Published in final edited form as:

J Risk Res. 2015 ; 18(2): 249–265. doi:10.1080/13669877.2014.896401.

Concerns and perceptions immediately following Superstorm Sandy: ratings for property damage were higher than for health issues

Joanna Burger^{a,b,c,*} and Michael Gochfeld^{b,c,d}

^aDivision of Life Sciences, Rutgers University, Piscataway, NJ, USA

^bEnvironmental and Occupational Health Sciences Institute, Rutgers University, Piscataway, NJ, USA

^cConsortium for Risk Evaluation with Stakeholder Participation, Vanderbilt University, Nashville, TN, USA

^dEnvironmental and Occupational Medicine, Rutgers Robert Wood Johnson Medical School, Piscataway, NJ, USA

Abstract

Governmental officials, health and safety professionals, early responders, and the public are interested in the perceptions and concerns of people faced with a crisis, especially during and immediately after a disaster strikes. Reliable information can lead to increased individual and community preparedness for upcoming crises. The objective of this research was to evaluate concerns of coastal and central New Jersey residents within the first 100 days of Superstorm Sandy's landfall. Respondents living in central New Jersey and Jersey shore communities were differentially impacted by the storm, with shore residents having higher evacuation rates (47% vs. 13%), more flood waters in their homes, longer power outages (average 23 vs. 6 days), and longer periods without Internet (29 vs. 6 days). Ratings of concerns varied both among and within categories as a function of location (central vs. coastal New Jersey), stressor level (ranging from 1 to 3 for combinations of power outages, high winds, and flooding), and demographics. Respondents were most concerned about property damage, health, inconveniences, ecological services, and nuclear power plants in that order. Respondents from the shore gave higher ratings to the concerns within each major category, compared to those from central Jersey. Four findings have implications for understanding future risk, recovery, and resiliency: (1) respondents with the highest stressor level (level 3) were more concerned about water damage than others, (2) respondents with flood damage were more concerned about water drainage and mold than others, (3) respondents with the highest stressor levels rated all ecological services higher than others, and (4) shore respondents rated all ecological services higher than central Jersey residents. These data provide information to design future preparedness plans, improve resiliency for future severe weather events, and reduce public health risk.

*Corresponding author. burger@biology.rutgers.edu.

Keywords

concerns; perceptions; disasters; hurricanes; Superstorm Sandy; preparedness

Introduction

Disasters and crises occur every day somewhere in the world (Norris, Tracy, and Galea 2009), although the frequency of storm-related events is increasing (Lane et al. 2013; NPCC2 2013). Such events threaten property, health, and the lives of people, as well as taxing emergency services and infrastructure, and disrupting personal safety and community operations. Disaster or crisis events are stressful to individuals and communities, both physically and mentally (Neria, Nandi, and Galea 2007; North, Oliver, and Pandya 2012; Neria and Shultz 2013). During a disaster, characterized by electricity outages lasting days, people are displaced to friends or shelters, roads are impassable, information sources may be non-operational, and people lack sufficient resources to survive (clean water, food, heat, and medicine). Serious health conditions, emotional distress, and grief follow disasters (Galea, Nandi, and Vlahov 2005, 2007; Hobfoll et al. 2007; McLaughlin et al. 2010; Shear et al. 2011).

Well over half of the US population lives in coastal watershed counties (NOAA 2012; Crosset et al. 2013), where storms and hurricanes are predicted to increase (Lane et al. 2013). Damages can be high, partly because of an increase in vulnerability and exposure to coastal flooding (Genovese and Przulski 2013). Superstorm Sandy made landfall in New Jersey on 29–30 October 2012, resulting in 159 deaths and causing over \$70 billion in damages (Freedman 2013). New Jersey and New York were particularly hard hit by *Sandy* because the storm stalled over the region. Thousands of homes were without power for weeks, and many people were displaced from homes damaged by storm surges, flooding, and loss of power. There were mandatory evacuation orders for some communities but not others. Many people sheltered in place, and others evacuated before or after the storm due to lack of electricity, heat, food, and contaminated drinking water (Kratovil 2012). After the storm, coastal homes and businesses were submerged in floodwater for weeks, and 9 months later, many people were still displaced. Over 345,000 housing units were destroyed in New Jersey alone, with nearly \$3 billion in damages to NJ transit, roads, and bridges (BBB 2012). Many coastal communities in New Jersey and New York are ethnically and economically vulnerable (Eisenman et al. 2007).

This study examined how people living along the coast and in central New Jersey rated various human health, public health and safety, property concerns, and ecological aspects within the first 100 days of Superstorm Sandy's landfall in New Jersey. People in coastal communities and in central New Jersey were surveyed. People were interviewed, and asked to rate on a scale of 1 (least important) to 5 (most important) a list of possible concerns, later categorized into ecological services, health, inconveniences, nuclear, and property damage. Nuclear was included because the main area damaged by Superstorm Sandy has a coastal nuclear facility (Oyster Creek), and memories of flooding and Fukushima damage were still fresh in people's minds.

Post-disaster needs assessments are essential to understand recovery, rebuilding, and resiliency, as well as post-disaster mental health assessments (Kessler et al. 2008). Part of assessment includes understanding how people perceive various aspects of a storm, and their major concerns immediately following a disastrous event (Cutter and Smith 2009). Sound public policy and wise management of future disasters can only be developed with a solid information base (Fairbank and Gerrity 2007; Schoenbaum, Butler, and Kataoka 2009). The present study addresses the need for information on people's concerns within 100 days of a disaster which will be useful for managers, risk assessors, and public policy-makers. The study was initiated immediately after *Sandy*, when many of the interviewees were still without power, and many were still displaced. Further, we separate the data into coastal and central because other works on hurricane effects often concentrate only on people within a narrow band along the shore, while a much wider area of New Jersey was without power after *Sandy*.

Methods

People were interviewed along coastal New Jersey from Sandy Hook to Atlantic City ($N = 347$), and in central New Jersey centered around New Brunswick ($N = 407$). No personal identifiers were obtained and the protocol was approved by the human subjects Institutional Review Board of Rutgers University. Interviews were conducted where people gathered, including town hall meetings, public meetings, FEMA and town offices, shelters, homes, recreation centers, universities, convenience stores, and fast food places, as well as make-shift food and coffee bars set up on street corners. People assessing damage and making repairs were also interviewed. Fast food places and convenience stores were often the only sources of food and supplies immediately following the storm. Everyone present was approached for an interview, and there was a very low refusal rate ($<5\%$). People were asked if they would participate in a survey being conducted by Rutgers University, and were told it was voluntary. An interview lasted about 25 min, but interviewers remained to talk with respondents about their concerns. Some interviews took over 2 h as people wanted to talk about their experiences. Interviews were conducted within 100 days of *Sandy* to ensure that people remembered their concerns and information sources.

This paper mainly addresses ratings of concerns and perceptions about property damage, personal safety and community health, inconveniences, nuclear power plant safety, and ecological issues. Specific health effects data and information sources can be found elsewhere (Burger et al. 2013; Burger and Gochfeld 2014). The entire questionnaire including several types of information: (1) storm effects (property damage, flooding, evacuation, and loss of power), (2) general concerns before, during, and after *Sandy*, (3) information sources (used and trusted), (4) health concerns, (5) renovations/repairs and mold, (6) rating of a list of concerns, and (7) demographics. Demographics were asked last so that people were at ease with giving information on ethnicity and income. People self-identified ethnicity and stressor level, and we later combined stressors into three categories: (1) power outages, (2) power outages + high winds, and (3) power outages + high winds + flooding. While these categories cause damage, they are stressors in and of themselves. The rating section listed 28 items. The interviewer named each item and the respondent rated their level of concern from 1 (least) to 5 (most concerned).

The information in this paper includes ratings of the list of 28 concerns, which were then grouped into five major concern categories (property damage, health, inconveniences, ecological services, and nuclear). For example, property damage included concerns about wind damage, electric wires, water damage, tree damage, and fire (Table 1). After respondents rated each concern, they were handed the list of 28 topics and asked 'name your top three concerns from the list.' This allowed for a comparison among concern types, forcing people to pick their greatest concerns.

Differences among groups were examined using Kruskal–Wallis non-parametric analysis of variance. A p value <0.05 was considered statistically significant (SAS 2005). We also developed General Linear Models to examine the factors that accounted for variation in the overall concern rating for the five main concern categories (property damage, health, inconvenience, ecological services, and nuclear). Independent variables were stressor level, distance to the ocean, age, sex, ethnicity, education, days without electricity and Internet, and home repairs needed.

Results

Demographics and damage

There were 347 completed interviews from shore communities and 407 from central New Jersey.

There were some demographic differences between the coastal and central New Jersey population interviewed. Respondents along the Jersey shore were older, had higher incomes, and were largely Caucasian (Table 2). Further, a higher percentage of shore respondents evacuated and lost electricity, had wind damage, and had flooding. Respondents living along the shore were without electricity for an average of 23 days, compared to 6 days for central Jersey residents.

Ratings of general concerns

Ratings were grouped into five concern categories: property damage, health, inconveniences, ecological services, and nuclear (given are the mean $\pm$ standard error). Overall, people were most concerned about property damage (mean of 3.6 ± 0.03), then inconvenience (mean of 3.2 ± 0.03) and health (3.0 ± 0.04), and finally ecological services (2.6 ± 0.04) and nuclear (2.5 ± 0.05).

The best models for the four main categories (property damage, health, inconvenience, and ecological services) explained the variation mainly in terms of stressor level, as well as location, distance to the coast, and demographics (Table 3). There were significant differences in ratings as a function of both sampling areas (central and shore) and stressor level (power outages, wind damage, and flooding) (Tables 2 and 3). Stressor level was entered as a significant variable explaining variation in ratings for more categories. We presented the data by location and stressor level because many previous studies of responses to hurricane disasters have focused on coastal communities, and we wanted our data to be comparable to past and future studies. No model was significant for nuclear.

Generally, people living along the shore who experienced greater power loss, higher winds, and flooding rated all concerns higher than others (Figure 1). For each location, there were significant differences in the ratings among the concern categories (Figure 1). That is, people in all three stressor conditions (power outages, high winds, and flooding) rated property damage the highest, followed by health and inconveniences. Nuclear plant safety was uniformly rated the lowest concern, and there were no differences in ratings between sampling areas or as a function of stressor strength. Although there were significant differences in overall ratings within categories (e.g. property damage, health), the greatest differences as a function of location occurred with ecological services (Figure 1). Respondents from the Jersey shore consistently rated ecological services of greater concern than did central Jersey respondents.

Ethnicity entered three of the five models (Table 3). In general, people from the Middle East were significantly more concerned about property damage than others, African Americans were more concerned about health and nuclear, Asians were more concerned about health, and Caucasians were more concerned about ecological services than others (Kruskal–Wallis χ^2 of 20.1 or more, all $p < 0.001$). When age entered, it was older people who were significantly less concerned about property damage, health, and inconveniences than others (χ^2 of 5.8 or more, $p < 0.06$).

All concern categories were correlated with one another ($p < 0.001$, $N = 756$). That is, people who rated one concern high did so for others also. The highest correlations were between health and property damage ($r = 0.57$), and property damage and inconvenience ($r = 0.49$); the lowest was between nuclear and property damage ($r = 0.30$).

Specific concern categories

There were significant differences in ratings for the different concerns that made up the major categories, both as a function of location and stressor level (Figures 2–6). For property damage, people were more concerned about wind damage and electrical wires. Not surprisingly, people experiencing the greatest stressor level were significantly more concerned about water damage than other respondents; respondents who experienced power outages and high winds were more concerned about tree damage than others (Figure 2). People were uniformly less concerned about fire than the other property damage issues.

A greater number of health concerns were listed in our survey (Figure 3). In general, people were most concerned about personal and community health and safety, and least concerned about pet health. Respondents with the greatest stressor level had higher ratings than people with lower stressor levels (Figure 3). There were significant differences in the rating of different health concerns as a function of location, type of concern, and level of stressor. The greatest differences as a function of stressor level were for health effects from mold and mold in the home (these two were in different places on the survey as an internal validity check). People who experienced flooding had the highest rating for mold health concerns and were most concerned about the health effects from cleaning products (because they were using excessive amounts to remove mold).

Overall, for the inconvenience category, respondents were most concerned about road closures and gasoline supply and least concerned about impacts on home gardens (Figure 4). There were significant differences in ratings of inconvenience types as a function of the type, stressor level, and location.

Respondents were generally the most concerned about beach and dune protection in the ecological services category, and least concerned about fish and wildlife (Figure 5). There were significant differences as a function of type, location, and stressor level. Respondents that had the greatest stressor level generally rated all types of ecological services higher than or the same as did other respondents (Figure 5).

The nuclear category included only 'nuclear power plant,' and people were generally not very concerned about nuclear compared to the other categories. Ratings ranged from a mean of 2.2 (Middle Eastern) to 2.6 (African Americans). No variables entered the models significantly to explain variation in nuclear ratings (Table 3).

Greatest concerns

When rating concerns, some people rate all concerns relatively high (e.g. few people rate a concern as one '1'). To further examine concerns relative to one another, we analyzed the responses to 'name your top three concerns from the list.' There were significant differences among types ($\chi^2 = 384, p < 0.001$), with personal safety heading the list, followed by water damage, tree damage, electrical wires, gas supply, wind damage, and community health (in that order, Figure 6). There were differences between the populations. Central Jersey respondents rated personal safety the highest, followed by gasoline supply, water damage, and electrical wires, while shore respondents rated water damage the highest, followed by personal safety, wind damage, tree damage, and community health (Figure 6).

Discussion

Overall, people rated property damage the highest, followed in descending order by health, inconveniences, ecological services, and nuclear. Ecological services showed the greatest difference as a function of stressor level, and nuclear showed no significant differences. There were significant differences in the ratings of four categories of concerns (property damage, health, inconveniences, and ecological services) as a function of stressor level (power outages, high winds, and flooding), location (central, coastal), and demographics. Respondents with the greatest stressors rated concerns higher. While there were differences as a function of category of concern, there were also significant differences within categories. Further, the data indicate that it is not sufficient to examine populations only by location (shore vs. central) or only by stressor (power outages, high winds, and flooding) because each exerts an influence. These findings provide insights that will aid in future preparedness for individuals and communities, as well as regions (coastal vs. inland).

Overall concerns

Respondents rated property damage the highest, followed by health, inconveniences, ecological services, and nuclear. There were significant differences among categories for all stressor levels and both locations, except for the comparison of the two locations for

respondents who suffered only power outages at the Jersey shore. These data indicate that people are not equally concerned about property and health and safety (of themselves and their community). We attribute this difference to the general phenomena of nearly everyone worrying about property damage during the storm, and facing damage after the storm, whereas many people did not have health concerns. That people were as concerned about inconveniences as they were about health and safety, indicates the relative importance of improving infrastructure in New Jersey, addressing communication and transportation issues, and dealing with improving methods of distribution for gasoline. When roads were impassable, gasoline demand decreased for automobiles and increased for generators. The latter proved to be a difficult problem because even when roads became passable, gasoline reserves were in short supply, there was some rationing, people could not pay for gasoline except with cash, and many people reported that some pumps did not work. This led to a 'run' on gasoline, with the result that some people were unable to obtain sufficient fuel for generators. The long period without power, especially for residents along the shore, magnified the problems of gasoline distribution.

The major factor accounting for variation in the four main categories was damage level. People rated concerns higher when they had more damage, which represents self-interest. For respondents from central Jersey, ethnicity was a significant factor accounting for variation for property damage, inconveniences, and ecological services. Partly, the lack of ethnic differences along the shore was a function of much less ethnic diversity; 87% of shore respondents were Caucasian, compared to only 47% for central Jersey.

Shore vs. central New Jersey respondents

There were significant differences both between and within concern categories, with higher ratings being given by shore residents and by those faced with the greatest stressors (power outages, wind, and flood). Although each of these resulted in damage, they themselves were stressors. Examining ratings for the individual types within each category indicates some differences that relate directly to stressor level. While there were differences, often significant, between the ratings of the types of property damage for central and coastal NJ respondents, the differences were greatest as a function of type (e.g. water damage and tree damage). People who experienced flooding obviously rated water damage to homes much higher than did people without flooding. This reflects personal experience. Tree damage, a direct result of high winds, was rated higher by the middle stressor category for shore respondents, but tree damage had similar ratings for all stressor categories in central Jersey respondents (e.g. there were no significant differences among stressor types). This suggests that respondents, especially those in central New Jersey, were equally concerned about tree damage even when they had such damage.

As might be expected, people rated personal and community health and safety the highest, but surprisingly, pet health was rated lowest. However, shore respondents rated community health the same or higher than personal health and safety, and the opposite was true for central Jersey respondents. This difference may be due to several factors, including age (shore residents were older, and expressed worries about neighbors), damage levels were higher along the shore leading to community concerns, and finally, shore communities may

be more dependent on neighbors and are more organized into recognizable communities (or towns). Central New Jersey towns run into one another, which may contribute to less of a community spirit. Finally, the mayors of shore communities took a very active role in informing residents of issues, and in rallying emergency services within their communities. Many of the shore communities had reverse 911, whereby the town called residents prior to, and after the storm to provide information about the impending storm. Subsequent town hall meetings informed people about mold, rebuilding, and recovery. Although there were significant differences in the concern ratings for different health types, people with the highest stressor levels always rated each type of health concern the highest, compared to other stressor types. This is not surprising. If you lose your house or a part due to storm surge and flooding, you are bound to rate health concerns higher. Shore communities had higher evacuation rates and longer periods without power, contributing to increases in health concerns. Finally, respondents experiencing flooding rated mold concerns much higher than all others. This is not surprising since mold directly increases following such flooding (Brandt et al. 2006), and mold prevention strategies are well described and studied (Barbeau et al. 2010).

People rated different inconveniences rather high, especially road closures, gasoline supply, and water drainage. All three of these impeded movement in and around communities and prevented people from access to stores, gasoline stations, and medical supplies. Even when roads were clear, people could not obtain enough gasoline to go anywhere, or to risk using what gas they had. This category, more than the others, suffers from our selection of the inconveniences. We initially thought that property damage, health, and ecological services would be concerns for most people, and our pilot survey did not turn up a large list of inconveniences. Perhaps road closures and lack of gasoline supplies were so important that no others were mentioned. The inconveniences were mainly aggravating and frustrating, rather than being life-threatening, except in the case of medical emergencies and food/water supplies. The relatively high rating for road closures and gas supplies indicates that future preparedness must consider the problems of infrastructure during emergencies, and methods of dealing with the inability of citizens to obtain necessary food, water, medicines, and other supplies.

Ecological services were rated higher overall by shore respondents, and certain types of ecological services concerns were rated higher by shore respondents and those with the highest stressor level (e.g. power outages, high winds, and flooding). Mean ratings for all types of shore residents ranged between 3 and 4, while those for central Jersey residents ranged from 1.5 to 3. These large differences occurred only for ecological services. One reason for the difference may be that central Jersey respondents were farther from the coast, and, therefore, less subject to direct surge flooding. The effect of proximity to a hazardous site or severe storms has been recognized for some time (Eränen 1997; Barnes et al. 2002; Trumbo et al. 2011). Because shore residents experienced extreme flooding, a higher percentage evacuated and power was out for longer duration, they experienced greater personal health issues and property damage, and more inconveniences. They looked to the sea for the cause, which brought to mind the barriers to flooding (dunes, beaches, and salt marshes). We suggest that this led to higher ratings for all the ecological services. Further, the media and governor stressed the differences between the damage to communities with

high protective dunes (less damage) and those without these protective barriers. That the media coverage stressed these differences, no doubt accounts for the similar ranking of some ecological services between shore and central Jersey respondents.

Perception of the relative importance of beach erosion, dune restoration, and dune protection for respondents along the shore is an important finding of this study because it indicates an understanding of the role these play in preventing or reducing flooding. However, this has not translated into smart reconstruction. Risk perception has been an important predictor of storm preparation and evacuation behavior with respect to predicted hurricanes (Peacock, Brody, and Highfield 2004). Most studies of responses to hurricanes have been conducted in Florida or in the Gulf of Mexico that experience frequent, devastating hurricanes (Peacock, Brody, and Highfield 2004; Trumbo et al. 2011). Coastal New Jersey, however, has not experienced regular or severe hurricanes, and even hurricane *Irene* with heavy rainfall inland the previous year did not result in coastal flooding or excessive damage. Many respondents reported that they had weathered other severe storms without undue damage. This is partly an optimistic bias and the deamplification of risk (Kasperson and Kasperson 1996). That is, people believe they are better off than others and will not suffer undue damage due to storm surges and flooding. Believing an approaching hurricane is not a serious threat has been reported previously (Riad, Norris, and Ruback 1999). Indeed, some respondents reported that damage from *Irene* had been much less severe than predicted, and therefore they believed that *Sandy* too would be less damaging than the warnings. An increased rating for beach restoration and protection may also be the result of perception that the risk of having property damaged was related to lack of ecological barriers.

Conclusions: implications for future risk, recovery, and resiliency

This study indicates that ratings of perceptions and concerns varied both among and within categories as a function of location (central vs. coastal New Jersey) and stressor level (power outages, high winds, and flooding). Generally, respondents were more concerned about property damage, then about health, inconveniences, and ecological services, with much less concern for nuclear even though a nuclear plant was located in their neighborhood or within the area. Respondents from the shore were generally more concerned both about the overall categories and about the types within each category. Three major differences have important implications for understanding future risk, recovery, and resiliency: (1) respondents with the highest stressor level (power outages + high winds + flooding) were more concerned about water damage than others, (2) respondents with flood damage were more concerned about water drainage and mold than others, and (3) respondents with the highest stressor level rated all ecological services higher than others, and shore respondents rated all ecological services higher than central jersey residents regardless of the stressor level. It is not surprising that shore residents with the highest level of stressors (and the greatest damage) rated concerns about wind damage, water damage, and mold the highest. This represents self-interest.

More importantly, all three indicate that shore residents who experienced the highest level of stress and damage rated concerns higher, and recognized the relationship between the ecological barriers (dunes and beaches), and surges and flooding. Further, they recognized

the importance of dune protection and dune restoration. This was less so for central Jersey residents, which suggests that there is a need to develop statewide (and coastwide) information strategies to increase awareness of the importance of ecological barriers that protect the land (dunes, salt marshes, and bays), and reduce risk to towns and communities. The interconnectedness of coastal regions with more inland communities must be made. In the present study, the distance central Jersey residents were from the coast averaged only about 30 km, which is relatively close. Thus, central and coastal Jersey respondents are linked ecologically, socially, and certainly economically. This is especially true in New Jersey where a significant source of revenue is from coastal tourism. The lack of the same understanding of the importance of dune protection and restoration is cause for concern, and suggests a real need to connect inland communities with coastal ones.

When given an opportunity to list their three most important concerns, the highest percentage of coastal respondents listed water damage, personal safety, wind and tree damage, and community health; and central Jersey residents listed personal safety, gasoline supplies, water damage, and electrical wires (in that order). This also indicates a degree of self-interest relating to stressor level and damage. Shore respondents were concerned about property damage and health, and central Jersey respondents were interested in personal safety, damage, and electrical wires. These data suggest that managers planning for future events need to concentrate on providing information and aid with respect to personal health, property issues, and infrastructure (e.g. gas supplies). When able to choose only three of the concerns presented to them, very few listed beach erosion, dune protection, and dune restoration, the ecological barriers to flooding. As expected, shore residents were more likely to mention these. Still it is encouraging that some people mentioned these, given the potential consequences of the other concerns.

Finally, the data suggest to us that there is a need for improving public information, thereby influencing their understandings and perceptions about the interconnectedness of human and ecological communities in reducing risk from future severe weather events, in preparedness, and in increasing resiliency of both ecological and human communities. Central and coastal Jersey communities are in reality close together geographically, and are dependent on each other culturally and economically. Further, the connectedness between ecological health and human health is nowhere as obvious as in coastal communities where the absence of salt marshes and dunes leads to much more flooding and severe damage. This is not only true of New Jersey, but is true of New York and most coastal states, indicating a need for a regional or coastwide strategy to reduce risk, decrease vulnerability, and increase resiliency.

Acknowledgments

We particularly thank the respondents who gave willingly of their time to be interviewed, and the many town officials, agency personnel, commercial owners, and others who gave permission to interview people in their facilities, as well as C. Jeitner, T. Pittfield, and M. Donio for help with the interviews and graphics. This research was funded by a pilot grant from NIEHS (P30ES005022).

References

- Barbeau DN, Grimsley LF, White L, El-Dahr Jane M. Mold Exposure and Health Effects following Hurricanes Katrina and Rita. *Annual Review of Public Health*. 2010; 31:165–178.

- Barnes G, Baxter J, Litva A, Staples B. The Social and Psychological Impact of the Chemical Contamination Incident in Weston Village, UK: A Qualitative Analysis. *Social Science & Medicine*. 2002; 55:2227–2241. [PubMed: 12409136]
- BBB (Barnegat Bay Beat). Special Report: Sandy – A Record Setting Storm. Toms River, NJ: Barnegat Bay Partnership Quart. Publ.; 2012. p. 7
- Brandt M, Brown C, Burkhart J, Burton N, Cox-Ganser J, Damon S, Falk H, et al. Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods. *Morbidity and Mortality Weekly Report*. 2006; 55:1–27. [PubMed: 16410759]
- Burger J, Gochfeld M. Health Concerns and Perceptions of Central and Coastal New Jersey Residents within 100 Days of Superstorm Sandy. *Science of the Total Environment*. 2014; 481:611–618. [PubMed: 24631998]
- Burger J, Gochfeld M, Jeitner C, Pittfield T, Donio M. Trusted Information Sources Used during and After Superstorm Sandy: TV and Radio were Used More Often than Social Media. *Journal of Toxicology and Environmental Health*. 2013; 76:1138–1150. [PubMed: 24279815]
- Crosset, K.; Cultiton, T.; Wiley, P.; Goodspeed, T. [Accessed April 17] Population Trends along the Coastal United States 1980–2008. 2013. <http://oceanservice.noaa.gov/programs/mb/pdfs/coastal.pop.trends.complete.pdf>
- Cutter, SL.; Smith, MM. [Accessed May 8, 2013] Fleeing from the Hurricane' Wrath: Evacuation and the Two Americas; *Environment*. 2009 Mar-Apr. p. 1-9. <http://www.environmentmagazine.org/Archives/Back%20Issues/March-April%202009/Cutter-Smithfull.html>
- Eisenman DP, Cordasco KM, Asch S, Golden JF, Glik D. Disaster Planning and Risk Communication with Vulnerable Communities: Lessons from Hurricane Katrina. *American Journal of Public Health*. 2007; 97(Suppl. 1):S109–S115. [PubMed: 17413069]
- Eränen L. Finnish Reactions Facing the Threat of Nuclear Accidents in Russian Nuclear Power Plants. *Patient Education and Counseling*. 1997; 30:83–94. [PubMed: 9110835]
- Fairbank JA, Gerrity ET. Commentary on 'Five Essential Elements of Immediate and Mid-term Mass Trauma Intervention: Empirical Evidence'. *Psychiatry*. 2007; 70:316–319.
- Freedman, A. [Accessed May 2, 2013] Heeding Sandy's Lessons, Before the Next Big Storm. *Climate Central*. 2013. www.climatecentral.org/news/four-lay-lessons-learned-from-hurricane-sandu-15928
- Galea S, Brewin CR, Gruber M, Jones RT, King DW, King LA, McNally RJ, Ursano RH, Petukhova M, Kessler RC. Exposure to Hurricane-related Stressors and Mental Illness after Hurricane Katrina. *Archives of General Psychiatry*. 2007; 64:1427–1434. [PubMed: 18056551]
- Galea S, Nandi A, Vlahov D. The Epidemiology of Post-traumatic Stress Disorder after Disasters. *Epidemiologic Reviews*. 2005; 27:78–91. [PubMed: 15958429]
- Genovese E, Przyluski V. Storm Surge Disaster Risk Management: The Xynthia Case Study in France. *Journal of Risk Research*. 2013; 16:825–841.
- Hobfoll SE, Watson, P P, Bell CC, Bryant RA, et al. Five Essential Elements of Immediate and Mid-term Mass Trauma Intervention: Empirical Evidence. *Psychiatry*. 2007; 70:283–315. [PubMed: 18181708]
- Kasperson RE, Kasperson JX. The Social Amplification and Attenuation of Risk. *The Annals of the American Academy of Political and Social Science*. 1996; 545:95–105.
- Kessler RC, Keane TM, Ursano RJ, Mokdad A, Zaslavsky AM. Sample and Design Considerations in Post-disaster Mental Health Needs Assessment Tracking Surveys. *International Journal of Methods in Psychiatric Research*. 2008; 17(S2):S6–S20. [PubMed: 19035440]
- Kratovil, C. [Accessed June 17, 2013] Drinking Water Problems Cause Evacuation of Every Dorm in New Brunswick. *New Brunswick Today*. 2012. <http://newbrunswicktoday.com/article/drinking-water-concerns-cause-rutgers-pull-students-out-new-brunswick>
- Lane, Kathryn; Charles-Guzman, K.; Wheeler, K.; Abid, Z.; Graber, N.; Matte, T. Health Effects of Coastal Storms and Flooding in Urban Areas: A Review and Vulnerability Assessment. *Journal of Environmental and Public Health*. 2013; 2013:1–13.
- McLaughlin KA, Fairbank JA, Gruber MJ, Jones RT, Osofsky JD, Pfefferbaum B, Sampson NA, Kessler RC. Trends in Serious Emotional Disturbance Among Youths Exposed to Hurricane

- Katrina. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2010; 49:990–1000.e2. [PubMed: 20855044]
- Neria Y, Nandi A, Galea S. Post-traumatic Stress Disorder Following Disasters: A Systematic Review. *Psychology and Medicine*. 2007; 38:467–480.
- Neria Y, Shultz JM. Mental Health Effects of Hurricane Sandy: Characteristics, Potential Aftermath, and Response. *Journal of American Medical Association*. 2013; 308:2571–2572.
- NOAA (National Oceanographic and Atmospheric Administration). [Accessed April 3, 2012] Communities: The U.S. Population Living in Coastal Watershed Counties. 2012. <http://stateofthecoast.noaa.gov/population/welcome.html>
- Norris FH, Tracy M, Galea S. Looking for Resilience: Understanding the Longitudinal Trajectories of Responses to Stress. *Social Science & Medicine*. 2009; 68:2190–2198. [PubMed: 19403217]
- North CS, Oliver J, Pandya A. Examining a Comprehensive Model of Disaster-related Posttraumatic Stress Disorder in Systematically Studied Survivors of 10 Disasters. *American Journal of Public Health*. 2012; 102:e40–e48. [PubMed: 22897543]
- NPCC2 (New York City Panel on Climate Change). *Climate Risk Information 2013*. New York: NYC Mayor's Office; 2013.
- Peacock WG, Brody SD, Highfield W. Hurricane Risk Perceptions Among Florida's Single Family Homeowners. *Landscape and Urban Planning*. 2004; 73:120–125.
- Riad JK, Norris FH, Ruback RB. Predicting Evacuation in Two Major Disasters: Risk Perception, Social Influence, and Access to Resources. *Journal of Applied Social Psychology*. 1999; 29:918–934.
- SAS (Statistical Analysis Systems). *Statistical Analysis*. Cary, NC: SAS; 2005.
- Schoenbaum M, Butler B, Kataoka Sheryl. Promoting Mental Health Recovery after Hurricanes Katrina and Rita. *Archives of General Psychiatry*. 2009; 66:906–914. [PubMed: 19652130]
- Shear MK, McLaughlin KA, Ghesquiere A, Gruber MJ, Sampson NA, Kessler RC. Complicated Grief Associated with Hurricane Katrina. *Depression and Anxiety*. 2011; 28:648–657. [PubMed: 21796740]
- Trumbo C, Lueck M, Marlatt H, Peek L. The Effect of Proximity to Hurricanes Katrina and Rita on Subsequent Hurricane Outlook and Optimistic Bias. *Risk Analysis*. 2011; 31:1907–1918. [PubMed: 21605150]

Figure 1.

Overall concern of respondents from central and coastal New Jersey. Each major concern is a composite of several types within that concern category (see methods for definitions).

Notes: Open circle = Jersey shore, and closed triangle = central New Jersey

respondents. * Indicates significant differences within each category.

Figure 2.

Variation in mean ($\pm$ SE) ratings for types of property damage as a function of location (shore, central New Jersey) and stressor level (power outages, high winds, and flooding). *Indicates a significant difference between the ratings of central and shore respondents. Overall comparison of the stressors for the shore and central Jersey respondents was significant ($X^2 = 10.6, p < 0.005$).

Figure 3.

Variation in mean ($\pm$ SE) ratings for types of health concerns as a function of location (shore, central New Jersey) and stressor level (power outages, high winds, and flooding). *Indicates a significant difference between the ratings of central and shore respondents. Overall stressor levels differed significantly among study sites ($X^2 = 35.9$, $p < 0.0001$).

Figure 4. Variation in mean ($\pm$ SE) ratings for types of inconveniences as a function of location (shore, central New Jersey) and stressor level (power outages, high winds, and flooding). *Indicates a significant difference between the ratings of central and shore respondents. Overall difference among stressors was significant ($X^2 = 14.1, p < 0.0008$).

Figure 5.

Variation in mean ($\pm$ SE) ratings for types of ecological services as a function of location (shore, central New Jersey) and stressor level (power outages, high winds, and flooding). *Indicates a significant difference between the ratings of central and shore respondents. Overall difference among stressors was significant ($\chi^2 = 9.6$, $p < 0.008$).

Figure 6.

Overall ranking of different types of concerns for respondents from central and coastal New Jersey. Shown is the percent of responses to the question – ‘Of the list given, what are your three top concerns?’ Concerns differed significantly between respondents in central and coastal New Jersey ($X^2 = 384, p < 0.0001$).

Table 1

Listing of concerns that respondents were asked to rate, grouped into major concern categories.

Property damage	Health and safety	Inconveniences	Ecological services
High winds	Personal safety	Gasoline supply	Dune protection
Downed wires (house)	Mold in home	Water drainage	Dune restoration
Water damage to house	Community health	Road closures	Beach erosion
Tree damage	Health effects from cleaning products	Smell of mold	Fish populations
Fire (house)	Oil contamination in water	Impact on home gardens	Bird populations
	Health effects from mold, or mold in home		Loss of salt marshes
	Pet health		Fishing places
	Toxics in water		Replace dune vegetation
	Toxics in sand		

Note: The category 'nuclear,' unlike all others, included only 'nuclear power plants.' Twenty-seven concerns are listed in the table, and nuclear makes it 28.

Table 2

Demographics and effects from Superstorm Sandy.

Demographics	Central New Jersey (N = 409)		Jersey shore (N = 347)		Kruskal-Wallis test χ^2 (P)
	Mean	Std Error	Mean	Std Error	
Age	32.64 $\pm$ 0.76		51.79 $\pm$ 0.76		218 (<0.0001)
Years of education	13.57 $\pm$ 0.27		14.98 $\pm$ 0.12		NS
Income	59,054 $\pm$ 7196		68,683 $\pm$ 3247		15.8 (<0.0001)
% Female	51.6%		46.5%		NS
Ethnicity					156 (<0.0001)
Caucasian	46.6%		86.8%		
Hispanic/Latino	7.2%		5.6%		
African American	6.5%		4.7%		
Indian	10.9%		1.8%		
Asian	23.3%		1.2%		
Other	5.4%				
% Evacuated	13.1%		46.8%		103 (<0.0001)
% That lost electricity	91.9%		99.4%		24.0 (<0.0001)
% Lost electricity and wind damage	39.6%		83.1%		156 (<0.0001)
% Lost electricity, wind damage, and flooding	13.7%		52.5%		135 (<0.0001)
Days w/o electricity?	6.01 $\pm$ 0.32		22.8 $\pm$ 1.36		242 (<0.0001)
Days w/o Internet?	6.45 $\pm$ 0.41		28.9 $\pm$ 1.72		235 (<0.0001)

Table 3Models explaining variation in personal concerns during and after *Sandy*.

	Property damage	Health	Inconveniences	Ecological services	Nuclear
Model					
<i>F</i>	5.2	9.9	10.1	23.5	0.39
df	11	11	11	11	11
<i>P</i>	<0.0001	<0.0001	<0.0001	<0.0001	NS
<i>r</i>	0.08	0.15	0.15	0.29	0.007
Factors entering <i>F</i> (<i>P</i>)					
Distance to Ocean or Bay	NS	4.2 (0.04)	NS	3.8 (0.05)	NS
Location (Coastal vs. Central)	NS	NS	NS	4.2 (0.04)	NS
Stressor level	15.5 (<0.0001)	35.3 (<0.0001)	46.1 (<0.0001)	10.6 (0.001)	NS
Location × stressor level	NS	NS	NS	NS	NS
Age	NS	7.4 (0.007)	5.3 (0.02)	NS	NS
Ethnicity	2.7 (0.03)	NS	2.3 (0.06)	7.3 (<0.0001)	NS
Education	10.9 (0.001)	NS	NS	NS	NS
Days without electricity	NS	4.5 (0.04)	3.5 (0.06)	NS	NS