Applied Research in Quality of Life (2020) 15:1151–1159
https://doi.org/10.1007/s11482-019-09722-3

Recovering after a Natural Disaster: Differences in Quality of Life across Three Communities after Hurricane Sandy

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Received: 10 October 2018 / Accepted: 26 March 2019 / Published online: 18 April 2019

In the wake of Hurricane Sandy in 2012, communities in New York followed several paths to recovery, including participation in a buyout program that resulted in the permanent relocation of households away from areas determined to be at risk for future hazards. This longitudinal study assessed recovery outcomes for residents from three communities on distinct recovery paths: one that rebuilt in situ (Rockaway Park), one that relocated through a buyout (Oakwood Beach), and one immediately adjacent to a neighborhood that relocated (Adjacent Oakwood).

Impacts of Natural Disasters on Quality of Life

This study examined residents' quality of life as it relates to the recovery paths experienced by three communities following Hurricane Sandy. Previous studies have assessed quality of life in the post-disaster recovery period and consider it to include components of physical and psychological health, social well-being, and environmental conditions (Ardalan et al. 2011; Papanikolaou et al. 2012; van den Berg et al. 2006). Findings suggest that disaster exposure continues to impact quality of life for many years, though the nature and duration of these impacts vary and may be influenced by factors such as age, gender, education, and vocation (Ardalan et al. 2011; Papanikolaou et al. 2012).

Studies that have focused on impacts to health-related quality of life have largely assessed injury and mortality (*c.f.* Johnson and Galea 2009) or the consequences of disaster exposure on mental health (*c.f.* Arata et al. 2000; Norris et al. 2002; van Griensven et al. 2006). Studies examining the impacts of disasters on physical health over time have found disaster exposure to be associated with negative physical health

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impacts in adults and children (Johnson and Galea 2009; Tucker et al. 2012; Uscher-Pines 2009) but found less evidence for impacts on self-rated health (Bei et al. 2013).

Post-Disaster Relocation

Although the literature suggests that natural disasters impact quality of life (Norris et al. 2002), in addition to demographic and economic factors, the extent of this impact may also be dependent upon whether residents rebuild within their home community or relocate. Post-disaster relocation has been found to be associated with negative physical and psychological health consequences (*c.f.,* Fussell and Lowe 2014; Hori and Schafer 2010; Sanders et al. 2003; Yzermans et al. 2005; Uscher-Pines 2009), with a large majority of studies suggesting that displaced survivors exhibit higher levels of psychological symptoms than disaster survivors who return to their original homes (Uscher-Pines 2009). Studies of the physical health impacts of relocation are limited, though researchers have found that relocated older adults experienced relatively more severe physical health impacts over time (Sanders et al. 2003; Uscher-Pines 2009). Beyond health impacts, quality of life for post-disaster relocates is influenced by their ability (or inability) to reestablish social resources (Sanders et al. 2003; Rumbach et al. 2016) and their perceived risk from future disasters (Perlaviciute et al. 2017).

Current Investigation

This study assessed the impact of Hurricane Sandy on measures of quality of life in three study communities over one and a half years. Hurricane Sandy made landfall in New Jersey in October 2012, and caused an estimated $50 billion in damages and 159 fatalities in the affected states (Hurricane Sandy Rebuilding Task Force 2013). Damages were particularly severe in New Jersey and New York. In New York alone, Sandy produced record-breaking storm surge in coastal communities that contributed to the damage or destruction of over 300,000 homes in the state (New York State Homes and Community Renewal 2013). In response to the storm, the State of New York implemented a home buyout program in several heavily impacted communities, with the goal of reducing vulnerability to future disasters (Binder and Greer 2016). The buyout program allowed the state to purchase previously developed land from willing homeowners, so that the land could be converted to and maintained as open space in perpetuity. In its original form, the buyout program was open to all substantially damaged homes (defined as homes damaged beyond 50% of their pre-storm value) located within the 500-year floodplain (New York State Homes and Community Renewal 2013). However, the program was later limited to ten geographically-defined communities, including three in New York City (Binder and Greer 2016; NY Rising, 2014). All homeowners within those defined communities were eligible to participate in the program though, in keeping with federal buyout policy, participation in the program was voluntary. Compared with previously implemented buyouts in the U.S., New York's home buyout program reflected limited government involvement in the buyout process (Greer and Brokopp Binder 2017). Homeowners were offered pre-storm market value for their homes and provided with some additional financial

incentives to encourage participation, though no assistance was provided with locating or relocating to a new home.

This study focused on three communities that followed distinct paths to recovery after Sandy: Rockaway Park, where most residents rebuilt in situ, Oakwood Beach, where most residents relocated through the buyout program, and Adjacent Oakwood, which is located immediately adjacent to Oakwood Beach. These communities were selected because they were geographically and demographically similar, they sustained similar levels of damage from Hurricane Sandy, and they were originally eligible for inclusion in the buyout program (Binder et al. 2015). Further, a previous study found no significant differences across the communities on measures of social capital or sense of place (Binder et al. 2018). Despite their similarities, residents in these communities responded differently, and largely collectively, to the idea of relocation through a buyout. In Oakwood Beach, residents organized immediately after Sandy to seek inclusion in the buyout (Greer and Binder 2018). These efforts were successful, and over 95% of the residents ultimately relocated (McGhee et al. 2019). Conversely, most residents of Rockaway Park rejected the idea of relocating and chose instead to rebuild (Binder et al. 2015). Residents in the adjacent neighborhood were ultimately excluded from the buyout program through what many viewed as a series of arbitrary decisions by the State, though they were directly impacted by the relocation of their neighbors in Oakwood Beach (Baker et al. 2018; Binder and Greer, 2016; Binder et al. 2018).

Here, we were interested in determining whether recovery experiences in communities impacted by Hurricane Sandy were associated with their initial and subsequent general heath, stress, and satisfaction with life. We sought to answer the following research questions:

> RQ1: Do the three communities differ in their quality of life, specifically, their general health, perceived stress or satisfaction with life, three and a half years after Hurricane Sandy?
> RQ2: Do the three communities differ in changes to their quality of life over the assessment period?
> RQ3: Do changes in perceived risk of hurricanes, floods, or crime account for changes in their quality of life?

Importantly, this study addresses these questions using a longitudinal approach to assess changes in quality of life over time. This represents an important contribution to the disaster literature in which longitudinal studies of disaster recovery are relatively uncommon (Norris 2006).

Materials and Methods

Beginning two years after Hurricane Sandy, a sample of members of three communities were interviewed three times over a 1.5-year period (i.e., every 6 months). The current study built on two previous mixed-methods studies of Hurricane Sandy focused on residents' lived experiences of the buyout program and factors that influenced relocation decision-making, including social capital, place attachment, and risk perception

(Baker et al. 2018; Binder 2014; Binder et al. 2015). Residents who participated in these previous studies were re-contacted and asked to participate in the current investigation. Of the original 104 participants, 61 agreed to participate in the current investigation. Fifty-seven new participants were then recruited using door-to-door surveying, direct mailings, and snowball sampling, for a sample size of 118 (41 from Rockaway Park [RP]; 31 from Oakwood Beach [OB], and 46 from Adjacent Oakwood [AOB]). Eight participants had missing data on demographic variables, leaving a total sample size of 110. Full-information maximum likelihood estimation was used to account for missing data on any endogenous variables.

Data were collected in the summer of 2016, winter of 2016–17 and the summer of 2017. Most surveys were completed in person, though a small number were completed by participants and returned by mail. The vast majority of the sample identified as White (94%) and married or living with a partner (74%). The average age was 57 years, and 60% were female.

Surveys included the General Health Item, the Perceived Stress Scale, the Satisfaction with Life Scale, and three neighborhood risk perception items. The General Health Item appears on many standard quality of life scales, including the PROMIS Global Health Scale and the Centers for Disease Control and Prevention's Healthy Days measure, and is commonly used as a stand-alone indicator (Barile et al. 2013; Hays et al. 2015). Participants were asked to rate their health as poor (1), fair (2), good (3), very good (4) or excellent (5). The Perceived Stress Scale-4 (PSS) is a common, empirically validated, measure that has been shown to detect differences in stress associated with neighborhood environments (Barile et al. 2017; Cohen and Williamson 1988) and the Satisfaction with Life Scale (SWLS) is a 5-item measure with demonstrated reliability and validity (Barile et al. 2013; Pavot and Diener 2009). For the current study, the PSS and SWLS demonstrated satisfactory reliability at each assessment point (PSS α at T1 = .78, T2 = .72, T3 = .83; SWLS α at T1 = .86, T2 = .86, T3 = .86). Finally, risk perception was assessed by asking participants during their initial interview "Before Sandy, how great a risk did the following incidents pose to you on a scale of 1-10, where 1 is no risk and 10 is extremely risky" for hurricanes, floods, and crime. These questions were followed up with "Currently (after Sandy), how great a risk…" for each scenario. These items were then scored to determine whether individuals reported less risk after Hurricane Sandy (coded as −1, represented in the sample, Hurricanes = 17%; Floods = 16%; Crime = 9%) similar risk as before Hurricane Sandy (coded as 0, represented in the sample, Hurricanes = 25%; Floods = 22%; Crime = 73%) or greater risk since Hurricane Sandy (coded as 1, represented in the sample, Hurricanes = 58%; Floods = 62%; Crime = 19%).

Latent growth analysis was used to determine the extent to which individuals' quality of life changed as a function of time and community membership. A single model was estimated using maximum likelihood with robust standard errors. The general health item was treated as ordinal and all other outcome measures were estimated as continuous summary scores (mean scores). Age, gender, and community membership were included as time invariant covariates.

All findings were derived from testing latent growth models with random intercepts using Mplus 8.0. RP (rebuilt in place) served at the reference community in the initial model, but a secondary model was also tested with OB (relocated through buyout) as

the reference community to demonstrate possible comparisons among the three communities. Potential changes in risk assessment post-Sandy were controlled for by incorporating responses to perceived changes in risk of hurricane, flood, and crime between the disaster and the first assessment.

Results

Our findings indicate that residents in the community adjacent to the buyout zone (AOB), experienced significantly worse general health, higher stress, and lower satisfaction with life compared to residents of RP, who largely decided to rebuild in place (Table 1; Fig. 1a, b). Residents of OB, who were offered and took the buyout, did not report significantly worse general health or higher stress compared to RP or AOB, but did report significantly lower satisfaction with life compared to RP (Fig. 1b). When examining these three constructs over 1.5 years, we found that despite reporting the highest levels of stress at the first assessment point, AOB had only modest increases in perceived stress. Contrary to this, both RP and OB reported significant increases in perceived stress compared to AOB (Fig. 1a). Changes in general health or satisfaction with life over time did not differ by community.

The assessed model took into account changes in participants' perceived risk of hurricanes, floods, and crime between Hurricane Sandy and the first assessment period. Accounting for changes in perceived risk enabled us to parse out changes in general health, stress, and satisfaction with life associated with risk perception, from those associated with the process of relocating (OB), rebuilding (RP), and/or living next to a community that relocated (AOB). We found that perceived changes in risk were largely not associated with changes in the three major outcomes, except a marginal association between changes in flood risk being associated with increases in stress (Fig. 1c) and increases in flood risk being associated with lower initial satisfaction with life scores (Fig. 1d).

Table 1 Results from the Latent Growth Analyses Examining Changes in Quality of Life by Community

	General health intercept		General health slope		Stress intercept		Stress Slope		Satisfaction with Life Intercept		Satisfaction with Life Slope	
	b	*p*	b	*p*	b	*p*	b	*p*	b	*p*	b	*p*
Age	−0.07	0.014	0.01	0.704	0.00	0.950	−0.01	0.082	0.00	0.967	0.00	0.107
Female	0.75	0.242	−0.44	0.251	0.01	0.974	0.09	0.307	0.04	0.782	−0.04	0.481
OB	0.37	0.747	−0.45	0.362	0.21	0.360	0.09	0.478	−0.67	0.006	0.04	0.692
AOB	−1.63	0.022	0.15	0.744	0.36	0.024	−0.24	0.007	−0.40	0.013	0.07	0.259
Hurricane	1.08	0.126	−0.24	0.636	−0.12	0.364	−0.03	0.746	0.21	0.176	0.00	0.983
Flood	−0.06	0.926	−0.12	0.825	0.12	0.272	0.18	0.074	−0.46	0.001	0.06	0.459
Crime	−0.04	0.955	−0.10	0.779	0.02	0.929	0.12	0.193	0.00	0.997	−0.03	0.713

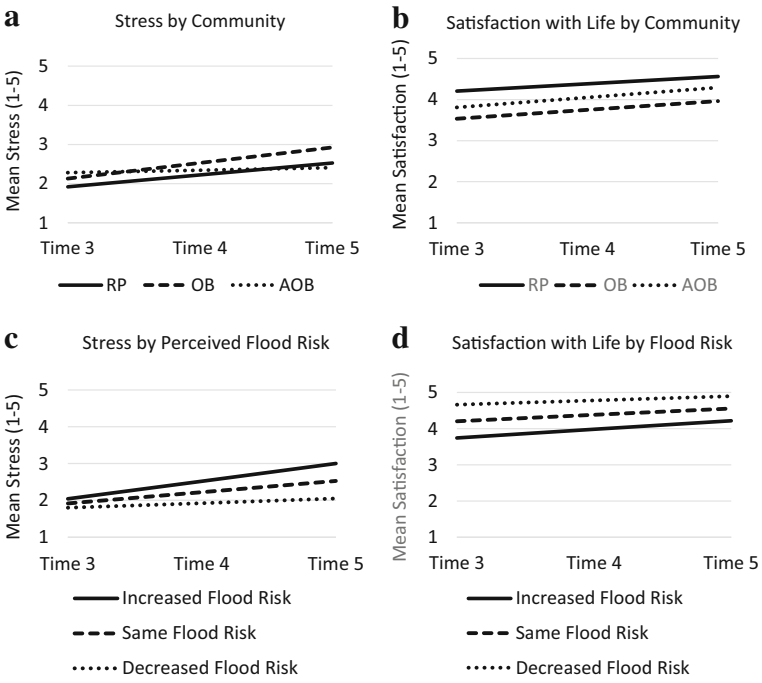

Fig. 1 Present main effects (intercepts) and slopes among communities (**a** and **b**) and flood risk (**c** and **d**) based on latent growth model results. **a** and **c** present changes in perceived stress and (**b** and **d**) present changes in satisfaction with life

Discussion

Research on the impacts of disasters on quality of life over time is limited, though this study suggests that this is an area that deserves greater attention as these outcomes may be influenced by broader recovery processes in addition to the hazard itself. In comparing quality of life outcomes across three communities that followed distinct paths to recovery after Hurricane Sandy, we found community-level differences related to general health, stress, and satisfaction with life. Our findings raise questions about the health and broader quality of life implications of post-disaster relocation programs, particularly on communities that are adjacent to buyout zones. In this case, the adjacent community is faring relatively poorly across all three indicators, even when compared to the community where most households relocated. This is notable, as residents of the adjacent community would not have experienced acute losses in social and place attachements associated with post-disaster relocation, and, relatedly, the literature has emphasized losses experienced by relocatees (Binder et al. 2018; Binder and Greer 2016; Fussell and Lowe 2014; Hori and Schafer 2010; Mortensen et al. 2009; Riad and Norris 1996; Sanders et al. 2003; Yzermans et al. 2005; Uscher-Pines 2009). By comparison, the community that rebuilt in place exhibited better general health and satisfaction with life than the other communities three years after the disaster.

It is possible that simply being provided an alternative to rebuilding via buyout programs may provide residents a level of perceived control over their neighborhood and future. In the

context of the current study, residents living in the community adjacent to the relocated community were not offered the opportunity to participate in a buyout program. Their proximity to the relocated community may have served as a constant reminder of their relative lack of control over their future (compared to those in the buyout zone, whom they perceived as having a choice). This may also have contributed to their lower health, lower satisfaction with life and higher stress compared to the community that rebuilt, which was not located near a buyout zone. Interestingly, despite having higher stress during their first assessment, residents of the community adjacent to the relocated community had almost no changes in their perceived stress compared to the other two communities. Both OB and RP experienced significant post-disaster changes (relocation and population/commercial changes, respectively) that may have contributed to higher stress. It is possible that providing residents the opportunity to determine the future of their neighborhood post-disaster may be an important determinant of their health, whether they decide to rebuild or not, while minimizing the number of changes a community experiences may, in turn, minimize long-term changes in stress.

This study is limited by its small sample size, limited follow-up period, and lack of randomization of the buyout program. Despite this, our findings may help inform post-disaster health research and recovery programs due to its longitudinal design. Namely, understanding the health trajectories among residents who pursued unique residential paths post-disaster is critically important to assessing the long-term process of recovery. Furthermore, understanding how changes in risk perception after a disaster can contribute to increased stress is an important consideration for disaster response and clinical personnel. Future post-disaster research should pursue questions of locus-of-control, and whether buyout opportunities, or lack thereof, contribute to or hinder the health and well-being of residents in the years following a natural disaster.

Funding This work was supported by the National Science Foundation #1536217.

Compliance with Ethical Standards

Conflict of Interest None.

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