

# Happily Ever After? Pre-and-Post Disaster Determinants of Happiness Among Survivors of Hurricane Katrina

Rocío Calvo · Mariana Arcaya · Christopher F. Baum · Sarah R. Lowe · Mary C. Waters

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**Abstract** This study investigated pre- to post-disaster changes in happiness of 491 women affected by Hurricane Katrina, and identified factors that were associated with the survivors' happiness after the storm. Participants completed surveys approximately 1 year before and 1 and 4 years after the storm. The surveys collected information on the women's happiness, social support, household characteristics, and hurricane exposure. We found that happiness significantly decreased from pre-disaster to 1 year post-disaster but there were no significant differences in happiness between the pre-disaster and 4 years post-disaster assessments. An exception were 38 women who continued to have lower levels of happiness 4 years post-disaster than at pre-disaster. These women were more likely to be living on their own after the storm and reported consistently lower levels of perceived social support from the community both before and after the storm than the other

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R. Calvo (✉) · C. F. Baum  
Boston College Graduate School of Social Work, McGuinn Hall, 140 Commonwealth Avenue,  
Chestnut Hill, MA 02467, USA  
e-mail: calvovil@bc.edu

R. Calvo · M. Arcaya  
Harvard Center for Population and Development Studies, Harvard School of Public Health,  
9 Bow Street, Cambridge, MA 02138, USA

C. F. Baum  
Department of Economics, Boston College, Maloney Hall, 140 Commonwealth Avenue, Chestnut Hill,  
MA 02467, USA

C. F. Baum  
Deutsches Institut für Wirtschaftsforschung (DIW Berlin), Mohrenstraße 58, 10117 Berlin, Germany

S. R. Lowe  
Mailman School of Public Health, Columbia University, 722 West 168th Street, New York, NY 10032,  
USA

M. C. Waters  
Department of Sociology, Harvard University, William James Hall, 33 Kirkland Street, Cambridge,  
MA 02138, USA

women of the sample. Factors associated with the survivor's happiness after the storm included exposure to hurricane stressors and losing a loved one to the hurricane. These were predictive of lower happiness 1 year post-disaster. Four years after the hurricane only exposure to hurricane stressors was predictive of lower levels of happiness. In contrast, pre-disaster happiness and post-disaster social support were protective against the negative effect of the hurricane on survivors' happiness.

**Keywords** Pre-disaster · Post-disaster · Happiness · Social support · Hurricane exposure

## 1 Introduction

Hurricane Katrina made landfall on August 29, 2005, resulting in one of the most devastating natural disasters in U.S. history. The flooding that followed caused widespread destruction across the Gulf Coast and miles inland. More than 60 % of the housing stock in New Orleans was destroyed, adding to an overall property damage of almost \$100 billion. Over a million people were evacuated from the Gulf Coast and 650,000 people were displaced over the long term (Hunter and David 2011). Hurricane Katrina not only was more destructive than any previous natural disaster in the U.S, it was also the deadliest since Hurricane San Felipe in 1928 killing over 1,800 people (Townsend 2006).

Whereas a considerable body of literature has documented both the immediate and long-term adverse effects of the hurricane on survivors, such as elevated levels of psychological distress and post traumatic stress (Mills et al. 2007; Paxson et al. 2012; Rhodes et al. 2010), research on the long-term consequences of Hurricane Katrina on positive indicators of well-being, including happiness, is much scarcer.

This study investigated the effect of Hurricane Katrina on the long-term happiness of 491 women who lived in New Orleans at the time of the disaster. A unique panel dataset that followed individuals from 1 year before the hurricane to approximately 4 years afterwards, permitted us to examine whether there were changes in the survivors' happiness after the disaster, whether the changes persisted in the long-run, and the factors that were associated with such changes.

### 1.1 Happiness and Natural Disasters

The limited research on the effect of natural disasters on survivors' happiness has yielded inconsistent results. Whereas some studies have noted enduring adverse effects of catastrophes on victims' happiness (Ardalan et al. 2011; LaJoie et al. 2010; Rateau 2009; Wang et al. 2000), others have shown that people adjust relatively quickly to their post-disaster circumstances (Kimball et al. 2006; Luechinger and Raschky 2009; Papanikolau et al. 2012; Priebe et al. 2011).

A major difficulty in assessing the effect of catastrophes on survivors' happiness is the unpredictability of natural disasters which prevented most past research from collecting information on individuals prior to the disasters, forcing studies to rely on individuals' retrospective accounts of their own well-being which might yield biased estimates. An exception to the lack of pre-disaster data is a study that compared the before- and after-earthquake quality of life of 268 elderly survivors of the 1999 Chi-Chi earthquake in

Taiwan (Lin et al. 2002). Findings showed that regardless of degree of exposure to the earthquake, survivors' overall quality of life did not change significantly from 2 weeks prior to the disaster to 12 months after the earthquake. Moreover, individuals' quality of life prior to the disaster was not predictive of overall quality of life in its aftermath. However, survivors did report lower quality of life in specific health-related domains such as physical capacity, psychological well-being, and environmental quality after the earthquake as compared with before it. In addition, compared with survivors who experienced less exposure, survivors who suffered the most devastating property damage after the earthquake reported an increase in social relationships, which was associated with receiving more support from the community after the earthquake than the less-affected respondents. Another exception is a recent study that examined the effect of the 2011 Japanese earthquake on the cognitive and affective components of happiness among a representative sample of young Japanese who were not directly affected by the disaster. Results showed that youths who were happier 3 months before the disaster were more likely to reflect on the negative consequences of the earthquake a few weeks after it and re-evaluate their lives as a consequence, which was associated with a slight increase in their post-disaster happiness (Uchida et al. 2013).

Additional variation on the effect of natural disasters on individuals' happiness could stem from how much time had passed since individuals suffered the disaster. In this vein, studies suggest that although survivors of natural disasters experience a decline in happiness in the more immediate aftermath of the event, people eventually adapt to the consequences of the catastrophe. For instance, Luechinger and Raschky (2009) found that although floods were associated with a decline in life satisfaction among Europeans up to a year after the event, 18 months after the disaster the association between the catastrophe and survivors' happiness was negligible. Similarly, evidence involving the victims of the wildfire disaster that devastated the Greek Peloponnese peninsula in 2007 showed that the initial decline in psychological well-being observed 6 months after the disaster was no longer present 3 years later (Papanikolaou et al. 2012). Another study also found that 8 years after the 1997 earthquake of the Marche region in central Italy, none of the stressful experiences associated with the catastrophe were predictive of survivors' quality of life (Priebe et al. 2011).

Degree of exposure and post-disaster resources have also been associated with survivors' happiness, although not consistently. For instance, a study that investigated the happiness of a representative sample of U.S. adults a year after Hurricane Katrina found that the negative widespread emotions experienced in the aftermath of the disaster were stronger in the regions closest to the devastation of the storm (Kimball et al. 2006). Another study found that although evacuees of Hurricane Katrina presented lower than regular levels of health-related quality of life 1 year after the storm, survivors' quality of life was neither related to hurricane exposure, such as how much risk of harm or death they felt and how many family and friends were injured, missing, or killed during the storm, nor to post-disaster resources such as employment or relocation status (LaJoie et al. 2010). In contrast, other research conducted with secondary data from the Federal Emergency Management Agency (FEMA) found a significant association between emotional well-being and residential property damage among survivors of Hurricane Katrina 1 year after the disaster (Rateau 2009).

Other findings from outside the United States have also revealed that variations in degree of exposure to a natural disaster and post-disaster resources were associated with survivors' differences in post-disaster quality of life. Thus, a study conducted to assess the relationship between the 1998 Chinese earthquake and survivors' post-disaster quality of

life found that, compared with individuals farther from the epicenter, survivors who were closer to the disaster but received more post-disaster support showed a general improvement in their happiness 9 months later (Wang et al. 2000). Similarly, Ardalan and colleagues (2011) found that survivors of the 2003 Bam earthquake in Iran reported better social relationships than the rest of the population 5 years after the disaster.

Our study builds on past research and contributes to the understanding of how natural disasters influence the happiness of survivors. Our sample is of particular interest because it contains pre- and post-disaster information on individuals who were directly affected by Hurricane Katrina, permitting a more robust and longer-run assessment of the effect of a natural disaster on survivors' happiness than previous research. Another advantage is that includes different indicators of exposure to the storm, permitting us to explore how different traumas experienced during a natural disaster contribute to the long-term happiness of survivors. In addition, because participants were recruited before the hurricane and we followed them for 4 years afterwards, we could examine whether pre-hurricane and post-hurricane factors such as happiness, social support and household income separately contributed to survivors' happiness in the aftermath of the storm.

## 2 Sample

### 2.1 Data Collection

Participants were initially part of the Opening Doors study, a program restricted to low-income parents that was designed to increase community college retention. Participants were full-time students at two New Orleans community colleges. To be eligible for the study, participants had to be between the ages of 18 and 34; be parents of at least one dependent child under the age of 19; have a household income under 200 % of the federal poverty level; and have a high school diploma or equivalent (see Brock and LeBlanc 2005 for further details).

A total of 1,019 individuals completed the baseline survey (Time 0; T0), which was conducted between November of 2003 and February of 2005. In the first post-hurricane follow-up survey (Time 1; T1), conducted between March 2006 and March 2007, we re-interviewed 711 of the original 1,091 respondents (or 69.8 % of the total sample). Trained interviewers conducted the survey over the phone, asking the same questions as in the T0 survey in addition to a module on hurricane exposure. We administered the second follow-up survey (Time 2; T2), between March 2009 and June 2010, to 752 of the 1,019 participants from T0 (or 73.8 % of the total sample). It included the same questions as the two previous surveys with the exception of the module on hurricane exposure. Virtually all of the participants (98 %) experienced the hurricane.

While we were able to locate between 711 and 752 participants after the hurricane to complete surveys for the second and third assessments, only 600 individuals completed all three surveys (T0, T1, and T2). The main goal of our study was to explore the long-term trajectory of respondents' happiness after the hurricane. The unique structure of our data permitted us to examine this question with the same individuals one and 4 years after the disaster. Alternatively, to increase our sample size, we could have included the individuals that completed only one of the two post-Katrina assessments. This strategy, however, would have yielded two different, and therefore incomparable, models of the trajectory of survivors' happiness.

Evidence suggests that the effect of natural disasters on happiness is different for men and women (Lin et al. 2002; Luechinger and Raschky 2009; Norris et al. 2002; Papanikolaou et al. 2012; Rateau 2009; Uchida et al. 2013). However, we had only 30 male respondents (or 5 % of the total sample) available to explore these differences. Therefore, we restricted the sample to women to avoid statistical noise. We also excluded 79 respondents who had missing baseline (T0) information on happiness. Our final sample was composed of 491 women affected by Hurricane Katrina.

## 2.2 Missing Data

Although the missing data were not missing completely at random, the missing rate of each variable was under 10 %. We handled missing data by multiply-imputed 25 data sets using iterative-chained equations in Stata version 12.1 to handle item nonresponse.

It is important to note that we imputed data only within each of the two post-Katrina assessments, and that we did not create entire missing waves of data of individuals who had only responded to one of the two post-Katrina assessments. Our rationale was twofold: First, we wanted to avoid concerns stemming from fabrication of a large amount of information, and second, we wanted to prevent depletion of variance, both among predictors in the same wave and between the same predictors in the two post-Katrina's assessments (Kalton 1986).

## 3 Measures

### 3.1 Happiness

Happiness is only a partial representation of subjective well-being (Raibley 2012)—a complex concept that lacks universal definition, but which is often understood as a personal assessment of one's life in general composed of a long-term cognitive dimension and a temporal affective dimension (Diener 1984; Diener et al. 1999; Lucas et al. 1996). Although both components are related to subjective well-being, the cognitive dimension has traditionally been considered a more stable indicator of subjective well-being because it is related to the eudaimonic philosophical tradition which entails the realization of one's potential in accordance with one's true nature. It therefore involves an evaluative component of one's own well-being and is considered less susceptible to external circumstances. In contrast, the affective dimension of subjective well-being relates to the hedonic philosophical tradition and stresses immediateness and descriptions of emotional states that are more prone to fluctuate (Delle Fave et al. 2011; McMahan and Estes 2011; Ryan and Deci 2001).

To measure the women's happiness we used a validated question related to the cognitive dimension of wellbeing that is frequently used in happiness research (Diener et al. 2013; Pavot and Diener 2009): "If you were to consider your life in general these days, how happy or unhappy would you say you are?" The respondents could choose among four categories: "not at all happy," "not very happy," "somewhat happy," or "very happy."

### 3.2 Hurricane Exposure

Three variables accounted for women's degree of hurricane exposure: hurricane-related stressors, bereavement, and property damage.

### 3.2.1 Hurricane-Related Stressors

To capture women's experiences during the hurricane we created a scale composed of eight questions. The eight questions, which assessed stressors experienced in the immediate aftermath of the storm, were drawn from a larger survey of the demographic and health characteristics, evacuation and hurricane experiences, and future plans of Hurricane Katrina evacuees. The scale was jointly designed by the Washington Post, the Kaiser Family Foundation, and the Harvard School of Public Health (Brodie et al. 2006). The women self-reported whether they had experienced any of the following conditions: (a) no fresh water to drink, (b) no food to eat, (c) felt their life was in danger, (d) lacked necessary medicine, (e) lacked necessary medical care, (f) had a family member who lacked necessary medical care, (g) lacked knowledge of safety of children, and (h) lacked knowledge of safety of other family members. We created a composite score with the count of affirmative responses to these items. The score ranged from 1 to 8 with higher numbers indicating worse experiences in the aftermath of Hurricane Katrina. Inter-item reliability (KR-20) of the scale was 0.84.

### 3.2.2 Bereavement

Bereavement was a dichotomous variable with the value of 1 if the woman had lost a family member or a close friend during the hurricane and its aftermath. The referent category (value 0) refers to the women who did not lose a family member or a close friend as a consequence of the storm and its aftermath.

### 3.2.3 Property Damage

Property damage was a self-reported categorical variable that measured the extent of damage to women's homes by the storm. It took the value of 1 if the house was moderately or seriously damaged and the value of 2 if the damage was enormous or the house was destroyed. The referent category (value 0) indicates that Hurricane Katrina did not affect the respondent's house or that the damage was negligible.

## 3.3 Characteristics of the Sample

### 3.3.1 Race/Ethnicity

Although hurricane exposure may be exogenous, pre-established societal forms of racial and class divisions may pattern its consequences. For instance, previous studies show that African Americans, who tend to live in housing of lower quality than other populations, have greater mortality, morbidity, and loss of personal belongings in the aftermath of natural disasters (Rivera and Miller 2007). Another study revealed that Black workers from New Orleans were four times more likely than their White counterparts to lose their jobs after Hurricane Katrina, which made their return after the evacuation more difficult and added stress to their recovery and reconstruction efforts (Elliott and Pais 2006).

Happiness is also unevenly distributed along racial and ethnic lines in the United States. With a representative sample of U.S. adults, Barger et al. (2009) showed that relative to Whites, both Black and Hispanics were less likely to be satisfied with their lives, even after adjusting for SES, health, and social relationships. To account for individuals' race/ethnicity we asked two questions: (a) "Are you Hispanic/Latina/Spanish?" and (b) "What is

your race?" Respondents could choose among the following options: White, Black, Asian or Pacific Islander, American Indian or Alaskan Native, and other. The variable race/ethnicity was a categorical variable with the following categories: Non-Hispanic White, non-Hispanic Black, Hispanic, and other. The reference category (value 0) were non-Hispanic White women.

### 3.3.2 Age

Age matters for happiness and influences post-disaster well-being. Research has shown that younger and older people report higher levels of happiness than middle-aged individuals, and that disasters have longer-lasting consequences for older than for younger people (Ardalan et al. 2011; Lin et al. 2002; North et al. 2012; Siedlecki et al. 2008). We therefore included women's self-reported age.

### 3.3.3 Number of Children

Findings on the relationship between parenthood and happiness are somewhat mixed. Whereas some studies have noted that parenthood is associated with lower levels of happiness, (see Blanchflower 2008 for a review), others have found that the relationship between parenthood and happiness is mediated by marriage and differs across societies (Vanassche et al. 2013). As for the effect of the storm on parenthood, a previous study of Hurricane Katrina survivors found that greater number of children in a household was associated with poorer mental health (Abramson et al. 2008). The variable number of children was a continuous variable that accounted for the number of children the respondents had at each time point (T0, T1 and T2). It ranged from 0 to 6 children.

### 3.3.4 Household Income

Income and happiness are correlated, especially among low-income individuals (Diener and Biswas-Diener 2002; Diener et al. 1999). Previous research has noted that income protected low-income mothers from chronic mental health problems suffered 4 years after Hurricane Katrina (Paxson et al. 2012). Similarly, economic problems were related with poor quality of life among survivors of the Chi-Chi earthquake 3 years after the disaster (Wu et al. 2006). The variable household income was the self-reported calculation of respondents' monthly income from all sources, including earnings from jobs as well as all benefits from social programs after the hurricane (T1, and T2).

### 3.3.5 Social Support

We included three indicators of social support in the analyses: marital status, perceived social support, and religiosity.

Evidence on the relationship between marriage and happiness within the disaster literature is inconclusive. For instance, Reid and Reczek (2011) examined the effect of marital status on the recovery process after Hurricane Katrina and found that relationships with their marital or intimate partner influenced the recovery of Katrina survivors, although the pattern was inconsistent. Some survivors experienced the relationship with their partners as a source of support, whereas for others it contributed to the stress associated with recovery. In the same vein, Lin et al. (2002) observed that although the elderly who

lived with a spouse 1 year after the Chi-Chi earthquake reported higher physical capacity than survivors who lived alone, marital status was not predictive of their psychological well-being, social relationships, or environmental well-being after the disaster. In contrast, another study found that 5 years after the 2003 earthquake that devastated the Kerman province of Iran, survivors who shared dwellings with a partner reported better quality of life than counterparts from the general population who did not (Ardalan et al. 2011).

The women in our study indicated at each time point (T0, T1, and T2) whether they were married and living with their spouse, divorced or never married and did not share dwellings with a partner, or whether, in contrast, they cohabitated with a partner. The variable marital status was a dichotomous variable with value 1 if the respondent was married or living with a domestic partner. The reference category (value 0) referred to the women who were not married and not living with a partner.

The relationship between perceived social support and happiness is well established in the literature (Calvo et al. 2012; Helliwell and Putnam 2004), and survivors of natural disasters are no exception. For instance, research has shown that support from their communities was essential for the women's recovery in the aftermath of Hurricane Katrina (Laditka et al. 2010), and that survivors who perceived greater pre-Katrina social support experienced fewer hurricane-related stressors and perceived higher social support in the aftermath of the storm (Lowe et al. 2010).

The positive relationship between post-disaster social support and individuals' quality of life has also been documented among the survivors of the 2003 Iranian earthquake (Ardalan et al. 2011) and the Chinese earthquakes of 1998, 1999 (Lin et al. 2002; Wang et al. 2000). In addition, a recent study on the association between post-traumatic stress disorder and the quality of life among Wenchuan earthquake survivors found that perceived social support weakened the negative effect of PTSD on the quality of life of the survivors 1 year after the disaster (Zhao et al. 2013).

We assessed the women's perception of social support at each time point (T0, T1, and T2), using eight items from the Social Provisions Scale (Cutrona and Russell 1987). Items assessed the extent to which participants perceived that there were people in their lives who valued them and on whom they could rely. Items were rated using a 4-point Likert scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Cronbach's alphas of this scale in this study were 0.83 for T0, 0.81 for T1, and 0.78 for T2.

Religiosity is positively, albeit weakly, associated with well-being (Kim-Prieto and Diener 2009). In addition, religious involvement and practice were shown to mitigate the effect of Hurricane Katrina by increasing psychological resources (Chan et al. 2012). The variable religiosity was an ordinal variable that measured how often the women attended church, synagogue, or any other religious service per week at T1 and T2. Participants rated their attendance on a 5-point scale ranging from 1 (*never*) to 5 (*several times per week*).

#### 4 Data Analysis Strategy

We first examined the effect of the hurricane on survivors' happiness. To assess the overall stability of women's happiness pre- and post- hurricane, we compared women's happiness across the three time points and estimated the concordance between each pair of time points (T0 vs. T1; T0 vs. T2; and T1 vs. T2) using two measures of association, Kendalls's Tau-b and Kruskal's Gamma statistics, which can range from  $-1.0$  (not associated at all) to  $1.0$  (perfect association). We also conducted Wilcoxon signed-ranks tests for repeated-measures to examine whether; overall, the women's happiness at T2 was different from



their happiness at T0 and at T1. In addition we examined the pre-and-post-Katrina characteristics that contributed to differences in women's happiness after the storm.

In our second step we conducted a series of regression analyses to assess the influence of different traumas experienced during the hurricane on women's happiness one and 4 years after the storm. In addition, we explored whether factors previously identified in the literature, such as pre-disaster happiness and post-disaster social support and income, were predictive of the women's happiness in the aftermath of the storm.

## 5 Results

### 5.1 Characteristics of the Sample

Table 1 provides information on the characteristics of the sample. Most women (84 %) self-identified as non-Hispanic Black; they were on average 25 years of age and had two children. Prior to the storm (T0) the majority of women were not married or living with a partner, perceived strong social support from their communities, and reported being somewhat happy or very happy.

The women experienced significant levels of loss as a result of the storm. They experienced an average of 2.9 of hurricane-related stressors, most of their homes were seriously damaged (85 %), and almost a third of our respondents lost a family member or a close friend as a result of the storm.

1 year after the storm (T1) the majority of the women (89 %) remained in the positive happy categories ("somewhat happy" or "very happy"), although the number of women who reported being very happy had decreased by 7 % from baseline (T0). Other changes from baseline observed 1 year after the hurricane (T1) were that the number of women who reported not being happy at all had doubled, the number of women who reported not being very happy had slightly increased (1 %), and that almost a quarter of the sample had got married or were sharing dwellings with a partner.

4 years after Hurricane Katrina (T2), the women's happiness resembled baseline levels (T0). More than 90 % of the sample was in the positive happy categories ("somewhat happy" or "very happy"). More specifically, the number of women who reported being very happy had increased by almost 6 % from T1 to T2. The unhappy categories also experienced a slight decrease from T1 to T2, particularly among women who reported not being very happy (2 %).

### 5.2 Cross-tabulations and Measures of Association Between Pre- and Post-Katrina Happiness

Table 2 shows that women's happiness was positively associated at each pair of time points, although it was stronger between adjacent waves (Kruskal's Gamma = 0.459 between T0 and T1) and (Kruskal's Gamma = 0.478 between T1 and T2), than between distant waves (Kruskal's Gamma = 0.266 between T0 and T2).

The diagonal cells of Table 2 represent the women who remained in a given happiness category between two time points and reveal that the majority of the sample concentrated in the positive happy categories ("somewhat happy" and "very happy") at any given time point. The cells above the diagonal show the women whose happiness increased between two time points, and the cells below show the women whose happiness decreased. Between T0 and T1, a total of 138 women experienced a decrease in happiness, whereas between T1

**Table 1** Happiness, hurricane exposure, and sociodemographic characteristics of women survivors of hurricane Katrina ( $N = 491$ )

	Pre-Katrina	Hurricane Katrina	Post-Katrina	
	T0 (2003–2004)	(2005)	T1 (2006–2007)	T2 (2009–2010)
Happiness (%)				
Not at all happy	0.8	–	2.9	2.7
Not very happy	7.5	–	8.6	6.4
Somewhat happy	54	–	58.5	55.1
Very happy	37.3	–	30.1	35.9
Hurricane exposure				
Hurricane-related stressors (1–8, low to high)	–	2.9 (2.2)	–	–
Level of Katrina's home damage (%)				
None or minimal	–	15.8	–	–
Moderate or serious	–	43.0	–	–
Enormous or destroyed	–	41.2	–	–
Family member or close friend died (%)				
No	–	68.9	–	–
Yes	–	31.1	–	–
Race/Ethnicity (%)				
Non-Hispanic White	10.4	–	–	–
Non-Hispanic Black	84.1	–	–	–
Hispanic	3.3	–	–	–
Other	2.2	–	–	–
Age	25.2 (4.6)	–	–	–
Number of children	1.8 (1.0)	–	2 (1.1)	2.3 (1.2)
Total household monthly income (\$)	–	–	1,848.97 (1,555.39)	2,692.26 (2093.50)
Social support (%)				
Unmarried and not living with partner	74.7	–	51.4	54.2
Married or living with domestic partner	25.3	–	48.6	45.1
Perceived social support (1–4, low to high support)	3.2 (0.5)	–	3.2 (0.5)	3.2 (0.5)
Frequency of attending religious services (1 = never to 5 = several times/week)	–	–	2.1 (1.3)	2.7 (1)

Standard deviations in parentheses

and T2, 130 women reported an increase in their levels of happiness. Sensitivity analysis using Wilcoxon signed-ranks tests between each pair of time points revealed that, on average, the women's happiness at T1 was significantly lower than their happiness at T0 [ $Z = -4.61$ ;  $p = 0.001$ ]. However, the difference between women's happiness at T0 and at T2 was not significant [ $Z = -1.04$ ;  $p = 0.30$ ].

Nevertheless, it is important to note that not all of the women regained pre-disaster levels of happiness 4 years after Hurricane Katrina. Actually, 38 women who felt "somewhat happy" or "very happy" with their lives prior to the hurricane, were "not very happy" or "not at all happy" 5 years later.

**Table 2** Cross-tabulations and measures of association of respondent's happiness at each point of time (T0 vs. T1), (T1 vs. T0), (T0 vs. T2)

	T1 (2006–2007)				T2 (2009–2010)			
	Not at all happy	Not very happy	Somewhat happy	Very happy	Not at all happy	Not very happy	Somewhat happy	Very happy
T0 (2003–2004)								
Not at all happy	0	2	2	0	0	1	2	1
Not very happy	2	12	19	4	1	4	23	9
Somewhat happy	9	22	169	64	8	19	153	82
Very happy	3	6	96	79	4	7	91	83
Kruskal's Gamma	0.459				0.266			
Kendall's Tau-b	0.267				0.151			
T1 (2006–2007)								
Not at all happy	–	–	–	–	3	3	7	1
Not very happy	–	–	–	–	4	8	24	6
Somewhat happy	–	–	–	–	3	13	180	89
Very happy	–	–	–	–	3	6	57	79
Kruskal's Gamma					0.478			
Kendall's Tau-b					0.286			

To understand what differentiated the 38 women who became less happy 4 years after the storm than they were prior to it from the rest of the respondents, we compared their characteristics with the rest of the sample. We conducted a series of *t* tests for differences in means for continuous variables that allowed for unequal variances, and Chi Square and likelihood ratio Chi Square tests for categorical variables.

We found that the 38 women who became less happy 4 years after the hurricane (T2) than they were a year prior to it (T0) were indistinguishable from those who maintained or increased their happiness on many characteristics, including level of exposure to the hurricane. We also found no race/ethnicity, age, or household composition differences between the two groups. Finally, the 38 less happy women did not vary from the rest of the cohort neither on T1 or T2 household income or religiosity, nor on T0 or T1 relationship status. What did distinguish the women who became less happy 4 years after the hurricane from the rest of the sample is that they were less likely to be married or living with a domestic partner at T2 ( $p = 0.01$ ), and reported significantly lower levels of perceived social support at all three time points ( $p \leq 0.006$ ).

### 5.3 Pre-and-Post Disaster Predictors of Women's Happiness 1 and 4 Years After the Storm

Table 3 shows the results of the two regressions on pre-disaster happiness and hurricane exposure on the women's happiness 1 (T1) and 4 years (T2) after the storm. The first model shows that 1 year after the storm (T1), the women who suffered higher exposure to the hurricane, indicated by number of hurricane-related stressors experienced, and by having lost a family member or a friend as a consequence of the storm, were less likely to

**Table 3** Ordered logistic regression models of hurricane exposure on happiness 1 year (T1) and 4 years (T2) after the disaster ( $N = 491$ )

Variable	Happiness 1 year (T1) after Hurricane Katrina	Happiness 4 years (T2) after Hurricane Katrina
Family, neighbors, or close friends died as a result of Katrina (no = reference)	0.425* (-0.15)	0.747 (-0.25)
Katrina-related stressors	0.869** (-0.05)	0.857** (-0.05)
Family, neighbors, or close friends died as a result of Katrina * Katrina-related stressors	1.198* (-0.11)	1.001 (-0.09)
Level of Katrina damage to home (minimal = reference)		
Serious Katrina damage to home	0.863 (-0.25)	0.797 (-0.23)
Enormous Katrina damage to home	0.984 (-0.28)	0.853 (-0.25)
Baseline happiness (not at all happy = reference)		
Not very happy at T0	1.509 (-1.38)	1.187 (-1.31)
Somewhat happy at T0	4.96 (-4.35)	1.232 (-1.31)
Very happy at T0	12.293** (-10.87)	2.317 (-2.47)

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

be very happy than the rest of the sample. However, the positive interaction coefficient of these two effects suggests that the effect of the hurricane-related stressors was less detrimental for the happiness of the women who faced the death of a loved one than for the women who did not. Property damage was not predictive of happiness 1 year after the hurricane but pre-Katrina happiness was predictive of post-Katrina happiness 1 year after the storm. Compared to the women who were not at all happy, the women who were very happy 1 year prior to storm (T0) were more likely to be very happy 1 year after it (T1). The second model shows that 4 years after the storm (T2) only exposure to hurricane-related stressors remained predictive of women's happiness.

Women reported subjective accounts of hurricane-related stressors, property damage, and bereavement. A concern is that these variables, which moderated post-disaster happiness, might be influenced by unmeasured pre-disaster personality characteristics that affect happiness. To address this concern we computed Spearman rank correlation coefficients to test for independence between baseline happiness and hurricane exposure. Baseline happiness was not correlated with hurricane-related stressors ( $p = 0.18$ ), home damage ( $p = 0.83$ ), or bereavement ( $p = 0.24$ ).

In addition, we conducted sensitivity analysis to assess the influence of post-disaster social support and household income in women's post-disaster happiness. Results revealed that baseline happiness (T0) and hurricane-related stressors were no longer predictive of women's happiness 1 year after the storm (T1) after adjusting for women's relationship status ( $B = 1.52$ ,  $SE = 0.32$ ,  $p < 0.05$ ), and their perceived support from the community ( $B = 2.76$ ,  $SE = 0.61$ ,  $p < 0.001$ ). Only losing a family member or a close friend remained predictive of the women's happiness 1 year the storm (T1). Similarly, 4 years after the storm, hurricane-related stressors were not predictive of women's happiness after adjusting for women's relationship status ( $B = 2.06$ ,  $SE = 0.43$ ,  $p < 0.001$ ), and their

perceived support from the community ( $B = 2.79$ ,  $SE = 0.64$ ,  $p < 0.001$ ). Household income and religiosity were not predictive of women happiness after the storm.

## 6 Discussion

This study investigated the long-term effects of Hurricane Katrina on the happiness of a particular group of survivors: young, low-income, predominantly non-Hispanic Black single mothers. We collected information on the women's happiness before and after the storm to investigate how their happiness changed from the pre-disaster assessment to 1 and 4 years after the storm, and how these changes depended on their pre-disaster happiness, on their exposure to the hurricane, and on their post-disaster social support and household income.

Women's happiness decreased and remained low for at least 1 year following Hurricane Katrina. 4 years later, however, most women had regained their pre-Katrina levels of happiness. These findings confirm previous studies that observed that the initial low levels of happiness reported by survivors of natural disasters increased as time from the catastrophe passed (Luechinger and Raschky 2009; Papanikolaou et al. 2012).

An exception to this general pattern were 38 women who presented higher levels of happiness prior to the hurricane but remained in the lower categories of happiness 4 years after the storm. These women were more likely than the rest of the sample to live alone after the storm and reported consistently lower levels of perceived social support from the community than the rest of the cohort both before and after the storm. We also found further evidence of the positive effect of perceived social support on the women's happiness one and 4 years after the storm when examining the long-term determinants of the women's happiness, which suggest that that social support is an important element for the recovery of victims of natural disasters. Similar results have been reported by other studies that have documented the protective effect of social support on exposure to Hurricane Katrina (Lowe et al. 2010), and on the quality of life of survivors of earthquakes occurred in Iran (Ardalan et al. 2011) and China (Lin et al. 2002; Wang et al. 2000; Zhao et al. 2013).

Other determinants of the post-disaster happiness of the women were exposure to hurricane stressors, bereavement and pre-disaster happiness. The degree of exposure to hurricane stressors and experiencing the death of a loved one decreased the women's happiness 1 year after the storm. However, the effect of hurricane-related stressors was less detrimental for the happiness of women that had lost a loved one to the hurricane than for the rest of the sample. 4 years after the storm, only exposure to hurricane-related stressors was predictive of women's happiness. In contrast, pre-disaster happiness was protective of post-disaster happiness 1 year after the hurricane, but not 4 years later. This evidence extends previous findings on the positive relationship between pre-and-post disaster happiness (Uchida et al. 2013).

Unlike previous research (Chan et al. 2012; Paxson et al. 2012) we did not find post-disaster religiosity or household income predictive of women's recovery. A plausible explanation is that although religiosity and income improved the mental health of survivors, which was the focus of previous research, they may not been as influential concerning the focus of our study, the cognitive component of well-being.

In summary, our study suggests that although Hurricane Katrina led to a short-term decline in the women's happiness, it was not associated with a long-term decline in happiness for most of the sample. However, lower levels of happiness before the storm,

experiencing more hurricane-related stressors or the loss of a loved one to the storm, and living alone or perceiving low social support after the storm, were predictive of long-term lower levels of happiness after the disaster.

Several limitations to this study should be noted. First, we had a nonrandom sample and therefore we do not know if our results are generalizable to other populations who experience natural disasters. Second, the results should be replicated in samples that include both male and female participants, and differences in post-disaster changes in happiness by gender should be assessed. Prior research shows that women experience everyday negative internal emotions such as sadness, guilt, and fear more often and with more intensity than men do (Nolan-Hoeksema and Rusting 2003). Women are also more vulnerable than men to the adverse psychological effects of natural disasters, including higher levels of post-traumatic stress disorder, panic, anxiety, and somatic complaints (Dell’Osso et al. 2011; Priebe et al. 2009). Therefore, it is likely that exposure to disaster differentially influences the happiness of men and women. Third, we could not adjust in our analyses for personality variables, although evidence indicates that personality influences happiness (Steel et al. 2008). For instance, high levels of neuroticism have been associated with a higher sensitivity to negative life events (Bolger and Schilling 1991; Larsen and Ketelaar 1991), whereas high levels of extroversion and agreeableness seem to buffer against negative emotions and contribute to an ability to adapt to negative life events (Boyce and Wood 2011; Pai and Carr 2010).

Despite these limitations, our results highlight the importance of facilitating interventions that improve the social support of victims of natural disasters to prevent long-term declines in happiness. In addition, very few studies have examined happiness adaptation to exogenous life events with prospective longitudinal data. By monitoring individuals’ happiness before and after the occurrence of a natural disaster, our study goes beyond previous research on the effect of natural disasters in happiness.

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