

Alcohol Consumption and Posttraumatic Stress After Exposure to Terrorism: Effects of Proximity, Loss, and Psychiatric History

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In recent years, numerous large-scale terrorist attacks on civilian targets have occurred, with the attacks of September 11, 2001, on Washington, DC, and the World Trade Center in New York City being followed by attacks in Bali, Sinai (Egypt), Madrid, London, and Jordan. These events cause physical destruction, death, and injury, and they take an additional psychological toll on large groups that are exposed to these acts of violence but not physically injured. People can be exposed to terrorist attacks in terms of physical proximity as well as psychological proximity (e.g., losing someone via death or disappearance),^{1,2} and reactions to such exposures include posttraumatic stress (PTS) symptoms and alcohol consumption.

Studies involving national samples showed that physical proximity to the World Trade Center on September 11, 2001, predicted PTS symptoms and posttraumatic stress disorder.^{3,4} However, studies involving individuals living in Manhattan indicated that although proximity of residence to the World Trade Center predicted PTS,^{1,5,6} actual proximity to the World Trade Center at the time of the attacks did not.⁷

There has not been a great deal of research on alcohol consumption in response to terrorist attacks. Studies have shown that adults seldom reported drinking to cope after September 11, 2001 (8%–13% of respondents reported having done so).^{6–8} However, drinking to cope may be viewed as undesirable, so simple yet specific questions quantifying consumption may yield more-valid information. Vlahov et al.⁹ found that 42% of Manhattan residents who reported that they consumed alcohol drank more the week after the World Trade Center attacks than the week before the attacks. The fact that drinking, but not PTS, continued 6 months later suggests the need for a better understanding of why individuals responded by consuming alcohol.¹⁰

Objectives. We examined the effects of exposure to or interpersonal loss resulting from a terrorist attack on posttraumatic stress and alcohol consumption after we controlled for psychiatric history assessed before the attack.

Methods. At baseline (1991–1992) and at 1- and 10-year follow-ups, an adult community sample of drinkers living approximately 12 mi (19.2 km) from the World Trade Center were evaluated for alcohol dependence and major depression. Of this group, 82.2% were assessed regarding the impact of the September 11, 2001, attacks, including proximity to the World Trade Center, interpersonal loss, posttraumatic stress, and alcohol consumption.

Results. In regression models, interpersonal loss and past major depression, but not proximity to the World Trade Center, predicted posttraumatic stress symptoms. Proximity and past alcohol dependence, but not interpersonal loss, predicted high levels of post-September 11 alcohol consumption. Past alcohol dependence did not modify the proximity–drinking relationship, and past major depression did not modify the loss–posttraumatic stress relationship.

Conclusions. Participants' responses to September 11 were specific to their type of exposure and not predetermined by their psychiatric history. A better understanding of responses to traumatic events should assist more-effective prevention and intervention efforts. (*Am J Public Health.* 2007;97:2268–2275. doi:10.2105/AJPH.2006.100057)

In a Midwestern workplace study, alcohol consumption rates were higher among women surveyed shortly after September 11 than among those surveyed before the attacks,¹¹ and earlier studies of survivors of the Oklahoma City bombing suggested that primarily individuals with a history of alcoholism responded by drinking.^{12,13} By contrast, in a study conducted in Israel,² where rates of alcohol disorders are low,¹⁴ physical proximity to a terrorist attack predicted binge drinking in a large sample of adolescents. Thus, previous alcohol dependence may not be the sole determinant of alcohol consumption in response to terrorist attacks.

Predictors of anxiety and stress often differ from predictors of alcohol consumption, and determinants of stress or alcohol consumption in response to terrorism remain inadequately understood. Better knowledge in this area is important for 2 reasons. First, it can help develop public health preparedness for future attacks. Second, it can assist in addressing broader questions about alcohol consumption in response to traumatic stress. Risks for

many types of trauma (e.g., accidents, combat exposure) are increased by the personality traits that also predict substance abuse.^{15,16} These traits can thus confound human studies focusing on trauma and substance abuse.

By contrast, exposure to terrorist attacks has been shown to be unrelated to the traits of the individuals exposed.¹⁷ As such, terrorist attacks create unfortunate natural experiments, unconfounded by personality traits, in which the effects of traumatic stress on alcohol consumption can be examined. Such studies can be used to address whether different aspects of exposure (e.g., physical proximity or interpersonal loss) have specific effects on drinking or PTS symptoms and how such responses may be moderated by previous psychiatric history.

A methodological problem associated with investigations of the moderating effects of previous psychiatric history on responses to terrorism is that postevent reports of such histories may be altered by the exposure itself (i.e., viewing one's past differently after the event). To preclude such bias, histories should

be obtained before terrorism exposure occurs,² but opportunities to examine responses to the September 11 attacks among previously evaluated individuals are rare. Most September 11 studies have been cross sectional, the exception¹⁸ being the Midwestern study mentioned earlier.¹¹ A new opportunity for such research arose in a longitudinal study of 791 individuals originally living in New Jersey near lower Manhattan.¹⁹ In this sample, we investigated the effects of physical and psychological exposure to the September 11 terrorist attacks and previously evaluated psychiatric history on postattack stress symptoms and alcohol consumption.

METHODS

Procedures

The original goal of the Community Health Survey was to investigate drinkers' natural history of alcohol consumption, abuse, and dependence.^{19–21} The study sample, created in 1991–1992, included members of households designated by random-digit dialing in a New Jersey county located 12 mi (19.2 km) from lower Manhattan; randomly selected individuals aged 18 to 65 years were screened for study eligibility. As one of the eligibility criteria, an individual had to have consumed 5 or more drinks on at least 1 occasion during the preceding 12 months. (In 1991–1992, 24.5% of US adults reported having consumed 5 or more drinks at least once in the preceding 12 months, and 41.8% reported that they had ever consumed 5 or more drinks on a single occasion.²²)

Household and individual eligibility status was determined for 81% of the randomly dialed numbers.²¹ Ninety-two percent of those eligible (n=962) were personally interviewed for the study after procedures had been fully explained and they had provided informed consent. After 1 year, 846 of these individuals were reinterviewed. A 10-year follow-up, conducted mainly by telephone, included 809 participants. Interviewers were trained according to procedures used in national surveys.^{23,24}

After September 11, 2001, the study was supplemented to include exposures and responses to the attacks. Of the original participants, 791 (82.2%) answered questions

focusing on September 11, some (n=212) as part of their 10-year interview and the remainder (n=579) via brief recontact. Those followed and lost to follow-up did not differ significantly at baseline in terms of age, gender, marital status, income, education, history of major depression, or family history of alcoholism or depression. Of the original respondents, 96.5% and 75.9% with and without a history of alcohol dependence, respectively, were included in the follow-up ($\chi^2_1=57.3$, $P<.01$).

Measures

Alcohol dependence and depression. Both at baseline and at the 1- and 10-year follow-ups, the Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS)^{25,26} was used to assess alcohol dependence as defined in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)*.²⁷ This instrument, a fully structured diagnostic interview designed for psychiatric epidemiology studies (and described in detail elsewhere^{23,24,28,29}), assesses all *DSM-IV* alcohol dependence criteria, allowing full identification of dependence diagnoses.³⁰ Many studies, including psychiatrist reappraisals, have shown that AUDADIS alcohol dependence diagnoses have excellent reliability and validity.^{31,32}

Data from the 3 waves were combined to create a variable indicating a history of alcohol dependence before September 11, 2001. Because the reliability and validity of *DSM-IV* alcohol abuse are more variable than the reliability and validity of *DSM-IV* alcohol dependence, we focused on dependence.

The AUDADIS was also used to assess major depressive episodes at all 3 waves. This instrument has been shown to have good or very good test–retest reliability (kappa values of 0.65–0.73) and validity (via psychiatrist reappraisals³² as well as impairment³³) in regard to diagnoses of major depressive episodes.^{26,33}

Computer algorithms from the 3 interview waves were used to create a variable indicating lifetime diagnosis of a *DSM-IV* major depressive episode before September 11, 2001. Major depressive episodes were included because (1) such episodes and PTS are both types of internalizing psychopathology,³⁴

(2) these were the types of episodes for which participants had been assessed prior to September 11, and (3) a meta-analysis suggested that depression is the aspect of pretrauma adjustment most strongly related to posttraumatic stress disorder.³⁵

Family history of alcoholism and family history of depression (among first-degree relatives) were assessed at all waves. Test–retest reliability values for these variables were very good or excellent (kappa values of 0.72–1.00).^{23,36}

Exposure to September 11 attack and related events. The main September 11 exposures were (1) distance from the World Trade Center to the location where respondents first heard about or experienced the attacks (“physical proximity”) and (2) whether or not respondents knew someone who had been lost (no remains found) or killed (“psychological proximity”). Other exposures assessed included time spent watching television coverage in the 7 days after September 11 and personally seeing the attack site.

Participants were asked where they first heard about or experienced the attacks; most gave an address or provided information identifying an address (n=603); those in transit gave approximate information (e.g., highway or nearest exit; n=188). We used ArcGIS 9.0 software (ESRI GIS Mapping and Software, Redlands, Calif) to calculate distances between the World Trade Center and these locations.

Post–September 11 drinking and posttraumatic stress symptoms. Modified AUDADIS questions were used to assess maximum number of drinks consumed per day in the 7 days after September 11, 2001 (“1-week drinking”), and during the 16 weeks from September 11 to December 31, 2001 (“16-week drinking”). Participants were also asked whether they drank to cope with the event.^{26,29} Self-reports about earlier alcohol consumption have been shown to be reliable 2 years later or more.³⁷

The PTS scale used in this study was composed of a subset of items derived from a reliable and valid self-report measure that assesses experiences of trauma³⁸ (the same items had been used in a national survey conducted soon after September 11, 2001³). On a scale ranging from 1 (not at all) to 5

(extremely), respondents rated how much they were bothered the week after September 11 in regard to (1) feeling very upset when they were reminded of what happened, (2) repeated thoughts or dreams about what happened, (3) difficulty concentrating, (4) insomnia, and (5) irritability. These ratings were summed to create PTS scores ranging from 5 (no stress) to 25 (maximum stress). The PTS scale had excellent internal consistency (Cronbach's $\alpha=0.83$) in our sample.

Statistical Analyses

Outcomes assessed included 1-week drinking, 16-week drinking, and PTS. Initially, we conducted the F test and *t* test (adjusted for unequal variances when necessary). Because of the distribution of these count variables, we used Poisson regression to analyze 1-week drinking, 16-week drinking, and PTS. In the models, the main predictors were physical proximity to the World Trade Center (in miles), knowing someone who had been lost or killed, past *DSM-IV* alcohol dependence and major depressive episodes, and family history of alcoholism or depression.

We examined whether past history of psychiatric disorder or gender modified the effects of September 11 exposures on the outcomes via interaction terms included in our models (e.g., interaction between psychiatric disorder and exposure of interest). Control variables included age, gender, race (White vs other), and number of days elapsed between September 11 and administration of September 11 questions. All tests were 2-tailed, and significance was set at less than .05.

RESULTS

Of the 791 participants, 46% were female ($n=364$); 84.6% were White ($n=669$), 13.8% were African American ($n=109$), and 1.6% were of other racial backgrounds ($n=13$). A total of 65.6% were married ($n=503$), 14.4% were divorced ($n=114$), and 22.0% had never been married ($n=174$). In terms of educational level, 21.2% had a high school education or less ($n=168$), and 78.8% had completed at least some college ($n=623$). Mean amount of time elapsed from September 11 to completion of the September 11 questions was 381.4 days ($SD=136.57$, range = 123–816;

this variable was not related to our outcome variables, as described subsequently).

By definition, 100% of the participants had consumed 5 or more drinks at least once during the year before their baseline interview. Slightly more than 45% ($n=359$) had a history of *DSM-IV* alcohol dependence before September 11 (Table 1), 38.8% ($n=307$) had a *DSM-IV* major depressive episode before September 11, 47.8% ($n=378$) had a family history of alcoholism, and 49.8% ($n=394$) had a family history of depression.

Physical Proximity and Interpersonal Loss

At the time of the attacks, 10.0% of the participants ($n=79$) were 0 to 5 mi from the World Trade Center (Table 1); the remaining participants were further away. About one third (32.1%; $n=254$) knew someone who had been lost or killed in the attacks. Of these individuals, 63.5% had lost friends, coworkers, or neighbors; 2.4% had lost a family member; and 34.1% had lost someone not categorized in one of the groups just mentioned (e.g., relative of a friend).

Posttraumatic Stress

Participants' mean PTS scale score was 11.02 ($SD=4.70$; Table 1), and the median was 10. In bivariate tests, PTS was related to history of a major depressive episode ($t_{789}=5.85$; $P<.001$), family history of depression ($t_{789}=4.18$; $P<.001$), history of alcohol dependence ($t_{789}=3.41$; $P=.001$), and family history of alcoholism ($t_{789}=2.29$; $P=.02$). Time elapsed between September 11 and the interview date was not related to PTS ($r=-0.06$; $P=.09$) nor was administration of September 11 questions at recontact as opposed to the 10-year interview (mean PTS scores of 11.15 [$SD=4.79$] and 10.17 [$SD=4.14$], respectively; $t_{789}=1.09$; $P=.44$).

Exposure, Other Predictors, and Posttraumatic Stress

Levels of PTS symptoms were significantly higher among respondents who knew someone who had been lost or killed ($P<.001$) but did not differ according to physical proximity to the World Trade Center (Table 1). Regression models (Table 2) indicated that interpersonal loss had a highly significant main effect on PTS, as did history of a major depressive

episode and family history of depression; history of alcohol dependence was marginally related to PTS. Interpersonal loss did not interact with history of a major depressive episode ($b=0.05$, $SE=0.05$; $P=.27$) or alcohol dependence ($b=0.01$, $SE=0.05$; $P=.78$) in predicting PTS. Thus, these disorders did not moderate the effects of interpersonal loss on PTS. An interaction between interpersonal loss and gender ($b=0.14$, $SE=0.05$; $P=.003$) showed that loss had a stronger effect on PTS among women.

PTS scale scores did not differ between participants who had lost a relative or significant other (mean = 12.93, $SD=4.07$) and those who had lost a friend, neighbor, or coworker (mean = 12.13, $SD=4.74$; $t_{789}=-1.18$; $P=.24$). The mean PTS score among those who had not lost anyone in the attacks was 10.47 ($SD=4.59$). The difference between the 3 groups was significant ($F_{2,788}=11.84$; $P<.001$).

Alcohol Consumption

In terms of maximum number of drinks consumed per day, means were 2.09 ($SD=2.83$, range = 0–25) during the first week after September 11 and 2.74 ($SD=3.26$, range = 0–30) during the 16 weeks between September 11 and the end of the year. At both points, men consumed more drinks than did women; also, those aged 36 to 41 years consumed more drinks per day after 16 weeks than did participants in other age groups (Table 1). Unmarried respondents drank more after 1 week and after 16 weeks than did married respondents. In bivariate tests, history of alcohol dependence predicted 1-week drinking ($t_{789}=5.12$; $P<.001$) as well as 16-week drinking ($t_{714}=5.16$; $P<.001$). History of a major depressive episode predicted 1-week drinking ($t_{789}=-2.44$; $P=.01$) but not 16-week drinking ($t_{789}=-1.46$; $P=.14$).

Variables that were not related to 1-week drinking or 16-week drinking included family history of alcoholism (1-week drinking, $t_{789}=0.46$; $P=.73$; 16-week drinking, $t_{789}=0.06$; $P=.95$), family history of depression (1-week drinking, $t_{789}=-0.56$; $P=.57$; 16-week drinking, $t_{789}=-0.52$; $P=.60$), time elapsed from September 11 to the interview (1-week drinking, $r=0.00$; $P=.95$; 16-week

TABLE 1—Mean Posttraumatic Stress Scale Scores and Alcohol Consumption, by Selected Characteristics: Community Health Survey, New Jersey, 2001

| | Total, No. | Posttraumatic Stress Scale Score | | | Highest Number of Drinks Consumed per Day in 7 Days After September 11 | | | Highest Number of Drinks Consumed per Day in 16 Weeks After September 11 | | |
|--|------------|----------------------------------|-------------------|-------|--|-------------------|-------|--|-------------------|-------|
| | | Mean (SD) | t or F test | P | Mean (SD) | t or F test | P | Mean (SD) | t or F test | P |
| Overall | 791 | 11.02 (4.70) | | | 2.09 (2.83) | | | 2.74 (3.26) | | |
| Gender | | | 6.03 | <.001 | | 5.85 | <.001 | | 5.80 | <.001 |
| Men | 427 | 10.21 (4.44) | | | 2.54 (3.20) | | | 3.45 (3.70) | | |
| Women | 364 | 12.21 (4.83) | | | 1.45 (2.03) | | | 2.01 (2.29) | | |
| Race | | | 0.21 | .83 | | 1.23 | .22 | | 1.64 | .10 |
| White | 669 | 11.00 (4.60) | | | 2.14 (2.81) | | | 2.82 (3.28) | | |
| Other | 122 | 11.11 (5.25) | | | 1.80 (2.93) | | | 2.30 (3.12) | | |
| Age group, y | | | 0.21 ^a | .89 | | 1.46 ^a | .22 | | 2.92 ^a | .03 |
| 27–35 | 220 | 11.18 (4.42) | | | 1.82 (2.94) | | | 2.50 (3.49) | | |
| 36–41 | 160 | 11.06 (4.79) | | | 2.24 (3.39) | | | 3.29 (4.22) | | |
| 42–49 | 215 | 11.04 (4.96) | | | 2.34 (2.67) | | | 2.90 (2.82) | | |
| 50–77 | 196 | 10.81 (4.68) | | | 2.01 (2.32) | | | 2.38 (2.48) | | |
| Marital status | | | 0.06 ^a | .94 | | 5.12 ^a | .006 | | 4.63 ^a | .01 |
| Married or living with someone | 503 | 11.06 (4.72) | | | 1.85 (2.47) | | | 2.49 (2.99) | | |
| Widowed, separated, or divorced | 114 | 11.02 (4.81) | | | 2.58 (3.80) | | | 2.99 (3.85) | | |
| Never married | 174 | 10.92 (4.62) | | | 2.47 (3.01) | | | 3.32 (3.52) | | |
| Educational level | | | 0.83 | .41 | | 0.84 | .40 | | 0.33 | .74 |
| High school or less | 168 | 11.29 (5.12) | | | 2.26 (3.96) | | | 2.82 (4.39) | | |
| Some college or more | 623 | 10.95 (4.59) | | | 2.05 (2.44) | | | 2.72 (2.88) | | |
| Had history of major depressive episode | | | 5.85 | <.001 | | −2.44 | .01 | | −1.46 | .14 |
| Yes | 307 | 12.23 (4.9) | | | 1.94 (3.1) | | | 2.70 (3.6) | | |
| No | 484 | 10.26 (4.4) | | | 2.19 (2.6) | | | 2.77 (3.0) | | |
| Had family history of depression | | | 4.18 | <.001 | | −0.56 | .57 | | −0.52 | .60 |
| Yes | 394 | 11.72 (4.8) | | | 2.03 (3.0) | | | 2.68 (3.5) | | |
| No | 397 | 10.34 (4.5) | | | 2.14 (2.7) | | | 2.80 (3.0) | | |
| Had history of alcohol dependence | | | 3.41 | <.001 | | 5.12 | <.001 | | 5.16 | <.001 |
| Yes | 359 | 11.65 (4.8) | | | 2.65 (3.4) | | | 3.39 (3.9) | | |
| No | 432 | 10.51 (4.6) | | | 1.63 (2.2) | | | 2.20 (2.5) | | |
| Had family history of alcohol problems | | | 2.29 | .02 | | 0.46 | .73 | | 0.06 | .95 |
| Yes | 378 | 11.42 (4.89) | | | 2.17 (3.0) | | | 2.75 (3.37) | | |
| No | 413 | 10.66 (4.50) | | | 2.02 (2.6) | | | 2.73 (3.16) | | |
| Within 5 mi of World Trade Center when attack occurred | | | 0.38 | .70 | | 3.1 | .002 | | 3.7 | <.001 |
| Yes | 79 | 11.22 (4.6) | | | 3.03 (3.4) | | | 4.00 (3.7) | | |
| No | 712 | 11.00 (4.7) | | | 1.99 (2.7) | | | 2.60 (3.2) | | |
| Knew someone lost or killed | | | 4.89 | <.001 | | 0.66 | .51 | | 1.56 | .12 |
| Yes | 254 | 12.20 (4.7) | | | 2.19 (3.0) | | | 3.00 (3.6) | | |
| No | 537 | 10.47 (4.6) | | | 2.04 (2.7) | | | 2.62 (3.1) | | |

^aF test

TABLE 2—Poisson Regression Results of Posttraumatic Stress Symptoms and Alcohol Consumption After September 11, 2001, by Physical Proximity, Interpersonal Loss, and Respondent and Family Histories: Community Health Survey, New Jersey, 2001

| | Posttraumatic Stress Symptoms in 7 Days After September 11 | | Highest Number of Drinks Consumed per Day in 7 Days After September 11 | | Highest Number of Drinks Consumed per Day in 16 Weeks After September 11 | |
|-----------------------------------|--|-------|--|------|--|------|
| | b (SE) | P | b (SE) | P | b (SE) | P |
| Within 5 mi of World Trade Center | 0.06 (0.04) | .11 | 0.35 (0.13) | .006 | 0.32 (0.12) | .006 |
| Knew someone lost or killed | 0.15 (0.02) | <.001 | 0.05 (0.09) | .57 | 0.09 (0.08) | .26 |
| Had history of alcohol dependence | 0.05 (0.02) | .05 | 0.12 (0.06) | .03 | 0.12 (0.06) | .05 |
| Had family history of alcoholism | -0.02 (0.02) | .29 | 0.04 (0.09) | .71 | -0.07 (0.08) | .93 |
| Had history of major depression | 0.12 (0.02) | <.001 | -0.18 (0.10) | .07 | -0.07 (0.09) | .39 |
| Had family history of depression | 0.06 (0.02) | .01 | -0.01 (0.10) | .95 | -0.05 (0.08) | .53 |

Note. N = 791. Analyses focused on number of drinks consumed per day; separate models were used for the following dependent variables: number of drinks consumed per day in the 7 days after September 11, number of drinks consumed per day in the 16 weeks after September 11, and traumatic stress symptoms. Control variables included age, gender, race, and time elapsed since interview.

drinking, $r = -0.04$; $P = .31$), and administration of September 11 questions at recontact versus the 10-year interview (1-week drinking, $t_{789} = 1.18$; $P = .24$; 16-week drinking, $t_{789} = 1.72$; $P = .09$).

Exposure, Other Predictors, and Alcohol Consumption

Levels of 1-week drinking and 16-week drinking were significantly higher among those who had been within 5 mi of the World Trade Center when the attack occurred but were not elevated among those who had experienced interpersonal loss (Table 1). Regression models (Table 2) indicated that physical proximity had a strong, significant main effect on both 1-week drinking and 16-week drinking, whereas history of alcohol dependence had a weaker but still significant main effect on 1-week drinking and a marginal effect on 16-week drinking. History of a major depressive episode was inversely related to 1-week drinking and was not related to 16-week drinking.

Physical proximity did not interact with alcohol dependence in predicting either 1-week drinking ($b = -0.02$, $SE = 0.25$; $P = .95$) or 16-week drinking ($b = -0.07$, $SE = 0.23$; $P = .77$). In addition, we found no interactions between physical proximity and history of a major depressive episode (1-week drinking, $b = -0.13$, $SE = 0.28$; $P = .64$; 16-week drinking, $b = 0.10$, $SE = 0.24$; $P = .68$) or between physical proximity and gender (1-week drinking, $b = 0.23$,

$SE = 0.34$; $P = 0.49$; 16-week drinking, $b = 0.25$, $SE = 0.29$; $P = .38$) in predicting drinking at either point. Thus, neither previous history nor gender moderated the effect of physical proximity on post-September 11 drinking.

Interpersonal loss was not related to 1-week drinking or 16-week drinking (Table 2), did not interact with alcohol dependence in predicting 1-week drinking ($b = 0.29$, $SE = 0.19$; $P = .10$) or 16-week drinking ($b = 0.01$, $SE = 0.17$; $P = 0.98$), and did not interact with gender in predicting 1-week drinking ($b = 0.08$, $SE = 0.20$; $P = .70$) or 16-week drinking ($b = -0.03$, $SE = 0.17$; $P = .88$). Nor was closeness with the person lost related to 1-week drinking ($F_2 = 0.94$; $P = .39$) or 16-week drinking ($F_2 = 2.31$; $P = .10$).

Other September 11 Exposures

Other types of exposures included watching television coverage and personally seeing the attack site. Time spent watching television coverage (in hours) predicted PTS when it was added to the interpersonal loss model ($b = 0.08$, $SE = 0.01$; $P < .001$; Table 2) but did not affect the significance or size of the parameter estimate for interpersonal loss. Number of hours spent watching coverage was not related to 1-week drinking ($F_{1,790} = 0.9$; $P = .34$) or 16-week drinking ($F_{1,790} = 0.7$; $P = .40$) and, when added to the models, did not alter the effect of proximity to the World Trade Center on alcohol consumption.

Because stress may engender watching television coverage as a form of vigilance, the causal direction is unclear.

The causal direction of seeing the attack site in person is clearer, but this effect was related to proximity to the World Trade Center ($\chi^2_1 = 118.45$; $P < .001$). When added to the models that included proximity, seeing the attack site was not related to either 1-week drinking ($b = 0.04$, $SE = 0.09$; $P = .65$) or 16-week drinking ($b = -0.03$, $SE = 0.08$; $P = .68$). Moreover, it was not related to PTS ($t_{789} = 0.02$; $P = .98$). Thus, television viewing and seeing the attack site did not contribute to our models.

Drinking to Cope

Approximately 11% of the respondents ($n = 86$) indicated that they drank to cope with feelings about September 11, a percentage falling within the range that has been reported for Manhattan general population samples.⁶⁻⁸ This variable was marginally related to physical proximity to the World Trade Center ($\chi^2_1 = 3.50$, $P = .06$) and was not related to interpersonal loss ($\chi^2_1 = 0.90$, $P = .28$). Drinking to cope was associated with 1-week drinking ($b = 0.79$, $SE = 0.12$; $P < .001$) and 16-week drinking ($b = 0.33$, $SE = 0.11$; $P < .001$). Physical proximity remained a significant predictor of both 1-week drinking ($b = 0.27$, $SE = 0.13$; $P = .004$) and 16-week drinking ($b = 0.26$, $SE = 0.10$; $P = .003$) when we controlled for drinking to cope.

DISCUSSION

Our main findings indicated that exposure to the September 11 terrorist attacks predicted alcohol consumption and PTSD symptoms. An important result was that previous alcohol dependence was not the main determinant of post-September 11 drinking. Participants with a history of *DSM-IV* alcohol dependence drank more than others after September 11, but physical proximity to the World Trade Center predicted drinking levels even after we controlled for past alcohol dependence, and the lack of interaction between alcohol dependence and physical proximity indicated that past alcohol dependence did not modify the effect of proximity on drinking. These data improve on data from earlier studies suggesting that most postdisaster drinking can be accounted for by predisaster alcoholism.¹²

Similarly, history of a major depressive disorder had a main effect on PTSD symptoms but did not account for the relationship between interpersonal loss and PTSD. Thus, in the planning of services after a terrorist attack, an exclusive focus on individuals with previous psychiatric histories would potentially overlook individuals in need.

We also investigated whether specific types of exposure led to different responses. Results indicated that physical proximity to the World Trade Center predicted higher alcohol consumption, whereas interpersonal loss predicted increased PTSD symptoms. In a study of Manhattan residents, drinking after September 11 was not related to proximity to the World Trade Center,^{9,10} but the limited distance range assessed may have obscured any relationships. In a study involving Israeli adolescents,² which produced results similar to ours, physical proximity to a terrorist attack predicted alcohol consumption and binge drinking, whereas interpersonal loss did not.

These findings suggest that drinking may be a response to trauma involving physical threat rather than to loss. Differences in responses according to type of exposure may arise, in part, because anxiety and substance abuse fall within different domains of psychopathology (internalizing and externalizing,³⁵ respectively). Future studies should attempt to replicate our findings and, in addition,

investigate whether the long-term significance of an exposure varies systematically with the type of exposure (which, in turn, may alter the type of response).³⁹

Under normal circumstances, PTSD reactions might be expected to result more from the loss of close relatives or confidants (i.e., important sources of social or instrumental support) than from some of the types of losses reported in our sample. Here, more-distant losses may have elicited PTSD because the context of the September 11 terrorist attacks altered their meaning; for example, after September 11, such losses may have served as an illustration to the participants of the role played by fate in sparing them while killing other ordinary people they knew. As noted, future studies should examine the meanings of these events.

Limitations and Strengths

Our study involved several limitations. First, additional psychiatric disorders were not assessed in waves 1 and 2. Samples of individuals who have been exposed to terrorism and who have previously assessed histories of other psychiatric disorders would be useful in conducting future studies. Second, individuals who had never consumed 5 or more drinks on a single occasion were not included, so our results cannot be extrapolated to these individuals. Future studies should include abstainers and lighter drinkers.

Third, respondents younger than 18 years were not included in the baseline (1991–1992) assessments, so the youngest respondents were 27 years old on September 11, 2001. Future studies should include younger adults. Fourth, information was obtained via self-reports in structured interviews, as is common in epidemiological studies. However, participants had previously reported considerable levels of drinking to us without penalties, so they had no reason to be concerned about adverse consequences. Furthermore, the measures used in this study have been shown to have good or excellent psychometric properties in our sample and others.

Fifth, assessments focused on traumatic stress symptoms and alcohol consumption rather than *DSM-IV* posttraumatic stress disorder and alcohol dependence, allowing an examination of important reactions shortly

after September 11 but not an assessment of the later emergence of full disorders. This information, although requiring additional follow-up, would be useful. Sixth, information on post-September 11 cigarette and drug use was not collected. Finally, the sample included mainly White and African American participants. Information from additional ethnic groups would be useful.

This study also had several unique strengths. First, the data were derived from a community sample of nearly 800 individuals originally living in a New Jersey county 12 mi from Ground Zero, allowing comparisons between those close to the World Trade Center and those further away. Second, diagnostic data on alcohol dependence and major depression had largely been collected before September 11 in 2 previous waves of interviews, and family histories were assessed on 3 occasions. The longitudinal nature of the study increased the likelihood that valid information was obtained. Third, the assessment instrument, the AUDADIS,^{27,36} has excellent reliability and validity in regard to the variables of interest in this study.

Fourth, because a large percentage of the sample (41%) was female, the study was uniquely situated to assess alcohol consumption and stress reactions after a terrorist attack among female as well as male drinkers. Fifth, all of the participants reported that they had consumed 5 or more drinks on a single occasion at least once, and at the time we first assessed the sample, approximately 25% of the US adult population reported having consumed the same number of drinks on 1 occasion.²² As a result, our sample represented a segment of the American general population that is important to understand in terms of risk for adverse reactions to terrorism exposure. Other studies of terrorism exposure and alcohol have included high numbers of nondrinkers,^{9,10,13} possibly diluting the apparent effects of a traumatic event on alcohol consumption.

Conclusions

Gene–environment interactions make important contributions to understanding complex traits and disorders.^{34,40–42} When stressful events are being examined as environmental risk factors, it is often difficult to clarify whether these events are the causes

or the consequences of psychopathology. The random nature of terrorism exposure avoids this problem. Therefore, future studies of psychological and behavioral responses to terrorism could be enhanced by collecting genetic information, potentially contributing a great deal to our understanding of complex traits and disorders as reactions to traumatic stress.

Terrorism unfortunately has the potential to touch the lives of a growing number of individuals in different settings. Our results highlight differences in individuals' responses to specific types of exposures, regardless of past history of alcohol dependence or depression. Future studies seeking to explain the reasons for our findings may provide a better understanding of responses to different types of trauma exposures, leading to the development of more-effective prevention and intervention efforts. ■

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Contributors

D.S. Hasin originated the study and supervised all aspects of its implementation. K.M. Keyes completed the analyses and assisted with the writing. M.L. Hatzenbuehler assisted with the analyses and writing. E.A. Aharonovich assisted with the study and reviewed drafts of the article. D. Alderson assisted with the analyses and reviewed drafts of the article.

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Human Participant Protection

This study was approved by the institutional review board of the New York State Psychiatric Institute. Participants provided written informed consent at the

baseline assessment. At all follow-up interviews, after a full explanation of the procedures, written consent was obtained for in-person interviews and verbal consent was obtained for telephone interviews.

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