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Vicarious Exposure to Terrorist Attacks and Substance Use: Results from an Urban Household Survey

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ABSTRACT *This study investigated the impact of the 9/11 attacks on substance use in Chicago, Illinois. The study design was a cross-sectional, audio-computer-assisted self-interview survey conducted in 2001 and 2002. Biological samples were also collected for toxicological analyses. Using a multistage area probability design, residents between the ages of 18 and 40 years were randomly selected. Compared to pre-9/11 interviewees, post-9/11 interviewees showed significantly less self-reported marijuana use, marijuana use per test results, and cocaine use per test results. Law enforcement and social–structural explanations for the findings are discussed.*

KEYWORDS *Substance use, Disasters, Epidemiology, Terrorist attacks, PTSD*

INTRODUCTION

Traumatic events and exposure to disasters can have profound effects on mental health, including posttraumatic stress disorder (PTSD) and drug and alcohol use.[1,2] The terrorist attacks on New York City and Washington, DC in September of 2001 had severe effects on the mental health of those living in the areas within and directly peripheral to the epicenter of these attacks. In the weeks after the attacks, people living in these areas showed high rates of stress-related symptomatology.[3–7] Additional signs of posttraumatic psychopathology were also documented, including increases in visits to health clinics for stress, anxiety, and adjustment reaction,[7] alcohol, tobacco, and marijuana use,[3–5] and PTSD symptomatology.[4,6,8]

Several studies focusing specifically on the relationship between exposure to disasters and post-disaster substance use have produced varied findings. Among survivors of the Oklahoma City bombing, most of those with pre-disaster alcohol and substance use disorders reported these disorders as "inactive" after the bombing.[9] Smith et al.[2] found that the degree of exposure to a disaster, and not histories of dependency, had a significant effect on post-disaster alcohol or substance abuse among hotel employees after a plane crash that killed ten people inside of the hotel. With respect to the September 11th terrorist attacks specifically, several studies have found strong evidence of increases in substance abuse and related symptomatology after 9/11. Vlahov et al.[4] found significant increases in self-

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reported tobacco, alcohol, and marijuana use among New York City residents after the September 11th attacks. Cohen et al.[10] found that while the effects of post-disaster psychopathology were greatest among those living near New York City at the time of the September 11th attacks, post-disaster PTSD and depression increased in other areas dislocated from New York City. Ample research has demonstrated a strong association between PTSD and substance abuse disorders,[2,11–14] and it is noteworthy that several reports in addition to the study of Cohen et al. have documented increases in stress and emotional distress in areas outside of New York and Washington, DC after 9/11[15]; however, research examining the link between 9/11 and substance use in a population with only vicarious experience of the 9/11 attacks is scarce.

Post-Disaster Substance Use

A majority of the research concerning the relationship between exposure to disasters and substance abuse suffers from two key deficits. The first relates to the difficulty in obtaining baseline data in studies of post-disaster substance use behavior. As traumatic events are impossible to predict, baseline data are difficult to obtain, making comparisons between pre-disaster use and post-disaster use complicated. In place of baseline data, self-reports estimating pre-disaster use are often substituted for the purposes of making comparisons. The potential for bias, however, makes this approach less than desirable. A second deficit is that post-disaster substance use research often focuses on populations in or near the epicenters of areas directly affected by traumatic events.

Several studies have addressed these issues by emphasizing data that allow for comparisons against a baseline, or focusing on populations dislocated from the epicenter of the event, but rarely have these issues been addressed in tandem. Creson et al.[16] used data from self-reports collected after the September 11th attacks and found that substance abuse patients at a Houston outpatient facility demonstrated higher rates of PTSD symptomatology and substance use after the September 11th attacks compared to clinical faculty and staff. Zywiak et al.[5] observed increases in relapses among a sample of 12 recovering alcoholics within 250 miles of the World Trade Center. Here, baseline data were available but for a very small group of individuals. Additionally, this study was carried out using participants located near the epicenter of the September 11th attacks and cannot enhance our understanding of the impact that disasters have on populations removed from the epicenter of traumatic events.

In their study on alcohol use and work stressors at a Midwestern university, Richman et al.[17] found elevated drinking behavior among women (but not men) surveyed after the September 11th attacks compared to those surveyed pre-9/11. Perrine et al.[18] examined the relationship between 9/11 and stress, emotional distress, and alcohol consumption among 127 self-reported drinkers enrolled in an on-going study in Vermont. This study focused on data provided by the sample between September 11, 2000 and December 30, 2001, which allowed for baseline comparisons of post-event alcohol use and emotional well-being. The authors found that alcohol consumption temporarily increased among both men and women on September 11th, 2001 and then returned to levels that were comparable to the average alcohol consumption of the past year. These studies are exceptions to the short-comings discussed previously in that baseline data were available and the studies were carried out far away from the World Trade Center. Two key weaknesses in these

studies concern (1) the exclusive focus on alcohol use and (2) the dependence on self-reports of substance use which may risk respondent bias.

The current study aims to address the previously discussed shortcomings in the literature concerned with post-disaster substance use by (1) using both self-reports and toxicological analyses of drug and alcohol use drawn from a population relatively distant from the epicenter of a major disaster—the 9/11 terrorist attacks; (2) comparing substance abuse among respondents interviewed after a disaster to those interviewed before the disaster (a baseline group); and by (3) providing generalizable findings through the use of data drawn from a household survey. Based on our review of the literature concerning substance use within and outside of areas directly affected by traumatic events, we hypothesize that respondents from our study sample interviewed after vicariously experiencing the September 11th attacks will show no change in their consumption of alcohol and other substances, as indicated by self-reports and toxicological analyses.

METHODS

Sample

Data used for this study came from a survey of English-speaking adults who resided in the City of Chicago. The survey was conducted from June 2001 to January 2002. Residents between the ages of 18 and 40 years were selected randomly to participate in a household drug use survey using a multistage area probability design.[19] At stage 1, census tracts in Chicago were selected randomly. At stage 2, one block was selected randomly from within each sampled tract. At stage 3, every household on the sampled block was screened for eligibility. At stage 4, one 18- to 40-year-old adult was selected at random from within each eligible household.[20]

A total of 627 surveys were completed. We used American Association for Public Opinion Research definitions for response rates (formula 3) and cooperation rates (formula 1).[21] According to this definition, the response rate is the number of completed interviews divided by the eligible sample. The cooperation rate is the number of completed interviews divided by the sum of the number of completed interviews and the number of refusals. Note that because those in the eligible sample included potential subjects who were never contacted by the interviewers despite repeated attempts, the response rate tends to be lower than the cooperation rate. Accordingly, the overall response and cooperation rates for this study were 40% and 74%, respectively. These rates reflect the challenges of conducting survey interviews in urban environments where response rates tend to be lower for many reasons.[22] When restricted-access, high-rise apartment buildings are excluded from consideration, the comparable response and cooperation rates were 51% and 75%, respectively.

Sample Characteristics

Using weighted sample estimates, 42.8% of the sample were between ages 18 and 25, 25.5% were between the ages of 26 and 30, and 31.8% were more than 31 years old (with the maximum age of 40 years). African Americans comprised the modal race/ethnicity group, comprising 35.6% of all respondents; about one third (33.2%) were white, 22.1% were Hispanic, and 9.2% were classified as “other”. By design, approximately one half of the weighted sample was female.

Survey

Surveys were administered in the home by trained interviewers from the University of Illinois at Chicago Survey Research Laboratory using audio computer self-interview procedures. Although the vast majority of subjects (90%) self-administered the substance use questions, subjects could also opt to have their questions administered by the interviewer. The study was approved by the University of Illinois at Chicago Institutional Review Board. Quality control activities included re-contacting randomly selected respondents to verify interview and specimen collection activities.

Drug Testing

Immediately after the drug assessment portion of the survey, subjects were asked to consent to participate in saliva and urine drug testing procedures and were offered either $10 or $20 for each sample provided depending on random assignment. The strengths and limitations of each of these procedures are articulated clearly by Wolff et al.[23] Of particular importance from an epidemiological perspective is that while the methods are generally consistent with respect to the types of substances they can detect, they vary with respect to their typical windows of detection, with oral fluid having the shortest (most drugs are detectable within 12–24h of use).[24,25] Urine testing typically has a window of detection of around 72h for some substances (cocaine), although marijuana can be detected several weeks after use if the use is chronic.[24] Although hair testing was conducted during the data collection period, it was not used to confirm the use of illicit substances for the purposes of this paper; because we are interested in the effect that the September 11 attacks had on substance use, the long window of detection afforded by hair testing may capture pre-9/11 substance use among respondents completing their survey after September 11. Using either a saliva or urine test, with their shorter windows of detection, ensures the time–order relationship between September 11 and substance use (further information about the drug testing protocol and toxicological analyses are provided in greater detail elsewhere).[26,27]

Drug Test Participation

As reported previously, the overall consent rate for test participation was high (90%).[26] Test specific levels of consent, however, varied. Oral fluid test consent rates of 90% were close to the overall rate consenting in any test. The consent rate for urine testing was 76%.

Unforeseen variation in specimen quantity at the toxicological analysis stage resulted in lower rates of useable specimens. Essentially, we omitted from the final sample a subset of respondents who provided biological samples—largely saliva samples—of insufficient quantity.

After excluding respondents without past month substance use self-reports or valid toxicological testing results for *both* urine and oral fluid tests, we achieved an unweighted sample size of 447 respondents and a final weighted sample of 439. Analyses from a previous paper utilizing the same data suggests that compared with the rest of the sample, African Americans, females, and those of lower socioeconomic status (SES) were overrepresented in the subgroup employed in this study.[28]

Drug Test Concordance

Concordance refers to the amount of agreement between self-report substance use and drug test results. In the current sample, overall concordance rates are relatively high. A comparison of concordance by race/ethnicity presented in an earlier paper

using these data showed that rates varied from 90% to 99% for crack/cocaine and 87% to 100% for marijuana.[28]

Drug Use Classification

For the purposes of this paper, we employed the use of two indicators of substance use: self-reports of alcohol, marijuana, and crack/cocaine use and saliva or urine tests for marijuana and crack/cocaine use. Respondents testing positive for marijuana or crack/cocaine on *either* the saliva or urine tests were considered as positive cases for use of that substance, respectively, whereas respondents testing negative for use of a particular substance on *both* tests were considered as negative cases for use of that substance. Separate analyses were used for self-reports of alcohol, marijuana, or crack/cocaine use. Our self-report cocaine measure combines responses to questions about use of any cocaine (in which subjects were asked about their use of "any form" of cocaine) and to questions specifically about use of crack.

Survey subjects were asked questions about lifetime substance use, the timing of most recent use, and use frequency for a variety of licit and illicit substances following the format used in the 2000 National Household Survey on Drug Abuse.[29] Subjects also were asked how many days in the past month they had consumed at least one alcoholic beverage, how many drinks they consumed on the days they drank, and how many days they consumed five or more alcoholic beverages in the past month.

Key Measures

Substance Use Operational definitions of substance abuse are based on both biological testing results and self-reports for marijuana and crack/cocaine use. Self-reports of substance use include any use within 30 days before the interview date. While respondents in this survey were asked about use of a range of illicit substances, only marijuana and crack/cocaine occurred with enough frequency to permit statistical analyses. To remain consistent with the literature,[4,5,30] we also conducted analyses on self-reported alcohol use. We examined three dimensions of drinking behavior: number of days having consumed at least one alcoholic beverage in the past month, average number of drinks consumed per day drinking in the past month, and number of days where five or more drinks were consumed on a single occasion in the past month. We also compared the pre- and post-9/11 groups using two dichotomous measures of drinking behavior: (a) status as a "current drinker" (one who consumed at least one alcoholic beverage in the past 30 days) and (b) frequency of binge drinking (i.e., consuming five or more drinks in one sitting) in the past 30 days.

Post-Disaster Response Exposure to 9/11, a key explanatory variable used in these analyses, was derived from the interview date for each respondent. Respondents interviewed before 9/11 were assigned a value of "0" for this variable, while respondents interviewed after 9/11 were assigned a value of "1". Respondents' interview before 9/11 were treated as the reference group.

Socioeconomic Status Our measure of socioeconomic status is a continuous scale based on three individual measures assessed in the survey: employment status (a three-category measure gauging whether a respondent was "not employed," "employed part-time," or "employed full-time"), income (a five-category measure of household income, ranging from "US$ 10,000 or less" to "US$ 80,000 or

more"), and education (a four-category variable ranging from "less than high school graduate" to college graduate or higher"). Groves and Couper[22] suggest that employment, education, and income are the most salient indicators of SES for survey participation purposes. In addition, a factor analysis suggested that these three measures in our study loaded highly on a single factor. Based on this, we constructed an additive measure by summing the three component items; the sum of the three values yielded a continuous scale ranging in value from 2 to 11 (Cronbach's α = 0.68). For data analytic purposes, we subdivided this measure into "low," "medium," and "high" values, treating the "high-SES" category as the reference group based on the observed frequency distribution of scores. As 5% of the sample left the income question blank, we imputed SES values for these cases. In our imputation, subjects with missing income values were assigned to an SES group based on the observed mean SES value for each combined education and employment score for those with non-missing income values; thus, the imputation was conditional on a subject's education and occupational status.

Age, Race/Ethnicity, and Gender We examined the impact of age (coded into three categories: 18–25, 26–30, and 31+ years) and race/ethnicity on alcohol and substance use. We included four categories of race/ethnicity: African American, Hispanic, other, and white. The "other" category combined subjects who classified themselves as "American Indian or Alaskan native," "Asian/Pacific Islander," "multiracial," or "something else." Gender was also included in the analyses. For analytic purposes, we treated those 31 years and older, white, and male as the reference groups for these variables, respectively.

Children We were also interested in looking at the effect that the presence of children in the household had on alcohol and substance use. Respondents with one or more children in the household were coded as "1", and with no children, "0". Those with no children in the household are treated as the reference group for this variable.

Analytic Strategy

Cross-tabulation procedures were used to estimate differences between the pre- and post-9/11 groups with respect to self-reported substance use and positive cases of substance use via saliva or urine tests. We employed the use of *t* tests to identify differences in pre- and post-9/11 alcohol use. To identify the correlates associated with self-reported substance use and use detected through testing, separate binary logistic regression models were developed predicting self-reported marijuana and crack/cocaine use and substance use identified through positive drug tests. In each regression model, positive cases of self-reported substance use and use detected through testing were coded as "1", and "0" if otherwise. All analyses were based on weighted data, and standard errors were adjusted for design effects using Stata Version 9.[31] These standard errors take into account design effects, with primary sampling units taken as the block within which each selected household was situated. Procedures for bivariate, OLS regression, and logistic regression analyses were based on the Stata "svy" command.

RESULTS

As outlined in Table 1, our sample yielded fairly stable demographic characteristics moving from the pre-9/11 group to the post-9/11 group. The only significant

TABLE 1 Pre/Post 9/11 respondent characteristics

	Interviewed pre-9/11 (n = 266)		Interviewed post-9/11 (n = 173)	
Variable	Number	Percentage	Number	Percentage
Age				
18–25	111	41.7	78	45.0
26–30	72	27.2	40	23.3
31+	83	31.1	55	31.7
Race/ethnicity				
African American	120	45.3	57	33.0
Hispanic	60	22.7	37	21.1
Other	23	8.7	16	9.4
White	62	23.3	63	36.5
Gender				
Male	123	46.3	85	49.2
Female	143	53.7	88	50.8
SES				
Low	90	34.0	35	20.0
Medium	128	48.1	76	44.1
High*	48	17.9	62	36.0
Children present in household				
Yes**	183	68.8	75	43.5
No	83	31.2	98	56.6

Only cases with valid urine and oral fluid tests were included. Sample sizes are weighted and rounded to the nearest whole value; some percentage estimates may not add up to 100% due to rounding.

*$p < 0.05$, **$p < 0.01$

differences between the pre- and post-9/11 groups concern SES and the presence of children in the household: respondents from the post-9/11 group were more likely to report 'high SES' ($\chi^2_{df=1,42} = 4.81$, $p < 0.05$) and were less likely to have children in the household compared to the pre-9/11 group ($\chi^2_{df=1,42} = 7.40$, $p < 0.01$).

We first used χ^2 tests of independence to contrast marijuana, crack/cocaine, and alcohol use by interview date—pre- or post-9/11 (see Table 2). Results show that those in the post-9/11 group were significantly less likely to self-report marijuana use for the past 30 days ($\chi^2_{df=1,42} = 4.60$, $p < 0.05$). Differences between the two groups with respect to self-reported crack/cocaine use were marginally significant, although in a direction consistent with the findings for marijuana ($\chi^2_{df=1,42} = 3.98$, $p < 0.10$). These findings are congruent with toxicological results: those in the post-9/11 group were significantly less likely to test positive for both marijuana ($\chi^2_{df=1,42} = 5.90$, $p < 0.05$) and crack/cocaine ($\chi^2_{df=1,42} = 6.96$, $p < 0.05$).

With respect to drinking behavior, the results shown in Table 2 suggest no significant differences between the pre- and post-9/11 groups with respect to status as a current drinker ($\chi^2_{df=1,42} = 0.76$, ns) or past 30 day binge drinking behavior ($\chi^2_{df=1,42} = 0.28$, ns). We then used t tests to analyze alcohol consumption between the two groups using the three dimensions of drinking behavior outlined above. Results from Wald tests of mean differences presented in Table 2 show no significant differences between the pre- and post-9/11 groups with respect to number of drinking days ($F = 0.00$, $df = 42$, ns), average drinks consumed per sitting ($F = 0.00$, $df = 42$, ns), or number of days having consumed five or more drinks ($F = 0.00$, $df = 42$, ns).

Table 3 summarizes the OLS regression analyses conducted to assess variables associated with our three dimensions of drinking behavior. In model one, Hispanics

TABLE 2 Pre/post-9/11 bivariate analyses

	Pre-9/11 (n = 266)		Post- 9/11 (n = 173)	
Variable	Number	Percentage	Number	Percentage
Self-report (past 30 days)				
Marijuana	65	24.38	25	14.31**
Cocaine/crack	14	5.1	2	0.9*
Any alcohol use	164	61.62	118	67.86
Binge drank	102	38.57	60	34.67
Drug test positive				
Marijuana	64	24.16	20	11.38**
Cocaine/Crack	30	11.13	8	4.63**
In past 30 days	Mean	95% CI	Mean	95% CI
No. of days drank	5.29	4.39, 6.19	5.31	3.38, 7.23
No. of drinks per day	3.39	2.87, 3.92	3.40	2.39, 4.41
No. of days had 5+ drinks	1.96	1.50, 2.42	1.94	1.10, 2.79

Only cases with valid urine and oral fluid tests were included. Sample sizes and subgroup frequencies are weighted and rounded to the nearest whole value; percentages are based on weighted (unrounded) sample sizes and frequencies.

*$p < 0.10$, **$p < 0.05$

differed significantly from whites with respect to the number of days having consumed alcohol in the past 30 days (b = –2.547, SE = 1.08, $p < 0.05$), and men spent significantly more days drinking than did women (b = 2.547, SE = 0.77, $p < 0.01$). Additionally, there was a marginally significant relationship between age and days spent drinking. Respondents aged 26–30 years spent more days drinking than respondents aged 31 years or older (b = 1.809, SE = 1.04, $p < 0.10$). Looking at model two, only gender was statistically associated with the number of drinks consumed per sitting; men consumed more per sitting than women (b = 1.909, SE = 0.55, $p < 0.001$). Model three examines the number of days respondents reported binge drinking, which was treated here as a continuous measure. Again, among all variables in the model, only gender showed a significant relationship with binge drinking, with men reporting more days of binge drinking than women (b = 1.70, SE = 0.56, $p < 0.01$). In fact, in all models, men consistently engaged in greater drinking behavior than women. The results from each regression model in Table 3 show that those interviewed after 9/11 did not statistically differ from those interviewed before 9/11 with respect to any of the three dimensions of drinking behavior examined. As our measures could alternatively be treated as counts, Poisson regression models were also estimated for each drinking measure (not shown here). The results from these models did not differ from those presented in Table 3.

To further test the effects of 9/11 on alcohol use, we regressed a dichotomous binge drinking measure on the same variables presented in previous models predicting drinking behavior (see Table 4). Similar to previous models, gender was statistically associated with binge drinking, with men nearly three times more likely to have reported at least one episode of binge drinking in the past 30 days compared to women (95% Confidence Interval [CI] = 1.696, 5.063, $p < 0.001$). Additionally, African Americans were almost half as likely to report experiencing at least one binge drinking episode in the past 30 days when compared to white respondents (95% CI = 0.217, 0.876, $p < 0.05$). Again, those in the post-9/11 group did not differ significantly from those in the pre-9/11 group with respect to binge drinking (95% CI = 0.396, 1.228, ns).

TABLE 3 OLS regression models predicting past 30 days drinking behavior ($n=439$)

	No. of days drank		No. of drinks per day		No. of days drank 5+ drinks per day	
Variables	*b*	SE	*b*	SE	*B*	SE
Age						
18–25	0.033	0.889	0.636	0.751	0.822	0.555
26–30	1.809	1.045*	0.215	0.642	0.281	0.521
31+	–	–	–	–	–	–
Race/ethnicity						
African American	−1.418	0.930	−0.105	0.395	−0.518	0.473
Hispanic	−2.547	1.0796**	0.382	0.696	−0.644	0.578
Other	−2.537	1.540	−0.407	1.205	−1.041	0.820
White	–	–	–	–	–	–
Gender						
Male	2.547	0.770***	1.909	0.547****	1.70	0.562***
Female	–	–	–	–	–	–
SES						
Low	−0.311	1.115	0.960	0.867	0.174	0.750
Medium	−0.718	0.951	−0.121	0.764	−0.103	0.594
High	–	–	–	–	–	–
Children present in HH						
Yes	−1.292	0.878	−0.965	0.911	−0.456	0.568
No	–	–	–	–	–	–
Interview date						
Post-9/11/2001	−0.588	0.707	−0.181	0.586	−0.243	0.376
Pre-9/11/2001	–	–	–	–	–	–
Constant	6.391	1.168****	2.579	0.766***	1.529	0.722**
R^2	0.101		0.065		0.060	

Only cases with valid urine and oral fluid tests were included. Sample size is weighted and rounded to the nearest whole value.

*$p<0.10$, **$p<0.05$, ***$p<0.01$, ****$p<0.001$

Logistic regression models evaluating factors associated with both self-reported marijuana and crack/cocaine use and evidence of substance use detected via drug testing are presented in Table 5. Looking first at the model predicting self-reported marijuana use, results show that age, gender, and interview date are all significantly associated with self-reported use. Specifically, those in the 18–25 age group were more likely to self-report marijuana use than those 31 years and older (95% CI 1.429, 5.050, $p < 0.01$). With respect to gender, men were nearly three times more likely than women to self-report marijuana use (95% CI = 1.552, 5.331, $p < 0.001$). Of particular interest from model one is the relationship between interview date and self-reported marijuana use: those interviewed after 9/11 were about half as likely to self-report marijuana use as those interviewed before 9/11 (95% CI = 0.298, 0.999, $p < 0.05$).

Looking at model two, which predicts marijuana detection via drug testing, a marginal relationship exists between interview date and marijuana detection, with those in the post-9/11 group less likely to test positive for marijuana than those from the pre-9/11 group (95% CI = 0.220, 1.014, $p < 0.10$).

Additional findings from model two show that African Americans were about four times more likely to test positive for marijuana compared to white respondents

TABLE 4 Odds ratios predicting binge drinking ($n=439$)

	Binge drinking[a]	
Variables	OR	95% CI
Age		
18–25	1.241	0.658, 2.340
26–30	1.531	0.783, 2.996
31+	1.00	–
Race/ethnicity		
African American	0.435	0.217, 0.876*
Hispanic	0.643	0.333, 1.244
Other	0.569	0.193, 1.684
White	1.00	–
Gender		
Male	2.930	1.696, 5.063**
Female	1.00	–
SES		
Low	1.701	0.842, 3.436
Medium	1.262	0.637, 2.450
High	1.00	–
Children present in HH		
Yes	0.597	0.305, 1.169
No	1.00	–
Interview date		
Post-9/11/2001	0.697	0.396, 1.228
Pre-9/11/2001	1.00	–
R^2	0.095	

Only cases with valid urine and oral fluid tests were included. Sample size is weighted and rounded to the nearest whole value.

*$p<0.05$, **$p<0.001$

[a]Goodness-of-fit statistics: $\chi^2=2.14$, $df=8$, ns.

(95% CI = 1.349, 12.508, $p < 0.05$), and men were almost twice as likely to test positive for marijuana compared to women (95% CI = 1.010, 3.334, $p < 0.05$). Finally, a marginally significant relationship was found between age and positive marijuana tests, with respondents aged 18–25 years about two and a half times more likely to test positive for marijuana than respondents aged 31 years or older (95% CI = 0.942, 6.829, $p < 0.10$).

The next set of models shown in Table 5 evaluate factors associated with self-reported crack/cocaine use and crack/cocaine use detected through drug testing. Results from the first model show that exposure to trauma is only marginally associated with self-reported crack/cocaine use, with those in the post-9/11 group less likely to self-report crack/cocaine use than those in the pre-9/11 group (95% CI = 0.021, 1.191, $p < 0.10$). Additionally, race was marginally associated with self-reported crack/cocaine use, with Hispanics about five times more likely to self-report crack/cocaine use than white respondents (95% CI = 0.758, 34.992, $p < 0.10$).

The second model predicting crack/cocaine use via drug testing shows a significant relationship between exposure to trauma and testing positive for crack/cocaine, with those in the post-9/11 group less than half as likely to test positive for crack/cocaine compared to the pre-9/11 group (95% CI = 0.202, 0.848, $p < 0.05$). Again, race was only marginally associated with testing positive for crack/cocaine,

TABLE 5 Logistic regression models predicting marijuana and cocaine/crack use ($n=439$)

	Marijuana				Cocaine/Crack			
	Past 30-day self-report[a]		Positive test result[b]		Past 30-day self-report[c]		Positive test result[d]	
Variables	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age								
18–25	2.686	1.429, 5.050***	2.536	0.942, 6.829*	0.882	0.220, 3.531	0.572	0.223, 1.462
26–30	1.602	0.666, 3.855	1.934	0.719, 5.202	0.344	0.045, 2.629	0.741	0.30, 1.830
31+	1.00	–	1.00	–	1.00	–	1.00	–
Race/ethnicity								
African American	1.430	0.720, 2.837	4.107	1.349, 12.508**	0.849	0.136, 5.295	3.416	0.758, 15.388
Hispanic	1.062	0.498, 2.267	1.928	0.585, 6.355	5.151	0.758, 34.992*	3.964	0.868, 18.103*
Other	0.89	0.289, 2.741	2.295	0.610, 8.629	0.592	0.033, 10.535	1.282	0.148, 11.101
White	1.00	–	1.00	–	1.00	–	1.00	–
Gender								
Male	2.876	1.552, 5.331****	1.835	1.010, 3.334**	2.140	0.535, 8.565	1.463	0.660, 3.243
Female	1.00	–	1.00	–	1.00	–	1.00	–
SES								
Low	1.745	0.685, 4.447	2.061	0.788, 5.391	–	–	–	–
Medium	1.028	0.414, 2.554	1.214	0.426, 3.464	–	–	–	–
High	1.00	–	1.00	–	–	–	–	–
Children present in HH								
Yes	0.967	0.447, 2.094	0.926	0.437, 1.965	1.140	0.202, 6.427	0.809	0.289, 2.264
No	1.00	–	1.00	–	1.00	–	1.00	–
Interview date								
Post-9/11/2001	0.546	0.298, .999**	0.472	0.220, 1.014*	0.157	0.021, 1.191*	0.414	0.202, 0.848**
Pre-9/11/2001	1.00	–	1.00	–	1.00	–	1.00	–
R^2	0.090		0.117		0.160		0.064	

Only cases with valid urine and oral fluid tests were included. Sample size is weighted and rounded to the nearest whole value.

*$p<0.10$, **$p<0.05$, ***$p<0.01$, ****$p<0.001$

[a]Goodness-of-fit statistics: $\chi^2=9.38$, $df=8$, ns

[b]Goodness-of-fit statistics: $\chi^2=2.85$, $df=8$, ns

[c]Goodness-of-fit statistics: $\chi^2=14.14$, $df=8$, $p<0.10$

[d]Goodness-of-fit statistics: $\chi^2=6.09$, $df=8$, ns.

with Hispanics almost four times as likely to test positive for crack/cocaine than white respondents (95% CI = 0.868, 18.103, $p < 0.10$). As there were no cases of self-reported 30-day crack/cocaine use in the high SES group and only one high SES group member who tested positive for this substance, STATA could not adjust for this variable in the cocaine prediction models. Attempts to incorporate a proxy measure for SES (education) in cocaine models yielded parameter estimates with very large standard errors and had little impact on the parameter estimates for cocaine-related 9/11 effects. Accordingly, we omitted SES adjustment in the cocaine regression models.

To estimate the fit of the logistic regression models, we conducted the Hosmer–Lemeshow goodness of fit procedure, using the Stata "estat gof, group(10)" command. Tests for goodness of fit for each model yielded no significant χ^2 values, which suggests that concerns about model misspecification are unsupported.

We re-estimated the OLS and logistic regression alcohol models shown in Tables 3 and 4, adding an interaction term combining respondents who were both male and interviewed after 9/11. This was done to further explore previous findings regarding possible gender-contingent effects of exposure to trauma on alcohol and substance use.[17] Results did not support these findings in that the interaction term never achieved a significant relationship with any of the three drinking behaviors, self-reported marijuana or crack/cocaine use, or drug use detected through testing.

DISCUSSION

The results presented here add to the complex findings concerning the impact of the terrorist attacks of September 11, 2001 on alcohol and substance use. Previous research generally suggests that direct exposure to events such as the 9/11 terrorist attacks increases the likelihood of substance abuse[4,5] and, in some cases, bears effects specific to certain groups, such as men or women or persons with greater exposure to the traumatic event.[2,3,17] Some previous research focused on the vicarious experience of traumatic events and substance use suggests otherwise.[18] Our findings suggest that among individuals affected by, yet distant from a disaster, vicarious exposure to such events may actually be associated with *lower* levels of illicit substance use (i.e., crack/cocaine, marijuana) and unrelated to the use of alcohol.

It is important to note that our use of the term disaster is in reference to a very specific type of disaster—a terrorist act of war. Our findings might differ in the case of a natural disaster, for instance. The terrorist attacks of September 11, 2001 engendered responses across an array of social institutions unlikely to be seen in the wake of a natural disaster. The 9/11 attacks were unanticipated, and the threat of subsequent attacks provoked military and domestic security responses that are especially relevant to the current study.

While we feel that these findings deserve a place in the general discourse on the relationship between traumatic exposure and substance use, we recognize several limitations in our study. First, the data that drive our analyses are not longitudinal; rather, our data come from two cross-sections of a common sample. Additionally, our study was not originally designed to assess the effect engendered by the events of September 11, 2001. This would, of course, have been impossible simply by virtue of the unpredictable nature of such an event; regardless, we recognize that this is a post hoc quasi-experimental, rather than an experimental, study.

Our analyses counted respondents who reported past month drug use after 9/11 as post-9/11 substance users. This raises the possibility that some of those interviewed after 9/11 could have been reporting on substance use that occurred before the terrorist attacks. By examining questions about timing of last drug use, we determined that both of the respondents reporting past month cocaine use post-9/11 specified last use as occurring at a time that possibly could have overlapped with pre-9/11 behavior. We also learned that out of 24 respondents reporting past month marijuana use, three specified last use as occurring at a time that could possibly have overlapped with pre-9/11 behavior. Nevertheless, we see little justification for eliminating these cases from the analysis. We were interested in tracking changes in recent drug use. As there is a tendency for respondents to under report very recent drug use on surveys,[32] our focus on a "past month" measure of use is a conservative strategy to begin with. From the standpoint of evaluating the study's power to detect a statistically significant drop in use, we believe that our strategy of counting both of the self-reported cocaine users and all three of the self-reported marijuana users as post-9/11 users is a more conservative approach than either dropping these subjects from the analysis or counting them as pre-9/11 users.

One limitation concerns the overrepresentation of African Americans and low-SES respondents in the final sample used here. As previously mentioned, this sample has a disproportionately higher proportion of African Americans and lower-SES respondents compared with the remainder of the sample that was excluded due to eligibility issues (i.e., drug test availability). It should be pointed out that sample selection biases have potential implications for the generalizability of the findings, but not necessarily for the causal associations examined in relation to interview date.

Another possible limitation of this study derives from the over-distribution of high SES individuals in the post-9/11 group. Evidence suggests that SES is related to substance use,[33] and to the extent that SES is related to our key independent variable—interview date—we could be overstating the relationship between exposure to trauma and substance use. Although we were unable to include SES in the models predicting crack/cocaine use shown in Table 5, we included SES in the models predicting marijuana use and found that even after controlling for SES, the effect of 9/11 was significantly associated with lower marijuana use. Thus, given that our analyses provided no evidence that SES was confounding the relationship between 9/11 and marijuana use, we believe that our inability to control for SES in certain models did not strongly bias our statistical conclusions.

Finally, our treatment of post-9/11 respondents includes some late responders who required multiple contact attempts. It is possible that these late responders could differ in important ways from the rest of the sample and, indeed, from the pre-9/11 sub-sample. Recent research exploring the differences between late and early survey responders has suggested important differences between the two groups, but not with respect to alcohol or illicit drug use.[34,35] To further examine the effect late responders may have had on our findings, we re-estimated the logistic regression models in Table 5 excluding respondents interviewed four or more months after September 11, 2001. The resulting regression parameters did not differ significantly from the results in Table 5, with one exception: in the model predicting self-reported marijuana use, the significance level for the 9/11 covariate is reduced slightly ($p < 0.05$ vs. $p = 0.087$), and the odds ratio increased slightly (from 0.546 to 0.590). The reduction in statistical significance here is likely due to the decreased sample size caused by omitting late interviewees. We concede that the inclusion of late responders in our post-9/11 sample is a concern, but in light of the recent literature

on the topic and additional iterations of our analytic models, we feel justified in our study design.

What can account for the pattern of findings that we observed in these data? We offer several possible explanations. After the events of September 11, 2001, an almost instant spike in domestic security measures had a considerable impact on American life. All domestic flights were grounded until September 13th, and numerous buildings thought of to be possible targets for additional terrorist acts were evacuated. Anyone with access to the Internet or news media of any kind had a front-row seat to the dramatic security response after the attacks no matter how far away they lived from Manhattan. A heightened "sense" of security could have reduced an individual's willingness to engage in illegal behaviors such as purchasing and consuming marijuana and cocaine. In addition, actual post-9/11 security enhancements likely made it more difficult for illicit substances to permeate the American border, driving down supply. For example, in the 5 years after 2001, US Drug Enforcement Agency narcotics seizures increased by about 30,000kg for cocaine and by 900kg for marijuana.[36] It is possible then that both perceptions related to heightened security and actual drug enforcement initiatives aggressively pursuing supply reduction after 9/11 could have driven down cocaine and marijuana use via a reduction in supply and decreased willingness to violate drug laws.

A second hypothesis suggests that temporarily heightened levels of social cohesion after 9/11 discouraged illicit behavior in the face of positive national and patriotic sentiment. Several commentators have suggested that evidence of social solidarity increased dramatically after the 9/11 attacks, which may have dissuaded potential drug users from engaging in substance use.[37,38] Indeed, drawing on the recent work of Lindstrom,[39] the post-9/11 period could have been a time where values shifted away from community "miniaturization" in favor of a state where individuals increased their level of trust and commitment to the larger society's collective social values, if only temporarily. Unfortunately, our survey data did not include measures of trust and community participation that would facilitate a direct evaluation of this explanation, but given the strong inverse relationship between social capital and substance use established in prior research,[40,41] we feel that this proposal warrants some consideration in explaining our findings.

While we believe that this study offers an important glimpse into the relationship between exposure to trauma and substance use, subsequent research is needed to enhance our understanding of this relationship. To this end, we offer several recommendations for future research. As was previously mentioned, too few studies have examined the impact of exposure to trauma and substance use among populations distant from the epicenter of such traumatic events and yet still affected by them. More attention must be paid to this area and the potential for a differential impact on substance use among populations with first-hand exposure to a traumatic event compared to those with only indirect exposure. Additionally, longitudinal designs are needed to determine any long-term impact indirect exposure to trauma may have on substance use. This is a difficult task to achieve, given that it is impossible to plan a study around an unforeseen event such as a disaster. Nevertheless, given the recent spate of natural disasters and acts of terror, it is important that future epidemiological surveys on substance use include measures of social trust, national values, community participation, and contextual security concerns in order to account for possible exogenous factors driving shifts in drug use patterns.

Finally, the findings presented here contrast with other reports of increased substance use among populations nearer to the epicenter of the 9/11 attacks. We feel that this contrast highlights important differences between populations directly exposed to traumatic events and populations with vicarious exposure only. Proximity to traumatic terrorist events may mediate both the type and extent of social–psychological responses and mechanisms employed by individuals and communities to cope with such responses. Psychological responses may be more common for those proximal to the epicenter. Consequently, symptoms of distress, which may include elevated drug and alcohol use, are more likely to be observed as a response to terrorist events for those closest to the epicenter. On the other hand, populations that are more distal from the epicenter of terrorist events may be more influenced in their behavior by sociological and social–structural factors. As those more distal from the epicenter of terrorist attacks may be influenced, for example, by shifts in societal norms favoring patriotism and law abiding behavior, their post-event behavior may be characterized by less illegal drug use. However "distal" and "proximal" may be difficult to operationally define. We recommend that future epidemiological studies devise and incorporate appropriate measurement tools to operationally define this construct. Such tools need to account for the extent to which proximal and distal populations interact with the epicenter of traumatic events. Additional retrospective research including geographically diverse samples is needed to further explore variations in responses to terrorist events and to evaluate possible theoretical explanations.

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