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Patterns of substance use among Hurricane Katrina evacuees in Houston, Texas

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Abstract

This paper focuses on changing patterns of substance use among low income, African American drug users evacuated from New Orleans, Louisiana, during Hurricane Katrina of August 2005. It examines the relationship between increases and decreases in alcohol and tobacco (AT) use and illicit drug (ID) use after Katrina and pre-disaster and within-disaster factors. Data from structured interviews with 200 Katrina evacuees currently living in Houston were collected 8–14 months after the disaster. Multivariate analysis revealed that rises in AT use were positively associated with education. Females and younger evacuees were more likely to have increased AT use. ID use increase was positively associated with resource loss and leaving the city before Katrina. Decreases in AT and ID use were found to be associated with disaster-related exposure. The paper discusses the specific consequences of disasters on disadvantaged minority substance users and the importance of developing public health disaster policies that target this population.

Keywords

African American; alcohol; disasters; illicit drugs; Hurricane Katrina; resource loss; risk factors; tobacco

Introduction

Most disaster research acknowledges that comorbid consequences such as psychological disorders and substance use often accompany socioeconomic loss and displacement (Galea et al., 2002; Kessler et al., 1995; North et al., 1999). However, research focused on explaining variations and changes in substance use patterns as a result of disaster experiences is limited (Clayer, Bookless-Pratz and Harris, 1985; Movaghar et al., 2005; Parslow and Jorm, 2006; Pfefferbaum and Doughty, 2001). Hurricane Katrina hit the Gulf Coast of southeast Louisiana in the United States on 29 August 2005, leaving in its wake perhaps the costliest disaster ever to occur in the country (Elliott and Pais, 2006). In Louisiana, the hurricane displaced an estimated 645,000 people to areas throughout the US

(United States Congress, 2006; Federal Emergency Management Agency, 2006; Gabe et al., 2005). Most of the approximately 200,000 Katrina evacuees displaced to Houston, Texas, were economically disadvantaged African Americans from New Orleans, Louisiana (Brodie et al., 2006; Gabe et al., 2005). This paper provides data on how patterns of illicit drugs, alcohol and tobacco use changed among these Katrina evacuees. Moreover, it contributes to an understanding of the impact of disasters on the lives of poor minority populations compared to other groups with greater social and capital resources (Brezina, 2008; Dyson, 2006; Elliott and Pais, 2006).

New Orleans pre-Katrina, the storm and the evacuation experience

New Orleans prior to Hurricane Katrina was one of the most disadvantaged urban areas in the US (National Center for Health Statistics, 2005). The city had a population of 485,000 with a racial composition that was 67, 28 and 5 per cent African American, White and other, respectively (United States Census Bureau, 2000a). Compared to other US cities, New Orleans had some of the highest rates of poverty, welfare dependency and unemployment as well as some of the lowest public health indicators (United States Census Bureau, 2000b, 2006; Administration on Children and Families, 2004). A highly dysfunctional public school system and reportedly one of the most politically corrupt city governments in the nation (Brinkley, 2006) exacerbated these disadvantages. The poor in New Orleans largely comprised African Americans, who lived in highly segregated and dilapidated public housing in the old urban core. Others resided in blighted residential areas, including the Lower Ninth Ward, the Ninth Ward, Tremé and Gentilly, which mostly consisted of low income homeowners (see Figure 1). These were neighbourhoods that New Orleans's annual 3.7 million visitors seldom saw when visiting the French Quarter, Garden District, the Jazz and Heritage Festival, Mardi Gras or other popular tourist destinations (New Orleans Metropolitan Convention and Visitors Bureau, 2006).

Another distinguishing characteristic of New Orleans compared to other US cities is that it had one of the highest drug-use prevalence rates in the country (Santibanez et al., 2005). According to the 2003 results of the Arrestee Drug Abuse Monitoring (ADAM) Program, 78 per cent of the adult male and 60 per cent of the adult female arrestee population in New Orleans tested positive for any of five drugs (cocaine, marijuana, methamphetamines, opiates and phenylcyclohexylpiperidine (PCP) (Zhang, 2003). African American neighbourhoods had the highest levels of crime, drug use and identified major drug distribution centres (National Drug Intelligence Center, 2001). Many of these neighbourhoods were located in areas most devastated by Katrina and the ensuing floods described above (Hartman and Squires, 2006).

These areas, though poor and characterised by excessive drug dealing and violence, still maintained a stout sense of community, as indicated by the following description of the Ninth Ward:

Everybody knew everybody, and engaged in the neighborhood rituals: sharing big pots of red beans and rice or playing dominoes on old-time porches or walking to the 'snowball' stand at dusk (Brinkley, 2006, p. 257).

Social cohesion and strong family-based networks sustained the residents of these communities. Unfortunately, the storm not only destroyed these communities' infrastructure (such as churches, businesses, housing and schools) but also this populations' collective fabric.

When Katrina hit the Louisiana coast, it was the third strongest hurricane on record to make landfall in the US. In New Orleans, the storm surge overpowered the levee system, causing breaches that flooded 80 per cent of the city. The major levee breaches in New Orleans

included those at the 17th Street and the London Avenue Canals, and the wide, navigable Industrial Canal (Comfort, 2006). These breaches flooded an estimated 77 per cent of the city (Gabe et al., 2005). Many New Orleans residents who did not evacuate prior to the storm found themselves trapped by the rising waters. These were mostly poor African Americans, including children, the disabled and the elderly. Most were either eventually rescued or they managed to escape by their own means, often by wading through contaminated floodwater and other dangerous debris. Many of these residents sought shelter at the Superdome or the New Orleans Convention Center. Others never made it to these facilities, but found relief from the flood on interstate overpasses and bridges. At all of these locations, people spent days after the storm in overcrowded and unsanitary environments with little food, water or relief from the summer heat. By 4 September, almost a week later, these makeshift shelters were dismantled and storm victims were transported to other cities, including Houston (Wang et al., 2007, 2008).

Substance use and disaster research

Studies on disaster victims have found that changes in substance abuse vary from small decreases to moderate increases among diverse populations. For instance, research following Hurricane Andrew of August 1992 found only two per cent of area residents reporting alcohol dependence (David et al., 1996). Among flood and mudslide victims in Puerto Rico, researchers discovered no rise in symptoms of alcohol use, even after controlling for exposure (Bravo et al., 1990). Researchers also found modest decreases in alcohol consumption after 11 September 2001 among a national sample of employed adults (Knudsen et al., 2005). In a study of the January 1995 Great Hanshin Earthquake in Japan, researchers discovered that the quantity of alcoholic beverages consumed in both the heavily damaged areas as well as throughout the prefecture fell from the pre-disaster level and that this decline was sustained two years later (Shimizu et al., 2000). A rapid assessment study conducted on a sample of 163 illicit opium users two weeks after the December 2003 Bam earthquake in Iran documented a reduction in opium drug use that was attributed to a fall in the availability of opium (Movaghar et al., 2005).

Other investigators found increases in alcohol, tobacco and marijuana consumption after the events of 11 September 2001. Vlahov et al. collected data using a random digit dialling procedure from Manhattan residents between five and eight weeks after the attacks (Vlahov et al., 2002). Analyses of pre and post-11 September revealed that approximately 27 per cent of respondents reported consuming more alcohol, tobacco or marijuana in the six month after the disaster than before it (Vlahov et al., 2004). Among New York City residents five months after 11 September, six per cent reported increased alcohol use (Boscarino et al., 2004). In yet another study, a major bushfire in Canberra, Australia, in January 2003 was found to have triggered increased tobacco use among young adults (Parslow and Jorm, 2006).

Few studies have specifically examined the complex relationship between the degree of disaster-related exposure and patterns of substance use. Among the aforementioned Manhattan sample, researchers found no significant differences in patterns of substance use between those directly affected by the 11 September events and those not directly affected (Vlahov et al., 2004). However, there has been no systematic evaluation of the consequences of level of exposure to the disaster, resource and social support loss and post-disaster substance use patterns. The absence of knowledge in this field exists despite recognition that within a disaster, factors such as resource loss mediate post-disaster outcomes such as psychological distress and physical symptoms (Smith and Freedy, 2000). Moreover, these studies indicate that one should place more attention on interaction between the social and cultural characteristics of the groups experiencing the disaster (that is, age, culture, religion and social class, among other variables). Lastly, one should consider macro contextual

factors before reaching conclusions about the relationship between changes in drug and alcohol use patterns and disasters.

Explaining Hurricane Katrina evacuee substance use patterns with a multivariate risk factor model

There is some literature describing the impact of disasters and other traumatic events in different countries (Iran, Japan and Puerto Rico). This research clearly suggests that specific cultures, histories, traditions and context may explain different disaster response styles and outcomes (Adams and Boscarino, 2005; Galea et al., 2004; Norris et al., 2001; Palinkas et al., 1992; Perilla, Norris, and Lavizzo, 2002). There is limited research specifically on how disasters differentially affect ethnic minorities in the US and other countries. For instance, Norris (1992) discovered levels of stress following traumatic events to be higher among African Americans compared to the general population. The differential levels of stress exhibited were found to be associated with the African American populations' degree of disaster exposure, economic status and experiences of discrimination.

In the Buffalo Creek study of 1972, for example, black men were less traumatised but exhibited a delayed-onset of Post-Traumatic Stress Disorder (PTSD) (Gleser et al., 1981). The limitation of this study was that it was not restricted to disasters but also included other traumatic events. However, the racial homogeneity of the Katrina evacuee population provided a unique opportunity for a comprehensive study of the relative risks and substance use outcomes among African Americans. We hypothesised that this population would be more vulnerable to post-disaster substance use increases given its lack of economic resources, severity of exposure and involvement in substance use and other risk behaviours prior to the storm. Moreover, this population is also more likely to be dependent on the public sector services that are often most disrupted during disasters.

This paper presents the results of an analysis using a multivariate risk factor (MRF) model to predict changes in substance use patterns before and after the hurricane among a distinctive low income, inner city, drug using population of African American Katrina evacuees from New Orleans. The model has been used in the past to predict mental health outcomes following natural disasters and is based on three broad categories of risk factors (pre-, within- and post-disaster).² Using a modified version of the MRF model, this analysis examines and identifies the relationships between patterns of increased and decreased alcohol and tobacco (AT) use and illicit drug (ID) use after Katrina and pre- and within-disaster risk factors (Freedy et al., 1992; Norris et al., 1999). Moreover, the study pinpoints independent factors associated with increases and decreases in alcohol/tobacco and illicit drug use among a sample of drug using evacuees living in Houston.

Materials and methods

Procedure and sample

Quantitative and qualitative data from semi-structured interviews with 200 Katrina evacuees currently living in Houston—part of an ongoing drug-abuse study—was collected between July 2006 and January 2007 using an adaptive sampling methodology (Thompson and Collins, 2002; Thompson and Seber, 1996). Supplemental in-depth ethnographic interviews also were held with evacuees. The sampling methodology included a combination of several techniques employed by the authors in prior studies of community samples of substance

²Pre-disaster factors include demographic characteristics, history of past exposure to traumatic events and pre-existing resources. Within-disaster factors refer to the objective nature of disaster exposure and subjective perceptions of the event. Post-disaster factors are those that occur in the weeks or months after the disaster.

users (Heckathorn, 1997; Heckathorn, Broadhead and Sergeyev, 2001; Yin et al., 1996). A sample of 26 Houston apartment complexes participating in the Housing Voucher Program was drawn at random from developments ($n = 143$) in two geographic regions known to have the highest concentration of evacuees. Persons eligible for the study were those living in one of the Katrina-affected areas, reporting substance use six months prior to and/or post Katrina, and/or in drug treatment six months prior to Katrina, more than 18 years but not older than 65, and currently living in the Houston metropolitan area. The Internal Review Board of the University of Houston approved the study. The sample was predominantly African American (98 per cent), and male (60 per cent), with an average age of 32. More than one-half of the sample did not graduate from high school (60 per cent) and was unemployed (65 per cent). Approximately 90 per cent of the sample stated that their home was 'demolished' or in a condition described as 'unable to live in'. More than 63 per cent reported that they did not leave the city before the hurricane.

Measures

The 1.5-hour interview was administered in-person to the respondents in the field. The interview instrument collected socio-demographic information and included established scales used in disaster research. Our study utilised the following *pre-disaster* measures:

- *Socio-demographics*: these variables included age, education, gender, income before Katrina, lifetime parole/probation, marital status and number of children.
- *Process of evacuation*: a single item was used to assess the respondent's evacuation process. Respondents were asked if they left the city before Katrina and the responses were coded as no = 0 or yes = 1.
- *Lifetime traumatic event exposure*: the Traumatic Stress Schedule (TSS) was employed to assess exposure to other potentially traumatic life events (Norris et al., 1999). The TSS evaluates exposure to nine traumatic events: fire, motor vehicle accident, physical assault (with and without a weapon), sexual assault, robbery, tragic death, other disaster and other hazard. Dichotomous responses were scored as 0 = unexposed and 1 = exposed and summed to obtain a total composite score.

This analysis used the following *within-disaster* measures:

- *Disaster-related exposure*: respondents were asked about the degree of exposure to the disaster using three modified measures of severity of exposure identified by prior research (Freedy et al., 1992; Freedy, Kilpatrick and Resnick, 1993; Norris et al., 1999). Threat to life was gauged by the following question: 'Did you ever feel like your life was in danger during the hurricane?' (0 = no, 1 = yes). Injury was measured by enquiring as to whether respondents or any member of their household were injured as a direct result of the hurricane (0 = no, 1 = yes). Finally, property damage was measured using a six-point scale from 0 = no damage to 6 = demolished. An overall composite score variable was created that ranged from zero to eight.
- *Resource loss*: resource loss was appraised using a 19-item Resources Questionnaire adapted from a 52-item scale designed to measure resource loss following a natural disaster (Freedy et al., 1992). The scale measures both internal and external resources by asking participants to rate the extent of loss of each resource since the hurricane (0 = no loss to 3 = quite a bit of loss). Resource loss includes such items as feeling that you have control over your life, a sense of optimism, feeling independent, a daily routine, time with loved ones, and time for adequate sleep. An overall composite score variable was created from a cumulative count of these 19 individual items (range = 0–57).

The following outcome measures were constructed:

- Alcohol and tobacco and illicit drug increase and decrease: self-reported substance use data were collected for alcohol, barbiturates, cocaine, crack, ecstasy, marijuana, sedatives, tobacco and tranquilisers. While there has been some concern regarding the accuracy of such information, it has been found to show good reliability and validity in reporting substance use behaviours in previous research (McElrath et al., 1994; Neaigus et al., 2001). Participants were asked first if they had ever used each of the substances before the hurricane and if so, how frequently they had done so 30 days before the storm. We then enquired as to whether they had used the substances since Hurricane Katrina and if so, how often in the past month from the time of interview. For the 30-day time frame, 10 fixed categorical choices were provided ranging from 'none' to '10 or more times a day, almost everyday'. Substance use 30 days before and 30 days since the interview were used to determine four distinct patterns of use—new use, increased use, stable use, and decreased use—following the conventions employed in the Manhattan study. For the purpose of this analysis, outcome measures for both increased and decreased AT and ID use were constructed. Increased users included 'new users' who started to use only after the hurricane.

Analysis

Frequencies were calculated for socio-demographics, pre-disaster, within-disaster, and the substance use increase and decrease outcome variables. Univariate logistic regression was employed to compare the theoretically ascertained risk/protective group with the comparison group for the AT and ID outcomes. Odds ratios (OR) were calculated that included 95 per cent confidence intervals (CI). Significant associations between AT and ID use and the contributing factors were determined by Pearson chi square test at a 0.05 or less level of significance. To test for the adjusted influence of significant factors associated with patterns of increases and decreases in AT and ID use, four separate multivariate logistic regression analyses were conducted. Contributing factors included in the multivariate models were those found to be associated ($p < 0.10$) with AT and ID use increase and decrease, respectively, by the Pearson chi square test. For each factor entered in the multivariate logistic regression model, adjusted odds ratios (AOR) and 95 per cent CIs are reported. The qualitative data were used to deepen the interpretation of the quantitative results.

Results

Prevalence of substance use

Overall lifetime prevalence pre Katrina ranged from 82 per cent for marijuana and 76 per cent for alcohol and tobacco to 18 per cent for ecstasy, crack and cocaine. Table I presents the prevalence of use of different substances 30 days before Katrina and the percentage of increased use (including new users) after Hurricane Katrina for each substance. Seventy-one per cent and 68 per cent reported using tobacco and alcohol, respectively, during the 30-day period before the storm. For illicit drugs, marijuana was the most widely reported at 74 per cent. The next highest, yet substantially less at 16 per cent, was prescription drugs (tranquilisers, barbiturates and sedatives). Less than 15 per cent of the population reported ecstasy, crack and cocaine use. The highest proportion of respondents reporting increases in use after the disaster was for marijuana (34 per cent) followed by alcohol and tobacco (both with 29 per cent). Modest increases in the use of ecstasy (12 per cent) were reported while tranquilisers (seven per cent), crack (six per cent) and cocaine (four per cent) reflected smaller percentage increases. Although not shown, among those who increased their use, a pattern of daily use was found for 25 per cent of the tobacco users, 22 per cent of the marijuana users and 13 per cent of the alcohol users.

Patterns of use by substances

Figure 2 depicts the substance use patterns (new, increased, stable and decreased users) of respondents 30 days before Katrina compared to 30 days prior to the interview (post-Katrina). One of the most pronounced findings was the relatively large number of 'new users' of ecstasy. A 58-year-old male former crack user described how the combination of age, drug popularity and Federal Emergency Management Agency (FEMA) money contributed to the high incidence of ecstasy in the sample:

As a user, as a parent, as a father, as a street person I've seen people come to Houston and go to other habits. The younger generation didn't do what they call x-pills [ecstasy]. They was not popular with the younger generation. Now you got these younger generations, got FEMA money you see what I'm saying, even the youngsters – they got money, they making money. Now they selling and buying out here.

Conversely, a similar percentage of evacuees (36 per cent) reported a decrease in ecstasy use after the storm, reflecting a proportional distribution between new and decreased ecstasy users. Distinct variations in patterns of use were observed for other types of substances. For instance, patterns of use were similar for cocaine, crack and prescription drugs, with the majority of users reporting a decrease ranging from 57–72 per cent of the sample. Only a relatively small percentage of respondents characterised their use of these three types of drugs as new, increased or stable. Moreover, patterns of marijuana use after Katrina were somewhat proportionately distributed among increased, stable and decreased use, with 23, 37 and 27 per cent, respectively. Thirteen per cent of respondents identified themselves as new marijuana users after the storm. The largest percentage of stable patterns of use was among tobacco users with one-half of the respondents identifying as such. Finally, the majority of alcohol users reported decreased patterns (35 per cent), followed by stable (29 per cent), increased (28 per cent) and decreased use (seven per cent).

Qualitative data collected among the evacuees indicate that patterns of decreased use were often times attributed to hardships associated with living in Houston, including difficulties in acquiring drugs. A 23-year-old male polydrug use respondent described problems with his life here compared to disaster-stricken New Orleans:

So that's how I mostly been making it, but its always trials and tribulations you having to go through. You know what I'm saying, so you know it's still hard. Even though it ain't New Orleans it's still hard, it's like it's twice as hard out here. I really can't get out here and hustle [access drugs] like I want to.

Pre- and within-disaster factors

The univariate analysis (see Table 2) showed that men (OR = 0.52; CI = 0.29, 0.92) and older evacuees (OR = 0.53; CI = 0.30, 0.93) were significantly less likely to have increased their AT use after Katrina. However, evacuees who left the city before the hurricane (OR = 1.91; CI = 1.07, 3.42) were nearly twice as likely to have increased their AT use after the disaster. This association is frequently illustrated in our qualitative data. A 38-year-old male in our study who was currently using crack expressed how social isolation and high resource loss contributed to his increased drinking after the disaster:

I got a little assistance from Red Cross. They give me \$360 on a debit card and that helped me a little bit. You know but I don't know nobody. I start getting high and then drinking. Seem like the drinking was all that everybody did. People that I ran across, I mean people that didn't drink in their life was now drinking.

One strong trend was observed for AT use increase: those with more education (OR = 1.72; CI = 0.97, 3.04) were more likely to have augmented their use. Other weaker trends were

found for not having children, lower income and high disaster-related exposure. The univariate analysis for rises in ID use revealed that those who left the city before Katrina were more than 1.5 times as likely to have increased their use (OR = 1.77; CI = 0.99, 3.16). A significant association also was found between resource loss and increased ID use: evacuees with high resource loss were almost twice as likely to have increased their ID use (OR = 1.98, CI = 1.08, 3.40).

Table 2 also identifies factors associated with decreases in AT and ID use. For instance, older evacuees were more likely to have decreased their AT (OR = 1.88; CI = 1.05, 3.38) and ID (OR = 1.80; CI = 1.03, 3.16) use. Moreover, those evacuees who reported having ever been on parole or probation were almost twice as likely to have decreased their ID use (OR = 1.81; CI = 1.03, 3.18). Of interest is that a negative association between within-disaster-related exposure and the likelihood of decreased use of AT (OR = 0.34; CI = 0.17, 0.67) was strong. In contrast, for ID (OR = 2.31; CI = 1.14, 4.70) use, evacuees characterised with high disaster-related exposure were more than two times as likely to have reduced their use after Katrina.

Factors associated with increases or decreases in substance use

In the multivariate logistic regression analysis (see Table 3), four variables were found to be independently associated with rises in AT use. The odds of AT use increase were higher among individuals with more education (AOR = 2.10; CI = 1.14, 3.87). Men (AOR = 0.47; CI = 0.25, 0.86) were less likely to have increased AT use. Older evacuees (AOR = 0.49; CI = 0.27, 0.89) were also less likely to have increased AT use after the disaster. In addition, a trend was discerned for those who left the city before Katrina (AOR = 1.74; 0.94, 3.20). For ID use, those who left the city before Katrina (AOR = 1.83; 1.01, 3.32) were more than 1.5 times as likely to have augmented their use. Similarly, those with high resource loss were twice as likely to have increased ID use (AOR = 1.99; CI = 1.11, 3.55).

Several factors were identified as being independently associated with decreases in AT and ID use after the disaster (see Table 3). Decreased AT use was more than twice as likely to occur among the older group of evacuees (AOR = 2.18; CI = 1.18, 4.05]. Concomitantly, although only a trend, this same older age group was found to be more than 1.5 times as likely to have decreased ID use (AOR = 1.64; CI = 0.92, 2.92). The most significant variable associated with both decreased AT and ID use was disaster-related exposure. That is, those evacuees who were highly exposed to the disaster were less likely to have reduced their AT use (AOR = 0.29; CI = 0.14, 0.59). However, this similarly highly exposed evacuee population was twice as likely to have decreased ID use (AOR = 2.04; CI = 0.99, 4.21). The account of a 28-year-old female drug addict with disaster exposure illustrates the link:

Okay my life before I left New Orleans like I said was bad. Had a bad life as far as with the drugs. I think if that had never happened [the hurricane], I probably wouldn't be where I'm at now. You know, in my own little place and my life together. I'm off of drugs you know what I'm saying, I wouldn't be like this here, I'd still be doing the same thing.

Discussion

Our results are among the first to focus on changing substance use patterns among disaster victims comprised of economically disadvantaged urban African Americans. This disaster population was highly vulnerable to post-disaster drug and alcohol use since its selection was based on previous drug use characteristics. A large proportion of this population of New Orleans residents lacked the resources and social capital to leave the area before the storm and to recover losses afterwards. Moreover, the fact that most of the study respondents were

from New Orleans' neighbourhoods that were the poorest and experienced the worst flooding made them highly susceptible to social trauma and psychological distress. Lastly, this population was the least likely to return to New Orleans and as of August 2008, nearly three years later, most of these people have a diaspora existence, rebuilding their lives in unfamiliar cities and towns throughout the US.

An overall moderate *increase* in substance use was found among this population of displaced low income and substance using disaster victims, replicating the findings of other studies of large-scale disasters (Dew and Bromet, 1993; Green et al., 1990; Marmar et al., 1999; Rubonis and Bickman, 1990; Smith et al., 1999; Stein et al., 2004; Vlahov et al., 2002; Vetter et al., 2008). This finding is in contrast to previous disaster studies drawn from general populations which have found smaller or no increases in use (Clayer, Bookless-Pratz and Harris 1985; Palinkas et al., 1993; Smith et al., 1999). Specifically, our data revealed that those with the strongest attachment to this community, such as women, young adults and individuals with higher education, were at elevated risk of increasing their alcohol and tobacco use. We tentatively conclude that some of our disaster survivors may have increased their alcohol and tobacco use as a coping mechanism to 'adjust to and overcome loss' during the recovery period, suggesting a short-term normative adaptation (Freedly, Kilpatrick and Resnick, 1993, p. 50; Pfefferbaum and Doughty, 2001; Vetter et al., 2008).

Our analysis also revealed an association between leaving the city before Hurricane Katrina and *increased illicit drug use*. We surmise that those who left had comparatively more monetary resources, social capital and transportation to depart before the impending storm (Brezina, 2008). More important, many may have had friends and relatives outside the storm's vicinity that would provide refuge. Assuming that friends and relatives had the same characteristics as the evacuees, this would have kept the availability of illicit drugs and other substances relatively stable. Findings also confirm that the within-disaster risk factor of cognitive appraisal of resource loss accounted for increased illicit drug use. This perceived loss may be reflective of this population's emotional and social attachment to the poor and working-class neighbourhoods that they were forced to abandon.

Our analysis of patterns of *decreased use* found this variable to be highly associated with disaster-related exposure. That is, evacuees who were highly exposed to the events of the disaster reduced their use of illicit drugs. Prior disaster research has shown that differential exposure among minorities is associated with specific psychological responses that are related to the cultural context (Norris et al., 2002; Perilla, Norris and Lavizzo, 2002). The cultural context of diasporas in our population may be forcing those respondents who were more highly exposed to the disaster to adapt to their changing social environment by decreasing their illicit drug use. This context-related adaptive process may parallel the post-traumatic growth that resulted in the reduction of psychological symptoms in other studies of Katrina evacuees (see, for example, Kessler et al., 2006). Future research needs to investigate the cultural mediators in this population that caused the more traumatically exposed evacuees to decrease their illicit drug use in Houston.

Overall patterns of substance use among the drug using Katrina evacuees may be related to the disruption of and lack of accessibility to the illicit drug market in New Orleans and exposure to new drug market opportunities in Houston. The majority of respondents described easy availability of drugs in their home communities in New Orleans. Neighbourhood-based dealers sold many of these drugs in a market that was familiar to most drug users. This is not the situation in metropolitan Houston, where drug-using evacuees were abruptly placed in large inhospitable apartment complexes with no knowledge of the local drug market. This may explain why this population had a higher percentage of increased tobacco, alcohol and marijuana use compared to others drugs, especially crack,

which was popular among New Orleans hard drug users (Zhang, 2003). The rise in marijuana use in our population may be also a reflection of the easy availability of this drug in Houston. Moreover, the presence of Mexican-origin dealers in the apartment complexes where evacuees were placed contributed to the accessibility of marijuana. The relatively large percentage of new users of ecstasy may be also related to greater availability of this drug in Houston compared to New Orleans (Maxwell, 2005). It will be interesting to see how drug use patterns change for this population as it becomes more socially familiar with the Houston drug market.

Lastly, substance use patterns among the Katrina sample compared to those among other drug-using disaster populations, such as in Miami and New York, may be best explained by the fact that the lives of the latter were not as disrupted by events as those of the New Orleans Katrina evacuees (Galea et al., 2002; Norris et al., 1999). For instance, even though the post-11 September 2001 context involved developments such as the closing of US borders, restricted public travel, limited public gatherings and the bombing of Afghanistan, these events had little impact on the daily lives of most New York City drug users (Factor et al., 2002). In contrast, thousands of Katrina evacuees were suddenly and permanently dislodged from their homes and neighbourhoods by the aftermath of the storm. The neighbourhoods most devastated by the hurricane were those where New Orleans' poorest citizens resided. Moreover, as in other disaster studies, Katrina African American evacuees were more traumatised than their white counterparts in New Orleans, as evidenced by our qualitative data (Perilla, Norris and Lavizzo, 2002).

Conclusion

Our study has begun to identify the distinct trajectories of substance use after a natural disaster such as Katrina. We were able to document substantial increases in substance use in this vulnerable population that will create both public health and public safety problems in the future. In doing so, we identified a poor inner city population that was at greatest risk during the disaster situation and was highly dependent on public sector services. The findings from this research point to the importance of developing public health disaster policies that specifically target substance-using populations in need of special drug treatment services (Wang et al., 2007, 2008). For example, pre-disaster drug treatment services may require flexibility in transferring services for individuals relocated to new locations after disasters. These services would also meet the needs of those former drug users who may have relapsed or developed more severe substance use because of disaster-related events. Lastly, the study identifies the importance of anticipating these disasters and the need for a disaster preparedness plan that consists of an interstate infrastructure for providing treatment for disaster victims.

Our findings need to be interpreted with caution in that certain relationships between risk and outcome, as well as the prevalence of symptoms, may be conditioned by post-disaster time and other factors. Our research focused on an intermediate period 8–14 months after the disaster while the Manhattan study collected data at more immediate periods. In addition, our study was limited to only one post-disaster measuring point. The general rule stated in reviews of the literature is that samples of disaster victims tend to improve as time passes. We employed also a lifetime prevalence of traumatic stress measure while previous studies, such as that of Vlahov et al. (2002), used a past-year measure. These differences in the retrospective time assessment of pre-disaster factors also may produce differences in their relationships to current post-disaster outcomes. Another limitation in our study was the relatively small sample size. We found a number of statistical trends in our data that may prove to be meaningful with a larger sample. For instance, disaster-related exposure may indeed emerge as a significant within-disaster risk factor for alcohol and tobacco use.

A final limitation of the analysis is the lack of testing of causal hypotheses. Research has suggested that gendered pathways exist among pre- and within-disaster risk factors and post-disaster behaviours (Brezina, 2008). To explore this supposition, we conducted a post hoc correlation analysis of the pre- and within-disaster risk factors.³ This post hoc analysis, along with our main findings, suggests that there may be gender- and age-specific causal pathways that influence post-disaster substance use patterns. These pathways should be investigated in future research using more elaborate multivariate statistical techniques on larger samples. Furthermore, future research should explore how within-disaster risk factors might lead to turning points in post-disaster substance use trajectories (Hser et al., 2007).

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³We found a significant correlation between pre-storm evacuation and female gender (Kendall Tau = -0.156, $p < 0.05$). Female gender was also associated with higher resource loss (Kendall Tau = -0.146, $p < 0.05$), a key within-disaster factor, but not with disaster-related exposure. Higher age also exhibited a significant positive correlation with resource loss (Kendall Tau = 0.214, $p < 0.01$).

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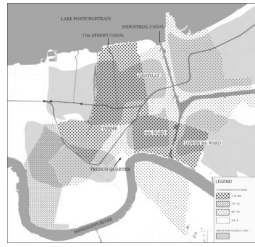


Figure 1.
Severe flooding areas and residence of New Orleans Katrina evacuee respondents

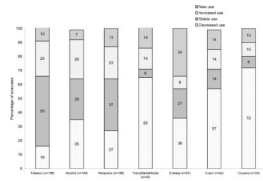


Figure 2. Substance use patterns 30 days prior to interview after Katrina among Houston evacuees

Table 1

Prevalence (%) of substance use and changes in use before and after Hurricane Katrina (n = 200)

Substance	30 days before Katrina * n (%)	Percentage increased use after Katrina ** n (%)
Tobacco	141 (71)	58 (29)
Alcohol	135 (68)	58 (29)
Marijuana	148 (74)	68 (34)
Tranquilisers/barbiturates/sedatives	31 (16)	14 (7)
Ecstasy	25 (13)	23 (12)
Crack	25 (13)	12 (6)
Cocaine	19 (10)	8 (4)

Notes:

* Number and percentage of respondents who used the substance 'within 30 days' before Katrina.

** Percentage of respondents who increased substance use 30 days prior to being interviewed compared with 30 days before Katrina. This percentage includes respondents who used the substance 30 days before Katrina and increased their frequency of use 30 days prior to the interview and those who were not using the substance before Katrina and reported use after Katrina (new users).

Table 2

Pre- and within-disaster factors, odds of increased/decreased AT and ID use Katrina among drug-using evacuees in Houston

Factor	N (%)	Increased use					Decreased use						
		AT (row %)	AT OR (95% CI)	P	ID (row %)	ID OR (95% CI)	P	AT (row %)	AT OR (95% CI)	P	ID (row %)	ID OR (95% CI)	P
PRE-DISASTER													
Gender													
Women	80 (40)	54	1.00	-	51	1.00	-	39	1.00	-	46	1.00	-
Men	120(60)	38	0.52 (0.29, 0.92)	0.02	43	0.73 (0.41, 1.28)	0.27	35	0.85 (0.47, 1.53)	0.59	48	1.09 (0.62, 1.92)	0.77
Age													
18-28	100 (50)	52	1.00	-	50	1.00	-	29	1.00	-	40	1.00	-
29-58	99 (50)	36	0.53 (0.30, 0.93)	0.03	43	0.77 (0.44, 1.34)	0.35	43	1.88 (1.05, 3.38)	0.03	55	1.80 (1.03, 3.16)	0.04
Education													
≤ High school	117 (59)	39	1.00	-	46	1.00	-	39	1.00	-	50	1.00	-
≥ High school graduate	83 (41)	52	1.72 (0.97, 3.04)	0.06	47	1.03 (0.59, 1.81)	0.91	33	0.74 (0.41, 1.34)	0.33	43	0.75 (0.43, 1.33)	0.33
Children													
No	54 (27)	52	1.00	-	41	1.00	-	28	1.00	-	48	1.00	-
Yes	146 (73)	41	0.65 (0.35, 1.21)	0.17	49	1.38 (0.73, 2.59)	0.32	40	1.71 (0.87, 3.39)	0.12	47	0.97 (0.52, 1.80)	0.91
Income before Katrina													
≤ 999	127 (64)	48	1.00	-	49	1.00	-	34	1.00	-	50	1.00	-
≥ 1,000	73 (36)	37	0.64 (0.35, 1.15)	0.13	43	0.77 (0.43, 1.38)	0.39	41	1.36 (0.75, 2.47)	0.31	44	0.79 (0.45, 1.41)	0.43
Marital status													
Other	29 (15)	38	1.00	-	48	1.00	-	45	1.00	-	52	1.00	-
Single	170 (85)	45	1.32 (0.59, 2.97)	0.50	47	0.95 (0.42, 2.05)	0.86	35	0.67 (0.30, 1.49)	0.33	47	0.83 (0.38, 1.83)	0.64
Lifetime parole/probation													
No	108 (54)	48	1.00	-	44	1.00	-	33	1.00	-	41	1.00	-
Yes	92 (46)	39	0.69 (0.39, 1.22)	0.20	50	1.30 (0.74, 2.27)	0.36	40	1.35 (0.76, 2.40)	0.31	55	1.81 (1.03, 3.18)	0.04
Left city before Katrina													
No	126 (63)	38	1.00	-	41	1.00	-	38	1.00	-	50	1.00	-

Factor	Increased use						Decreased use						
	N (%)	AT (row %)	AT OR (95% CI)	P	ID (row %)	ID OR (95% CI)	P	AT (row %)	AT OR (95% CI)	P	ID (row %)	ID OR (95% CI)	P
Yes	74 (37)	54	1.91 (1.07, 3.42)	0.03	55	1.77 (0.99, 3.16)	0.05	34	0.83 (0.46, 1.51)	0.54	43	0.76 (0.43, 1.36)	0.36
Lifetime traumatic event exposure total score													
Low	92 (48)	46	1.00	–	47	1.00	–	39	1.00	–	44	1.00	–
High	101 (52)	44	0.92 (0.52, 1.62)	0.77	49	1.07 (0.61, 1.89)	0.81	35	0.83 (0.46, 1.48)	0.52	51	1.33 (0.75, 2.34)	0.33
WITHIN-DISASTER													
Disaster-related exposure total score													
Moderate	44 (22)	34	1.00	–	52	1.00	–	57	1.00	–	32	1.00	–
High	156 (78)	47	1.70 (0.85, 3.42)	0.13	45	0.74 (0.38, 1.45)	0.39	31	0.34 (0.17, 0.67)	0.00	52	2.31 (1.14, 4.70)	0.02
Resource loss total score													
Low	113 (57)	41	1.00	–	40	1.00	–	37	1.00	–	46	1.00	–
High	84 (43)	49	1.39 (0.79, 2.45)	0.26	56	1.92 (1.08, 3.40)	0.03	37	0.99 (0.55, 1.77)	0.97	48	1.07 (0.61, 1.88)	0.82

Table 3

Multivariate logistic regression analysis of factors associated with AT and ID increases and decreases after Katrina among drug-using evacuees in Houston

Factor	Increased use			Decreased use		
	AT AOR (95% CI)	p	ID AOR (95% CI)	p	AT AOR (95% CI)	ID AOR (95% CI)
Gender						
Women	1.00	-	-	-	-	-
Men	0.47 (0.25, 0.86)	0.02	-	-	-	-
Age						
18-28	1.00	-	-	1.00	-	1.00
29-58	0.49 (0.27, 0.89)	0.02	-	2.18 (1.18, 4.05)	0.01	1.64 (0.92, 2.92)
Education						
≤ High school	1.00	-	-	-	-	-
≥ High school graduate	2.10 (1.14, 3.87)	0.02	-	-	-	-
Left city before Katrina						
No	1.00	-	1.00	-	-	-
Yes	1.74 (0.94, 3.20)	0.08	1.83 (1.01, 3.32)	0.05	-	-
Resource loss total score						
Low	-	-	1.00	-	-	-
High	-	-	1.99 (1.11, 3.55)	0.02	-	-
Lifetime parole/probation						
No	-	-	-	-	-	1.00
Yes	-	-	-	-	-	1.55 (0.87, 2.77)
Disaster-related exposure total score						
Moderate	-	-	-	-	1.00	-
High	-	-	-	-	0.29 (0.14, 0.59)	2.04 (0.99, 4.21)
					0.00	0.05