theories about fear of crime may offer insights about the use of public shelters in disaster situations. This study focuses on fear of victimization and gendered explanations of fear of crime in public shelters during hurricane events. From surveys of 424 North Carolina residents, 179 respondents described safety concerns with staying in a public shelter. Fear of victimization was the most commonly identified safety concern in connection to anticipated shelter use, significantly more so than concerns related to sanitation or structural integrity. Female respondents more often described fear of violent and sexual crimes in public shelters, which could be explained through the sexual assault hypothesis. We draw into our analysis literature examining the relationship between fear of crime and gender as we explore the implications of the results on planning for evacuation and sheltering in disaster events. By directly addressing perceived security in public shelters, we hope to expand our understanding of an important U.S. disaster setting by bridging research between fear of crime and disaster studies.

Citation

King, R.V., & North, C.S. (2021). Mental health needs in large-scale shelters: Lessons from Dallas. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/mental-health-needs-in-a-large-scale-shelters-lessons-from-dallas>

Citation

La Greca, A.M., Brodar, K.E., Danzi, B.A., Tarlow, N., Silva, K., & Comer, J.S. (2019). Before the storm: stressors associated with the Hurricane Irma evacuation process for families. *Disaster Medicine and Public Health Preparedness*, 13(1), 63–73. <https://doi.org/10.1017/dmp.2019.9>

Abstract

OBJECTIVE: Parents and children are vulnerable populations following hurricanes, and evacuation is an important safety strategy. Yet, little is known about “before the storm” stressors, particularly the surrounding evacuation, affecting families. Thus, following Hurricane Irma, we evaluated both stressful and positive aspects of the evacuation process for families, and we compared perceived safety and stress before, during, and after the hurricane across evacuating and non-evacuating families. **METHODS:** South Florida parents of children under age 18 years (N=554; 97% mothers) completed an online survey in the months following Hurricane Irma, assessing perceptions of stress, safety, and evacuation experiences. Quantitative data and open-ended responses were gathered. **RESULTS:** Most families (82%) residing in mandatory evacuation zones evacuated, although many not in mandatory zones (46%) also evacuated. Parents who evacuated felt significantly safer during the storm, but more stressed before and during the storm, than non-evacuees. Evacuation-related travel and multiple family issues were rated as most stressful, although some positive aspects of evacuation were offered. **CONCLUSION:** Findings have implications for emergency planners (eg, pre-/post-storm traffic flow needs, emotional needs of parents arriving at shelters) and for families (eg, importance of developing family disaster plans, controlling media exposure) to reduce evacuation stress for future storms. (*Disaster Med Public Health Preparedness*. 2019;13:63-73).

Citation

Lagiewski, R., & Perotti, V. (2023). Customer experiences and situational vulnerability: An exploration of hotel services during a disaster. *International Journal of Hospitality Management*, 108. <https://doi.org/10.1016/j.ijhm.2022.103360>

Abstract

Hotels have gained greater attention in society for the ability to provide services to individuals during disasters and crises. With critical resources like food, shelter, and staff, a hotel can represent an ideal refuge for individuals in need. However, the extant research on disaster and hotels provides minimal insights into the experiences of customers and the specific areas where hotels may be helping or making matters worse. This study builds on the hotel service, disaster, and vulnerability literature to identify the central attributes and characteristics of service experienced by customers during a disaster. Using multiple text analysis methods including natural language processing, semantic theme analysis, and qualitative content analysis, we investigate customer experiences during situational vulnerability through public consumer review data. The

findings reveal service attributes of care, provisions, and transactions influence the support or in some cases impair well-being of individuals utilizing hotel services during a disaster.

Citation

Merlo, K., Conen, K., Yusuf, W., Marshall, J., Behr, J., & Dunn, E. (2021). Hurricane shelters and COVID-19: Protecting workers' emotional well-being. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/hurricane-shelters-and-covid-19-protecting-workers-emotional-well-being-of-shelter-workers>

Citation

Niederkrötenhaler, T., Parker, E.M., Ovalle, F., Noe, R.S., Bell, J., Xu, L., Morrison, M.A., Mertzluft, C.E., & Sugerman, D.E. (2013). Injuries and post-traumatic stress following historic tornados: Alabama, April 2011. *PLoS One*, 8(12), e83038. <https://doi.org/10.1371/journal.pone.0083038>

Abstract

OBJECTIVES: We analyzed tornado-related injuries seen at hospitals and risk factors for tornado injury, and screened for post-traumatic stress following a statewide tornado-emergency in Alabama in April 2011. **METHODS:** We conducted a chart abstraction of 1,398 patients at 39 hospitals, mapped injured cases, and conducted a case-control telephone survey of 98 injured cases along with 200 uninjured controls. **RESULTS:** Most (n = 1,111, 79.5%) injuries treated were non-life threatening (Injury Severity Score ≤ 15). Severe injuries often affected head (72.9%) and chest regions (86.4%). Mobile home residents showed the highest odds of injury (OR, 6.98; 95% CI: 2.10-23.20). No severe injuries occurred in tornado shelters. Within permanent homes, the odds of injury were decreased for basements (OR, 0.13; 95% CI: 0.04-0.40), bathrooms (OR, 0.22; 95% CI: 0.06-0.78), hallways (OR, 0.31; 95% CI: 0.11-0.90) and closets (OR, 0.25; 95% CI: 0.07-0.80). Exposure to warnings via the Internet (aOR, 0.20; 95% CI: 0.09-0.49), television (aOR, 0.45; 95% CI: 0.24-0.83), and sirens (aOR, 0.50; 95% CI: 0.30-0.85) decreased the odds of injury, and residents frequently exposed to tornado sirens had lower odds of injury. The prevalence of PTSD in respondents was 22.1% and screening positive for PTSD symptoms was associated with tornado-related loss events. **CONCLUSIONS:** Primary prevention, particularly improved shelter access, and media warnings, seem essential to prevent severe tornado-injury. Small rooms such as bathrooms may provide some protection within permanent homes when no underground shelter is available.

Citation

North, C.S., King, R.V., Fowler, R.L., Kucmierz, R., Wade, J.D, Hogan D., & Carlo, J.T. (2015). Delivery of mental health care in a large disaster shelter. *Disaster Medicine and Public Health Preparedness*, 9(4), 423–429. <https://doi.org/10.1017/dmp.2015.63>

Abstract

Large numbers of evacuees arrived in Dallas, Texas, from Hurricanes Katrina and Rita just 3 weeks apart in 2005 and from Hurricanes Gustav and Ike just 3 weeks apart again in 2008. The Dallas community needed to locate, organize, and manage the response to provide shelter and health care with locally available resources. With each successive hurricane, disaster response leaders applied many lessons learned from prior operations to become more efficient and effective in the

provision of services. Mental health services proved to be an essential component. From these experiences, a set of operating guidelines for large evacuee shelter mental health services in Dallas was developed, with involvement of key stakeholders. A generic description of the processes and procedures used in Dallas that highlights the important concepts, key considerations, and organizational steps was then created for potential adaptation by other communities.

Citation

Park, C.L., Sacco, S.J., & Mills, M.A. (2019). Do religious habits and coping help in the immediate aftermath of a crisis? Relations with Hurricane Katrina evacuees' acute stress symptoms and functional impairment. *Psychological Trauma: Theory, Research, Practice, and Policy*, 11(6), 563–570. <https://doi.org/10.1037/tra0000426>

Abstract

Objective: Religious coping has been shown to relate to psychological adjustment in survivors of disasters months or even years afterward. However, because very few studies have assessed coping and well-being during the immediate crisis, little is known about the role of religiousness at this critical time. **Method:** We studied a sample of 132 Hurricane Katrina evacuees (56% male, 74.2% African American, mean age of 43 years) relocated to a Red Cross emergency shelter in Austin, Texas, within 19 days of Hurricane Katrina's landfall. **Results:** Participants reported high levels of acute stress disorder (ASD) symptoms and functional impairment as well as high resource loss. Belief that God is in control and negative religious coping (perceiving punishment) were positively related to ASD symptoms while negative religious coping (perceiving abandonment) was related to higher functional impairment. The negative religious coping-ASD symptom relationship was moderated by resource loss, such that, for those with lower levels of resource loss, negative religious coping (perceiving punishment) related to even higher levels of ASD symptoms, an effect that diminished with higher resource loss. Neither positive religious coping nor pre-Katrina frequency of service attendance or private prayer related to ASD symptoms or functional impairment. **Conclusions:** At least in this sample at the height of disruption following a disaster, little evidence of salutary effects of religiousness were observed. It may be that such effects take time to emerge as people begin their recovery processes or that not all groups find help through their religious coping resources.

Citation

Pfefferbaum, B., Jacobs, A. K., & Schreiber, M. D. (2020). Stepped care: Mental health triage, screening, and referral for children in shelters. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/stepped-care-mental-health-triage-screening-and-referral-for-children-in-shelters>

Citation

Schwartz, R.M., Rasul, R., Kerath, S.M., Watson, A.R., Lieberman-Cribbin, W., Liu, B., & Taioli, E. (2018). Displacement during Hurricane Sandy: The impact on mental health. *Journal of Emergency Management*, 16(1), 17–27. <https://doi.org/10.5055/jem.2018.0350>

Abstract

OBJECTIVE: To assess the effect of displacement due to Hurricane Sandy on mental health outcomes among residents of the greater New York City (NYC) area. **DESIGN:** Prospective, cross sectional. **SETTING:** NYC area residents, including Queens, Staten Island, and Long Island. **PARTICIPANTS:** In a 4.25 year period (June 2012 to September 2016), a convenience sample of 1,615 adult residents from the greater NYC area completed validated measures of hurricane exposure (including displacement), perceived stress, depression, anxiety, and post-traumatic stress disorder (PTSD) symptoms as well as indicators of alcohol, illicit substance, and tobacco use. **MAIN OUTCOME MEASURES:** Perceived stress, depression, anxiety and PTSD symptoms and alcohol, illicit substance, and tobacco use. **RESULTS:** Multivariable analyses indicated that displaced participants were more likely to have PTSD (adjusted odds ratio [AOR]: 2.21, 95% CI: 1.73-2.82), depression (AOR: 1.37, 95% CI: 1.05-1.79) and anxiety symptoms (AOR: 1.30, 95% CI: 1.01-1.67) and had a 1.16 unit increase in perceived stress score (SE = 0.38) compared to nondisplaced participants. Staying with friends/family versus at a shelter was significantly associated with a 48 percent decreased odds of having PTSD symptoms (AOR: 0.52, 95% CI: 0.31-0.88) and of being a current tobacco user (AOR: 0.52, 95% CI: 0.30-0.92). **CONCLUSIONS:** Displacement is associated with negative mental health outcomes, particularly displacement to shelters. Disaster preparedness efforts should involve increasing mental health resources to those who are displaced and providing support services within the shelter setting.

Citation

Shah, A.A., Valles, N., Banu, S., Storch, E.A., & Goodman, W. (2018). Meeting the mental health needs of Hurricane Harvey evacuees. *The American Journal of Psychiatry*, 175(1), 13–14. <https://doi.org/10.1176/appi.ajp.2017.17101108>

Citation

Taioli, E., Tuminello, S., Lieberman-Cribbin, W., Bevilacqua, K., Schneider, S., Guzman, M., Kerath, S., & Schwartz, R.M. (2018). Mental health challenges and experiences in displaced populations following Hurricane Sandy and Hurricane Harvey: The need for more comprehensive interventions in temporary shelters. *Journal of Epidemiology and Community Health*, 72(10), 867–870. <https://doi.org/10.1136/jech-2018-210626>

Abstract

Hurricane exposure can have a profound impact on mental health, leading to increased symptoms of stress, anxiety, depression and post-traumatic stress disorder that are still present years after the storm. Those displaced following a hurricane are particularly vulnerable to adverse mental health outcomes, especially if displaced to temporary shelters. The current work highlights the experiences and mental health challenges of displaced populations following Hurricane Sandy and Hurricane Harvey, as well as describing barriers to conducting research in the immediate aftermath of Hurricane Harvey and the need for more comprehensive interventions in these vulnerable populations.

Citation

Truong, T. T., Shah, A., Goodman, W. K., Banu, S., Salloum, A., Williams, L., & Storch, E. A. (2020). Mental health interventions in shelters: Lessons from Hurricane Harvey. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/planning-in-advance-promoting-health-and-wellness-in-disaster-shelters>

Citation

Tuason, M.G., Güss, C.D., & Carroll, A.L. (2012). The disaster continues: A qualitative study on the experiences of displaced Hurricane Katrina survivors. *Professional Psychology: Research & Practice*, 43(4), 288–297. <https://doi.org/10.1037/a0028054>

Abstract

Disaster survivors have not only experienced a tragedy, but they may also have been simultaneously displaced to places usually unfamiliar to them. What does being displaced mean in terms of survivors' experiences? This qualitative study explored, through in-depth interviews, the experiences of nine displaced Hurricane Katrina (HK) survivors. Using critical theory as a framework, our intent was to describe the experiences before, during, and after HK of displaced survivors who sought disaster relief aid from a social services agency in a city in southeastern United States. A consensual qualitative research (CQR) analysis (Hill et al., 2005) yielded four domains: (a) Life before HK, (b) preparing for the storm, (c) losses after HK, and (d) consequences of being displaced. For these nine participants, life before HK was fraught with family conditions of poverty, substance abuse, and criminal arrest. In preparing for the storm, participants made the decision to stay or evacuate, depending on their contexts and available resources. Losses after HK included lives, shelter, employment, belongings, safety, and community. Consequences of being displaced included financial hardship, the fight for resources, loss of trust and faith in government, inadequate health care, strained relationships with family or friends, and separation from community. Displacement after the storm resulted in more vulnerability and the loss of a cultural community, which had been the participants' main source of support. These results underscore how practitioners and policymakers need to consider how culturally different the survivors' home was from where they were relocated.

Citation

Veenema, T. G. & Casey-Lockyer, M. (2021). Planning in advance: Promoting health and wellness in disaster shelters. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/planning-in-advance-promoting-health-and-wellness-in-disaster-shelters>

Citation

Wang, C., Rider, E., Manning, S., Fast, J., & Islam, T. (2023). Qualitative analysis of the lived experience of tornado survivors and factors affecting community resilience: A case study of an EF3 tornado in Jacksonville, Alabama. *Weather, Climate & Society*, 15(1), 133–144. <https://doi.org/10.1175/WCAS-D-22-0067.1>

Abstract

Residents in the Southeast region of the United States are frequently threatened by tornadoes. Previous research indicates that it is important to study the experience of tornado victims to better understand individual risk perception, preparedness, protective action, response, and recovery strategies that contribute to overall community resilience. In this study, we employ an oral-history approach and analyze the lived experience of survivors of an EF3 (on the enhanced Fujita scale) tornado in Jacksonville, Alabama. Using snowball sampling, we conducted in-depth interviews of 25 residents of Jacksonville, Alabama, who experienced the EF3 tornado on 19 March 2018. The recorded interviews were analyzed using qualitative software. Most of the participants described the support system and the range of resources accessible through the network of relations as the critical factors that facilitated recovery and contributed to resilience. The majority also emphasized the importance of being prepared and proactive when addressing future storms, but some of their actions revealed that they were also used to being reactive. The participants were either long-term residents (homeowners) or transient college students (renters), and the data gave insight into different recovery paths and challenges. Further, findings revealed ongoing trauma and recovery challenges due to the extensive, unexpected damage and the lack of temporary housing and contractor availability often associated with small, rural towns. This research aims to provide a scientific basis for improved efforts in preparedness and protective actions as well as in response and recovery strategies in tornado events and for identifying factors of community resilience in tornado-prone areas. Significance Statement: Grounded in the narratives and reflections of the participants on their tornado experiences, the oral-history interviews generated important insights into psychological-behavioral responses to a disaster, as well as key building blocks of resilience, adding to the body of research surrounding disaster impact and vulnerability, especially for small, rural towns. The preserved voices, stories, and social memory are expected to benefit current and future generations of the community facing similar threats. The findings of this study will further help to inform better practice of local emergency managers and government officials for promoting public awareness of tornadoes and other weather-related risks so as to be more prepared for future extreme weather events.

Policy, Planning, and Preparedness

Articles examining the development and implementation of disaster preparedness policies and plans related to sheltering; Studies on the assessment of shelter programs and the capability of facilities to respond to emergencies.

Citation

Barnett, D.J., Strauss-Riggs, K., Klimczak, V.L., Rosenblum, A.J., & Kirsch, T.D. (2021). An analysis of after action reports from Texas hurricanes in 2005 and 2017. *Journal of Public Health Management and Practice*, 27(2), E71–E78. <https://doi.org/10.1097/PHH.0000000000001120>

Abstract

OBJECTIVE: To review and analyze After Action Reports from jurisdictions in Texas following Hurricanes Katrina and Rita in 2005 and Hurricane Harvey in 2017 in order to assess the utility of AARs as a quality improvement measurement tool. **METHODS:** The authors searched the

Homeland Security Digital Library, the Assistant Secretary for Preparedness and Response Technical Resources, Assistance Center, and Information Exchange, and Google Scholar for any AARs that covered the response phase of at least one of the 3 hurricanes, mentioned the state of Texas, and suggested solutions to problems. The authors applied public health emergency management (PHEM) domains, as outlined by Rose et al, to frame the AAR analysis. AARs were coded by 2 reviewers independently, with a third acting as adjudicator. As an example, the problem statements in 2005 and 2017 AARs from 1 statewide agency were compared. RESULTS: Sixteen AARs met the inclusion criteria. There were 500 identified problem-solution sets mapped to a PHEM domain. The content was unevenly distributed, with most issues coming under PHEM 2: Policies, Plans, Procedures, and Partnerships at 45.2% in the 2005 hurricanes and 39.9% in 2017. AARs lacked consistent format and were often prepared by the response agencies themselves. Five consistent issues were raised in 2005 and again in 2017. These were volunteer management and credential verification, donations management, information sharing, appropriately identifying those requiring a medical needs shelter, and inadequate transportation to support evacuation. CONCLUSION: Because of the lack of objective data, inconsistent format, unevenly distributed content, and lack of adherence to any framework, AARs are fraught with shortcomings as a tool for PHEM. Inclusion of more objective reporting measures is urgently needed.

Citation

Behr, J., Yusuf, W., Whytlaw, J. L., Hutton, N., Marshall, J., & Merlo, K. (2021). Evacuation shelters during a pandemic: Planning for staff, volunteer, and client well-being. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/evacuation-shelters-during-a-pandemic-planning-for-staff-volunteer-and-client-well-being>

Citation

Brodie, M., Weltzien, E., Altman, D., Blendon, R.J., & Benson, J.M. (2006). Experiences of hurricane Katrina evacuees in Houston shelters: Implications for future planning. *American Journal of Public Health, 96*(8), 1402–1408. <https://doi.org/10.2105/AJPH.2005.084475>

Abstract

OBJECTIVES: To shed light on how the public health community can promote the recovery of Hurricane Katrina victims and protect people in future disasters, we examined the experiences of evacuees housed in Houston area shelters 2 weeks after the hurricane. METHODS: A survey was conducted September 10 through 12, 2005, with 680 randomly selected respondents who were evacuated to Houston from the Gulf Coast as a result of Hurricane Katrina. Interviews were conducted in Red Cross shelters in the greater Houston area. RESULTS: Many evacuees suffered physical and emotional stress during the storm and its aftermath, including going without adequate food and water. In comparison with New Orleans and Louisiana residents overall, disproportionate numbers of this group were African American, had low incomes, and had no health insurance coverage. Many had chronic health conditions and relied heavily on the New Orleans public hospital system, which was destroyed in the storm. CONCLUSIONS: Our results highlight the need for better plans for emergency communication and evacuation of low-income and disabled citizens

in future disasters and shed light on choices facing policymakers in planning for the long-term health care needs of vulnerable populations.

Citation

Choi, J., Ozguven, E. E., & Abichou, T. (2020). Planning for unplanned resources: Extending emergency shelter capacity through cooperation. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters*, Natural Hazards Center, University of Colorado Boulder. <https://hazards.colorado.edu/news/research-counts/special-collection/planning-for-unplanned-resources-extending-emergency-shelter-capacity-through-cooperation>

Citation

Jenkins, J.L., McCarthy, M., Kelen, G., Sauer, L.M., & Kirsch, T. (2009). Changes needed in the care for sheltered persons: A multistate analysis from Hurricane Katrina. *American Journal of Disaster Medicine*, 4(2), 101–106.

Abstract

Following Hurricane Katrina, nearly 1,400 evacuation shelters were opened in 27 states across the nation to accommodate the more than 450,000 evacuees from the gulf region. The levee breaks in New Orleans and storm surge in Mississippi brought about significant morbidity and mortality, ultimately killing more than 1,300 people. The purpose of this study was to summarize the health needs of approximately 30,000 displaced persons who resided in shelters in eight states, including prescription medication needs, dispersement of durable medical equipment, and referrals for further care.

Citation

Jiang L. & Tedeschi C.M. (2020). Preparedness and response at long-term care facilities following Hurricane Sandy: A qualitative analysis of experiences and attitudes among staff and administrators. *Journal of Emergency Management*, 18(5), 383–398. <https://doi.org/10.5055/jem.2020.0487>

Abstract

BACKGROUND: In late 2012, Hurricane Sandy struck the eastern United States. Healthcare infrastructure in New York City-including long-term care facilities (LTCFs)-was affected significantly. The authors examined the impact of the storm on LTCFs 2 years after the event, using a qualitative approach consisting of a semistructured interview focused on preparedness and response. Important insights regarding preparedness and response may be lost by quantitative analysis or outcome measurement alone. During Sandy, individuals at LTCFs experienced the event in important subjective ways that, in aggregate, could lead to valuable insights about how facilities might mitigate future risks. The authors used data from a semistructured interview to generate hypotheses regarding the preparation and response of LTCFs. The interview tool was designed to help develop theories to explain why LTCF staff and administrators experienced the event in the way they did, and to use that data to inform future policy and research. **METHODS:** Representatives from LTCFs located in a heavily affected area of New York City were approached for participation in a semistructured interview. Interviews were digitally recorded and transcribed.

Recurrent themes were coded based on time period (before, during, or after the storm) and content. A grounded theory approach was used to identify important themes related to the participants' experiences. RESULTS: A total of 21 interviews were conducted. Several overarching themes were identified, including a perception that facilities had not prepared for an event of such magnitude, of inefficient communication and logistics during evacuation, and of lack of easily identifiable or appropriate resources after the event. Access to electrical power emerged as a key identifier of recovery for most facilities. The experience had a substantial psychological impact on LTCF staff regardless of whether they evacuated or sheltered in place during the storm. CONCLUSION: Representatives from LTCFs affected by Sandy experienced the preparation, response, and recovery phases of the event with a unique perspective. Their insights offer evidence which can be used to generate testable hypothesis regarding similar events in the future, and can inform policy makers and facility administrators alike as they prepare for extreme weather events in similar settings. Results specifically suggest that LTCFs develop plans which carefully address the unique qualities of extreme weather events, including communication with local officials, evacuation and transfer needs in geographic areas with multiple facilities, and plans for the safe transfer of residents. Emergency managers at LTCFs should consider electrical power needs with the understanding that in extreme weather events, power failures can be more protracted than in other types of emergencies.

Citation

Karaye, I.M., Thompson, C., Perez-Patron, M., Taylor, N., & Horney, J. A. (2020). Estimating evacuation shelter deficits in the Houston–Galveston Metropolitan Area. *Risk Analysis*, 40(5), 1079–1091. <https://doi.org/10.1111/risa.13448>

Abstract

Evacuation is frequently used by emergency managers and other officials as part of an overall approach to reducing the morbidity and mortality associated with hurricane landfall. In this study, the evacuation shelter capacity of the Houston–Galveston Metropolitan Statistical Area (MSA) was spatially assessed and shelter deficits in the region were estimated. These data provide essential information needed to eliminate shelter deficits and ensure a successful evacuation from a future storm. Spatial statistical methods—Global Moran's I, Anselin Local Moran's I (Local Indicators of Spatial Association [LISA]), and Hot Spot Analysis (Getis-Ord G_i^*) were used to assess for regional spatial autocorrelation and clustering of evacuation shelters in the Houston–Galveston MSA. Shelter deficits were estimated in four ways—the aggregate deficit for the Houston–Galveston MSA, by evacuation Zip-Zone, by county, and by distance or radii of evacuation Zip-Zone. Evacuation shelters were disproportionately distributed in the region, with lower capacity shelters clustered closer to evacuation Zip-Zones (50 miles from the Coastal Zip-Zone), and higher capacity shelters clustered farther away from the zones (120 miles from the Coastal Zip-Zone). The aggregate shelter deficit for the Houston–Galveston MSA was 353,713 persons. To reduce morbidity and mortality associated with future hurricanes in the Houston–Galveston MSA, authorities should consider the development and implementation of policies that would improve the evacuation shelter capacity of the region. Eliminating shelter deficits, which has been done successfully in the state of Florida, is an essential element of protecting the public from hurricane impacts.

Citation

Lach, H.W., Langan, J.C., & James, D.C. (2005). Disaster planning: Are gerontological nurses prepared? *Journal of Gerontological Nursing, 31*(11), 21–27. <https://doi.org/10.3928/0098-9134-20051101-07>

Abstract

This article is a review of basic, but important information about disaster planning considerations for older populations. The recent hurricane experiences in the South confirmed how critical this planning is, and the importance of early evacuation in saving lives. This is highlighted when comparing the official responses during Hurricane Katrina and Hurricane Rita. Advance preparations result in more control and safety in a dangerous situation. In New Orleans, the delay in evacuation of older adults resulted in panic and confusion, without an easy solution. Those who could not be easily evacuated remained, sometimes at great cost. Gerontological nurses need to advocate for the planning and resources that would assist older adults in a safe and early evacuation if indicated. Adequate support personnel, transportation, and pre-positioned supplies should all be in place for use following a disaster event. Rescue is more costly than evacuation, in both resources and human suffering, and places both rescuers and victims at risk. Each individual, facility, and community needs disaster and evacuation plans that are widely disseminated in advance of any disaster. These plans must address the unique needs of older adults. Hurricane Katrina demonstrated the importance of evacuation before the impact of disaster. When individuals have advance notice of an impending disaster, evacuation can be conducted in a more orderly, planned way to get older adults to safety. Hurricane Rita proved that even advance evacuation is not problem-free, but is well worth the effort. Each facility needs to be prepared to be self-sustaining, to “shelter in place” for at least 72 hours. This requires having the resources and supplies to support at least minimal safe function. However, facilities in locations that could be isolated for longer periods of time should consider having even more supplies in reserve. Recent events may prompt gerontological nurses to ask themselves, their facilities, and communities--Are we prepared?

Citation

Laditka, S.B., Laditka, J.N., Cornman, C.B., Davis, C.B., & Richter, J.V. (2009). Resilience and challenges among staff of gulf coast nursing homes sheltering frail evacuees following Hurricane Katrina, 2005: Implications for planning and training. *Prehospital and Disaster Medicine, 24*(1), 54–62. <https://doi.org/10.1017/s1049023x00006543>

Abstract

PURPOSE: The purpose of this study was to: (1) explore experiences and responses of staff in caring for sheltered, frail, Hurricane Katrina evacuees; and (2) identify how planning and training can be enhanced for staff who may care for frail older populations during and after disasters. **METHODS:** Individual, in-person, semi-structured interviews were conducted with 38 staff members in four nursing homes in Mississippi, sheltering 109 evacuees in November 2005, nine weeks after Hurricane Katrina. Twenty-four were direct care staff, including certified nursing assistants, licensed nurses, dietary aides, and social workers; 14 were support staff, including maintenance and business managers. The number interviewed in each nursing home averaged 9.5 (range 6-15). Using a discussion guide and focusing on their experiences caring for nursing home evacuees, staff were asked to describe: (1) experiences; (2) problems; (3) what helped; and (4)

what was learned. Data were processed using grounded theory and thematic analysis. Responses of direct care staff differed in emphasis from those of support staff in several areas; responses from these groups were analyzed separately and together. Three of the researchers identified recurring themes; two organized themes conceptually. RESULTS: Staff emphasized providing emotional reassurance to evacuees as well as physical care. Many described caring for evacuees as “a blessing,” saying the experience helped them bond with residents, evacuees, and other staff. However, caring for evacuees was difficult because staff members were extremely anxious and in poor physical condition after an arduous evacuation. Challenges included communicating with evacuees’ families, preventing dehydration, lack of personal hygiene supplies, staff exhaustion, and emotional needs of residents, evacuees, and staff. Teamwork, community help, and having a well-organized disaster plan, extra supplies, and dependable staff helped personnel cope with the situation. CONCLUSIONS: Staff of nursing homes that sheltered Katrina evacuees demonstrated resilience in the disaster’s aftermath. Many placed the well-being of residents as their first priority. Results underscore the importance of planning, teamwork, and adequate supplies and staffing. Training for long-term care staff should emphasize providing emotional support as well as physical care for residents and evacuees during and following disasters. Nurses, social workers, and other staff members responsible for promoting emotional well-being for nursing home residents should be prepared to respond to disasters.

Citation

Levitan, M. (2013). Hazard Mitigation: Safety Rooms and Shelters. *International Journal of Mass Emergencies & Disasters*, 31(3), 420–427. <https://doi.org/10.1177/028072701303100309>

Abstract

The article discusses the accessibility advantages provided by in-residence shelters over outdoor storm cellars or community shelters. Topics include the interim guidance produced by the U.S. Defense Civil Preparedness Agency for building designs and protection of occupants from tornado winds, the steps in the development of design criteria for tornado resistance, and the optimal protective actions for the assurance of life safety in tornadoes.

Citation

Logan, M., Bradley, B.M., Chen, B., Kruger, J., Van Meter, J., Paetznick, B., Smith, M.J., & Romero-Steiner, S. (2022). A policy analysis of preparedness for hurricane evacuations in the United States, 1990 to 2019: Implementation in coastal states. *Health Security*, 20(1), 65–73. <https://doi.org/10.1089/hs.2021.0125>

Abstract

Hurricane or typhoon evacuations in the United States are typically managed by state, territorial, or tribal emergency management officials with federal, state, and local agency operational support. The evacuation process may involve issuing mandatory or “voluntary” evacuation orders to alert the community and mitigate loss of life and injury. We conducted an analysis of state and local hurricane evacuation policies identified through a literature review (January 1990 to June 2019) and key informant interviews with state public health and emergency management officials in Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Texas in October and November 2019. Findings from the literature review show that most gaps in hurricane evacuation

preparedness-based on 44 policy-related publications identified in the review-could be categorized into 4 themes: shelters, evacuation decisionmaking, at-risk populations, and transportation. Findings from key informant interviews for 7 states revealed that coastal states have been able to address most of these gaps since Hurricane Katrina in 2005. However, an important remaining gap in preparedness is providing timely warnings to at-risk populations during hurricane evacuations.

Citation

Marshall, J., Yusuf, J.W., Dunn, E., Merlo, K., Behr, J.G., Shekari, A.M., Scott, B.L., Cruz, M., Whytlaw, J.L., & Hutton, N.S. (2021). Challenges for the disaster workforce during a compound hurricane-pandemic. *Journal of Emergency Management*, 19(7), 9–18.
<https://doi.org/10.5055/jem.0591>

Abstract

The COVID-19 pandemic has created new workforce considerations for emergency management community in addressing cumulative and cascading disasters. This research identifies how emergency management planning for both the changing dynamics of COVID-19 and the upcoming hurricane season may change under a compound threat. Many jurisdictions have faced challenges in providing adequate staffing of shelters before the pandemic. Now, fatigue among staff further exacerbates these challenges as resources are stretched thin. Six workshops, involving 265 national, state, and local leaders, staff, experts, and advocates from 22 states, and a range of disciplines (disaster planning, public health, social services, academia, and healthcare), were convened to identify concerns and potential strategies to address staffing, training, logistics, and support. Strategies proposed to increase the number and skill set of staff available involve increased reliance upon volunteers and nonprofit organizations. Mental health resources, personal protective equipment, sanitation supplies, and defining roles within emergency shelters were recommended to reduce fatigue and redistribute responsibilities. Findings illuminate additional research avenues regarding assessing the underlying stressors contributing to the planning process and effective means of implementing these interventions to bolster emergency management shelter operations during a prolonged pandemic and in the future.

Citation

Merrell, D., Simmons, K. M., & Sutter, D. (2002a). Taking shelter: Estimating the safety benefits of tornado safe rooms. *Weather and Forecasting*, 17(3), 619–625.

Abstract

Over the past several decades, engineers have made significant progress in the design and construction of structures able to withstand tornadic winds and debris. The aftermath of the 3 May 1999 F5 tornado in Moore, Oklahoma, highlighted the modest market penetration of tornado shelters in metropolitan areas. The authors use historical data from Oklahoma to estimate the potential casualties that tornado shelters could prevent and calculate that the cost per fatality avoided in single-family homes is \$29 million while the cost per fatality avoided for mobile homes is \$2.6 million. The estimates are sensitive to the proportion of strong (F3 or stronger) tornadoes and the choice of an interest rate for present-value calculations. If the F-scale distribution of Oklahoma

tornadoes resembled a reported national frequency distribution and fatalities per category storm are held constant, the permanent home cost per fatality avoided triples to \$88 million.

Citation

Merrell, D., Simmons, K. M., & Sutter, D. (2002b). The market for tornado safety: Analysis of applications to the Oklahoma Saferoom Initiative. *Journal of Economics*, 28(1), 35.

Abstract

We examine applications to the Oklahoma Saferoom Initiative, which offered rebates to residents for construction of an in-home tornado shelter. Markets for risk mitigation are prone to market failure because consumers treat low probability, high consequence events as zero probability events. Tornado and tornado casualty rates vary across Oklahoma counties, and according to expected utility theory the application rate should vary accordingly. We confirm this prediction. Recent tornadoes and casualties, not surprisingly, predict application rates better than fifty year totals.

Citation

Nigg, J. M., Barnshaw, J., & Torres, M. R. (2006). Hurricane Katrina and the flooding of New Orleans: Emergent issues in sheltering and temporary housing. *Annals of the American Academy of Political & Social Science*, 604, 113–128. <https://doi.org/10.1177/0002716205285889>

Abstract

Hurricane Katrina created an unprecedented need for sheltering and temporary housing across a four-state area along the Gulf Coast. This article reviews the disaster literature with respect to sheltering and temporary housing and contrasts how these needs actually developed with respect to both the preimpact and postimpact evacuation situations. The article also investigates the ways that intergovernmental planning failed to anticipate the need for shelter/housing solutions or to implement effective measures to put those plans into operation.

Citation

Rincon, E., Linares, M.Y., & Greenberg, B. (2001). Effect of previous experience of a hurricane on preparedness for future hurricanes. *The American Journal of Emergency Medicine*, 19(4), 276–279. <https://doi.org/10.1053/ajem.2001.22668>

Abstract

The purpose of this study was to examine the hypothesis that having experienced a major hurricane will promote better preparedness for future ones. A survey was conducted in November 1999 at Miami children's Hospital. No statistical differences were found between the population that was present in Dade County during hurricane Andrew and the one that was not; in regard of the possession of a generator at home, the obtaining of material to secure their home, the presence of hurricane shutters, the willingness to evacuate their home in case of advise. Only 37% of the families that experienced hurricane Andrew would go to a shelter versus 49% for the families that did not ($P < .05$). It was concluded that we can safely reject the hypothesis that having experienced

a major hurricane will promote better preparedness for future ones. Those who experienced hurricane Andrew were less willing to go to a shelter compared with the group that did not.

Citation

Sanusi, F., Choi, J., Ulak, M. B., Ozguven, E. E., & Abichou, T. (2020). Metadata-based analysis of physical-social-civic systems to develop the knowledge base for hurricane shelter planning. *Journal of Management in Engineering*, 36(5). [https://doi.org/10.1061/\(ASCE\)ME.1943-5479.0000802](https://doi.org/10.1061/(ASCE)ME.1943-5479.0000802)

Abstract

Emergency shelters are essential to protect evacuees from any threats posed by a hurricane and provide them with basic needs and assistance until it is safe to return to their homes. In a posthurricane situation, existing critical infrastructure for emergency shelters is likely being challenged to its limits in response to growing evacuee needs. As such, the engagement of diverse infrastructure sectors across different system domains (i.e., spanning physical systems to civic and social systems) in planning is critical to adequately support the operation of shelters during posthurricane recovery. Despite the importance of these multidimensional systems, there is limited understanding in the current literature about the interplay of physical-social-civic systems in supporting the operation of emergency shelters in posthurricane situations. In order to address this gap, this study conducts an extensive literature review with a focus on the functions of critical interdependent infrastructure for hurricane shelter operations and develops a metadata-based knowledge base critical for integrated shelter planning. This study establishes critical knowledge for emergency preparedness, which includes (1) an understanding of the interdependent nature of multidimensional infrastructure systems as related to hurricane shelter operations, (2) identification of the capacity requirements to operate shelters during posthurricane recovery, and (3) integration of the aforementioned findings into the current practice of shelter planning. The developed knowledge is demonstrated through a real-world Hurricane Michael-focused case study of shelter operations in Bay County, Florida. Last, critical research needs and challenges are discussed, with planning recommendations.

Evacuation and Decision-Making Behavior

Articles focusing on the factors influencing evacuation decision-making; Research that explores behavioral and protective responses during evacuations in response to warnings.

Citation

Balluz, L., Schieve, L., Holmes, T., Kiezak, S., & Malilay, J. (2000). Predictors for people's response to a tornado warning: Arkansas, 1 March 1997. *Disasters*, 24(1), 71–77. <https://doi.org/10.1111/1467-7717.00132>

Abstract

On 1 March 1997, powerful tornadoes touched down in Arkansas (USA) on a Saturday afternoon. Twenty-six fatalities and 400 non-fatal injuries were reported. We performed a population-based cross-sectional study to determine factors associated with appropriate responses to tornado

warnings. Of 146 survey participants, 140 (96 per cent) knew the difference between “tornado watch” and “tornado warning” and were aware of when the warning was announced. Of those 140 participants, 64 (45.7 per cent) responded to the warning by seeking shelter, and 58 (90.6 per cent) of those 64 acted within five minutes of hearing the warning. Four factors were positively associated with those seeking shelter: having graduated from high school (OR = 4.2, 95 per cent CI = 1.1-15.5); having a basement in one’s house (OR = 3.8, 95 per cent exact CI = 1.1-17.1); hearing a siren (OR = 4.4, 95 per cent CI = 1.3-18.9); and having prepared a household plan of response when tornadoes occur (OR = 2.6, 95 per cent CI = 1.1-6.3). On the basis of these findings, we recommend: first, that people who live in tornadoprone areas have a personal plan of action to help them respond immediately to warnings; second, public-health education officials in areas with frequent tornadic activity should do more to educate the public about what they can do to protect themselves from a tornado; and third, that emergency-management officials planning protection measures for vulnerable communities should consider that most people have limited time (our study documented five minutes) in which to respond to a tornado warning. Thus, shelters in tornado-prone areas should be quickly accessible by residents.

Citation

Brown, S., Archer, P., Kruger, E., & Mallonee, S. (2002). Tornado-related deaths and injuries in Oklahoma due to the 3 May 1999 tornadoes. *Weather and Forecasting*, 17(3), 343–353.

Abstract

During the evening hours of 3 May 1999, 58 tornadoes occurred in Oklahoma. One tornado reached F5 intensity and left a widespread path of death, injury, and destruction in and around the Oklahoma City metropolitan area. Other communities across the state were also affected. Data on persons who died or were injured were collected from medical examiner reports, hospital medical records, and follow-up questionnaires. In addition, community surveys were conducted in the damaged areas, and a random telephone survey of people in the Oklahoma City area was conducted. A total of 45 persons died, and 645 survivors were treated at a hospital for injuries/health conditions related to the tornadoes. Detailed analyses were conducted on the 40 deaths and 512 nonfatal injuries that resulted directly from the tornadoes. The average age of persons who died was significantly higher than that of injured survivors. Almost three-fourths (74%) of survivors were treated in an emergency department and released; 26% were hospitalized, with an average stay of 7 days. The most common kinds of injuries were soft-tissue injuries (cuts, bruises, and scrapes), fractures/dislocations, and brain injuries. The most common causes of injuries for survivors were being hit by flying/falling debris and being picked up or blown by the tornado. Probable causes of death included multiple injuries (50%), head injuries (23%), chest trauma (18%), and traumatic asphyxia (10%). The proportion of deaths among injured persons was higher in mobile homes, apartment buildings, and outdoors than in houses. The vast majority of persons received television warnings; few persons received warnings by weatherband radio. Survey data indicated that since the tornadoes there had been only a slight increase in the proportion of persons with a storm shelter on their home premises and in the proportion of persons who know the location of the nearest shelter. Effective preparedness plans should be developed in advance of situations with tornadic potential and implemented in a timely manner when warnings are issued. The accessibility and knowledge of the location of shelters also needs to be increased. Warning systems should be integrated and duplicative, and they should include traditional methods and new technology.

Citation

Collins, J., Dunn, E. A., Jones, R. K., Polen, A., Rao, N. R., Murphy, S., & Welford, M. (2024). Hurricane risk perceptions and evacuation decision-making in the postvaccine era of COVID-19 in U.S. coastal states Impacted by North Atlantic hurricanes. *Weather, Climate & Society*, 16(1), 51–65. <https://doi.org/10.1175/WCAS-D-23-0003.1>

Abstract

During peak disease transmission in 2021, the compounding threat posed by the pandemic and hurricane season required coastal states to understand evacuation behaviors during a major hurricane to inform the planning process. While research relating to hurricane evacuation behavior and perceptions of risk has increased since the start of the pandemic, there is minimal understanding of how perceptions have changed now the COVID-19 vaccine is available. A total of 1075 individuals across seven U.S. coastal states participated in a study on evacuation intentions postvaccine availability. Findings revealed that most survey participants (50.9%) preferred to stay home if a major hurricane threatened their area, and only 3.9% would evacuate to a public shelter. Approximately half (56.2%) of individuals viewed the risk of being in a shelter as more dangerous than enduring hurricane hazards. When considering shelter use, nearly half of respondents (49.4%) stated they would evacuate to a shelter before the pandemic; now, only one-third (34.3%) would consider evacuating to a shelter during the pandemic. Statistically significant findings include the relationship between those who lived in evacuation zones A or B (25.5%) and the choice to shelter in place at home (40.5%) or evacuate to a hotel (36.9%). There was a statistically significant relationship between the level of education and choosing to evacuate to a hotel. Additionally, the influence of pet ownership on evacuation decision-making was found to be statistically significant. Officials can use the results of this study to strengthen community preparedness and planning strategies across diverse populations.

Citation

Comstock, R.D. & Mallonee, S. (2005). Comparing reactions to two severe tornadoes in one Oklahoma community. *Disasters*, 29(3), 277–287. <https://doi.org/10.1111/j.0361-3666.2005.00291.x>

Abstract

The authors compared the effect of the 3 May 1999 F5 and 8 May 2003 F3 tornadoes on the community of Moore, Oklahoma, by canvassing damaged areas after both tornadoes and surveying residents. Significantly more 1999 than 2003 residents reported property damage and injuries. Television and tornado sirens were the most common warnings each year, however, more 1999 residents received and responded to television warnings. Importantly, storm shelters were used more frequently in 2003. Fifty-one per cent of residents who experienced both tornadoes took the same amount of protective action in 2003 as they had in 1999; 22% took less; and 27% took more. Residents who took less action said that the reason for doing so was inadequate warning and shelter. First-hand experience of tornadoes prompts people to heed warnings when adequate notification is received and to take effective protective action when adequate shelter is available.

Citation

DeWinter-Maciag, T. A., & McPherson, R. A. (2023). A spatial analysis of decisions made in response to simulated tornado warnings in the United States. *Weather, Climate & Society*, 15(4), 999–1011. <https://doi.org/10.1175/WCAS-D-22-0133.1>

Abstract

Although decision-making in response to tornado warnings is well researched, most studies do not examine whether individual responses to these warnings vary across different geographical locations and demographic groups. This gap is addressed by using data from a decision experiment that places participants virtually in a simulated tornado warning and asks them to minimize the costs of their decisions. The authors examine the following: 1) what demographic attributes may contribute to choices to minimize costs to protect assets at a specific location in a tornado warning, 2) whether there is a spatial component to how these attributes influence decision-making, and 3) if there are specific U.S. regions where individuals do not make protective decisions that minimize their overall cost. Multilevel regression analysis and poststratification are applied to data from the simulated decision experiment to estimate which demographic attributes and National Weather Service County Warning Areas are most associated with the costliest protective decisions. The results are then analyzed using spatial autocorrelation to identify spatial patterns. Results indicate that sex, race, and ethnicity are important factors that influence protection decisions. Findings also show that people across the southern portions of the United States tend to make more costly protective decisions, as defined in this work. Significance Statement: Tornadoes, although rare, threaten both life and property. Studies have shown that certain demographic groups are more negatively impacted by disasters than others and are at higher risk of severe weather hazards. We ask if there are demographic characteristics or geographic locations in common among people who are more prone to making protection decisions during tornado warnings to minimize economic costs. Results can help warning providers, such as the National Weather Service, direct resources and education to specific types of decision-makers or locations to improve sheltering decisions.

Citation

Dombroski, M., Fischhoff, B., & Fischbeck, P. (2006). Predicting emergency evacuation and sheltering behavior: A structured analytical approach. *Risk Analysis*, 26(6), 1675–1688. <https://doi.org/10.1111/j.1539-6924.2006.00833.x>

Abstract

We offer a general approach to predicting public compliance with emergency recommendations. It begins with a formal risk assessment of an anticipated emergency, whose parameters include factors potentially affecting and affected by behavior, as identified by social science research. Standard procedures are used to elicit scientific experts' judgments regarding these behaviors and dependencies, in the context of an emergency scenario. Their judgments are used to refine the model and scenario, enabling local emergency coordinators to predict the behavior of citizens in their area. The approach is illustrated with a case study involving a radiological dispersion device (RDD) exploded in downtown Pittsburgh, PA. Both groups of experts (national and local) predicted approximately 80-90% compliance with an order to evacuate workplaces and 60-70% compliance with an order to shelter in place at home. They predicted 10% lower compliance for people asked to shelter at the office or to evacuate their homes. They predicted 10% lower compliance should

the media be skeptical, rather than supportive. They also identified preparatory policies that could improve public compliance by 20-30%. We consider the implications of these results for improving emergency risk assessment models and for anticipating and improving preparedness for disasters, using Hurricane Katrina as a further case in point.

Citation

Hammer, B., & Schmidlin, T. W. (2002). Response to warnings during the 3 May 1999 Oklahoma City tornado: Reasons and relative injury rates. *Weather and Forecasting*, 17(3), 577–581.

Abstract

Residents of homes that sustained F4 or F5 damage in the deadliest of the 3 May 1999 tornadoes were surveyed to determine their responses to the tornado warning, reasons for their responses, and relative injury rates. There were 190 people in 65 surveyed houses at the time that warnings were issued. Television was the most commonly cited source of the warning (89%), followed by a telephone call (37%), sirens (37%), and AM/FM radio (25%), and 55% received the warning from more than one source. Nearly one-half (47%) of the residents fled their homes before the tornado struck. Of those who fled, 65% went to a tornado shelter, of whom 70% ran to the shelter (median distance 30 m) and 30% drove to the shelter (median distance 4.8 km). About one-half (53%) of those who fled their homes left in a vehicle. None of those who fled their homes, by foot or by vehicle, were injured. Of those who stayed in the home, 39% sought shelter in a bathroom, 38% in a closet, 9% in a hallway, and 15% in other rooms. Reasons for not leaving included believing the storm would not strike their house, believing it was too late or too dangerous to leave, having no transportation available, or having no alternative shelter available. Thirty percent of those who remained in their homes were injured and 1% killed. The rate of serious injury was not significantly different for those in a closet (14%), hallway (20%), or bathroom (23%). Tornado preparedness and warning programs should recognize that long tornado warning lead times and street-level television coverage allow residents to make reasoned decisions to minimize risk and that those decisions may include driving out of the path of the tornado.

Citation

Jon, I., Huang, S.-K., & Lindell, M. K. (2019). Perceptions and expected immediate reactions to severe storm displays. *Risk Analysis*, 39(1), 274–290. <https://doi.org/10.1111/risa.12896>

Abstract

The National Weather Service has adopted warning polygons that more specifically indicate the risk area than its previous county-wide warnings. However, these polygons are not defined in terms of numerical strike probabilities ($p(s)$). To better understand people's interpretations of warning polygons, 167 participants were shown 23 hypothetical scenarios in one of three information conditions-polygon-only (Condition A), polygon + tornadic storm cell (Condition B), and polygon + tornadic storm cell + flanking nontornadic storm cells (Condition C). Participants judged each polygon's $p(s)$ and reported the likelihood of taking nine different response actions. The polygon-only condition replicated the results of previous studies; $p(s)$ was highest at the polygon's centroid and declined in all directions from there. The two conditions displaying storm cells differed from the polygon-only condition only in having $p(s)$ just as high at the polygon's edge nearest the storm cell as at its centroid. Overall, $p(s)$ values were positively correlated with expectations of

continuing normal activities, seeking information from social sources, seeking shelter, and evacuating by car. These results indicate that participants make more appropriate p(s) judgments when polygons are presented in their natural context of radar displays than when they are presented in isolation. However, the fact that p(s) judgments had moderately positive correlations with both sheltering (a generally appropriate response) and evacuation (a generally inappropriate response) suggests that experiment participants experience the same ambivalence about these two protective actions as people threatened by actual tornadoes.

Citation

Kuligowski, E.D. (2020). Field research to application: A study of human response to the 2011, Joplin tornado and its impact on alerts and warnings in the USA. *Natural Hazards*, 102(3), 1057–1076. <https://doi.org/10.1007/s11069-020-03945-6>

Abstract

An EF-5 tornado occurred on May 22, 2011, in the populated area of Joplin, Missouri, causing 161 fatalities and over 1000 injuries. A conceptual model of protective action decision making was developed based on interviews with Joplin tornado survivors to further understand the factors that influenced decision making and sheltering behavior in the 2011 storm. The model showed that the majority of survivors decided at some point before the tornado hit that the act of seeking protection was not necessary, primarily due to a lack of tornado-related physical cues; previous experiences with tornadoes via false alarms; confusing and/or inconsistent emergency communication regarding the tornado; and/or tornado beliefs about Joplin's geography. These individuals took action to protect themselves after witnessing audible or visual cues signaling imminent danger to them. Since this work was completed, efforts have been underway to translate this research from theory to practice. Namely, the findings from this work have been developed into guidance for communities on alerting for tornadoes, including the development of message templates and decision-making tools to improve methods for communicating with populations under imminent threat of tornadoes and other wind storm events.

Citation

Mason, J.B., & Senkbeil, J.C. (2014). Implications of the 2011 Tuscaloosa EF4 tornado for shelter and refuge decisions. *Natural Hazards*, 74(2), 1021–1041.

Abstract

This research provides an overview and discussion of language used in tornado safety recommendations along with development of a rubric for scaled tornado safety recommendations. Residents living in affected areas and those temporarily housed at relief stations were surveyed to collect information on their experiences during a 2-week period following the April 27, 2011 Tuscaloosa, Alabama EF4 tornado. Respondents were asked about their refuge plans during the storm and about any future changes to those plans. A specific focus of this research evaluated the adequacy of each respondent's plan. Each refuge plan was compared using a tornado refuge rubric developed through the use of enhanced Fujita (EF) scale degree of damage ratings for available damage indicators. There was a significant difference in the counts of refuge adequacy for Tuscaloosa residents when holding the locations during the April 27 tornado constant and comparing adequacy ratings for weak (EF0-EF1), strong (EF2-EF3), and violent (EF4-EF5) tornadoes. There was also a significant difference when comparing the future tornado refuge plans of those

same participants to the adequacy ratings for weak, strong, and violent tornadoes. This research introduces renewed discussion on proper refuge and shelter alternatives for days when violent tornadoes are forecasted.

Citation

McGuire, L.C., Ford, E.S., & Okoro, C.A. (2007). Natural disasters and older US adults with disabilities: Implications for evacuation. *Disasters*, 31(1), 49–56. <https://doi.org/10.1111/j.1467-7717.2007.00339.x>

Abstract

We analysed 2003 and 2004 Behavioral Risk Factor Surveillance System (BRFSS) data from New Orleans-Metairie-Kenner, LA to produce estimates of the number of community dwelling people aged 65 years or older with a disability and requiring special equipment.(4) Approximately, 47,840 (31.6 per cent) older adults with a disability and 24,938 (16.6 per cent) older adults requiring the use of special equipment were community dwelling and might require assistance to evacuate or a shelter that could accommodate special equipment. Older adults who need special equipment were likely to be female, unmarried and white, and to rate their health as fair or poor. Personnel who plan and prepare for evacuations and temporary shelter during disasters need baseline information on the number of older adults with a disability or who require special equipment. A surveillance system, such as the BRFSS, gathers information that planners can use to prepare for and to deliver services.

Citation

Page-Tan, C., & Fraser, T. (2022). COVID-19 to go? The role of disasters and evacuation in the COVID-19 pandemic. *Global Environmental Change Part A: Human & Policy Dimensions*, 73. <https://doi.org/10.1016/j.gloenvcha.2022.102471>

Abstract

Increased evacuation-related mobility did not lead to increased cases of COVID-19. • Sheltering-in-place during a disaster led to decreased COVID-19 transmission rates. • Shelter-in-place orders could prevent a disaster within a disaster in a pandemic. • Updated accommodation and cleaning protocols could curb the spread of disease. Since the start of the pandemic, some U.S. communities have faced record storms, fires, and floods. Communities have confronted the increased challenge of curbing the spread of COVID-19 amid evacuation orders and short-term displacement that result from hazards. This raises the question of whether disasters, evacuations, and displacements have resulted in above-average infection rates during the COVID-19 pandemic. This study investigates the relationship between disaster intensity, sheltering-in-place, evacuation-related mobility, and contagion following Hurricane Zeta in Southeastern Louisiana and The Wildfires in Napa and Sonoma Counties, California, known as the Glass Fire. We draw on data from the county subdivision level and mapped and aggregated tallies of Facebook user movement from the Facebook Data for Good program’s Geolnsights Portal. We test the effects of disasters, evacuation, and shelter-in-place behaviors on COVID-19 spread using panel data models, matched panel models, and synthetic control experiments. Our findings suggest associations between disaster intensity and higher rates of COVID-19 cases. We also find that while sheltering-in-place led to decreases in the spread of COVID-19, evacuation-related mobility did not result in

our hypothesized surge of cases immediately after the disasters. The findings from this study aim to inform policymakers and scholars about how to better respond to disasters during multi-crisis events, such as offering hotel accommodations to evacuees instead of mass shelters and updating intake and accommodation procedures at shelters, such as administration temperature screenings, offering hand sanitizing stations, and providing isolated areas for ill evacuees.

Citation

Peterson, L.J., June, J., Sakib, N., Dobbs, D., Dosa, D.M., Thomas, K.S., Jester, D.J., & Hyer, K. (2020). Assisted living communities during Hurricane Irma: The decision to evacuate or shelter in place and resident acuity. *Journal of the American Medical Directors Association, 21*(8), 1148-1152.e3. <https://doi.org/10.1016/j.jamda.2020.01.104>

Abstract

OBJECTIVES: To investigate the factors associated with whether assisted living communities (ALCs) in Florida evacuated or sheltered in place for Hurricane Irma in 2017, focusing on license type as a proxy for acuity of care. **DESIGN:** Cross-sectional study using data collected by the state through its emergency reporting system and a post-hurricane survey. **SETTING AND PARTICIPANTS:** Analyses included all 3112 ALCs in the emergency reporting system. A subset of 1880 that completed the survey provided supplementary data. **METHODS:** χ^2 tests were used to examine differences between ALC characteristics (license type, size, payment, profit status, rural location, geographical region, and being under an evacuation order) and whether they evacuated. Logistic regression was used to test associations between characteristics and evacuation status. **RESULTS:** Of 3112 ALCs, 560 evacuated and 2552 sheltered in place. Bivariate analysis found significant associations between evacuation status and evacuation order, license type (mental health care), payment, and region. In the adjusted analysis, medium and larger ALCs were 43% ($P < .001$) and 53% ($P < .001$) less likely to evacuate than ALCs with fewer than 25 beds. Compared with ALCs in the Southeast, nearly every region was more likely to evacuate, with the highest likelihood in the Central West (odds ratio 1.76, 95% confidence interval 1.35–2.30). ALCs under an evacuation order were 8 times more likely to evacuate ($P < .001$). We found no relationship between evacuation status and having a license to provide higher care. **CONCLUSIONS AND IMPLICATIONS:** Prior research highlighting harm associated with evacuation has led to recommendations that long-term care facilities carefully consider resident impairment in evacuation decision-making. Evidence that small ALCs are more likely to evacuate and that having a higher-care license is not associated with evacuation likelihood shows research is needed to understand how ALCs weigh resident risks in decisions to evacuate or shelter in place.

Citation

Smith, S.K., & McCarthy, C. (2009). Fleeing the storm(s): An examination of evacuation behavior during Florida's 2004 hurricane season. *Demography, 46*(1), 127–145. <https://doi.org/10.1353/dem.0.0048>

Abstract

The 2004 hurricane season was the worst in Florida's history, with four hurricanes causing at least 47 deaths and some \$45 billion in damages. To collect information on the demographic impact of those hurricanes, we surveyed households throughout the state and in the local areas that

sustained the greatest damage. We estimate that one-quarter of Florida’s population evacuated prior to at least one hurricane; in some areas, well over one-half of the residents evacuated at least once, and many evacuated several times. Most evacuees stayed with family or friends and were away from home for only a few days. Using logistic regression analysis, we found that the strength of the hurricane and the vulnerability of the housing unit had the greatest impact on evacuation behavior; additionally, several demographic variables had significant effects on the probability of evacuating and the choice of evacuation lodging (family/friends, public shelters, or hotels/motels). With continued population growth in coastal areas and the apparent increase in hurricane activity caused by global warming, threats posed by hurricanes are rising in the United States and throughout the world. We believe the present study will help government officials plan more effectively for future hurricane evacuations.

Citation

Walters, J.E., Mason, L.R., Ellis, K., & Winchester, B. (2020). Staying safe in a tornado: A qualitative inquiry into public knowledge, access, and response to tornado warnings. *Weather and Forecasting*, 35(1), 67–81. <https://doi.org/10.1175/WAF-D-19-0090.1>

Abstract

Tornadoes in the southeastern United States continue to cause substantial injury, death, and destruction. The present study seeks to 1) understand inadequate warning access, less understanding, and/or less likelihood of responding to tornado warnings; 2) examine public attitudes about NWS communications; and 3) explore the perceptions of NWS personnel regarding public response to tornado warnings, factors that might influence response, and how their perceptions impact their communication. Participants include a purposive sample of NWS forecasters in Tennessee (n = 11) and residents (n = 45) who were identified as having low access to, low knowledge of, or an unsafe response to tornado warnings in a previous study. A qualitative approach with semi structured interviews was used. Findings indicated that most participants had at least one warning source. Barriers to warning access included electricity outages, rurality, lack of storm radio, heavy sleeping, and hearing impairments. Most participants had knowledge of NWS guidelines for safe shelter seeking but still engaged in behaviors considered unsafe. Proximity, personal experience, and influence of family and friends emerged as influencers of response to warnings. NWS personnel perceived that proximity played a significant role in shelter-seeking behavior as well as the need for confirmation. Poor access to safe shelter arose as a major concern for NWS personnel, specifically mobile home residents. Messaging and specificity in warnings to evoke safe shelter-seeking behavior surfaced as critical issues for NWS personnel. Implications for education and policy changes to enhance public safety and improve public health are noted.

Citation

Whitehead, J.C., Edwards, B., van Willigen, M., Maiolo, J.R., Wilson, K., & Smith, K.T. (2000). Heading for higher ground: Factors affecting real and hypothetical hurricane evacuation behavior. *Global Environmental Change Part B: Environmental Hazards*, 2(4), 133.

Abstract

The purpose of this paper is to assess the determinants of hurricane evacuation behavior of North Carolina coastal households during Hurricane Bonnie and a future hypothetical hurricane. We use

the data from a telephone survey of North Carolina coastal residents. Hypothetical questions are used to assess whether respondents will evacuate and where in the case of a future hurricane with varying intensities. We examine the social, economic, and risk factors that affect the decisions to evacuate and whether to go to a shelter or motel/hotel relative to other destinations. The most important predictor of evacuation is storm intensity. Households are more likely to evacuate when given evacuation orders, when they perceive a flood risk, and when they live in mobile homes. Households who own pets are less likely to evacuate. Non-white households, pet owners and those with more education are less likely to go to either a motel/hotel or shelter, preferring instead to stay with friends or family.

Public Health and Medical Response

Articles focusing on medical needs and response in shelters during disaster response; Research on public health impacts of shelters, chronic disease, and cascading disasters.

Citation

Arrieta, M.I., Foreman, R.D., Crook, E.D., & Icenogle, M.L. (2008). Insuring continuity of care for chronic disease patients after a disaster: Key preparedness elements. *The American Journal of the Medical Sciences*, 336(2), 128–133. <https://doi.org/10.1097/MAJ.0b013e318180f209>

Abstract

BACKGROUND: Care for patients with chronic diseases is a challenge after a disaster. This is particularly true for individuals from health disparate populations as they are less likely to evacuate, have fewer financial resources and often depend on resource-strapped institutions for their care. The specific aim of the study presented here was to elicit challenges and solutions in the provision of health care to those with chronic diseases after Hurricane Katrina in coastal Alabama and Mississippi. **METHODS:** Focusing on agencies providing care to health disparate populations, a qualitative methodology was employed using in-depth interviews with health and social service providers. Participants identified key elements essential to disaster preparedness. **RESULTS:** Predisaster issues were patient education and preparedness, evacuation, special needs shelters, and health care provider preparedness. Postdisaster issues were communication, volunteer coordination, and donation management. **CONCLUSIONS:** Lessons learned from those on the ground administering health care during disasters should inform future disaster preparations. Furthermore, the methodological approach used in this study engendered collaboration between health care institutions and may enhance future interagency disaster preparedness.

Citation

Condon S, Savoia E, Cadigan RO, Getchell M, Burstein JL, Auerbach B, & Koh HK. (2010). "Operation Helping Hands:" Massachusetts health and medical response to Hurricane Katrina. *Prehospital and Disaster Medicine*, 25(1), 80–86. <https://doi.org/10.1017/s1049023x0000772x>

Abstract

INTRODUCTION: As Hurricane Katrina bore down on New Orleans in August 2005, the city's mandatory evacuation prompted the exodus of an estimated 80% of its 485,000 residents. According to estimates from the US Centers for Disease Control and Prevention (CDC), at least 18 states subsequently hosted more than 200,000 evacuees. **HYPOTHESIS/PROBLEM:** In this case study, "Operation Helping Hands" (OHH), the Massachusetts health and medical response in assisting Hurricane Katrina evacuees is described. Operation Helping Hands represents the largest medical response to evacuees in recent Massachusetts history. **METHODS:** The data describing OHH were derived from a series of structured interviews conducted with two leading public health officials directing planning efforts, and a sample of first responders with oversight of operations at the evacuation site. Also, a literature review was conducted to identify similar experiences, common challenges, and lessons learned. **RESULTS:** Activities and services were provided in the following areas: (1) administration and management; (2) medical and mental health; (3) public health; and (4) social support. This study adds to the knowledge base for future evacuation and shelter planning, and presents a conceptual framework that could be used by other researchers and practitioners to describe the process and outcomes of similar operations. **CONCLUSIONS:** This study provides a description of the planning and implementation efforts of the largest medical evacuee experience in recent Massachusetts history, an effort that involved multiple agencies and partners. The conceptual framework can inform future evacuation and shelter initiatives at the state and national levels, and promotes the overarching public health goal of the highest attainable standard of health for all.

Citation

Cruz, M.A., Garcia, S., Chowdhury, M.A., Malilay, J., Perea, N., & Williams, O.D. (2017). Assessing the congregate disaster shelter: Using shelter facility assessment data for evaluating potential hazards to occupants during disasters. *Journal of Public Health Management and Practice*, 23(1), 54–58. <https://doi.org/10.1097/PHH.000000000000445>

Abstract

Disaster shelter assessments are environmental health assessments conducted during disaster situations to evaluate the living environment of shelters for hygiene, sanitation, and safety conditions. We conducted a secondary data analysis of shelter assessment records available (n = 108) on ice storms, floods, and tornado events from 1 state jurisdiction. Descriptive statistics were used to analyze results of environmental health deficiencies found in the facilities. The greater numbers of environmental health deficiencies were associated with sanitation (26%), facility physical issues (19%), and food areas (17%). Most deficiencies were reported following ice storms, tornadoes, and flood events. This report describes the first analysis of environmental health deficiencies found in disaster shelters across a spectrum of disaster events. Although the number of records analyzed for this project was small and results may not be generalizable, this new insight into the living environment in shelter facilities offers the first analysis of deficiencies of the shelter operation and living environment that have great potential to affect the safety and health of shelter occupants.

Citation

Gavagan, T.F., Smart, K., Palacio, H., Dyer, C., Greenberg, S., Sirbaugh, P., Fishkind, A., Hamilton, D., Shah, U., Masi, G., Ivey, R.T., Jones, J., Chiou-Tan, F.Y., Bloodworth, D., Hyman, D., Pavlik, V., Feigin, R.D., Mattox, K., & Whigham, C. (2006). Hurricane Katrina: Medical response at the Houston Astrodome/Reliant Center Complex. *Southern Medical Journal*, 99(9), 933–939. <https://doi.org/10.1097/00007611-200609000-00012>

Abstract

On September 1, 2005, with only 12 hours notice, various collaborators established a medical facility--the Katrina Clinic--at the Astrodome/Reliant Center Complex in Houston. By the time the facility closed roughly two weeks later, the Katrina Clinic medical staff had seen over 11,000 of the estimated 27,000 Hurricane Katrina evacuees who sought shelter in the Complex. Herein, we describe the scope of this medical response, citing our major challenges, successes, and recommendations for conducting similar efforts in the future.

Citation

Hamilton, D.R., Gavagan, T., Smart, K., Weller, N., Upton, L.A., Havron, D.A., Fishkind, A., Persse, D., Shank, P., Shah, U.A., & Mattox, K. (2009). Houston's medical disaster response to Hurricane Katrina: Part 1: The initial medical response from Trauma Service Area Q. *Annals of Emergency Medicine*, 53(4), 515–527. <https://doi.org/10.1016/j.annemergmed.2008.10.024>

Abstract

After Hurricane Katrina hit the Gulf Coast on August 29, 2005, thousands of ill and injured evacuees were transported to Houston, TX. Houston's regional disaster plan was quickly implemented, leading to the activation of the Regional Hospital Preparedness Council's Catastrophic Medical Operations Center and the rapid construction of a 65-examination-room medical facility within the Reliant Center. A plan for triage of arriving evacuees was quickly developed and the Astrodome/Reliant Center Complex mega-shelter was created. Herein, we discuss major elements of the regional disaster response, including regional coordination, triage and emergency medical service transfers into the region's medical centers, medical care in population shelters, and community health challenges.

Citation

Hyer, K., Brown, L.M., Christensen, J.J., & Thomas, K.S. (2009). Weathering the storm: Challenges to nurses providing care to nursing home residents during hurricanes. *Applied Nursing Research*, 22(4), e9–e14. <https://doi.org/10.1016/j.apnr.2008.11.001>

Abstract

This article documents the experience of 291 Florida nursing homes during the 2004 hurricane season. Using quantitative and qualitative methods, the authors described and compared the challenges nurses encountered when evacuating residents with their experiences assisting residents of facilities that sheltered in place. The primary concerns for evacuating facilities were accessing appropriate evacuation sites for residents and having ambulance transportation contracts honored. The main issue for facilities that sheltered in place was the length of time it took

for power to be restored. Barriers to maintaining resident health during disasters for those who evacuated or sheltered in place are identified.

Citation

Murray, K.O., Kilborn, C., DesVignes-Kendrick, M., Koers, E., Page, V., Selwyn, B.J., Shah, U.A., & Palacio, H. (2009). Emerging disease syndromic surveillance for Hurricane Katrina evacuees seeking shelter in Houston’s Astrodome and Reliant Park Complex. *Public Health Reports*, 124(3), 364–371. <https://doi.org/10.1177/003335490912400304>

Abstract

Transmission of infectious diseases became an immediate public health concern when approximately 27,000 New Orleans-area residents evacuated to Houston’s Astrodome and Reliant Park Complex following Hurricane Katrina. This article presents a surveillance system that was rapidly developed and implemented for daily tracking of various symptoms in the evacuee population in the Astrodome “megashelter.” This system successfully confirmed an outbreak of acute gastroenteritis and became a critical tool in monitoring the course of this outbreak.

Citation

Ridpath, A.D., Bregman, B., Jones, L., Reddy, V., Waechter, H., & Balter, S. (2015). Challenges to implementing communicable disease surveillance in New York City evacuation shelters after Hurricane Sandy, November 2012. *Public Health Reports*, 130(1), 48–53. <https://doi.org/10.1177/003335491513000106>

Abstract

Hurricane Sandy hit New York City (NYC) on October 29, 2012. Before and after the storm, 73 temporary evacuation shelters were established. The total census of these shelters peaked at approximately 6,800 individuals. Concern about the spread of communicable diseases in shelters prompted the NYC Department of Health and Mental Hygiene (DOHMH) to rapidly develop a surveillance system to report communicable diseases and emergency department transports from shelters. We describe the implementation of this system. Establishing effective surveillance in temporary shelters was challenging and required in-person visits by DOHMH staff to ensure reporting. After system establishment, surveillance data were used to identify some potential disease clusters. For the future, we recommend pre-event planning for disease surveillance.

Citation

Rozeman, P.A. & Mayeaux, E.J. Jr. (2006). Hurricanes Katrina and Rita: Evacuee healthcare efforts remote from hurricane affected areas. *Southern Medical Journal*, 99(12), 1329–1333. <https://doi.org/10.1097/01.smj.0000242327.53907.4f>

Abstract

Hurricanes Katrina and Rita produced the largest evacuation due to a natural disaster in United States history. Many people were evacuated or rescued from New Orleans and the Gulf Coast, resulting in a need for mass disaster shelters and medical care for months following the storms. The shelter healthcare system that was successfully developed in the Shreveport-Bossier City,

Louisiana area was accomplished with little support from customary sources. This report is written after much discussion and introspection of community leaders involved “on the ground,” who organized and provided medical services to evacuees of south Louisiana. Its purpose is to compile “lessons learned” in preparation for the next disaster recovery effort that might affect this or any other region of our country.

Citation

Schnall, A.H., Roth, J.J., Ekpo, L.L., Guendel, I., Davis, M., & Ellis, E.M. (2019). Disaster-related surveillance among U.S. Virgin Islands shelters during the Hurricanes Irma and Maria response. *Disaster Medicine and Public Health Preparedness*, 13(1), 38–43.
<https://doi.org/10.1017/dmp.2018.146>

Abstract

OBJECTIVES: Two Category 5 storms, Hurricane Irma and Hurricane Maria, hit the U.S. Virgin Islands (USVI) within 13 days of each other in September 2017. These storms caused catastrophic damage across the territory, including widespread loss of power, destruction of homes, and devastation of critical infrastructure. During large scale disasters such as Hurricanes Irma and Maria, public health surveillance is an important tool to track emerging illnesses and injuries, identify at-risk populations, and assess the effectiveness of response efforts. The USVI Department of Health (DoH) partnered with shelter staff volunteers to monitor the health of the sheltered population and help guide response efforts. **METHODS:** Shelter volunteers collect data on the American Red Cross Aggregate Morbidity Report form that tallies the number of client visits at a shelter’s health services every 24 hours. Morbidity data were collected at all 5 shelters on St. Thomas and St. Croix between September and October 2017. This article describes the health surveillance data collected in response to Hurricanes Irma and Maria. **RESULTS:** Following Hurricanes Irma and Maria, 1130 health-related client visits were reported, accounting for 1655 reasons for the visits (each client may have more than 1 reason for a single visit). Only 1 shelter reported data daily. Over half of visits (51.2%) were for health care management; 17.7% for acute illnesses, which include respiratory conditions, gastrointestinal symptoms, and pain; 14.6% for exacerbation of chronic disease; 9.8% for mental health; and 6.7% for injury. Shelter volunteers treated many clients within the shelters; however, reporting of the disposition (eg, referred to physician, pharmacist) was often missed (78.1%). **CONCLUSION:** Shelter surveillance is an efficient means of quickly identifying and characterizing health issues and concerns in sheltered populations following disasters, allowing for the development of evidence-based strategies to address identified needs. When incorporated into broader surveillance strategies using multiple data sources, shelter data can enable disaster epidemiologists to paint a more comprehensive picture of community health, thereby planning and responding to health issues both within and outside of shelters. The findings from this report illustrated that managing chronic conditions presented a more notable resource demand than acute injuries and illnesses. Although there remains room for improvement because reporting was inconsistent throughout the response, the capacity of shelter staff to address the health needs of shelter residents and the ability to monitor the health needs in the sheltered population were critical resources for the USVI DoH overwhelmed by the disaster.

Citation

Schnall, A. (2021). Take shelter: monitoring the health of diverse populations during disaster. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/take-shelter-monitoring-the-health-of-diverse-populations-during-disaster>

Citation

Shipp Hilts, A., Mack, S., Li, Y., Eidson, M., Nguyen, T., & Birkhead, G.S. (2016). New York state public health system response to Hurricane Sandy: An analysis of survey feedback. *Disaster Medicine and Public Health Preparedness, 10*(3), 454–462. <https://doi.org/10.1017/dmp.2016.70>

Abstract

OBJECTIVE: The objective was to provide a broad spectrum of New York State and local public health staff the opportunity to contribute anonymous feedback on their own and their agencies' preparedness and response to Hurricane Sandy, perceived challenges, and recommendations for preparedness improvement. **METHODS:** In 2015, 2 years after Hurricane Sandy, public health staff who worked on Hurricane Sandy response were identified and were provided a link to the anonymous survey. Quantitative analyses were used for survey ratings and qualitative content analyses were used for open-ended questions. **RESULTS:** Surveys were completed by 129 local health department (LHD) staff in 3 counties heavily impacted by Sandy (Nassau, Suffolk, and Westchester) and 69 staff in the New York State Department of Health who supported the LHDs. Staff agreed that their Hurricane Sandy responsibilities were clearly defined and that they had access to adequate information to perform their jobs. Challenges were reported in the operational, communication, service interruptions, and staff categories, with LHD staff also reporting challenges with shelters. **CONCLUSIONS:** New York local and state public health staff indicated that they were prepared for Hurricane Sandy. However, their feedback identified specific challenges and recommendations that can be addressed to implement improved preparedness and response strategies.

Citation

Vest, J.R. & Valadez, A.M. (2006). Health conditions and risk factors of sheltered persons displaced by Hurricane Katrina. *Prehospital and Disaster Medicine, 21*(2), 55–58. <https://doi.org/10.1017/s1049023x00003356>

Abstract

INTRODUCTION: During disasters, public health departments assume the role of maintaining the health of displaced persons. Displaced persons arrive with acute and chronic conditions as well as other risk factors. Descriptions of these conditions may aid future shelter planning efforts. **METHODS:** Approximately 4000 individuals from New Orleans, displaced by Hurricane Katrina, were sheltered in Austin, Texas. A stratified random sample of the population was selected using individual beds as the primary sampling unit. Adults were interviewed about their acute symptoms, chronic diseases, and other risk factors. **RESULTS:** The results indicate a substantial proportion of adults arrived with some symptoms of acute illness (49.8%). A majority of the adults reported living with a chronic condition (59.0%), and the prevalence of some chronic conditions was higher than

that of the general population. Also, several factors that could complicate service delivery were prevalent. **DISCUSSION:** Acute illnesses present transmission risks within the shelter. Furthermore, chronic diseases must be managed and may complicate care of acute illnesses. Risks like activity limitation or substance abuse may complicate shelter operations. Defining the potential scope of the illness burden may be used to help public health departments better plan the services they must deliver to displaced populations.

Pets and Companion Animals

Articles focusing on the challenges and solutions related to evacuating and sheltering pets and companion animals during disasters.

Citation

Austin, J. J. (2013). Shelter from the storm: Companion animal emergency planning in nine states. *Journal of Sociology and Social Welfare*, 40(4), 185–210.

Abstract

Failure to evacuate pets in an emergency has negative implications for public health, the economy, emotional well-being of pet owners, and physical health of animals. These effects may be at least partially mitigated by a robust plan to accommodate pets. Nine state companion animal emergency plans were reviewed to determine the extent to which they addressed the needs of companion animals, utilizing characteristics of a model emergency plan. States were compared utilizing variables such as population, pet friendliness, and emergency preparedness funding in order to explain differences in plan composition. This comprehensive review produced a list of recommendations for emergency managers as they create future versions of their plans.

Citation

Austin, J. J. (2020). All in the family: Planning for animals is planning for people. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters, Natural Hazards Center, University of Colorado Boulder*. <https://hazards.colorado.edu/news/research-counts/special-collection/all-in-the-family-planning-for-animals-is-planning-for-people>

Citation

Babcock, S.A. & Smith, D.G. (2020). Pets in Comprehensive Disaster Planning: The Post-Hurricane Katrina Experience. *American Journal of Public Health*, 110(10), 1500–1501. <https://doi.org/10.2105/AJPH.2020.305752>

Citation

Douglas, R., Kocatepe, A., Barrett, A.E., Ozguven, E.E., & Gumber, C. (2019). Evacuating people and their pets: Older Floridians' need for and proximity to pet-friendly shelters. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 74(6), 1032–1040. <https://doi.org/10.1093/geronb/gbx119>

Abstract

OBJECTIVES: Pets influence evacuation decisions, but little is known about pet-friendly emergency shelters' availability or older adults' need for them. Our study addresses this issue, focusing on the most densely populated area of Florida (Miami-Dade)-the state with the oldest population and greatest hurricane susceptibility. **METHOD:** We use Geographic Information Systems (GIS)-based methodology to identify the shortest paths to pet-friendly shelters, based on distance and congested and uncongested travel times-taking into account the older population's spatial distribution. Logistic regression models using the 2013 American Housing Survey's Disaster Planning Module examine anticipated shelter use as a function of pet ownership and requiring pet evacuation assistance. **RESULTS:** Thirty-four percent of older adults in the Miami-Dade area have pets-35% of whom report needing pet evacuation assistance. However, GIS accessibility measures show that travel time factors are likely to impede older adults' use of the area's few pet-friendly shelters. Logistic regression results reveal that pet owners are less likely to report anticipating shelter use; however, the opposite holds for pet owners reporting they would need help evacuating their pets-they anticipate using shelters. **DISCUSSION:** High pet shelter need coupled with low availability exacerbates older adults' heightened vulnerability during Florida's hurricane season.

Citation

Farmer, A. K., DeYoung, S. E., & Wachtendorf, T. (2016). Pets and evacuation: An ongoing challenge in disasters. *Journal of Homeland Security & Emergency Management*, 13(4), 1. <https://doi.org/10.1515/jhsem-2016-0051>

Abstract

Pet ownership may continue to be an impediment to evacuation and sheltering for disasters, despite the passage of the 2006 PETS Act. Many Americans consider pets to be a part of the family, and are hesitant to follow evacuate orders if they cannot bring household pets along. We present findings of qualitative data collected from residents in eastern North Carolina, an area that is susceptible to hurricane storm surge flooding, and other severe weather events. Additionally, analysis of hazard mitigation plans for the state of North Carolina and the four areas in which the data were collected reveal that the state level plan includes significant planning for pets, while the local hazard plans do not dedicate plans to address evacuation and sheltering of companion animals. Implications for future research include clear communication about pet friendly shelters, broader inclusion and protection of vulnerable animals that are tied to the human and environmental well-being, and updating local mitigation plans to include specific plans for including animals in evacuation.

Citation

Federico, J. L. (2020). PET PODs: Including pets in your community evacuation shelter plan. *Research Counts, Volume 4, Special Collection on Mass Sheltering and Disasters*, Natural Hazards Center, University of Colorado Boulder. <https://hazards.colorado.edu/news/research-counts/special-collection/pet-pods-including-pets-in-your-community-evacuation-shelter-plan>

Citation

Federico, J.L., & Banks, R.E. (2020). PET PODs: A tool to assist with good welfare provisions during emergent conditions. *Journal of Applied Animal Welfare Science*, 23(3), 253–264. <https://doi.org/10.1080/10888705.2019.1619179>

Abstract

The PETS Act amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act to ensure state and local emergency preparedness operational plans included provisions for individuals with household pets and service animals following a major disaster or emergency. While the national newsworthy events are usually large scope disasters, there are also local events which do not meet the minimal conditions to qualify for state or federal level welfare support. Local governments should be prepared to house pets at evacuation shelters, regardless of the breadth of the event, and especially for local events that do not reach the level of state or federal disasters. Wake County, North Carolina developed a concept of prepared sustainment “PET PODs” equipped with inventory and operational instructions required to create and operate an animal evacuation shelter, which could be, or not be, closely associated with the human evacuation shelter. The Wake County Animal Center “PET PODs” provided supplies for animals which arrived with their owners at evacuation shelters during Hurricane Florence, which in addition to volunteer personnel and donated feed provisions, established the foundation for good animal welfare for dozens of animals.

Citation

Hunt, M.G., Bogue, K., & Rohrbaugh, N. (2012). Pet ownership and evacuation prior to Hurricane Irene. *Animals* 2(4), 529–539. <https://doi.org/10.3390/ani2040529>

Abstract

Pet ownership has historically been one of the biggest risk factors for evacuation failure prior to natural disasters. The forced abandonment of pets during Hurricane Katrina in 2005 made national headlines and led to the passage of the Pet Evacuation and Transportation Standards Act (PETS, 2006) which mandated local authorities to plan for companion animal evacuation. Hurricane Irene hit the East Coast of the United States in 2011, providing an excellent opportunity to examine the impact of the PETS legislation on frequency and ease of evacuation among pet owners and non-pet owners. Ninety pet owners and 27 non-pet owners who lived in mandatory evacuation zones completed questionnaires assessing their experiences during the hurricane and symptoms of depression, PTSD, dissociative experiences, and acute stress. Pet ownership was not found to be a statistical risk factor for evacuation failure. However, many pet owners who failed to evacuate continue to cite pet related reasons.

Agency Reports

Post-hurricane and tornado reports conducted by federal agencies to assess building performance, damage, and impacts.

Citation

Federal Emergency Management Agency (FEMA). (2005). *488: Hurricane Charley in Florida: Observations, Recommendations, and Technical Guidance* (Mitigation Assessment Team Report).

Citation

FEMA. (2005). *489: Hurricane Ivan in Alabama and Florida Observations, Recommendations, and Technical Guidance* (Mitigation Assessment Team Report).

Citation

FEMA. (2009). *P-757: Hurricane Ike in Texas and Louisiana: Building Performance Observations, Recommendations, and Technical Guidance* (Mitigation Assessment Team Report).

Citation

FEMA. (2010). *Mississippi Tornado Outbreak, April 23rd-24th Damage and Safe Room Performance Observations, Recommendations, and Conclusions* (Pre-Mitigation Assessment Team Report).

Citation

FEMA. (2012). *P-908: Spring 2011 Tornadoes: April 25-28 and May 22: Building Performance Observations, Recommendations, and Technical Guidance* (Mitigation Assessment Team Report).

Citation

FEMA. (2013). *P-942: Hurricane Sandy in New Jersey and New York: Building Performance Observations, Recommendations, and Technical Guidance* (Mitigation Assessment Team Report).

Citation

FEMA. (2018). *P-2020: Hurricanes Irma and Maria in Puerto Rico: Building Performance Observations, Recommendations, and Technical Guidance* (Mitigation Assessment Team Report).

Citation

FEMA. (2018). *P-2021: Hurricanes Irma and Maria in the U.S. Virgin Islands: Building Performance Observations, Recommendations, and Technical Guidance* (Mitigation Assessment Team Report).

Citation

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Citation

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