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Alcohol Use, Mental Health Status and Psychological Well-being 2 Years After the World Trade Center Attacks in New York City

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Abstract: Over the past 30 years, studies have shown that survivors of community-wide disasters suffer from a variety of physical and mental health problems. Researchers also have documented increased substance use in the aftermath of these disasters. In the present study, we examined the relationship between alcohol use and mental health status within the context of the terrorist attacks on the World Trade Center in New York City (NYC). The data for the present report come from a 2-wave panel study of adults living in NYC on the day of the attacks. Wave 1 (W1) and Wave 2 (W2) interviews occurred one year and two years after the attacks, respectively. Overall, 2,368 individuals completed the W1 survey (cooperation rate, 63%) and 1,681 completed the W2 survey (re-interview rate, 71%). The alcohol use variables examined were binge drinking, alcohol dependence, increased days drinking, and increased drinks per day. The outcomes examined included measures of posttraumatic stress disorder (PTSD),

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major depression, BSI-18-Global Severity and measures of SF12-mental and physical health status. After controlling for demographic, stress, and resource factors, multivariate logistic regressions indicated that all alcohol measures were related to one or more of these outcomes. In particular, binge drinking was related to partial PTSD, while alcohol dependence was associated subsyndromal PTSD, severity of PTSD, depression, BSI-18 global severity, and SF-12 poor mental health status. Increased post-disaster drinking was positively associated with subsyndromal PTSD and negatively associated with SF-12 physical health. We discuss reasons for these results and the negative consequences that heavy alcohol use may have on the postdisaster recovery process.

Keywords: Community disasters, alcohol use, psychological well-being, mental health, stress and coping, post-traumatic stress disorder

INTRODUCTION

Over the past 30 years, studies have shown that survivors of community-wide disasters suffer from both physical and mental health problems (1–7). Posttraumatic stress disorder (PTSD), depression, anxiety, respiratory aliments, cardiovascular conditions, and panic disorder have been commonly reported consequences of such disasters and mass trauma (1, 6, 8–12). Researchers also have documented the increase in substance use in the aftermath of community disasters (7, 13–18). In fact, substance use has been a documented comorbid factor accompanying physical and psychological problems after exposure to trauma (13, 19, 20).

In the present study, we examined the relationship between alcohol use and mental health status within the context of the terrorist attacks on the World Trade Center (WTC) on September 11, 2001. Approximately 2,800 persons died and thousands were injured during this disaster, which was one of the largest death tolls of any disaster in the United States (21). Many residents directly witnessed the events and/or had relatives or friends die in the attacks. A large area of lower Manhattan's business district was destroyed further exacerbating social and economic hardships in the area. The scope of the September 11 attacks and their impact on the local community in the weeks that followed suggested that these events might have significant long-term consequences for mental and physical health and for alcohol use. Indeed, early postdisaster research documented a high prevalence of psychological symptoms and disorders among residents of New York City (NYC), with 7.5% of those living south of 110th Street in Manhattan reporting symptoms related to PTSD and 9.7% having symptoms of depression one month after the attacks (5). These early studies also documented the increased use of

substances such as alcohol and marijuana and linked this increase to psychological disorders (16–18).

Here we report the association between earlier alcohol use and later physical and psychological well-being. This relationship is important because alcohol use may hinder the resolution of psychological distress and the treatment of psychological problems. We use panel data from a 2-wave community survey of NYC residents who were living in NYC at the time of the attacks to answer 3 questions. First, was there an increase in alcohol use after the World Trade Center Disaster (WTCD)? Second, was postdisaster alcohol use associated with later physical and psychological problems? Third, were the associations between alcohol use and mental health status maintained once other factors, such as demographic characteristics, stress exposures, and psychological resources were taken into account?

As with our previous report on the WTCD (22), the stress process model guided our approach (23, 24). This model suggests that individuals subjected to disordered or challenging environments generally requires them to respond both physiologically through changes in the neuroendocrine and hormone systems and psychologically, usually through a revision of cognitive functioning (24, 25). Serious environmental challenges that result in significant biological and/or cognitive alterations are defined as stressful and referred to as stressors. The consequence of exposure to these stressors can be psychological and physical distress, often in the form of depression and health problems (1, 2, 6, 26). Finally, individuals attempt to deal with stressors by accessing social support or various coping strategies (termed, problem focused, emotion focused, and avoidance focused) (23, 24). Most researchers tend to define alcohol use as an avoidance coping strategy.

DATA AND METHODS

The data for the present study come from a 2-wave panel study of English or Spanish speaking adults living in NYC on the day of the WTCD. For wave 1 (W1), we conducted a telephone survey a year after the attacks, using random-digit dialing. When interviewers reached a person at a residential telephone number, they obtained verbal consent and then ascertained the area of residence, screening out ineligible individuals (i.e., language other than English or Spanish, did not live in NYC on September 11, 2001, etc.). If more than one eligible adult lived in the household, interviewers selected based on the person with the most recent birthday. As part of the overall study, we oversampled residents who reported receiving any mental health treatment in the year after the

attacks. The population also was stratified by the 5 NYC boroughs and sampled proportionately. Questionnaires were translated into Spanish and then back-translated by bilingual Americans to ensure their linguistic and cultural appropriateness. Interviews occurred between October and December, 2002. Between October 2003 and February 2004, we attempted to re-interview all W1 participants for our W2 survey (i.e., 2 years after the WTCD).

The procedures were the same for both waves. Trained interviewers using a computer-assisted telephone interviewing system conducted the interviews. All interviewers were supervised and monitored by the survey contractor in collaboration with the investigative staff. A protocol was in place to provide mental health assistance to participants who required psychiatric counseling. The mean duration of the interviews was 45 minutes for W1 and 35 minutes for W2. The Institutional Review Board of the New York Academy of Medicine reviewed and approved the study's protocols.

Overall, 2,368 individuals completed the W1 survey and 1,681 completed the W2 survey. Approximately, 7% of the interviews were conducted in Spanish for W1 and 5% for W2. Using industry standards (27), the W1 cooperation rate was approximately 63% and the re-interview rate for W2 was 71%. (Specifically, the W1 cooperation rate = completed interviews [2369] + screen outs—respondents not living in NYC at the time of the interview, not living in NYC on September 11, or did not speak English or Spanish [4985] + quota outs—respondents who were eligible to be interviewed but were a gender or lived in a borough where the required number of interviews had been completed [117]/completed interviews + screen outs + quota outs + refusals [4,330]. Our response rate was 37% (completed interviews/quota outs + refusals + residential phone but not interviewed by end of data collection [1,945])). A sampling weight was developed for each wave to correct for potential selection bias related to the number of telephone numbers and persons per household and for the oversampling of treatment-seeking respondents. In addition, as discussed below, demographic weights also were used for W2 data in order adjust for slight differences in response rates by different demographic groups, as is common practice in panel surveys (28). With these weights, both waves could be treated as a random, representative sample of NYC residents who were living in NYC on the day of the WTCD.

An analysis comparing the weighted W1 sample and Census data for NYC indicated no differences for age, gender, race, or New York City Borough. Thus, the W1 sample appeared to be representative of NYC and was not demographically biased due to the cooperation rate or sample selection. When we compared responders for the W2 sample to nonresponders (unweighted), however, we found that Whites, older respondents, and women more likely to participate in the W2 survey.

Consequently, to correct for this potential bias, we adjusted our W2 data for these differences using sampling weights derived from W1 data, which is often the recommended method (28). After weighting, a comparison between the W1 and the W2 samples revealed no differences between for age, gender, race, or NYC Borough, indicating that the weights corrected for differing participation rates for these four demographic variables.

DEPENDENT VARIABLES

In our analyses, we focused on measures related to mental health status, functional health status, and psychological well-being. Since there were relatively few respondents who met the full DSM-IV criteria for PTSD in the past year in W2 (n = 95) (29), we assessed two different measures of subsyndromal or partial-PTSD. First, we calculated subsyndromal PTSD following methods described by Blanchard et al. and Galea et al (30–32). Individuals who had symptoms that met criteria B (re-experiencing the traumatic event) and either criteria C (avoidance of thoughts or places related to the event) or criteria D (arousal) were classified as having subsyndromal PTSD. The second PTSD measure was coded according to the method described by Breslau, Lucia, and Davis (33). Respondents meet criteria for partial PTSD if they experienced at least one symptom from each symptom group (B, C, and D) and the symptoms lasted at least one month in duration. Both of these measures were heterogeneous with respondents meeting criteria for full PTSD in both groups and respondents meeting criteria for partial PTSD a subset of subsyndromal PTSD. We used these 2 measures to identify individuals who suffer from PTSD symptoms, but did not necessarily meet full criteria. Although individuals who fail to meet criteria for full PTSD do not have as severe functional problems as those who do, they have significantly more problems in work and social relationships than those who do not meet criteria for even subsyndromal PTSD (33). Thus, we utilized these measures as general indicators of psychological problems related to trauma.

To test for the possible association between alcohol use and the severity of PTSD symptoms, we asked respondents who reported a PTSD symptom to indicate whether that particular symptom bothered them "not at all," "just a little," "somewhat," or "a lot" in the past 30 days, which were coded 0, 1, 2, and 3, respectively. (If the respondent did not have the symptom at all he/she was coded "0" for that particular symptom.) This method of calculating symptom severity is similar to the one used for the PTSD Symptom Checklist (34). We summed the 17 PTSD symptom severity items and then divided respondents into two groups: no or low symptom severity (score 0–6) and moderate to

high severity (score 7 or more). We based this cut-point on an examination of the frequency distribution for this scale, which resulted in about a 90th percentile split for our study population.

For a diagnosis of major depression, we used a version of the SCID's major depressive disorder scale from the nonpatients version (35), which also has been used in telephone-based population surveys (5, 36–39). Following DSM-IV criteria (29), respondents met the criteria for depression if they had 5 or more depression symptoms for at least 2-weeks in the past 12 months. In the current study, Cronbach's alpha for the 10 symptoms used in this scale was 0.87. Data related to the validity of this scale also were previously reported and suggested that this scale can successfully diagnose depression in the general population (37–39).

Our psychiatric symptom measure was based on the Brief Symptom Index-18 (BSI-18), a self-reported psychiatric scale derived from the Hopkins Symptom Checklist (40). The measure contained 18 items divided into 3 subscales relating to somatization, anxiety, and depression. For this study, we used the entire 18 items to generate a Global Severity Index (GSI). The BSI-18 has been standardized based on a national community sample and has clinical T-scores to define cases. We used a T-score of 65 or higher for case definition, representing a symptom score above the 90th percentile. Cronbach's alphas for BSI-18 scales ranged from 0.74 to 0.89 and test-retest correlations ranged from 0.68 to 0.90 for the BSI scale (40).

General physical and psychological well-being was assessed using the Short Form-12, version 2 (SF-12-v2). This scale consisted of 12 items scored so that high scores reflect better health (Cronbach's alpha = .87). Following recommended scoring algorithms, the items were summed and converted into standardized T-scores to form 2 scales (41). Although both scales contained all 12 items, the physical health measure (SF-12-v2 physical component, range 7 to 71) emphasized items on physical functioning, vitality, and body pain over the past 30 days. The psychological health measure (SF-12-v2 mental component, range 7 to 74) stressed items on emotional problems, feeling depressed, and feeling calm or peaceful over the past 30 days. In our study, we used the recommended score of 30 or less to define individuals as unhealthy cases for each measure (41). The SF-12-v2 has been reported to have excellent validity and reliability and has been extensively used in health research (41–43).

INDEPENDENT VARIABLES

Alcohol Measures

Four measures of alcohol use are our key independent variables. The first alcohol outcome was binge drinking. Consistent with previous surveys

and standardized measures used in epidemiologic studies of alcohol abuse (44, 45), the W2 survey asked how many times during the year after the WTCD the respondent had 6 or more alcoholic drinks on one occasion. We coded the responses, with never or less than monthly (coded 0) compared to monthly or more often (coded 1). Second, the W2 survey inquired about the respondent's consumption of alcoholic beverages based on the CAGE criteria for alcohol dependence, a widely used and validated scale (46, 47). Using these data we defined respondents as meeting criteria for alcohol dependence if they had 2 or more positive responses on the CAGE survey (e.g., criticized about drinking, drank first thing in the morning, etc.). Due to the fact that so few respondents met criteria in any given year, we created a dummy variable for meeting the CAGE criteria for the 24 months between the WTCD and the W2 interview, with not meeting criteria as the reference group. Third, we calculated an increase in drinking per day measure for the year after the WTCD, which was the difference between the reported number of drinks per day in the month prior to the W1 survey (i.e., approximately 12 months after the WTCD) minus the number of drinks per day in the month before the WTCD. In order to make the increase clinically meaningful, we divided the sample into those who had an increase of 2 or more drinks per day (coded 1) versus those who had less of an increase, no change, or a decrease in drinking (coded 0). The fourth alcohol measure was an increase in the number of drinks per month pre- versus post-WTCD. Like the drinks per day measure, we wanted to make a clinically meaningful division and, thus divided the sample into those who had an increase of 4 or more drinks per month pre- versus post-WTCD compared to those who did not. Respondents who had less than a 4 drink per month increase in drinking alcoholic beverages were the reference group. Although some of these alcohol measures were collected during the W2 survey, all reflect alcohol use between the WTCD and the W1 survey, except for alcohol dependency, as noted.

Background Characteristics

Our analyses included 6 demographic variables age, education, children under 18 in the home, gender, marital status, and race/ethnicity. Age was coded into 4 categories, 18–29, 30–44, 45–64, and 65+, with 65+ coded as the reference category. Education, children under 18 in the home, gender, and marital status were dummy coded, noncollege graduate versus college graduate, no children versus having children, male versus female, and not married versus married (including living together), with noncollege graduate, no children, male, and not married

the reference category. Consistent with most research (48), race/ethnicity was self identified in the following manner. First, the survey interviewer asked the respondent if he/she was of "Spanish or Hispanic origin?" We next queried the respondent about his/her race, which included White, Black or African American, Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, or "some other race." Using the responses to these 2 questions, we classified all respondents as follows: non-Hispanic White, non-Hispanic Black or African American, Hispanic, and Other Race/No Race Given. Non-Hispanic White was the reference category. All of the demographic variables reflect W1 data, unless the data were missing, in which case, the W2 data were substituted.

Stress, Risk Factors, and Psychological Resources

Our analyses included 3 stressors that may have placed the individual at higher risk for poor well-being, and 2 psychological resources that could have lowered such risk. The W1 survey inquired about 14 possible events (yes; no) that the responded could have experienced during the WTC attacks. Since there was not an a priori method of assessing the severity of any individual exposure event, we summed the events into a WTCD exposure scale and coded them into low exposure (0–1 event), moderate exposure (2–3 events), high exposure (4–5 events), and very high exposure (6+ events). Low exposure was the reference category. Second, the negative life event scale was the sum of eight experiences that the respondent could have had in the 12 months before the WTCD (e.g., divorce, death of spouse, problems at work) (4). Based on an examination of the frequency distribution, we coded respondents into three groups (no life events, one life event, and 2 or more life events), with no life events the reference category. The third stress measure focused on 10 lifetime traumatic events, other than the WTCD, which could have happened to the respondent before the WTCD (e.g., forced sexual contact, being attacked with a weapon, etc.) (4). Respondents were coded into one of 4 categories, no traumas, 1 trauma, 2–3 traumas, and 4 or more traumas, with no traumas as the reference category.

Our social psychological resource variables included, social support and self-esteem, both of which were collected during the W1 survey (49, 50). Social support (Cronbach's alpha = .83) was the sum of 4 questions about emotional, informational, and instrumental support (e.g., Someone available to help if confined to bed). Based on an examination of the scale's frequency distribution, we coded respondents into approximately 3 equal size groups: low, moderate, and high social support. Self-esteem, was measured by a reduced form of Rosenberg's

self-esteem scale (51). The scale (Cronbach's alpha = .73) was the sum of 5 items in the original scale (e.g., I certainly feel useless at times; On the whole, I am satisfied with myself). The response options were strongly agree (coded 1) to strongly disagree (coded 4). We coded items so that high scores reflected high self-esteem. The scale had a highly skewed frequency distribution, with over 70% of the respondents having scores between 17 and 20. Therefore, we divided respondent into three categories: low (5–17), moderate (18–19), and high self-esteem (20). For these resource variables, low social support and low self-esteem were the reference categories. All of these stress/risk and resource measures were used and validated in other WTCD studies in New York City (5, 31, 37–39).

STATISTICAL ANALYSIS

Our analytic strategy proceeds in several steps. First, we present descriptive statistics for the sample and for the 7 outcome variables. Then, we estimate a series of logistic regression equations. More specifically, we regress each of the 7 outcomes separately on binge drinking, alcohol dependence, 4+ increase in drinks/month, and 2+ increase in drinks/day, without controlling for demographic, stress, or resource variables. Next we introduce the demographic variables. The third equation contains the alcohol variable, demographics, and stressor/risk variables. Finally, we add the 2 resource variables. These 4 steps allow us to examine changes in the association between the drinking and the outcome measures, as we introduce more statistical controls into the logistic regression model. For all analyses, we use the survey estimation (svy) command set in Stata, version 7, to generate frequency distributions, point estimates, correlations, and our regression models (51). This estimation procedure adjusts the data to take into account our sampling design. All p-values presented are based on 2-tail tests.

RESULTS

Descriptive statistics for the sample are presented in Table 1. As reported in other WTCD studies, compared to other areas of the United States, residents of NYC are educated, with more than 40% having a college degree. Over 40% had children under 18 living in the household and about 50% were married or living together (5, 37). In terms of exposure to stressful events, almost 75% of the respondents reported experiencing 2 or more WTCD related events, 44% reported at least one negative life event in the year before the WTCD, and slightly more than 16% reported at least four or more lifetime traumatic events, other than the WTCD.

Table 1. Study descriptive statistics (N = 1681)

Independent variables	% (N)*
Age	
18–29	22.7 (284)
30–44	32.9 (596)
45–64	32.5 (589)
65+ (reference)	11.9 (215)
Education	
Non college graduate (reference)	58.3 (906)
College graduate	41.7 (775)
Kids under 18 in home	
No (reference)	55.8 (1041)
Yes	42.2 (640)
Gender	
Male (reference)	46.2 (693)
Female	53.8 (988)
Marital status	
Not married (reference)	49.7 (972)
Married	50.3 (709)
Race	
White (reference)	43.0 (782)
African American	26.0 (422)
Latino	24.1 (367)
Other	7.0 (110)
Exposure to WTCD	
Low (0–1 events) (reference)	26.7 (362)
Moderate (2–3 events)	43.9 (719)
High (4–5 events)	21.8 (416)
Very high (6+ events)	7.6 (184)
Negative life events year before WTCD	
None (reference)	56.0 (848)
One	27.5 (467)
2 or more	16.5 (366)
Lifetime traumatic events	
0 events (reference)	33.6 (466)
1 event	23.4 (400)
2–3 events	26.7 (484)
4+ events	16.2 (331)
Social support	
Low (reference)	34.3 (573)
Moderate	36.9 (636)
High	28.8 (472)

(*Continued*)

Table 1. Continued

Independent variables	% (N)*
Self-esteem	
Low (reference)	32.2 (613)
Moderate	25.0 (408)
High	42.9 (660)
Binge drinking year postdisaster	
No (reference)	84.1 (1423)
Yes	15.9 (258)
Alcohol dependent anytime 2 years post-WTCD	
No (reference)	95.1 (1578)
Yes	4.9 (103)
Increase of 4+ days drinking/Mo. pre vs. post-WTCD	
No (reference)	90.0 (1498)
Yes	10.0 (183)
Increase of 2+ drinks/Day pre vs. post-WTCD	
No (reference)	93.7 (1566)
Yes	9.3 (115)

*% are weighted data, Ns are unweighted data.

We highlight the fact that almost 15% met study criteria for binge drinking, 5% met the CAGE criteria for alcohol dependence in the 2 years between the WTCD and the W2 survey, 10% reported an increase of 4 or more days drinking per month pre-versus post-WTCD, and 9% reported an increase of 2 or more drinks per day, pre- versus postdisaster.

The percentages of respondents meeting criteria for the 7 W2 dependent variables are shown in Table 2. Twenty percent of the respondents reported enough PTSD symptoms to be classified as subsyndromal, 8% met criteria for partial PTSD, and almost 10% reported high PTSD symptom severity. About 12% of the respondents had symptoms of major depression in the past year and roughly 9% were defined as unhealthy (a "case") on the BSI-18 Global Severity Index. For the SF12 measures, 8% were defined as unhealthy on the SF12-physical component and 7% were defined as unhealthy on the SF12-mental component. Finally, 29% of the respondents were classified as having psychological or physical problems on at least one of the 7 outcomes assessed.

The bivariate results of the logistic regression analyses (Table 3) indicated that for every outcome, except the SF12-physical health component, harmful alcohol use or an increase in alcohol consumption increased the likelihood of poor well-being. The multivariate findings

Table 2. Descriptive statistics for the mental health status and well-being outcomes assessed (N = 1681)

Dependent variables	% (N)*
Subsyndromal PTSD	
No	80.2 (1253)
Yes	19.8 (428)
Partial PTSD	
No	91.9 (1496)
Yes	8.1 (185)
PTSD symptom severity	
Low/Moderate	90.5 (1456)
High	9.5 (225)
Depression past year	
No	88.4 (1404)
Yes	11.6 (277)
BSI18-Global Severity Index	
Not a case	91.3 (1470)
Case	8.7 (211)
SF12–poor physical health	
No	92.5 (1518)
Yes	7.5 (163)
SF12–poor mental health	
No	93.4 (1532)
Yes	6.6 (149)
Yes on any of the above outcomes	
No	70.7 (1076)
Yes	29.3 (605)

*% are weighted data, Ns are unweighted data.

showed that alcohol dependence was the most consistently related to the 7 outcomes, with it being statistically significant in all models, except for partial PTSD and the SF12-physical health component. Once all of the other factors were controlled, binge drinking was associated with only one outcome (partial PTSD), while days drinking and drinks per day were related to 2 measures. Thus, although there was some evidence that earlier alcohol use was related to later psychological problems, many of the associations were not significant, once statistical controls were introduced.

Looking at the 7 outcomes individually, the results indicated that all of the alcohol measures have bivariate associations with meeting criteria for subsyndromal PTSD (Table 3, panel 1) and that those relationships were maintained after controlling for demographic factors (Table 3, rows 1 and 2). The relationship between binge drinking and subsyndromal

Table 3. Logistic regression odds ratios (ORs) and 95% confidence limits (CLs) for W2 psychological and physical health outcomes regressed on alcohol use, demographic, stressor, and resource variables following the World Trade Center disaster (N = 1681)

Dependent variables	Binge drinking OR (95% CL)	Alcohol dependence OR (95% CL)	Increased 4+ days drinking/mo OR (95% CL)	Increased 2+ drinks/day OR (95% CL)
Subsyndromal PTSD				
No other vars. controlled	1.58 (1.10–2.27)*	2.65 (1.57–4.45)***	1.92 (1.27–2.89)**	2.26 (1.37–3.72)***
Demographics[†]	1.63 (1.10–2.40)*	2.92 (1.69–5.04)***	2.04 (1.33–3.12)***	2.02 (1.18–3.46)**
+Stress[‡]	1.42 (0.93–2.17)	2.27 (1.31–3.93)**	2.03 (1.30–3.17)**	1.98 (1.09–3.61)*
+Resource[§]	1.38 (0.88–2.16)	2.40 (1.37–4.21)**	1.99 (1.28–3.11)**	1.86 (1.02–3.41)*
Partial PTSD				
No other vars. controlled	2.03 (1.26–3.27)**	2.38 (1.29–4.41)**	1.71 (0.99–2.95)	1.89 (0.99–3.59)
Demographics	2.08 (1.24–3.48)**	2.45 (1.29–4.67)**	1.67 (0.96–2.91)	1.56 (0.81–3.02)
+Stress	1.93 (1.13–3.29)*	1.87 (0.96–3.63)	1.48 (0.85–2.60)	1.44 (0.72–2.86)
+Resource	1.84 (1.06–3.18)*	1.92 (0.93–3.96)	1.43 (0.80–2.55)	1.39 (0.68–2.85)
PTSD symptom severity				
No other vars. controlled	1.86 (1.19–2.92)**	2.41 (1.36–4.27)**	1.70 (1.04–2.78)*	2.07 (1.16–3.71)*
Demographics	2.00 (1.24–3.23)**	2.49 (1.40–4.44)**	1.80 (1.10–2.95)*	2.00 (1.07–3.74)*
+Stress	1.66 (0.99–2.78)	1.89 (1.03–3.45)*	1.63 (0.99–2.99)	1.83 (0.99–3.41)
+Resource	1.60 (0.94–2.73)	1.93 (1.00–3.72)*	1.55 (0.94–2.55)	1.75 (0.94–3.28)
Depression past year				
No other vars. controlled	1.74 (1.17–2.61)**	3.59 (2.09–6.16)***	1.98 (1.24–3.15)**	2.16 (1.23–3.79)**
Demographics	1.56 (1.02–2.38)*	3.63 (2.07–6.56)***	1.89 (1.19–3.01)**	1.71 (0.95–3.07)
+Stress	1.28 (0.81–2.04)	2.87 (1.62–5.04)***	1.78 (1.07–2.95)*	1.55 (0.80–2.99)
+Resource	1.18 (0.73–1.90)	2.94 (1.63–5.29)***	1.67 (0.99–2.82)	1.36 (0.69–2.70)

(*Continued*)

Table 3. Continued

Dependent variables	Binge drinking OR (95% CL)	Alcohol dependence OR (95% CL)	Increased 4+ days drinking/mo OR (95% CL)	Increased 2+ drinks/day OR (95% CL)
BSI-18: Global Severity Index				
No other vars. controlled	1.88 (1.22–2.91)**	3.86 (2.12–7.02)***	1.50 (0.88–2.56)	1.25 (0.64–2.47)
Demographics	1.61 (0.99–2.64)	4.45 (2.33–8.51)***	1.50 (0.85–2.64)	0.88 (0.42–1.84)
+Stress	1.28 (0.76–2.18)	3.74 (1.93–7.25)***	1.31 (0.71–2.40)	0.76 (0.33–1.74)
+Resource	1.19 (0.69–2.05)	3.91 (2.07–7.37)***	1.18 (0.63–2.22)	0.58 (0.24–1.38)
SF12–poor physical health				
No other vars. controlled	0.63 (0.37–1.11)	1.07 (0.51–2.28)	0.39 (0.15–0.90)*	0.44 (0.20–1.01)
Demographics	0.81 (0.42–1.56)	1.34 (0.58–3.11)	0.38 (0.14–1.02)	0.45 (0.19–1.09)
+Stress	0.76 (0.38–1.51)	1.18 (0.51–2.69)	0.33 (0.13–0.84)*	0.45 (0.19–1.09)
+Resource	0.74 (0.37–1.45)	1.09 (0.46–2.57)	0.32 (0.13–0.80)*	0.40 (0.16–0.97)*
SF12–poor mental health				
No other vars. controlled	1.41 (0.81–2.43)	2.30 (1.19–4.45)*	1.44 (0.79–2.60)	1.63 (0.79–3.36)
Demographics	1.51 (0.84–2.73)	2.58 (1.25–5.32)**	1.51 (0.82–2.76)	1.57 (0.73–3.40)
+Stress	1.36 (0.73–2.52)	2.21 (1.07–4.54)*	1.47 (0.79–2.76)	1.55 (0.71–3.36)
+Resource	1.31 (0.69–2.47)	2.30 (1.08–4.90)*	1.41 (0.76–2.61)	1.44 (0.66–3.15)

*$p < .05$
**$p < .01$
***$p < .001$
†Demographic controls: age, education, kids in home, gender, marital status, race/ethnicity.
‡Stress controls: exposure to WTCD, negative life events, traumatic events.
§Resource controls: social support and self-esteem.

PTSD became nonsignificant when stress factors were introduced into the equations (Table 3, row 3). All other alcohol measures remained statistically significant for subsyndromal, even after controlling for social and psychological resources (Table 3, row 4).

Binge drinking and alcohol dependence were related to meeting the more restrictive criteria for partial PTSD only for the bivariate model (Table 3, row 1) and after controlling for demographic characteristics. Once the stress variables were introduced into the model, alcohol dependence's association with this outcome became nonsignificant, but binge drinking remained statistically significant in the partial PTSD models. Interestingly, neither of the increase in alcohol consumption measures was related to partial PTSD.

The alcohol measures also have statistically significant associations with PTSD symptom severity in the bivariate model and multivariate model when controlling for demographic variables (Table 3, panel 3, rows 1 and 2). All of the relationships were rendered nonsignificant, however, except for alcohol dependence, when stress variables were controlled (Table 3, row 3). The association between alcohol dependence and PTSD symptom severity was still statistically significant after introducing social and psychological resources (Table 3, row 4).

The depression measure was related to all of the alcohol use measures in the bivariate logistic regressions (Table 3, panel 4, row 1). The measure for increased drinks per day was not statistically significant once demographic factors were controlled (Table 3, row 2) and binge drinking was not significant after controlling for stress factors (Table 3, row 3). Only alcohol dependence remained statistically significant after introducing social and psychological resource variables in the model. A respondent who met criteria for alcohol dependence, controlling for all other variables, was almost 3 times more likely to be depressed (OR = 2.94) in the past year, compared to those who did not meet these criteria.

For the BSI18-GSI scale (Table 3, panel 5), only binge drinking and alcohol dependence were statistically significant for the bivariate association (Table 3, row 1). In all of the other models, only alcohol dependence was significantly related to this outcome. However, this alcohol use variable was strongly associated with the BSI18-GSI, with alcohol dependent respondents about 4 times more likely to be rated in poor psychological health (OR = 3.91) than respondent who were not alcohol dependent.

The results for the two SF-12 measures indicated differing relationships between these two outcomes and the alcohol measures. Alcohol consumption was related to better physical health and poorer mental health. More specifically, once all of the variables were entered into the model (Table 3, panel 6, row 4), an increase of 4 or more days drinking per month or an increase of 2 or more drinks per day was associated with a decrease

likelihood of having poor physical health. In contrast, alcohol dependence was associated with an increase likelihood of being defined as unhealthy on the SF-12 mental health component. Interestingly, binge drinking was not related to either of these outcomes and alcohol dependence was the only alcohol measure related to the SF-12 mental health component.

Finally, examining other components of the stress model (results available from the corresponding author upon request), suggested exposure to greater WTCD events was related to worse health and functioning for all of the outcomes, except for the SF12-physical health component. This result did not change when social resource variables were included in the model. A similar pattern held for self-esteem. That is, respondents with high self-esteem had better well-being compared to those with lower self-esteem, except for the SF12-physical health component. Thus, the stress process model may provide a useful perspective for linking community-wide disasters and alcohol use to later well-being.

DISCUSSION

Using a sample of residents living in NYC at the time of the terrorist attacks on the World Trade Center, we examine the extent to which earlier alcohol use predicted physical and psychological well-being. Unlike other studies examining alcohol use and mental health, we assess a variety of alcohol, mental health, and well-being measures. The findings suggest that alcohol use, especially ''harmful'' use like binge drinking or alcohol dependence, was related to well-being such that increased use was related to worse mental health, but possibility improved physical health. Returning to the 3 questions of interest, our results indicate that about 10% of respondents reported an increase in the amount of alcohol they consumed (days drinking/month and drinks/day) after the WTCD compared to before the attacks. In addition, between 5 and 15% of the respondents engaged in pathological drinking. Second, the bivariate analyses showed that all 4 of the alcohol measures were associated with meeting criteria for subsyndromal PTSD, PTSD symptom severity, and depression. Both binge drinking and alcohol dependence were associated with the BSI18-GSI, while an increase in days drinking was related to the SF-12 physical health component and only alcohol dependence was associated with the SF-12 mental health component.

Once demographic, stress, and resource factors were included in the analyses, though, binge drinking was related to partial PTSD, alcohol dependence was related to 5 outcomes (subsyndromal PTSD, PTSD symptom severity, depression, GSI18-GSI, and SF-12 mental health), an increase of 4 or more days drinking per month was linked to 2 outcomes (subsyndromal PTSD and SF-12 physical health), and an increase

of 2 or more drinks per day was associated with 2 outcomes (subsyndromal PTSD and SF-12 physical health). Thus, alcohol dependence was the most predictive of later well-being, while binge drinking was the least predictive, controlling for other factors.

One of the unexpected findings was that increases in alcohol use seem related to better physical health. For both increase in days drinking and drinks per day, respondents who reported such changes in their alcohol consumption also scored better on the SF12-physical health component and were less likely to be defined as unhealthy. Given that neither binge drinking nor alcohol dependence were statistically associated with physical health, it is possible that increases in alcohol use, even increases as large as the ones investigated, but not unhealthy use, lower stress and the negative physical consequences linked to this psychological state (52, 53). An additional possibility is that the negative consequences for health do not manifest themselves for a long period of time. In the present study, we follow respondents only for 2 years and have retrospective alcohol data for 3 years. Such a short timeframe may not be sufficient to adequately assess the physical consequences of alcohol use.

There are a number of explanations for why alcohol use negatively influences psychological well-being. For example, individuals my use substances like alcohol to cope with symptoms associated with psychological problems (54, 55). For example, alcohol use may dampen the physiological responses related to PTSD such as hyperarousal or re-experiencing. Such self medication behavior, however, is typically seen as an avoidance coping strategy, which is usually not associated with positive outcomes (23, 24, 54, 56). Thus, it is entirely possible that attempts at alcohol withdrawal may actually intensify symptoms for individuals with PTSD or depression (15, 18, 55). These reactions may interfere with the resolution of the traumatic experience, prolonging symptoms following the disaster. Finally, studies assessing the link between PTSD and substance use within the context of the WTCD have shown that even when individuals no longer meet criteria for the disorder, their substance use remained elevated in the post disaster period, pointing to the addictive properties of alcohol, cigarettes, and illicit drugs (17, 18, 56).

STUDY LIMITATIONS

It should be noted that there are both limitations and strengths to our study. First, by omitting individuals without telephones and those who did not speak either English or Spanish, we may have missed highly vulnerable individuals and ethnic groups. Since our sample matched the 2000 Census for NYC; however, these exclusion criteria did not appear to have introduced systematic demographic bias. Nevertheless,

we are limited in our generalizations about the association between alcohol use and well-being beyond English- and Spanish-speaking groups. Only a few studies focus on how the WTC attacks affected the physical or mental health of immigrant communities or the wide variety of ethnic groups living in NYC (57). In addition, all measures of alcohol use, mental health status, and physical well-being were based on self-report. Although there has been significant progress in assessing individual substance use and mental health with standardized instruments administered (20, 22, 33), there continue to be discrepancies between lay and clinician-based assessments of community samples.

Finally, our conclusions are limited by the retrospective nature of the predisaster data. That is, we did not have any predisaster data. The disaster experience itself may alter retrospective data on predisaster well-being or substance use. This limitation, though, is common in almost all trauma and disaster research (5, 22, 33). In addition, our data do not allow us to model changes in alcohol use and well-being over a longer period of time. In her review of the research on trauma and alcohol use, Stewart found that trauma and the development of PTSD preceded drinking problems, but that drinking seems to also worsen PTSD symptoms (55). Although longitudinal data collected over a period of 5 to 10 years may be necessary to disentangle the causal relationships among trauma, well-being, and alcohol use, such data are rare. Nevertheless, this may be the best strategy and this is especially the case for assessing the links between trauma, drinking, and physical diseases. Finally, treatment outcome studies may require longer follow-up periods than is typical, given the protracted relationship between trauma, alcohol use, and mental health problems.

These limitations should not overshadow the strengths of the study, which include the use of a large random sample representative of NYC adults, the assessment of physical and mental well-being using standard scales and measurements, the use of a variety of alcohol use measures, and a specific community-wide disaster context. A conclusion of our analyses is that alcohol use seems to have at least a moderate association with psychological disorders following the WTCD, but only a weak association with physical health. It is possible that alcohol use may be related to physical well-being, but that such effects may take longer to manifest. Thus, based on our findings, continuing investigation of the alcohol use and physical and psychological health seems warranted.

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