Increased alcohol use after Hurricane Ike: The roles of perceived social cohesion and social control

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Abstract

Hurricane Ike, the third costliest hurricane in US history, made landfall in the Galveston Bay Area in September, 2008. Existing literature postulates that maladaptive behavior such as increased alcohol use is often exhibited by disaster survivors in coping with both disaster-related traumatic events and post-disaster stressful events. In addition, it has also been postulated that survivors' perceptions of social cohesion and social control can potentially serve to moderate such behavior. The purpose of this paper is to study such hypotheses for Hurricane Ike. In particular, we investigate the following four hypotheses: (H1) There is an increase of alcohol use by survivors of Hurricane Ike in the Galveston Bay Area; (H2) There are positive associations between both Ike-related trauma and post-Ike stress events and the increase in alcohol use; (H3) There are negative associations between both perceived social cohesion and social control and the increase in alcohol use following Ike; and finally that (H4) perceived social cohesion and social control serve to moderate the associations between both Ike-related trauma and post-Ike stress events and increased alcohol use after Ike. Using public use survey-weighted data from the Galveston Bay Recovery Study (GBRS) of Ike survivors (N=658), we tested these hypotheses using logistic regressions controlling for other key socioeconomic variables. Our results confirm H1 and H2. Hypotheses H3 and H4 are partially confirmed with respect to social control, but show that (i) there is a positive association between perceived social cohesion and the increase in alcohol use following Ike, and that (ii) while perceived social cohesion and social control do moderate the association between post-Ike stress events and increased alcohol use, they have no effect on the association between Ike-related trauma and increased alcohol use.

Introduction

In September of 2008, Hurricane Ike made landfall in the Galveston Bay Area of Texas. It was the third costliest hurricane in US history, killing 195 persons and causing property damage of about $30 billion (Pietrzak et al., 2012). In addition to this loss of life and property, Ike also had devastating psychological effects on its survivors, including well documented increases in the prevalence of posttraumatic stress disorder (PTSD) and depression (Norris, Sherrieb, Galea, 2010; Pietrzak et al., 2012). Studies of other disasters have also found an increase in alcohol use among survivors [including Hurricane Katrina in New Orleans (Beaudoin 2011; Cerdá, Tracy, and Galea, 2011), the Murray Federal Building bombing in Oklahoma City (Dw et al, 1999), and the World Trade Center attack in Manhattan (Vlahov et al., 2002; Bonanno, et. al., 2007)]. These findings suggest that the traumatic effects of disasters may be related to increased alcohol use. In this setting, the main objectives of the present study are to analyze such relations for Hurricane Ike in the Galveston Bay Area, and more generally, to explore the behavioral mechanisms underlying this increase in alcohol use.

Our work is most closely related to the Hurricane Katrina study by Cerdá, Tracy, and Galea (2011), who found that increased alcohol use was associated both with increased numbers of Katrina-related traumatic events and post-disaster stress events. They noted that even those post-disaster stressors not directly related to the hurricane itself may serve to magnify the distress induced by this disaster, [also found among survivors of the World Trade Center attack in Manhattan (Bonanno, et. al., 2007)]. One objective of our present study is to determine whether similar relations hold for Hurricane Ike. One additional finding of this Katrina study was that increased alcohol use was associated with lower levels of "social support" received by survivors. Our present study of Hurricane Ike also focuses on certain relations between survivors and their surrounding communities. But in a manner similar to the study of Hurricane Sandy by Heid et. al. (2016), our focus is directed more toward survivors' perceptions of those community resources typically designated as *collective efficacy*, which are described in broad terms by Bandura (1986) as ''judgments about group capabilities to make decisions, to enlist supporters and resources, to devise and carry out appropriate strategies, and to withstand failures and reprisals''. (Alternative definitions are summarized in Benight, 2004.)

Such perceptions of community resources are postulated to have a moderating effect on forms of maladaptive behavior including alcohol consumption (Benight, 2004). Specifically, following Sampson, Raudenbush, & Earls, (1997), we focus on the influence of perceived "social cohesion" and "social control" on increased alcohol use by survivors: where *perceived social cohesion* is here taken to reflect an individual's perceptions of trust and connection among community members, and *perceived social control* is taken to reflect perceptions of "the capacity of a group to regulate its members according to desired principles" (Sampson et al., 1997). [While alternative definitions of these concepts are given by others (such as in the detailed development by Kawachi and Berkman, 2014), the survey data for our study (discussed below) is based directly on the operational definitions of Sampson et al. (1997).]

More recent literature suggests that the concepts of "social cohesion" and "social control" be de-coupled, and treated as distinct variables (Gau, 2014; Heid et al, 2016, Cagney et al, 2016). On the one hand, social control tends to suppress antisocial behavior by community members, such as underage drinking (Kawachi and Berkman, 2014, Ducan, Ducan & Strycker, 2002). On the other hand, social cohesion tends to be more supportive in nature. For example, social cohesion can help to maintain community resources in hard times, contributing to the overall health of its members (Kawachi, Kennedy, & Glass, 1999).

In light of this previous work, we are interested not only in the separate effects of these two social dimensions on increased alcohol use, but also the degree to which they may serve to moderate the associations between increased alcohol use and both the numbers of Ike-related traumatic events and post-Ike stressful events suffered by survivors. For example, neighbors helping each other to rebuild after hurricane disasters may create a social environment in which maladaptive responses to such stressful situations are less likely. In terms of substance abuse in particular, the social stress model of Rhodes & Jason (1990) postulates that the likelihood of such behavior by adolescents is a function of both the stress levels they experience and the extent to which they are offset by "stress moderators, social competencies, and resources".

To explore these questions, our prior hypotheses were that: (H1) There is an increase of alcohol use by survivors of Hurricane Ike in the Galveston Bay area; (H2) There are positive associations between both Ike-related trauma and post-Ike stress events and the increase in alcohol use; (H3) There are negative associations between both perceived social cohesion and

social control and the increase in alcohol use following Ike; and finally that (H4) perceived social cohesion and social control serve to moderate the associations between both Ike-related trauma and post-Ike stress events and increased alcohol use after Ike.

Data and Methods

The data used for this study was taken from the Galveston Bay Recovery Study (GBRS) public use file (PUF), accessed online at the Inter-University Consortium for Political and Social Research (ICPSR) (National Center for Disaster Mental Health Research, Galea, & Norris, 2016). GBRS is an epidemiological and mental health study of (N=658) disaster survivors randomly drawn from the adult population residing Galveston or Chamber counties at least one month before Hurricane Ike made landfall on September 13, 2008.

Sampling

Stratified sampling was employed to ensure the inclusion of residents in those areas most affected by Hurricane Ike, and who were most likely to have experienced hurricane-related traumatic events. Within both Galveston and Chambers counties, 80 clusters of Census blocks were selected from five separate regions (strata), ranging from areas that suffered direct storm-surge damage to non-flooded and non-poverty areas. Telephone and face to face interviews were conducted in either Spanish or English, in three waves at approximately 2-6, 6-9, and 14-18 months after the hurricane, respectively. Given that our study focuses on the immediate impact of Hurricane Ike on alcohol drinking (and in particular on post-Ike stressors that are most likely to magnify the stress induced by this disaster), we have used only the first wave of interview data. With respect to this first wave, information was obtained on alcohol use before and after Ike, lifetime traumatic events and stress before Ike, and perception of social cohesion and social control after Ike. Demographic variables include race/ethnicity, age, education, marital status, household income, whether household income declined after Ike, employment status, and whether jobs were lost because of Ike.

Finally, it should be noted that the sample used involves only survivors who were still living in the Galveston Bay Area at the time of the interviews. Any survivors who left and did not return during this six-month period were implicitly excluded from the sample. However, unlike Hurricane Katrina (Fussell, Sastry, & VanLandingham 2010), there is no evidence of substantial population exodus following Hurricane Ike. Moreover, since our study is particularly concerned with *place-based* stressors occurring after Ike, this exclusion should have no effect on our results.

Measurement

Information about GBRS respondents' behavior before and after Hurricane Ike was obtained by asking each respondent a series of questions. Our key variables were constructed from these questions as outlined below. [A full listing of all questions can be found in Galea, & Norris (2016).]

Our binary measure for *Increased alcohol use* was constructed with value "1" if the difference between the respondent's number of drinks in the *post-Ike* period (i.e., during the 30 days before the interview) and the *pre-Ike* period (i.e., in the 30 days before Ike) was positive, and with value "0" otherwise. Those respondents with increased alcohol use who did not drink

during the pre-Ike period are designated as *new drinkers*. In addition, following Sheehan et al (1997; 1998), the dichotomous variable, *Alcohol abuse before Ike*, was constructed as a "yes" answer to any of a series of symptoms with onset before Ike, such as "being intoxicated more than once while ignoring other family responsibilities".

Our stress variables were constructed from a list of twelve stressful events, modified by Boardman et al (2001; 2004), including questions about "serious financial problems" and "problems getting access to adequate healthcare". For respondents who had experienced any of these events before Ike, the indicator variable, *Any stressful events before Ike*, was defined to be one and zero otherwise. In addition, the number of these twelve event type types experienced by a respondent after Ike was taken was taken to define the categorical variable, S*tressors after Ike*, with ordinal scale: 0 = "none", 1 = "low", and 2 or more = "high".

Our trauma variables distinguish between those trauma events related to Ike and those not related. The latter were specified by list of ten general questions (following Breslau, et al, 1991; 1998), including the experience of being "robbed or mugged" or experiencing "the sudden unexpected death of someone close". For respondents who experienced any of these events before Ike, the indicator variable, *Any traumatic events before Ike*, was defined to be "1" and "0" otherwise. Following Galea and Norris (2016), Ike-related trauma was based on personal experiences of four items, including "physical injury resulting from Ike" and "a family member or close friend was killed as a result of Ike". The number of "yes" answers to these four questions was used to construct a categorical variable, *Number of Ike-related traumatic events*, with ordinal scale: 0 = "none", 1 = "low", and 2 or more = "high". A related variable focused on threatening events related to Ike, and was specified (again following Galea and Norris, 2016) in terms of answers to four questions, such as "being stranded during or after Ike" or "being unsure about the safety or whereabouts of family members". Here the categorical variable, *Number of Ike-related threatening events*, was constructed with ordinal scale: 0 = "none", 1 = "low", and 2 or more = "high". A second related variable focused on property damage from Ike, as specified by six items including "homes" and "cars". A dummy variable, *Ike-related property damage*, was then constructed with value "1" if respondents experienced least three of these damage items.

Turning next to respondents' community perceptions, our perceived social cohesion variable was operationalized by the answers to five questions constructed in Sampson (1997). In particular, respondents were asked to answer the following questions on a 5-point scale: 1. "This is a close-knit neighborhood; 2. "People around here are willing to help their neighbors"; 3. "People in this neighborhood generally don't get along with each other"; 4. "People in this neighborhood do not share the same values"; 5. "People in this neighborhood can be trusted". The 5-point scale ranged from 1 = "strongly disagree" to 5 = "strongly agree". After the scales on items 3 and 4 were reversed (to ensure comparability), the five scores were averaged. This mean score was taken to represent the level of *social cohesion* perceived by the respondent. Recent literature indicates that this score achieved high levels of internal consistence in measuring social cohesion in behavioral outcomes [Cronbach's alpha at 0.80], health outcomes [Cronbach's alpha at 0.79], and mental health outcomes [Cronbach's alpha at 0.79] after disaster or other traumatic events (Bellin et al., 2014; Cagney, et al, 2016; Heid, et al, 2016).

Our perceived social control variable was again operationalized (following Sampson et al.,1997), by answers to five questions. Here participants were asked to respond on a 5-point

Likert scale (ranging from 1 = "very likely" to 5 = "very unlikely") as to whether their neighbors would intervene if (i) "their neighborhood children were skipping school and hanging out on a street", (ii) "their neighborhood children were spray-painting graffiti on a local building, (iii) "children were showing disrespect to an adult", (iv) "a fight broke out in front of their house", and (v) "the fire station closest to their home was threatened with budget cuts". The mean score on these five items was then take to represent the level of *social control* perceived by the respondent. As with social cohesion, this measure has been shown to exhibit high levels of internal consistency (Bellin et al., 2014; Cagney, et al, 2016; Heid, et al, 2016).

One additional purpose of this study was to examine whether there are disparities between various demographic and socioeconomic groups while controlling for other covariates. Turning first to demographics, four mutually exclusive groups were studied: Non-Hispanic white (white), Non-Hispanic black (black), Hispanic, and other non-Hispanic racial groups (other). Other demographic variables include gender (female or male); age group (18-24 year old, 25-34 year old, 35-44 year old, 45-54 year old, 55-64 year old, 65 year old and above); marital status (married, living with a partner, separated, divorce, windowed, never married). Our socioeconomic variables include categorical education attainment with ordinal scale (less than high school, high school, some college or above), employment status before Ike (employed or not on the eve of Hurricane Ike), and household income less than 40k (median level of the sample) or not.

Our final variable relates to certain time effects. Even within the first wave of GBRS, respondent interviews occurred over a time interval of 4 months, from 2 to 6 months following Ike. Some related studies, including the study of tobacco use by Parslow and Jorm (2006) following a major Australian bush fire, have found a relation between degree of usage and duration since the disaster. Therefore, it is of interest here to include the duration from Ike to interview times as a possible predictor of increased alcohol use.

Weights and Missing Data

GBRS PUF published the sampling weights used for each individual to account for differential sampling probabilities across the five strata areas. In order to draw meaningful inferences on demographic variables as well as Ike related variables, our statistical analysis incorporated these weights reflecting the actual distributions of relevant demographic attributes within the overall population. With respect to missing data, our study included only those (N=632) individuals who responded to the "increased alcohol use" question. Of this data, only 9% involved missing variables with more than 90% corresponding to non-reported income. In each of our statistical analyses, all observations with additional missing data were removed (list-wise deletion). Although multiple imputation methods are possible here, the missing-at-random (MAR) assumption underlying such procedures is questionable at best. Moreover, the present list-wise deletion procedure is known to yield results that are more robust to violations of MAR, especially in the present context of logistic regression (Allison, 2001). In addition, it should be noted that any remaining biases in this approach tend to understate significance levels and yield conservative estimates of effects. Additional sampling discussion is given in the Statistical Analysis section below.

Statistical Analysis

Our analysis begins in Table 1 with weighted summary statistics of all relevant variables, including (i) prevalence of alcohol drinking before and after Hurricane Ike, (ii) rates of increased alcohol use after the disaster, and (iii) all other key explanatory variables used in the subsequent analyses. In Table 2 we employ weighted two-way cross-tabulation and logistic regression to assess the bivariate associations between each covariate and increased alcohol use. Finally, we employ two related logistic regression models to predict increased alcohol use behavior in terms of these explanatory variables. The *Main Effects* (ME) model includes all explanatory variables in Table 2 above. The second *Interaction Effects* (IE) model includes additional interaction terms focusing on possible relations between Ike-impact variables (Ike-related trauma, post-Ike stressors) and survivors' perception-of-community variables (perceived social cohesion, perceived social control). Here it should be noted that the overall significance of such interaction effects was confirmed by applying a composite Wald test ($p = 0.008$). In addition, Taylor linearization methods were used for all variance estimation in these survey-design based regression analyses. However, as mentioned above, list-wise deletion reduced our effective sample sizes to $N = 632$ for the cross-tabulations and $N = 574$ for the logistic regressions. So as an added check on standard errors, we employed parametric bootstrap procedures to approximate the sampling distributions of beta coefficients in our logistic regressions [shown by Davidson and MacKinnon (2006) to be a more powerful method than asymptotic tests for smaller sample sizes.] These results (not reported) confirmed that the Taylor linearization method was quite effective at this sample size.

Results

Our key results are with respect to the four hypotheses stated in the Introduction. With respect to hypothesis H1, Table 1 shows that 26% of the survivors in our study group experienced increased alcohol use after Ike [with 95% confidence interval (0.200, 0.308)]. With respect to hypothesis H2, results for the ME model in Table 3 show that both survivors experiencing greater numbers of Ike-related traumatic events and those experiencing post-Ike stressful events were at higher risk of increased alcohol use. In particular, the odds ratios and p-values for those experiencing the highest numbers (≥ 2) in each of these event categories are, respectively, (OR = 8.69, p =0.034) and (OR = 4.16, p = 0.001). In other words, those survivors who suffered two or more trauma (respectively, stress) events were at least 8 (respectively, 4) times more likely to increase their alcohol use after Ike. Turning to hypothesis H3, the results are strikingly mixed. While perceived social control is indeed protective against increased alcohol use (OR = 0.61, p = 0.002), there is a significantly *positive* association between perceived social cohesion and increased alcohol use (OR = 1.87, p = 0.012). Turning finally to hypothesis H4, our results are again mixed. First, with respect to the possible moderating effects of perceived social cohesion and social control on the association between post-Ike stressors and increased alcohol use, our findings support only the latter effect. In particular, results for the IE model show that perceived social control was protective against increased alcohol use for those survivors experiencing at least two post-Ike stressors (OR = 0.23, p = 0.038). However, perceived social cohesion produced exactly the opposite effect, i.e., at high levels of post-Ike stress ($\geq$ two stressors), those survivors reporting greater levels of perceived social cohesion were at higher risk of increased alcohol use (OR = 5.07, p = 0.050). This result is even more dramatic for those experiencing a single stressor event (OR = 6.12, p = 0.009). Additional support for these opposite interaction effects can be given in terms of the predictive marginal effects of post-Ike

stressors on increased alcohol use for both perceived social cohesion and social control, as illustrated in Figure 1. Here it is clear that for survivors experiencing at least one stressor, there is a strong negative marginal effect for perceived social control, but an equally strong positive marginal effect for perceived social cohesion. Finally, turning to the second part of hypothesis H4, we see that neither perceived social cohesion nor social control has any significant effect on the association between Ike-related trauma and increased alcohol use (with all p-values above 0.15). This general lack of significance (confirmed by our parametric bootstrap results), is considered further in the Discussion section.

Our two logistic regression models reveal a number of other interesting results. Note first that among the demographic and socioeconomic control variables employed in the ME model, the three most significant predictors of increased alcohol use are number of children, income and age. With respect to children, those survivors with 3 or more children are at higher risk (OR = 2.93 p = 0.007) of increased alcohol use than those with fewer children. Notice also that this result is very similar to that in the IE model (OR = 3.02 p = 0.006), suggesting that these effects are unrelated to perceived social cohesion or social control effects. This is further supported by the bivariate logistic regression results in Table 2, which show that (controlling for no other factors) those survivors with three or more children are at significantly greater risk of increased alcohol use (p = 0.050). A similar result is seen for income, where respondents with either lower-middle incomes (OR = 4.77 p = 0.023 for $40,000-$59,999) or high incomes (OR = 9.69 p = .002 for $80,000-$99,999) are at greater risk of increased alcohol use than those in other income groups. While these significance levels are somewhat lower in the IE model, their bivariate significance in Table 2 (p = 0.04 and p = 0.01, respectively) again suggests that these effects are largely unrelated to perceived social cohesion or social control effects. However, the situation is quite different with respect to age, where respondents aged 65 and older are at greater risk (OR = 4.25 p =0.039) for increased alcohol use in the ME model, but not in the IE model (p = 0.198), suggesting that interaction effects are playing a role here. Further investigation in terms of cross tabulations (not reported) show that this age group perceived much higher levels of social cohesion than the reference group (ages 18 to 24), and moreover, that age 65 and over group experienced many more instances of a single post-Ike stressor than higher level (>=2) stressor. When taken together, these factors suggest that risk in this age group is being largely accounted for by the strong positive interaction (OR = 6.12, $p = 0.009$) between perceived social cohesion and single post-Ike stressors in the IE model. A similar but opposite effect is seen for Hispanics, who are at relatively greater risk of increased alcohol use than non-Hispanic Whites (reference group) in the IE model (OR = 2.46, $p = 0.054$), but exhibit no significant difference (p = 0.198) in the ME model. Here auxiliary cross tabulations (not reported) show that it is not Hispanics, but rather the non-Hispanic White reference group which is now involved in the interaction. In particular, this reference group exhibits both the highest numbers of post-Ike stressors, and highest levels of perceived social cohesion, suggesting that much of their risk for increased alcohol use is now being captured by the positive social cohesion-stressor interaction term (OR = 5.07, $p = 0.050$). Since this is not true for Hispanics, their *relative* risk for increased alcohol use compared to this reference group is now significant in the IE model.

Finally, it should be noted that in the original results of Sampson et al. (1997), it was the strong correlation (r > 0.80) between perceived social cohesion and social control across Chicago neighborhoods that motivated their interpretation of these variables as reflecting a common latent variable, designated as “collective efficacy”. So even though this correlation is somewhat lower in our present study (r = 0.52), it nonetheless suggests that there may be collinearity issues with

these two variables. However, the VIF scores in both of our model are quite low for perceived social cohesion (VIF= 1.59 in the ME model; VIF=2.22 in IE model) and for perceived social control (VIF= 1.48 in ME model; VIF=2.14 in IE model). So by most standards in the literature [as for example, Allison (1999) and Sampson & Raudenbush (1999)], there appear to be no serious collinearity issues in either of these models].

Discussion

Among the many consequences of Hurricane Ike, the prevalence of alcohol use within our study group increased from 47% before Ike to 53% afterwards. Moreover, 26% of this group increased their individual alcohol use, and among these, more than a third were new drinkers (i.e., those who did not drink during the pre-Ike period). This increased alcohol use is particularly striking when compared to national statistics during the same time period, where drinking actually decreased from 52% to 51.6% in spite of the 2008 economic recession (Bor et al., 2013).

Our findings that disaster-related trauma and post-disaster stressors are key risk factors for increased alcohol use after Hurricane Ike are consistent with those of Cerda et al. (2011), who established the same relationships for survivors of Hurricanes Katrina and Rita. These findings add further support to this previous work. But our main results focus on the possible moderating effects of perceived social cohesion and social control on the associations between these trauma/stress factors and increased alcohol use.

With respect to such moderating effects, there is some related work in the literature. The study of Hurricane Sandy by Heide et al. (2016) found that perceived social cohesion had a strong effect in reducing PTSD among victims, but that perceived social control had no significant effect. In a similar study of Hurricane Sandy, Cagney et al. (2016) found that perceived social cohesion and social control (in separate models) were positively associated with greater levels of perceived community preparedness and resilience by survivors. In non-disaster contexts, many studies (Bellin et al., 2014; Cohen, Inagami, & Finch, 2008; Maimon & Browning, 2012; Meyers et al., 2013) have confirmed the original findings of Sampson et al. (1997) that perceived social cohesion and social control tend to have similar positive "collective efficacy" effects on mental health and behavioral outcomes.

From this viewpoint, perhaps our most interesting finding is that perceived social cohesion was *positively* associated with higher levels of increased drinking among Ike survivors (OR = 1.87, $p = 0.012$), and in addition that this association was more strongly positive when the survivors experienced ~~at~~ higher levels (≥ 2) of ~~Ike-related~~ stress after Ike (OR = 5.07, p = 0.05). Such findings are not without precedent however. Most relevant to our present study is the finding of Beaudoin (2011) that perceived social cohesion ("neighborliness") among Hurricane Katrina survivors had a positive relation to increased alcohol use. Moreover, while there are cases where social cohesion can foster "bad" behavior by groups (Kawachi and Berkman, 2014), this is less clear for social drinking. For example, there is some evidence suggesting that social drinking can serve to increase social bonds within groups (Sayette et al., 2012), and that (among college students) such drinking can often lead to more positive outcomes that solitary drinking, including lower levels of depression and higher self-efficacy (Christiansen, Vik, & Jarchow, 2002). In the present setting, this raises the question of whether increased drinking related to perceived social cohesion by disaster survivors should be treated as "maladaptive" behavior.

One additional finding of this study was that while perceived social cohesion and social control both significantly influenced the effects of Ike-related stress on increased alcohol use, neither of such influences were observed for Ike-related trauma ($p > 0.15$ in all cases). So while such trauma events are a significant risk factor for increased drinking, this relationship does not appear to be influenced (either moderated or stimulated) by individual perceptions of social cohesion or social control. To the extent that trauma events can be viewed as more intense forms of stress, it may be that individuals experiencing extreme levels of stress are less sensitive to such social perceptions. In any case, this remains an open question.

Finally, this study has several limitations that should be noted. First, the use of self-reported data necessarily relies on personal perceptions, such as the self-reported levels of alcohol use. Here it would be desirable to obtain more objective measures. Moreover, the retrospective nature of this survey relies on personal recall by respondents, which constitutes a second source of measurement error. In addition, the specific questions used to define both perceived social cohesion and social control necessarily impose limitations on these qualitative concepts. For example, with respect to perceived social cohesion, the questions employed in the present study, as formulated by Sampson et al. (1997), are somewhat different from those employed by Hikichi et al. (2016) in their study of Tsunami survivors and by Benight (2004) in his study of forest fire survivors. Note also that while the use of only the first wave of survey data allowed us to focus on the immediate impact of Ike trauma and post-Ike stressors, certain consequences of Ike may involve longer durations. In this regard, it should be noted that while the duration-since-disaster variable was found to be insignificant, this was only defined with respect to the first six months following the disaster. Indeed, the total percent of increased alcohol use did decrease slightly over the three waves of the full study. Such time effects will be developed in more detail in subsequent work.

In conclusion, this study has shown that both exposure to Ike-related trauma events and post-Ike stressor events were risk factors for increased alcohol use following this disaster. While similar results have been found in studies of Hurricanes Katrina and Rita (Cerda et al., 2011), this is the first study to relate these risk factors to survivors' perceptions of social cohesion and social control. Here it was found that perceived social control buffered the effect of post-Ike stressors on increased alcohol use, suggesting that disaster relief efforts place more emphasis on fostering social control within survivor communities. In contrast, it was found that perceived social cohesion was associated with higher alcohol use by survivors. But the policy consequences of this finding are less clear. Here more research is needed to determine the positive as well as negative consequences of social drinking by survivors.

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Table 1 Weighted Summary Statistics of Respondent Characteristics

Variable		% or Mean (SD) [i]	N [ii]
Any alcohol drink before Ike	No	53%	338
	Yes	47%	294
	Total	100%	632
Any alcohol drink after Ike	No	47%	305
	Yes	53%	327
	Total	100%	632
Increased alcohol use	No	74%	497
	Yes	26%	135
	Total	100%	632
New drinker	No	92%	575
	Yes	8%	57
	Total	100%	632
Race & ethnicity	White	64%	382
	Black	14%	96
	Hispanic	18%	119
	Other	4%	33
	Total	100%	630
Gender	Female	52%	378
	Male	48%	254
	Total	100%	632
Age group	18-24 yrs.	13%	55
	25-34 yrs.	18%	101
	35-44 yrs.	20%	105
	45-54 yrs.	21%	113
	55-64 yrs.	14%	111
	65+ yrs.	14%	147
	Total	100%	632
Marital status	Married	55%	302
	Living with a partner	7%	33
	Separated	5%	30
	Divorced	8%	77
	Widowed	5%	74
	Never been married	21%	114
	Total	100%	630
Employment status before Ike	Employed	37%	266
	Not-employed	63%	366
	Total	100%	632
Household income before Ike	<$10,000	7%	65
	$10,000-$19,999	11%	73
	$20,000-$39,999	21%	110
	$40,000-$59,999	15%	93
	$60,000-$79,999	12%	59
	$80,000-$99,999	13%	48
	$100,000+	21%	131
	Total	100%	579
Education attainment	< High school	15%	86
	school degree or equivalent	29%	147
	>=college	56%	399
	Total	100%	632
	0	60%	404

Number of children under 18-year-old	1	10%	56
	2	18%	89
	>=3	12%	83
	Total	100%	632
Alcohol abuse before Ike	No	74%	498
	Yes	26%	134
	Total	100%	632
Duration since Ike (months)	2	9%	76
	3	18%	142
	4	16%	138
	5	38%	200
	6	18%	76
	Total	100%	632
Number of Ike threatening events	0	21%	174
	1	49%	279
	>=2	30%	179
	Total	100%	632
Number of traumatic events in Ike	0	90%	561
	1	8%	61
	>=2	3%	10
	Total	100%	632
Number of properties damaged by Ike	0-2	69%	395
	3 or more	31%	237
	Total	100%	632
Number of stressors after Ike	0	76%	497
	1	17%	99
	>=2	7%	36
	Total	100%	632
Perceived Social Cohesion		3.91 (0.90)	632
Perceived Social Control		3.92 (1.02)	627

[i] SD: standard deviation

ii N: Number of respondents

Table 2. Weighted two-way cross tabulation and simple (bivariate) logistic regression of increased alcohol use behavior on respondents' characteristics

	N [i]	% increase	OR [ii]	*P* value
Total	632	26		
Race & Ethnicity				
White, non-Hispanic	382	27	1.00	
Black, non-Hispanic	96	19	0.64	0.397
Hispanic	119	27	1.02	0.964
Other, non-Hispanic	33	5	0.44	0.422
Design-based F Statistic (2.75, 197.67) = 0.37; P value = 0.757				
Gender				
Male	254	30	1.00	
Female	378	21	0.66	.265
Design-based F Statistic (1, 72) = 1.27; P value = 0.264				
Age group				
18-24 yrs	55	17	1.00	
25-34 yrs	101	26	1.82	0.229
35-44 yrs	105	28	1.94	0.225
45-54 yrs	113	31	2.28	0.179
55-64 yrs	111	23	1.47	0.601
65+ yrs	147	24	1.62	0.554
Design-based F Statistic (4.06, 292.41) = 0.34; P value = 0.853				
Marital status				
Married	302	28	1.00	
Living with a partner	33	23	0.79	0.721
Separated	30	30	1.13	0.858
Divorced	77	23	0.80	0.695
Widowed	74	12	0.36	0.087
Never been married	114	24	0.10	0.685
Design-based F Statistic (3.57, 257.16) = 0.37; P value= 0.811				
Duration since Hurricane Ike (months)				
2	76	30	1.00	
3	142	32	1.11	0.886
4	138	22	0.65	0.581
5	200	28	0.92	0.918
6	76	15	0.42	0.255
Design-based F Statistic (3.31, 238.57) = 0.75; P = 0.534				
Employment Status before Ike				
Employed	366	21	1.00	
Not-employed	266	28	0.66	0.374
Design-based F Statistic (1, 72) = 0.81; P = 0.369				
Household Income before Ike				
<$10,000	65	11	1.00	
$10,000-$19,999	73	22	2.18	0.160
$20,000-$39,999	110	20	1.99	0.305
$40,000-$59,999	93	28	3.17	0.040
$60,000-$79,999	59	29	3.32	0.195
$80,000-$99,999	48	43	5.97	0.010
$100,000+	131	27	3.00	0.078
Design-based F Statistic (3.81, 274.57) = 1.03; P value = 0.389				
Education Attainment				
< High school	86	31	1.00	
High school or equivalent	147	19	0.53	0.328
Some college or higher	399	27	0.84	0.759

Design-based F Statistic (1.60, 115.23) = 0.75; P = 0.444				
Number of Children				
0	404	23	1.00	
1	56	20	0.85	0.744
2	89	29	1.41	0.409
>=3	83	39	2.23	0.048
Design-based F Statistic (2.86, 205.72) = 1.58; P value = 0.198				
Any traumatic events before Ike				
No	60	19	1.00	
Yes	572	27	1.49	0.375
Design-based F Statistic (1, 72) = 0.81; P value = 0.3724				
Any Stressors before Ike				
No	42	7	1.00	
Yes	590	27	5.14	0.010
Design-based F Statistic (1, 72) = 8.56; P value = 0.005				
Alcohol abuse before Ike				
No	497	18	1.00	
Yes	135	8	1.51	0.292
Design-based F Statistic (1, 72) = 1.135 P value= 0.2901				
Number of Hurricane Ike threatening events				
0	174	24	1.00	
1	279	26	1.12	0.804
>=2	179	27	1.19	0.695
Design-based F Statistic (1.98, 142.82) = 0.0740; P value = 0.9274				
Number of traumatic events in Ike				
0	561	24	1.00	
1	61	30	1.32	0.506
>=2	10	62	5.10	0.129
Design-based F Statistic (1.64, 118.30) = 2.1481; P value = 0.1304				
Number of properties damaged by Ike				
0-2	395	25	1.00	
3 or more	237	27	1.11	0.773
Design-based F Statistic (1, 72) =0.0842; P value = 0.7725				
Number of stressors after Ike				
0	497	23	1.00	
1	99	27	1.26	0.643
>=2	36	51	3.44	0.044
Design-based F Statistic (1.99, 143.30) = 2.2132; P value = 0.113				
Perceived social cohesion	632		1.36	0.155
Perceived social control	627		0.86	0.373

[i] Number of respondents

[ii] OR: Odds ratio

Table 3. Weighted multiple logistic regressions to estimate an increase in alcohol use by respondent characteristics

	Model 1 Main Effect		Model 2 Interaction Effect	
VARIABLES	**OR** [i]	***P* value**	**OR**	***P* value**
Race & Ethnicity				
White, non-Hispanic	1	.	1	.
Black, non-Hispanic	0.55	0.288	0.54	0.226
Hispanic	1.86	0.198	2.46*	0.054
Other non-Hispanic	0.39	0.391	0.33	0.282
Gender				
Male	1	.	1	.
Female	0.78	0.518	0.85	0.683
Age group				
18-24yrs	1	.	1	.
25-34 yrs	1.75	0.550	1.18	0.855
35-44 yrs	0.94	0.936	0.42	0.270
45-54 yrs	1.78	0.400	1.27	0.708
55-64 yrs	2.00	0.433	1.29	0.765
65+ yrs	4.25**	0.039	2.57	0.198
Marital Status				
Married	1	.	1	.
Living with a partner	1.33	0.772	1.07	0.941
Separated	1.72	0.434	1.77	0.371
Divorced	0.90	0.858	0.63	0.477
Widowed	0.68	0.645	0.62	0.617
Never been married	2.15	0.296	2.14	0.276
Duration since Hurricane Ike (months)				
2	1	.	1	.
3	1.28	0.663	1.69	0.367
4	0.58	0.399	0.95	0.929
5	0.97	0.952	1.08	0.899
6	0.44	0.249	0.63	0.524
Employment Status before Ike				
Employed	1	.	1	.
Not-employed	0.70	0.403	0.71	0.423
Household Income before Hurricane Ike				
<$10,000	1	.	1	.
$10,000-$19,999	1.88	0.369	1.32	0.740
$20,000-$39,999	4.39**	0.033	4.34*	0.050
$40,000-$59,999	4.77**	0.023	3.39	0.101
$60,000-$79,999	4.36	0.107	3.71	0.175
$80,000-$99,999	9.69***	0.002	8.70***	0.005
$100,000+	5.79**	0.025	4.84*	0.067
Education Attainment				
< High School	1	.	1	.
=High school or equivalent	0.62	0.342	0.70	0.559
Some college or higher	0.76	0.591	0.98	0.977
Number of Children under 18				
0	1	.	1	.
1	2.02	0.316	2.06	0.304
2	2.73**	0.032	3.40***	0.009
3	2.93***	0.007	3.02***	0.006
Any traumatic events before Ike				

No	1	.	1	.
Yes	1.36	0.486	1.64	0.146
Any stressor before Ike				
No	1	.	1	.
Yes	4.51	0.117	4.17	0.140
Alcohol abuse before Ike				
No	1	.	1	.
Yes	0.88	0.677	0.85	0.652
Number of Hurricane Ike threatening events				
0	1	.	1	.
1	1.00	0.998	1.06	0.897
>=2	1.09	0.855	1.13	0.816
Number of Ike-related traumatic events				
0	1	.	1	.
1	2.27*	0.084	2.69**	0.017
>=2	8.69**	0.034	398.67**	0.040
Number of properties damaged by Ike				
<=2	1	.	1	.
>=3	0.98	0.965	1.00	0.993
Number of stressors after Ike				
0	1	.	1	.
1	2.10	0.147	2.33*	0.071
>=2	4.16***	0.001	3.20**	0.037
Perceived social cohesion	1.87**	0.012	1.48	0.190
Perceived social control	0.61***	0.002	0.73*	0.054
Perceived Social cohesion interacting with the Number of Ike traumatic events				
Social cohesion # 0			1.00	.
Social cohesion # 1			0.51	0.153
Social cohesion # >= 2			6.18	0.244
Perceived social control interacting with the Number of Ike traumatic events				
Social control # 0			1.00	.
Social control # 1			0.77	0.449
Social control # >= 2			2.31	0.248
Perceived social cohesion interacting with the number of stressors after Ike				
Social cohesion # 0			1.00	.
Social cohesion # 1			6.12***	0.009
Social cohesion # >= 2			5.07**	0.050
Perceived social control interacting with the number of stressors after Ike				
Social control # 0			1.00	.
Social control # 1			0.33**	0.043
Social control # >= 2			0.23**	0.038
Constant	0.01***	<0.001	0.01***	<0.001
Design Based F-test (df1; df2)	(42; 31) 3.47***		(50; 23) 9.23***	
Observations	574		574	

[i] OR: odds ratio;

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

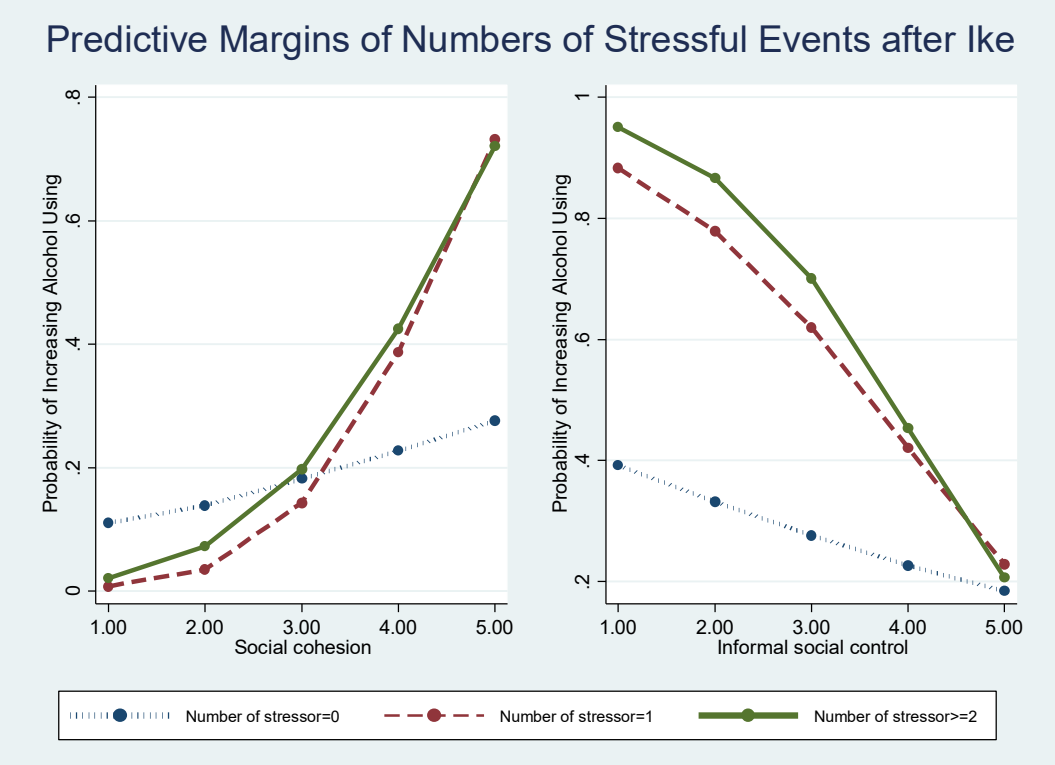

Figure 1. Predictive margins of post-Ike stressors experienced by survivors