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Health concerns and perceptions of central and coastal New Jersey residents in the 100 days following Superstorm *Sandy*

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Abstract

Superstorm *Sandy* made landfall in New Jersey 29–30 October 2012 (80 km/hr winds), and many residents were evacuated, were without power for days to several weeks, and suffered property damages or lost their homes. The objective of this study was to understand health concerns within 100 days of this devastating storm that might improve recovery, future preparedness, and resilience. We conducted a survey of New Jersey residents in central (N = 407) and shore communities (n=347) about health concerns before, during, and after Superstorm *Sandy*. People were interviewed at public places, town hall and FEMA meetings, health and university centers, and other gathering places. 47 % of shore and 13 % of central Jersey respondents evacuated. Both populations were concerned about agents of destruction, survival needs, and possessions before and during the storm, but they were mainly concerned about survival needs thereafter. During the storm, medical issues were the greatest concern for shore respondents (23 %) vs secure and safe food and water (29 %) for central respondents. Medical concerns increased after the storm. In the future, 42 % of shore respondents would prepare more, while 51 % of central residents would buy more supplies; 20 % (shore) and 11 % (central) would heed future evacuation warnings. Before *Sandy* many residents did not heed warnings and evacuation orders, but worried about property damage, while during and after their major concerns were personal and community health. Prevention of future health and property impacts could be enhanced by stronger evacuation enforcement, better preparedness information, greater attention to the possibility of prolonged power outages, and more attention to medical needs during and after a storm.

Keywords

Anxiety; Concerns; Food security; Health; Preparedness; Resiliency

1. Introduction

Superstorm *Sandy* made landfall in New Jersey 29–30 October 2012, resulted in 159 deaths, caused over \$70 billion in damages, and led to the release of nearly 11 billion gallons of sewage into waterways (Freedman, 2013). The east to west movement of Hurricane *Sandy*, opposite of what normally happens, resulted in combining the hurricane with a “nor-easter”, creating the Superstorm. Record high surges of 2.6 m above high tide were accompanied by 130 km/hr maximum sustained winds at landfall near Atlantic City, and 142 km/hr peak wind gusts (BBB, 2012). 346,000 housing units were destroyed in New Jersey, with nearly \$3 billion in damages to NJ transit, roads, and bridges (BBB, 2012). Direct economic losses for New Jersey alone have been estimated at 29.4 billion dollars – 31 % of the total economic losses from the storm (Kunz et al., 2012).

New Jersey and New York were particularly hard hit, with thousands without power for weeks, and many displaced from homes damaged by storm surges. Mandatory evacuation orders were issued for some shore communities before the storm. Some people sheltered in place, while others evacuated. Many evacuations occurred after the storm passed due to lack of electricity, heat, and food, and to contaminated drinking water (Kratovr, 2012). In the aftermath, coastal homes and businesses were submerged in flood water for weeks, and coastal New Jersey and New York faced difficult decisions regarding whether to demolish or rebuild.

Serious health conditions, emotional distress, and grief follow such disasters (Galea et al., 2007; McLaughlin et al., 2010; Shear et al., 2011). Post-disaster needs assessments are essential to understand construction and rebuilding, as well as post-disaster mental health (Kessler et al., 2008). Determining a path forward is partly dependent upon understanding perceptions and responses before, during, and after a disaster, including people’s decisions to evacuate (Cutter and Smith, 2009). Understanding responses to stress can also contribute to developing resiliency (Norris et al., 2009). It is challenging to determine costs for different aspects of recovery and preparedness (Schoenbaum et al., 2013), leading to development of sound public policy (Fairbank and Gerrity, 2007). Numerous studies have focused on trauma (Neria et al., 2008; Hensley-Haloney and Varela, 2009), health risks and effects (Aciermo et al., 2007; Ruggiero et al., 2009; Barbeau et al., 2010), mold (Brandt et al., 2006), evacuation and relocation (Uscher-Pines, 2009), and risk communication (Reynolds and Seeger, 2005)

The purpose of this study was to assess the concerns and perceptions of coastal and central New Jersey residents before, during, and after Superstorm *Sandy* (hereafter called *Sandy*). Specific objectives were to examine 1) Damage and evacuation behavior, 2) General concerns, 3) Health concerns, and 4) Future preparedness, and to examine differences in concerns between coastal and central New Jersey residents. We predicted that concerns would differ between the two groups because of the nature of expected and real damages, and that self-identified health concerns would vary with location and evacuation times. While nearly all NJ residents were without electricity, flood and wind damage differed among groups. We interviewed people using various locations to assemble a convenience sample.

2. Methods

Our overall protocol was to interview subjects about their concerns and perceptions. The survey protocol was approved by Rutgers University Institutional Review Board as “exempt”, since no personal identifiers were obtained. People were informed that the survey was being conducted by faculty and staff from Rutgers University, and subjects were asked if they would consent to participate. Respondents voluntarily answered questions. They were informed that they were not being identified, and no names were recorded. They were informed that the study results would be available by request, as well as on our web site.

2.1. Subject selection

Interviews were conducted where people gathered to seek food or shelter, gain information or exchange thoughts about *Sandy*, including town and public meetings, FEMA and town offices, shelters and homes, universities, convenience stores, fast food places, and other places people gathered (e.g. coffee and food outposts set up to aid residents).. Fast food places were often the only sources of food and supplies immediately following the storm. We approached everyone present for an interview; we did not exclude anyone, and we had a very low refusal rate (< 5 %). Once an interview was completed, we approached each new person that entered the facility. At town meetings, FEMA offices and other places, people were often waiting in lines or standing about waiting for help, and they wanted to discuss their experiences. We interviewed people in order.

2.2. Protocol

The survey instrument had questions dealing with storm effects, property damage, flooding, evacuation, loss of power, general concerns, health concerns, information sources, renovations/repairs, and demographics. A pilot survey helped refine the questions. General and health concern questions were asked on different parts of the survey. Since the questions were open-ended, people could give multiple, unprompted answers. All respondents were asked about the concerns they had before, after, and during *Sandy*. Since all interviews were conducted within 100 days of the storm, people remembered their concerns at different times.

The project required several interviewers who were trained and had been interviewing people about environmental concerns for over five years. All people entering meetings or in other places were approached, asked if they would participate in a survey being conducted by Rutgers University, and were told it was voluntary. An interview lasted about 20 minutes, but interviewers remained to talk with respondents who wanted to continue discussing their experiences. Interviews were conducted within 100 days of *Sandy* to assure that people remembered their concerns before, during and after *Sandy*.

Differences between the responses of subjects in central compared to coastal New Jersey were examined using Kruskal-Wallis non-parametric Analysis of Variance. We used Contingency X^2 to examine differences within categories for responses before, during and after the storm. A probability < 0.05 was considered statistically significant.

3. Results

3.1. Demographics and effects

Overall, respondents averaged 52 years, had 15 years education, and had a mean income of \$68,700; 19 % were retired, and 47 % were female. There were significant differences between the Jersey shore and central Jersey populations in age, income, ethnic composition, and type of home (Table 1). Respondents living along the shore were older, had higher incomes, were more likely to live in a house, and were more likely Caucasian than the central Jersey residents interviewed. While 86 % of respondents living along the shore were Caucasian, only 47 % of central Jersey respondents were.

Within each population (shore vs central Jersey) there were no significant ethnic differences in age, or in the percent that were unemployed, disabled, students, or retired. However, shore Caucasians had significantly higher incomes than did others ($X^2 = 11.7$, $P < 0.09$), and they had more education ($X^2 = 15.6$, $P < 0.001$). The income disparities as a function of ethnicity were less severe for central Jersey residents. For both samples, there were significant income differences as a function of percent unemployed, age, and years of education. As income increased, education and age increased and percent unemployed or disabled decreased.

Evacuation was mandatory for 70 % of those that evacuated. 47 % of the respondents interviewed along the Jersey shore evacuated, while only 13% of central Jersey respondents did; Evacuation was longer in duration for shore compared to central Jersey respondents (Table 1), with many people still unable to return home 100 days after the storm. While the percent of evacuations did not vary as a function of income for shore residents, evacuation rates for central Jersey residents were highest for those earning less than \$25,000/year, and lowest for those earning over \$60,000/year ($X^2 = 7.7$, $P < 0.02$).

Flood water in homes was higher for shore residents than for those living in central Jersey (Table 1). Shore residents were without electricity for longer and used generators for significantly more days, although daily use was similar (Table 1). Long power outage periods were due to the dangers of turning on power while the grid was exposed to flooding. This information on evacuations and damages addresses objective 1.

3.2. General concerns before, during, and after Sandy

Since the questions about general concerns were open-ended, people can mention a variety of concerns. Using all responses, we assigned the concerns expressed by each person into 12 categories. These categories were derived from an examination of the responses by four different researchers. The categories were: possessions (worries about car, house, boats, equipment), agents of destruction (e.g. wind, rain, water), survival needs (food, water, shelter), personal health and safety (self, friends, family), community safety, future actions (evacuate sooner, buy more supplies), emotional worries (stress, anxiety), the storm itself (how big it would be, would it hit, when would it hit), actions (preparing or evacuating), communication (lack of information, or confusing messages), or respondents said they had no concerns. Health and safety usually meant immediate concerns for their well-being, while

survival needs were things needed for surviving after the storm passed. While these categories are arbitrary, they are discrete and easily understood.

We then constructed an overall conceptual model of the concerns expressed by respondents about Superstorm *Sandy* (Fig. 1). The model illustrates that before the storm people had no worries, worried about the storm itself or specific stressors from the storm (surge, wind, water), or they engaged in actions (prepare, shelter in place, evacuate). Once the storm hit, people experienced effects, and were worried immediately about health and safety, and about survival needs and possessions. After the storm, people began worrying about recovery and resiliency. The percent of people engaged in each of these worry compartments varied by survey location (e.g. central or coastal New Jersey).

While figure 1 illustrates our conceptual model, Table 2 shows the frequency of responses for people living in central and coastal New Jersey, as a function of whether they felt these concerns before, during, and after the storm. For example, 36 % of respondents living along the shore were worried about possessions before the storm, 48 % were worried about them during the storm, and only 19 % were worried about them after the storm (Table 2). Survival needs were highest after the storm, compared to during or before for the Jersey shore residents.

The greatest concerns involved possessions, agents of destruction, and health and safety (Table 2). In table 2, the concerns expressed by the most people are listed at the top of the table. Some concerns were greatest before the storm and during the storm (e.g. agents of destruction, health, safety), while others were greatest after the storm (e.g. survival needs, future actions, Table 2).

The percent of people who said they had no concerns was highest for the Jersey shore before the storm (16 %), decreased during the storm (5%), and increased after (10%). Similarly, more central Jersey respondents were not worried before (14%) and after the storm (18%), compared to during the storm (5%). Thus, only 5 % of all respondents were not worried during the storm. These data address objective 2: general concerns.

3.3. Health concerns

Personal and community health concerns figured prominently in the general concerns expressed by subjects (Fig. 1, Table 2). When asked later in the survey specifically about health concerns (objective 3), respondents listed many issues, including medical concerns, access to medications and food/water, surviving, family safety, dangerous living conditions, and money as their primary health concerns. There were significant differences between the population, both during and after the storm (Fig. 2). During the storm respondents from central Jersey were most concerned about food, water and surviving, while shore respondents were most concerned about medical issues (Fig. 2). After the storm, shore respondents remained concerned about medical issues and living conditions, while central respondents were not very concerned (e.g. < 10 % reported any one type of concern). Respondents that listed surviving as a concern mentioned heat, flooding, electrical wires, drowning, generator exposure, and lack of shelter. Those mentioning food and water were concerned about both healthy food (spoilage), and food availability. Those mentioning

dangerous conditions mentioned beach debris, beach contamination, trees falling, flying objects, and the house falling down.

The primary medical concerns and living condition concerns are shown in table 3. More shore respondent's listed medical concerns, both during and after *Sandy*, than did central Jersey respondents. Whereas medical concerns increased after the storm for coastal residents, it decreased for central Jersey residents (Table 3). The main medical concerns of shore respondents were stress, asthma, and respiratory ailments, while central Jersey respondents listed colds, flu, and blood pressure (Table 3). Access to medical help was more of a problem during the storm than after, for both central and coastal respondents.

Mold was the primary health effect that we categorized as a living condition. Although shore respondents experiences more flooding, some central Jersey respondents did as well, and both groups reported mold in their homes (Table 3). While only 8 % of shore respondents reported mold in their homes before *Sandy*, 19 % reported it after. Most respondents (70%) who had a mold problem used professionals to address them, and the rest remediated mold themselves. People who remediated themselves used gloves (73%), a paper mask (55%), a respirator (20%), and goggles (4%), and only one person used a Tyvek suit. People who relied on professionals mainly gutted parts of their house (70%), used a fungicide (23%), and used a vacuum (11%); 10 % just let the house "dry out".

3.4. Future preparedness

When asked what they would do differently (objective 4), most shore respondents said they would prepare more (i.e. secure their property and belongs), but central Jersey respondents said they would buy more supplies (batteries, food, fuel, candles, working radio, Fig. 3). While 20 % of central Jersey respondents said they would buy a generator, less than 10 % of shore respondents mentioned this; the latter group noted it would not have done any good because the first floor flooded, their house was severely damaged, or their house was completely destroyed. Even a year later, this remains a problem in houses that are not yet repaired; people living on the second floor cannot use electricity because of dampness in the electrical on the first floor.

4. Discussion

4.1. Overall concerns

As predicted, the nature of general concerns shifted before, during and after the storm. In the week before the storm, people worried about the storm itself, agents of destruction (wind, fire, rain, surges, flooding), and personal and community health and safety. Before and during *Sandy*, respondents were concerned about personal health and safety of friends, family, and their community, but after, concerns mainly shifted to recovery and preparing for the future, although health and safety concerns remained. Initially, possessions were a primary concern, followed by personal health and safety. Concerns differed depending upon the level of exposure and damage; people living along the shore had more flooding, higher water in their homes, and longer periods without power. Fewer central Jersey respondents were concerned after the storm, while over 25 % of coastal respondents were concerned

about medical and living conditions after the storm because many were still without permanent housing. This largely relates to the degree and permanency of damage. The power was out for an average of 6 days for central respondents, but 23 days for shore respondents. Similarly, water damage and complete destruction were greater for shore respondents. The combination of longer power outages, longer evacuation periods, more flooding, and home destruction resulted in shore residents exhibiting both higher levels of general concern, and greater health concerns, after *Sandy*.

After the storm, people worried about personal health and safety, but also about returning to homes, rebuilding, and community recovery. Resiliency (e.g. dune protection) was an underlying issue for some shore respondents. A unique aspect of these data was that they were gathered within 100 days of the storm, when people still remembered their concerns, perceptions and fears. After a storm, attention shifts to recovery, and it is easy to forget previous health and safety concerns, survival needs, and worry about possessions.

In other studies of hurricanes, risk perception was an important predictor of storm preparation and evacuation behavior (Peacock et al., 2004). Many studies were conducted in Florida or in the Gulf that experience frequent or devastating hurricanes (Dow and Cutter, 2000; Peacock et al., 2004; Trumbo et al., 2011). New Jersey, however, has not experienced regular or severe hurricanes. Thus, a significant proportion of respondents interviewed in this study did not believe the storm was going to make landfall, and if it did, they did not believe it would be severe. Believing that an approaching hurricane is not a serious threat has been reported elsewhere (Riad et al., 1999). Partly the disbelief in our study was an effect of strong warnings the previous year about Hurricane *Irene*, which did not result in severe coastal flooding and damage. It may also be the result of perception that the risk was small, and the consequences of leaving property unattended were greater (Riad et al., 1999). Many stated that they had weathered other severe storms without undue damage. This is partly an optimistic bias (Trumbo et al., 2011) and the deamplification of risk (Kasperson and Kasperson, 1996). That is, people often believe they are better off than others, and they can deamplify the risks, as some did in our sample. Indeed, even those who had concerns before *Sandy* made landfall deamplified the risk because they did not adequately prepare by bringing in sufficient supplies or evacuating.

4.2. Health concerns

Health concerns figured prominently on open-ended questions about health, and there were significant differences in types and levels of concerns between central and coastal New Jersey respondents. A higher percentage of coastal than central Jersey respondents mentioned medical concerns (access to doctors and/or prescriptions) as their greatest health issues. Medical concerns increased post-*Sandy* for shore respondents and decreased for central respondents. Coastal respondents experiencing the storm surge and flooding reported greater concerns and higher anxiety. The U.S. population living adjacent to coasts is increasing (Crossett et al., 2013), making potential health effects from severe storms a regional public health issue. The effect of proximity to a hazardous site or severe storms has been recognized for some time (Eranen, 1997; Barnes et al., 2002; Trumbo et al., 2011), although sometimes proximity leads to complacency. We suggest, however, that in the case

of *Sandy*, the responses were proportional to the severity of the effects they experienced (more flood damage, longer loss of electricity, and longer evacuation periods). The prolonged nature of the disruptions led to greater concerns and higher levels of anxiety.

Stress and anxiety were the greatest response at the shore, while central respondents mentioned respiratory illnesses (e.g. 'flu') most often. This difference is interesting because it indicates that shore residents that experienced the greatest damage and displacement realized the levels of stress they were exposed to, while central respondents focused on acute illnesses. Concerns about access to medical care and to medications was greatest during the storm and immediately after; people who sheltered in place were unable to get anywhere for help or medications. Shelters varied in their ability to provide medical care and medications.

Post-*Sandy*, mold was a significant health concern for 19 % of shore respondents, but only 4% of central residents. Flooding was more common, reached higher levels, and lasted longer for the former. 70% of shore residents used professionals for mold remediation, partly due to the need for complete gutting and renovations, and partly due to higher income and better insurance. Although do-it-yourself mold safety information was abundantly available from FEMA, town officials and others, many respondents did not use precautions (gloves, masks), and fewer than 20 % used respirators. This indicates a public health need for disseminating clear information on mold remediation. Mold prevention strategies are well described and studied (Barbeau et al., 2010). Our results, however, indicate that a significant proportion of respondents affected had professionals remediate the mold, rather than doing it themselves. Protective measures employed by the latter group were minimal. Even though information was available from municipalities and the web, most respondents we interviewed relied on friends for information on health and safety of mold removal. Mold problems from *Sandy* still remain in the northeast (ALIGN, 2013), and in most, the mold problem will be dealt with by homeowners rather than professionals.

4.3. Public health implications

The results of this survey provide information that will be useful in preparing for future catastrophic events, despite the methodological limitations (i.e. convenience sample). The main conclusions we draw are the following: 1) Some people did not believe the warnings about the severity of the storm, did not prepare, and did not evacuate, 2) People who did prepare somewhat were still not adequately prepared for the length or severity of the flooding and lack of power, 3) People often lacked simple supplies to withstand the period without power (batteries, radio, food, water, generator fuel), 4) Concerns were stronger and longer lasting for coastal residents who experienced greater flooding, longer periods without power, and greater evacuation rates (many are still unable to return home after a year), than central Jersey respondents, 5) Anxiety and stress were the greatest health concern expressed by coastal residents, followed by respiratory problems and access to medical care, while central Jersey respondents were most concerned about flu and other illnesses derived from lack of electrical power during the cold spell, and 6) Mold was a great concern for 19 % of coastal respondents, and 30% did their own mold remediation with only gloves and masks.

These data indicate that certain types of information are needed by people to deal with on-coming severe weather events, including potential severity of the storm and its aftermath,

during and after a storm. These all relate to preparedness. Emergency preparation ‘kits’ and advice are available, but have not reached vulnerable individuals. Even though *Sandy* was predicated five days in advance, many coastal residents doubted the predicted severity; many had lived through Irene with little or no damage to themselves or their property. Thus the balance between undue alarm and adequate warning remains a critical issue.

The extreme duration of power outages was unique to this storm. Large sections of New Jersey were without power for well over a week, roads were damaged, gas could not be delivered or pumped, electronic cash registers and credit card systems did not work, and other problems were created that made access to food, water, and medical supplies difficult. The possibility of such long power outages is now a reality, and has to be part of preparedness for communities, health care facilities, businesses, and residences. Preparedness has to include sufficient supplies, including medical supplies, for longer than two weeks. The lack of preparedness for such a long period without power leaves room for improvement, both by individuals and communities (Cutter and Smith, 2009).

The major medical concern expressed by coastal respondents within 100 days of the storm was anxiety, an effect noted for New York residents as well (Neria and Shultz, 2012). Mental illness and post-traumatic stress (PTSD) following disasters is a burgeoning field (Acierno et al., 2007; Galea et al., 2007; Neria et al., 2007; Hensley-Maloney and Varela, 2009), particularly given the increase in severe storms in coastal U.S. PTSD is the condition most often measured (Norris and Elrod, 2006), with an incidence of 30–40% among direct victim (Galea et al., 2005). In the present study, “stress” and “anxiety” were self-identified, but only 13 % of shore respondents volunteered “stress” as a concern. The lower percentage of people reporting stress in our study may be due to the immediacy of our study; respondents were still worried about dangerous living conditions, being displaced, and obtaining sufficient food, water and medicines which came to mind first on our open-ended questions. Their focus in the first 100 days was on obtaining food and shelter, returning home, and repairing damage. Further, people who did not list anxiety or stress may well have felt it, but were more concerned about the more immediate issues (food, shelter). In the present study, anxiety was highest for coastal residents, and anxiety increased after the storm, in contrast to central Jersey respondents who experienced less stress after the storm. Understanding recovery from such anxiety and stress is a critical public health need, especially for locations such as New Jersey, New York and the northeast that are not usually exposed to such events.

Reducing anxiety for respondents severely affected by *Sandy* may be a function of addressing both physical needs (shelter, food, home repair, insurance), as well as emotional needs and the recognized anxiety of respondents. Effective disaster planning may require addressing both aspects within a framework that reduces anxiety while addressing individual needs (Eisenman et al., 2007). We suggest that identifying the cause of anxiety is the first step. For our respondents, some of the anxiety was about survival needs, such as finding shelter, repairing homes, or having access to medical care. Others reported only “general anxiety or worry,” and could not identify why they were anxious. Identifying the causes of anxiety for these people could lead to developing strategies for both individuals and health professional coping with this symptom.

4.4. Public health policy and resiliency

These data have public health and communication implications: 1) Some respondents, even those living along the shore, did not believe it would happen or that the consequences would be great, 2) Concern for the health and safety of themselves and others was lower before the storm, and increased during the storm, 3) Concern for survival needs was low before the storm, but increased during and after the storm as people realized they did not have enough food, water, radios, batteries, or heat to survive such a long period without electricity or mobility, 4) Health concerns differed depending upon severity of effects: during the storm; food and water, medical issues, and surviving were the most important aspects, while after, medical concerns and living conditions were the greatest concerns, and 5) After the storm, anxiety and stress were reported frequently. These findings suggest that public health professionals, media, and governments have a responsibility to provide more convincing information about potential severity of storms, essentials needed to shelter in place, essentials needed to evacuate, and medical supplies or access to medical care for those that shelter in place. For example, few systems were adequately hardened to provide continuity of medical care and medication for such prolonged outages.

Guided by disbelief, many respondents were not prepared with adequate food, water and medical supplies to survive, particularly in damaged homes after the storm. Even in the 100 days following the storm over 5 % of respondents were still worried about inadequate food and water, medical supplies and doctors, and living conditions. This suggests that although aid was forthcoming from a number of governmental and non-profit organizations, it was not sufficient to deal with the aftermath of the severe storm. Further, living conditions still remain a problem in New Jersey as many evacuees have not yet returned to their homes.

Five intervention techniques have been suggested to deal with stress, including promoting a sense of safety, calming, sense of self and community-efficacy, connectedness, and hope (Hobfoll et al., 2007). To these five interventions, we suggest: 1) providing time-lines for addressing lack of housing, dangerous living conditions, and energy restoration, 2) providing adequate medical care and access to doctors, and 3) providing adequate transportation to vulnerable individuals and populations.

More general, long-term lessons from *Sandy* include re-thinking coastal development, investing in weather infrastructure, learning from communication failures, and adjusting to the age of consequences and cascading effects. From our research we suggest that investing in preparedness information and immediate mental health (e.g. anxiety and other disorders) care should be strengthened. Dealing with the immediate problems of survival and property damage and repair are clearly critical, but sufficient pre-disaster planning will decrease the survival concerns, and dealing with mental health issues immediately following the storm may decrease long-term mental health issues. The realization that large sections of a region could be without power for a week or more was transformational; prior planning did not include regional power outages for such an extended period. These outages disrupted local and regional communities, economies, and housing, and left whole communities without adequate and secure medical supplies and aid, food and water, housing, and transportation. Integrated planning and future preparedness must now take into account the mechanisms

and infrastructure to deal with such long-term loss of power. At this point, a year after Sandy, many shore communities are still seriously disrupted, many families displaced, and many insurance/financial issues are unresolved. Our study did not address resilience, but illustrates the close link between resilience and preparedness.

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Figure 1.

Conceptual model showing concerns expressed by people about the storm itself, specific stressors resulting from the storm (wind, surge, water), and concerns about effects. Concerns also led directly to actions, which were expressed as concerns (i.e. I was worried about preparing or evacuating). During all phases, people worried about communication (or lack thereof, and security for their homes and possessions).

Figure 2. Major concerns expressed by respondents during and after the storm. All respondents were asked about their concerns during the storm, and after the storm. There were significant differences in the response of subjects as a function of location (central vs. coastal New Jersey).

Figure 3.

Differences in future responses to another storm as a function of whether people lived in central or coastal New Jersey. Central Jersey residents would bring in more supplies, while coastal residents would prepare their property (homes, cars).

Table 1

Demographics and some effects from Superstorm Sandy.

	Central New Jersey (N=409)	Jersey Shore (N=347)	
	Mean Std Error	Mean Std Error	Kruskal-Wallis Chi-square (p)
Age	32.64 ± 0.76	51.79 ± 0.76	218 (<0.0001)
Education (years)	13.57 ± 0.27	14.98 ± 0.12	NS
Income	59,054 ± 7,196	68,683 ± 3,247	15.8 (<0.0001)
Female (%)	51.6%	46.5%	
Ethnicity			161 (<0.0001)
Caucasian	46.6%	86.8%	
Hispanic/Latino	6.2%	5.0%	
African American	6.5%	4.7%	
Indian	10.9%	1.8%	
Asian	23.3%	1.2%	
Middle Eastern	5.4%		
South American	1.0%	0.6%	
Type of Home			56.9 (<0.0001)
House	71.4	84.3%	
Apartment	24.3%	5.2%	
Condo	4.0%	8.0%	
Business		2.5%	
Dorm	0.3%		
Distance Ocean (km)	34.2 ± 1.74	3.44 ± 0.35	384 (<0.0001)
Lived in town (years)	12.97 ± 1.7	17.2 ± 0.73	13.7 (0.002)
Evacuated (days)	11.24 ± 2.92	35.1 ± 2.77	25.0 (<0.0001)
Still evacuated as of 1 January 2013	0.5%	10.4%	38.4 (<0.0001)
Height Water in Basement (cm)	37.9 ± 9.58	102.6 ± 10.4	15.4 (<0.0001)
Height Water in First Floor (cm)	35.6 ± 12.2	80.9 ± 4.3	9.75 (0.002)
Days w/o electricity	6.01 ± 0.32	22.79 ± 1.36	242 (<0.0001)
Days Used Generator	5.7 ± 0.53	9.13 ± 0.82	15.6 (<0.0001)
How many Hrs/day Generator was used	6.38 ± 0.62	7.68 ± 0.69	NS
Days w/o Internet?	6.45 ± 0.41	28.86 ± 1.72	235 (<0.0001)

Table 2

Percent of subjects (N = 747) from the Jersey Shore and Central New Jersey that were concerned about the following with Hurricane Sandy. People often gave more than one response. People often gave more than one response, so the percentages in each column can add up to more than 100 %.

Jersey Shore	BEFORE	DURING	AFTER	X² (p)	Wilson 90% Confidence Limit
Chi-square = 477 (<0.0001)	Percent	Percent	Percent		
Possessions	36	47.5	19.4	37.6 (<0.0001)	0.42 – 0.50
Agents of destruction	26.5	40.4	4.1	94.9 (<0.0001)	0.51 – 0.62
Survival needs	8	19.3	33.9	58.6 (<0.0001)	0.50 – 0.62
Personal, friend, family safety	18.3	23.7	8.1	24.6 (<0.0001)	0.41 – 0.53
Future Actions	0	0.6	25.8	170 (<0.0001)	0.94 – 0.99
Community safety	4.7	9.8	11.3	9.7 (0.008)	0.36 – 0.53
Shore protection	3.5	7.7	4.9	5.5 (0.06)	0.37 – 0.58
Emotional worries (self)	2.4	1.5	5.8	11.5 (0.003)	0.46 – 0.73
Storm itself	7.4	1.5	0	35.0 (<0.0001)	0.69 – 0.92
Actions					
Evacuate	2.4	3.9	0	12.3 (0.002)	0.44 – 0.77
Prepare	2.1	0.6	0	8.6 (0.01)	0.50 – 0.92
No Concerns	15.9	5.3	9.6	18.7 (<0.0001)	0.43 – 0.59
Communication	0	0	2.3	15.9 (0.0003)	0.74 – 1.0
Central New Jersey	BEFORE	DURING	AFTER	X² (p)	Wilson 90% Confidence Limit
Chi-square = 368 (<0.0001)	Percent	Percent	Percent		
Survival needs	32.8	54.2	43.3	21.2 (<0.0001)	0.38 – 0.45
Agents of destruction	31.8	33.5	4.5	87.7 (<0.0001)	0.43 – 0.53
Possessions	18.6	23.0	15.0	6.2 (0.05)	0.35 – 0.46
Personal, friend, family safety	16.5	16.9	8.5	11.8 (0.0003)	0.34 – 0.47
Future Actions	0.0	0.0	20.8	166 (<0.0001)	0.97 – 1.0
Community safety	0.6	2.3	9.3	42.9 (<0.0001)	0.66 – 0.85
Emotional worries (self)	2.6	1.8	4.0	NS	0.35 – 0.62
Shore protection	1.0	1.5	4.3	10.9 (0.004)	0.47 – 0.76

Jersey Shore	BEFORE	DURING	AFTER	X ² (p)	Wilson 90% Confidence Limit
Chi-square = 477 (<0.0001)	Percent	Percent	Percent		
The storm itself	2.3	0.5	0.0	4.5 (0.03)	0.57 – 0.94
Actions					
Evacuate	1.3	0.3	0.0	7.0 (0.03)	0.50 – 0.96
Prepare	1.3	0.0	0.0	9.9 (0.007)	0.65 – 1.0
Communication	0.0	0.3	1.0	5.2 (0.08)	0.43 – 0.95
No Concerns	14.0	4.9	18.0	30.1 (<0.0001)	0.43 – 0.56

Table 3

Medical and living condition concerns. Given are number and percent of subjects giving these answers

Jersey Shore During the Storm?	During the Storm		Post Storm		X ² (p)	Wilson 90% Confidence Limit
Medical Concerns	Frequency	Percent	Frequency	Percent		
Stress / Anxiety	76	23.0%	79	26.3%	NS	0.44–0.58
Respiratory/Pneumonia/Bronchitis/Asthma	36	10.9%	40	13.3%	NS	0.43–0.62
Medication	12	3.6%	20	6.7%	NS	0.48–0.75
Access to Medical Help	7	2.1%	2	0.7%	NS	0.50–0.92
Catching a Cold/Flu/Illness	7	2.1%	1	0.3%	4.5 (0.03)	0.59–0.97
Depression/Mental Health	2	0.6%	3	1.0%	NS	0.27–0.86
High Blood Pressure	3	0.9%	8	2.6%	8.0 (0.005)	0.75–1.0
Overall Health	2	0.6%	3	1.0%	NS	0.52–1.0
Diabetes	1	0.3%	1	0.3%	NS	0.42–1.0
Lupus	2	0.6%	1	0.3%	NS	0.12–0.88
Power for Medical Reasons	1	0.3%	1	0.3%	NS	0.42–1.0
Allergies	1	0.3%	1	0.3%	NS	0.27–1.0
Boredom	1	0.3%	1	0.3%	NS	0.27–1.0
Heart Condition	1	0.3%	1	0.3%	NS	0.27–1.0
Pregnant	1	0.3%	1	0.3%	NS	0.27–1.0
Sleep Apnea	1	0.3%	1	0.3%	NS	0.27–1.0
Living Conditions	16	4.8%	74	24.6%	37.4 (<0.0001)	0.75–0.88
Mold	14	4.2%	56	18.7%	25.2 (<0.0001)	0.71–0.87
Dust	1	0.3%	9	3.0%	9.0 (0.003)	0.77–1.0
Chemicals/Contaminants	1	0.3%	4	1.3%	NS	0.44–0.95
Sewage, Radiation, Rodents, Security	1	0.3%	5	1.6%	NS	0.50–0.96
Central New Jersey	During the Storm		Now		X ² (p)	Wilson 90% Confidence Limit
	Frequency	Percent	Frequency	Percent		
Medical Concerns	51	14.1%	27	8.3%	7.4 (0.007)	0.56–0.74

Jersey Shore During the Storm?	During the Storm		Post Storm		X ² (p)	Wilson 90% Confidence Limit
	Frequency	Percent	Frequency	Percent		
Cold/Flu/Illness	20	5.5%	17	5.2%	NS	0.41–0.67
Blood Pressure	3	0.8%	5	1.5%	NS	0.35–0.84
Medication	8	2.2%			8.0 (0.005)	0.75–1.0
Injury	7	1.9%			7.0 (0.008)	0.72–1.0
Respiratory/Pneumonia/Bronchitis/Asthma	3	0.8%	2	0.6%	NS	0.27–0.86
Access to Medical Help	4	1.1%			4.0 (0.05)	0.59–1.0
Stress/Anxiety	3	0.8%	1	0.3%	NS	0.36–0.94
Allergies	1	0.3%	1	0.3%	NS	0.12–0.88
Diabetes	2	0.6%			NS	0.42–1.0
Insomnia			1	0.3%	NS	0.27–1.0
Living Conditions	11	3.0%	28	8.6%	7.4 (0.007)	0.59–0.82
Mold	8	2.2%	14	4.3%	NS	0.46–0.78
Contaminants			11	3.4%	11.0 (0.0009)	0.80–1.0
Fumes/Bacteria/Rodents/Other	3	0.9%	3	0.9%	NS	0.22–0.78