

Probable Cigarette Dependence, PTSD, and Depression after an Urban Disaster: Results from a Population Survey of New York City Residents 4 Months after September 11, 2001

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Disaster exposure may exacerbate psychopathology and substance-related disorders. Four months after September 11, 2001, using random-digit dialing to contact a representative sample of adults ($N = 2001$) living in New York City, we assessed cigarette smoking and symptoms of probable cigarette dependence using measures from the National Survey on Drug Use and Health. A total of 36.8% of smokers reported increased cigarette use; 10.4% of respondents reported three or more symptoms of cigarette dependence and were considered cases of probable cigarette dependence based on DSM-IV criteria. Cases were more likely to report an increase in cigarette use since September 11 than non-cases (69.4% among cases vs. 2.2% among non-cases, $p < 0.001$). Cases were more likely to have probable posttraumatic stress disorder (PTSD) and depression than non-cases (18.1% vs. 5.7% for PTSD, $p < 0.001$; 23.6% vs. 6.0% for depression, $p < 0.001$). Increased cigarette use since September 11 was associated with probable PTSD among cases (23.4% vs. 6.4%, $p = 0.011$) and non-cases (15.1% vs. 5.5%, $p = 0.034$) but was associated with probable depression only among cases of probable cigarette dependence (28.3% vs. 13.3%, $p = 0.027$). This study showed the co-occurrence of probable cigarette dependence with increased cigarette use and the co-occurrence of probable cigarette dependence with probable PTSD and depression after September 11.

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INTRODUCTION

The September 11, 2001, terrorist attack on the World Trade Center in New York City (NYC) was the largest terrorist attack in United States history, killing an estimated 2,752 people ("A New Account," *New York Times*, 2003). A substantial proportion of the population of NYC was affected either directly or indirectly by the attacks and a considerable burden of substance use and mental health problems has been documented in the aftermath of the attacks, including increased cigarette use, posttraumatic stress disorder (PTSD), and major depression (Galea et al., 2002; Vlahov et al., 2002).

Most of the extant research investigating the association between traumatic event exposure and cigarette use has focused on individual victims of traumatic events, including war veterans, families of homicide victims, and victimized women (Acierno, Kilpatrick, Resnick, Saunders, & Best, 1996; Beckham et al., 1995; Mezey, Evans, & Hobdell, 2002; Op Den Velde and colleagues (2002). This research suggests that persons exposed to traumatic events may be at risk for increased cigarette use and cigarette abuse/dependence. Breslau, Davis, and Schultz (2003) examined persons exposed to traumatic events other than mass disasters and compared the likelihood of developing cigarette dependence among persons who developed PTSD to those who did not develop PTSD. They found that the likelihood of substance dependence following traumatic event exposure was linked to the development of psychological symptoms (Breslau, Davis, & Schultz, 2003). Data are sparse on the association between traumatic event exposure and substance-related problems in the general population after a disaster. A study by Smith, Christiansen, Vincent, and Hann (1999) assessed the effects of the 1995 Oklahoma City bombing on the general population of Oklahoma City and reported an increased use of cigarettes in the aftermath of the bombing (Smith, Christiansen, Vincent, & Hann, 1999). Similarly, Vlahov et al. (2002) reported an increase in cigarette use among residents of NYC in the first five to

eight weeks following the September 11 attacks (Vlahov et al., 2002). Neither of these studies reported symptoms of substance dependence or abuse.

In this study, we used data from a survey conducted 4 months after September 11 to investigate symptoms of cigarette dependence in the general population of NYC in the aftermath of the September 11 attacks. Our objectives were 1) to assess the prevalence of probable cigarette dependence in NYC 4 months after September 11, 2) to identify the factors associated with probable cigarette dependence in NYC after the September 11 attacks, and 3) to assess the relation between probable cigarette dependence, increased cigarette use, and probable PTSD and depression.

METHODS

Participants and Procedures

We conducted random-digit-dial telephone interviews approximately 4 months after the September 11, 2001, attacks (January 15-February 21, 2002). The sampling frame consisted of adults from all five boroughs of NYC, with an oversampling of Manhattan residents living south of 110 Street for comparison with a previous survey. The adult in each household with the most recent birthday was selected to be interviewed. Up to ten attempts were made to conduct the interview. Interviews were conducted in either English or Spanish. The mean interview time was approximately 35 minutes. The cooperation rate for the survey was 64% and was based on the sum of the number of completed interviews, quota-outs (those who were eligible for the interview but who were excluded because the quota for borough or gender was exceeded), and screen-outs (those who were younger than 18 years old, who did not speak English or Spanish, or who did not live in the city) divided by the sum of completed interviews, quota-outs, screen-outs, refusals, and premature terminations. The response rate was 36% and was based on the sum of completed interviews and partial interviews divided by the

sum of eligible residential telephone numbers and telephone numbers of unknown eligibility. Further details on sample selection are provided elsewhere (Galea et al., 2003). The Institutional Review Board at the New York Academy of Medicine approved the study, and all study subjects provided oral consent at the time of the interview.

Measures

We used measures from the National Survey on Drug Use and Health (NSDUH), structured according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)*, to measure cigarette dependence (Epstein & Gfroerer, 1998). *DSM-IV* requires that a respondent meet three out of seven dependence criteria to be considered substance dependent. Consistent with this definition, we defined a case of cigarette dependence as a person who had three or more symptoms of dependence for cigarette use (e.g., smoking cigarettes more often or in larger amounts than intended, needing to smoke more in order to get the same effect, wanting to stop or cut down on smoking but being unable to do so). Each question was preceded by the phrase “Since the World Trade Center disaster” to specifically assess symptoms of dependence since the September 11 attacks. Because the time period of evaluation was 4 months after September 11, we refer to persons who satisfied three of out of seven dependence criteria as persons with probable cigarette dependence throughout this paper. To assess smoking status, we asked respondents if they smoked cigarettes every day, some days, or not at all since the World Trade Center disaster. Persons who reported smoking every day or some days in the previous 12 months were considered smokers. For cigarette frequency, we asked respondents if they had been smoking more cigarettes since the World Trade Center disaster and created a dichotomous variable “increased cigarette smoking” for the analysis.

Respondents were asked about demographics, including age, gender, race, education, and marital status. We assessed social

support by asking about emotional (e.g., “someone to love you and make you feel wanted”), instrumental (e.g., “someone to help you if you were confined to bed”), and appraisal (e.g., “someone to give you good advice in a crisis”) support (Sherbourne & Stewart, 1991) in the 6 months before the September 11 attacks and summed responses. The combined social support score was divided into thirds for analysis. Respondents were asked about the occurrence of any of eight traumatic events (e.g., being attacked or being in a major accident) in their lifetime, as well as about stressors in the 12 months prior to September 11 (e.g., the death of a spouse or a recent divorce). For the analysis, prior lifetime traumatic experiences were categorized according to whether respondents experienced zero, one, two to three, or four or greater stressful events. Stressors in the 12 months prior to September 11 were categorized as zero, one, or two or greater for the analysis.

Respondents’ exposures to September 11-related trauma were evaluated by collecting information on a number of potential exposures, including proximity to the disaster, having been injured in the attacks, having a friend or relative killed, having possessions lost or damaged, having lost a job because of the attacks, or having been involved in the rescue effort. We created a composite variable that summarized whether respondents were “directly affected” by the event. For the purposes of these analyses, respondents who were in the World Trade Center on September 11, were injured during the attacks, had a friend or relative killed, had possessions lost or damaged, lost a job because of the attacks, or were involved in the rescue effort were classified as “directly affected” by the events of September 11. We categorized proximity by whether respondents lived north or south (closer to the World Trade Center) of 14th Street. Media exposure was assessed by asking respondents about the frequency with which they viewed four specific traumatic television images (e.g., people falling or jumping from the World Trade Center) in the 7 days after September 11, and the total exposure to these images was

categorized into thirds of exposure for analysis.

We identified cases of probable PTSD using a modified version of the National Women's Study (NWS) PTSD module (Kilpatrick et al., 1998), based on the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (American Psychiatric Association, 1995). This PTSD scale is designed for administration by trained, non-clinical interviewers and has been used in a number of large-scale mental health surveys (Acierno et al., 2000; Galea et al., 2003; Resnick, Kilpatrick, Dansky, Saunders, & Best, 1993). The NWS PTSD scale includes questions on the three PTSD criteria domains, reexperiencing (criterion B), avoidance (criterion C), and arousal (criterion D). Probable PTSD cases were required to have one symptom from criterion B, three from criterion C, and two from criterion D. In order to select for cases of probable PTSD related to the September 11 attacks, we required that all content-related symptoms be associated with the attacks. The Cronbach alpha for the symptoms used in this scale was 0.90 (Galea, Boscarino, Resnick, & Vlahov, 2003). In addition, when validated against the clinician-administered *Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Third Edition Revised* (SCID) (Spitzer, Williams, & Gibbon, 1987) the PTSD scale used had a sensitivity of 98.8% and a specificity of 79.1% (Kilpatrick et al., 1998). In a validation study comparing the NWS PTSD module to the PTSD Checklist (PCL) (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996), an established screening measure for PTSD, the PCL had a sensitivity of 75% and a specificity of 95% in detecting PTSD cases as classified by our instrument (Boscarino, Galea, Ahern, Resnick, & Vlahov, 2003; Galea, Resnick, Kilpatrick, & Vlahov, 2004). In a receiver operating characteristic analysis (Hosmer & Lemeshow, 2000) we found that the optimal recommended PCL cut-off score of ≤ 50 best predicted PTSD using our instrument (area under the curve = 0.97) (Boscarino et al., 2004).

We used a modified, validated version of the SCID's (Spitzer et al., 1987) major de-

pressive episode scale to identify cases of probable depression after September 11. Consistent with *DSM-IV* guidelines, cases of probable depression were required to have five or more symptoms for at least 2 weeks. In addition to being used in previous surveys focusing on the effects of the September 11 attacks, this scale has also been used in other population surveys (Galea et al., 2002; Galea et al., 2003). The Cronbach alpha for the scale was 0.79 (Boscarino, Galea, Ahern, Resnick, & Vlahov, 2002). Furthermore, in a validation study comparing our instrument to the Brief Symptom Inventory (BSI) (Derogatis, 2001), a widely used depression scale, the BSI depression scale had a sensitivity of 73% and specificity of 87% as classified by our instrument (Boscarino et al., 2004). In a receiver operating characteristic analysis (Hosmer & Lemeshow, 2000) the BSI depression cutoff score of ≤ 65 best predicted depression using our instrument (area under the curve = 0.89) (Boscarino et al., 2004).

Statistical Methods

We calculated the prevalence of probable cigarette dependence in the sample. Two-tailed chi-square tests were used to test for associations between probable cigarette dependence and the variables of interest. Variables that were significantly associated with probable cigarette dependence ($p \leq 0.10$) were included in multivariable regression models. Using two-tailed chi-square tests, we compared the prevalence of probable PTSD and depression among smokers without probable cigarette dependence to the prevalence of probable PTSD and depression among non-smokers without probable cigarette dependence and found no significant differences; smokers without probable cigarette dependence and non-smokers without probable cigarette dependence were then combined in the analyses. Two-tailed chi-square tests were also used to examine the co-occurrences of probable cigarette dependence with increased cigarette use, probable cigarette dependence with probable PTSD and depression, and in-

Table 1.
Associations Between Probable Cigarette Dependence and Probable PTSD and Depression Four Months after the September 11, 2001 Terrorist Attacks among Residents of New York City ($n = 2001$)

	N	% with PTSD	<i>p</i> value*	% with Depression	<i>p</i> value*
Total	2001	7.4		9.0	
Cigarette Dependent	202	18.1	< 0.001	23.6	< 0.001
Non-Cigarette Dependent	1799	5.7		6.0	

Note. *two-tailed chi-square *p*-value.

creased cigarette use with probable PTSD and depression. All analyses were performed using SUDAAN (Shah, Barnwell, & Bieler, 1997) and weighted to adjust for the number of telephones, persons in the household, and oversampling.

RESULTS

Demographics

Of 2,001 persons interviewed, 506 were from the Manhattan oversample. The mean age was 42.6 years, 53.5% of respondents were female, and the racial/ethnic composition was 40.5% White, 25.7% African American, and 25.0% Hispanic. Regarding proximity to the World Trade Center site, 3.7% of respondents lived south of 14th Street at the time of the attacks. The age, gender, race, and residence distributions for the sample were consistent with estimates from the 2000 U.S. Census data (U.S. Census Bureau, 2000). The September 11 attacks were seen in person by 24.6% of respondents, and 25.4% of respondents were directly affected by the attacks.

The prevalence of smoking after the September 11 attacks in the sample was 24.9%, and an increase in cigarette use since September 11 was reported by 9.1% of the total sample (36.8% of smokers). Two hundred two persons, or 10.4% of the total sample (41.7% of smokers), reported three or more symptoms of cigarette dependence after September 11 and were considered cases of probable cigarette dependence.

Associations Between Probable Cigarette Dependence and Increased Cigarette Use

An increase in cigarette use after September 11 was reported by 69.4% of cases of probable cigarette dependence, while only 2.2% of non-cases reported an increase in cigarette use after September 11 ($p < 0.001$).

Associations Between Probable Cigarette Dependence and Probable PTSD and Depression

The associations between probable cigarette dependence and probable PTSD and depression are presented in Table 1. Cases of probable cigarette dependence were more likely to have probable PTSD after September 11 (18.1% cases vs. 5.7% among non-cases, $p < 0.001$) and depression after September 11 (23.6% among cases vs. 6.0% among non-cases, $p < 0.001$).

Associations Between Probable Cigarette Dependence, Increased Cigarette Use, and Probable PTSD and Depression

The associations between probable cigarette dependence and increased cigarette use with probable PTSD and depression are presented in Table 2. Increased cigarette use after September 11 was associated with probable PTSD among cases of probable cigarette dependence (23.4% vs. 6.4%, $p = 0.011$) and non-cases (15.1% vs. 5.5%, $p = 0.034$). Increased cigarette use after September 11 was associated with probable depression only

Table 2.
Associations Between Probable Cigarette Dependence, Increased Cigarette Use, and Probable PTSD and Depression Four Months after the September 11, 2001, Terrorist Attacks among Residents of New York City ($n = 2001$)

	Cigarette Increase	<i>n</i>	<i>n</i> PTSD	% PTSD	<i>p</i> Value*	<i>N</i> Depression	% Depression	<i>p</i> Value*
Cigarette Dependent	Yes	133	29	23.4	0.011	36	28.3	0.027
	No	68	4	6.4		10	13.3	
Non-cigarette Dependent	Yes	47	8	15.1	0.034	5	8.5	0.461
	No	1743	107	5.5		124	5.9	

Note. *two-tailed chi-square *p* Value

among cases of probable cigarette dependence (28.3% vs. 13.3%, $p = 0.027$).

1.68, $p = 0.003$), and probable depression after September 11 (OR = 2.70, $p < 0.001$).

Bivariate Analyses

In bivariate analyses (Table 3), the variables that were significantly associated with probable cigarette dependence since September 11 were moderate age (age 35–44) ($p = 0.029$), less education ($p = 0.064$), more lifetime traumatic events before the September 11 attacks ($p < 0.001$), more life stressors 12 months prior to the attacks ($p < 0.001$), more media exposure ($p < 0.001$), being directly affected by the attacks ($p < 0.001$), probable PTSD after September 11 ($p < 0.001$), and probable depression after September 11 ($p < 0.001$). Gender, race/ethnicity, marital status, and social support were not significantly associated with probable cigarette dependence since September 11.

Multivariable Analyses

In multivariable models (Table 3), the variables that were significantly associated with probable cigarette dependence were fewer years of education (odds ratio [OR] = 2.32 for respondents with less than a high school degree compared to those with a graduate degree, $p = 0.007$), life stressors in the 12 months prior to the September 11 attacks (OR = 1.77 compared with no life stressors, $p = 0.038$), media exposure (OR = 2.08 for respondents with high media exposure compared with low media exposure, $p = 0.006$), being directly affected by the disaster (OR =

DISCUSSION

In the 4 months after September 11, 2001, 10.4% of respondents (41.7% of smokers) in a representative general population survey of NYC reported three or more symptoms of cigarette dependence. An increase in cigarette use since the September 11 attacks was reported by 36.8% of smokers. Cases, or persons who met criteria for probable cigarette dependence, were more likely than non-cases to report an increase in cigarette use after September 11. Cases were also more likely than non-cases to have probable PTSD and depression after September 11. An increase in cigarette use since September 11 was associated with probable PTSD among cases of probable cigarette dependence and non-cases, but an increase in cigarette use since September 11 was only associated with probable depression among cases. We found that fewer years of education, more life stressors in the 12 months prior to September 11, more media exposure to the attacks, being directly affected by the attacks, and probable depression were associated with probable cigarette dependence after September 11 in multivariable models.

We estimated that 10.4% of the general population of NYC had probable cigarette dependence 4 months after the September 11 attacks. Although our estimate is based on symptoms present within a 4-month period,

Table 3.
Bivariate and Multivariable Associations Between Variables of Interest and Cigarette Dependence Depression
Four Months after the September 11 Terrorist Attacks among Residents of New York City (N = 2001)

Variable	<i>n</i>	% Cigarette Dependent	<i>p</i> Value*	OR (95% CI)	<i>p</i> Value*
Total	2001	10.4			
Age					
18–24	213	10.1	0.029	1.00	0.322
25–34	493	11.4		1.16 (0.63–2.14)	
35–44	468	13.8		1.21 (0.67–2.17)	
45–54	346	11.0		1.20 (0.64–2.28)	
55+	438	5.9		0.64 (0.31–1.32)	
Gender					
Male	891	10.0	0.646		
Female	1110	10.7			
Race/Ethnicity					
White	930	11.3	0.420		
Asian	91	6.1			
African American	475	9.3			
Hispanic	406	12.1			
Other	59	7.2			
Education					
Graduate Degree	290	5.8	0.064	1.00	0.007
College Degree	663	9.2		1.65 (0.79–3.47)	
Some College	414	12.7		2.61 (1.23–5.52)	
High School Grad/GED	427	12.9		3.33 (1.54–7.21)	
< High School Grad	191	8.8		2.32 (0.93–5.77)	
Marital Status					
Married	768	8.5	0.230		
Divorced	200	10.4			
Separated	79	17.7			
Widowed	139	12.1			
Never Married	736	11.9			
Unmarried Couple	67	11.3			
Social Support					
High	593	9.0	0.300		
Medium	694	11.2			
Low	553	12.2			
Lifetime Traumatic Events before 9/11					
0	570	8.6	< 0.001	1.00	0.126
1	461	7.0		0.82 (0.46–1.46)	
2–3	559	10.1		0.95 (0.57–1.59)	
4+	411	17.8		1.52 (0.89–2.59)	
Life Stressors 12 months before 9/11					
0	1094	7.2	< 0.001	1.00	0.038
1	569	12.1		1.53 (0.98–2.37)	
2+	338	18.5		1.77 (1.11–2.81)	
Live Below 14th Street					
No	1862	10.3	0.413		
Yes	139	13.0			
Media Exposure					
Low	640	6.9	< 0.001	1.00	0.006
Medium	641	9.9		1.58 (0.98–2.56)	
High	643	14.9		2.08 (1.33–3.25)	
Directly Affected					
No	1455	8.2	< 0.001	1.00	0.003
Yes	546	16.8		1.68 (1.13–2.52)	
PTSD After 9/11					
No	1853	9.2	< 0.001	1.00	0.161
Yes	148	26.9		1.51 (0.85–2.69)	
Depression After 9/11					
No	1789	8.7	< 0.001	1.00	< 0.001
Yes	176	31.4		2.70 (1.65–4.41)	

Note. OR = odds ratio; CI = confidence interval. *two-tailed chi-square *p* Value

rather than the 12 months typically used to measure dependence, this prevalence estimate is higher than the 8.6% 12-month prevalence estimate of cigarette dependence reported by the National Household Survey on Drug Abuse (NHSDA), the precursor to the NSDUH (Kandel, Chen, Warner, Kessler, & Grant, 1997). Because only those who smoke cigarettes are at risk of dependence, rates of dependence based on the entire population are confounded by the overall prevalence of smoking in the population. When we compare the prevalence of cigarette dependence conditional on use, we find that our estimate of 41.7% is substantially higher than the 28.0% reported by the NSDUH (Kandel et al., 1997). Nine point one percent (9.1%) of our total sample and 36.8% of smokers in our study increased their cigarette use since September 11, suggesting that traumatic event exposure is associated with increased substance use. These findings are consistent with our previous findings at different time points after September 11 (Vlahov et al., 2002) and comparable to those from a study by Smith and colleagues (1999), which reported a 29.2% rate of smokers smoking more than usual in a general population survey of Oklahoma City residents a few months after the Oklahoma City bombing (Smith et al., 1999).

Previous epidemiologic studies have suggested that Whites may be at a greater risk of cigarette dependence than non-Whites and females at a greater risk than males (Breslau, Jonson, Hiripi, & Kessler, 2001; Kandel and colleagues 1997). Few studies have reported on the correlates of cigarette dependence among persons exposed to traumatic events. Although Breslau and colleagues (2001) showed that Whites exposed to trauma were at a higher risk for cigarette dependence than Blacks, these findings were not corroborated either by our study, or by a study by Emmons and colleagues (2003) of adult survivors of childhood cancer (Breslau et al., 2001; Emmons et al., 2003). All three studies, however, did identify less education as a significant correlate of cigarette dependence (Breslau et al., 2001; Emmons et al., 2003). The overall lack of association between demo-

graphic factors and cigarette dependence in posttrauma research suggests that psychosocial factors may be more important determinants of cigarette dependence than demographic factors.

We found that specific pre-event, peri-event, and post-event factors were associated with probable cigarette dependence after September 11. The odds of having probable cigarette dependence in the 4 months after September 11 increased with the number of life stressors experienced in the 12 months prior to the event. Population studies have demonstrated a correlation between stressful events and higher levels of smoking (Colby, Linsky, & Straus, 1994). Our results suggest that life stressors before a traumatic event may be related to an individual's pre-event vulnerability to developing cigarette dependence after traumatic event exposure. However, without a longitudinal study, it is impossible to rule out the possibility that persons exposed to traumatic events in the 12 months before September 11 were more likely to represent preexisting cases of cigarette dependence. Among preexisting cases, exposure to disaster may either have no effect or contribute to the persistence of cigarette dependence. Though we documented a dose-response relation between the number of life stressors in the 12 months before September 11 and probable cigarette dependence subsequent to September 11, longitudinal research which documents incident cigarette dependence will be necessary to clarify this issue. In our study, cases of probable cigarette dependence were more likely to have been directly affected by the September 11 attacks than non-cases. This corroborates previous findings that traumatic event exposure is associated with cigarette dependence (Breslau et al., 2003).

Exposure to specific television images in the media coverage of the September 11 attacks has been documented as a correlate of both probable PTSD and increased cigarette use (Ahern et al., 2002; Vlahov et al., 2002) and was identified as a correlate of probable cigarette dependence in this study. Prior studies have shown that exposure to trauma-related imagery increases substance craving

among individuals with co-occurring substance dependence disorders and PTSD (Coffey et al., 2002). Similarly, in a study of Vietnam combat veterans with PTSD, Beckham and colleagues (1995) found that smokers reported a high frequency of smoking in response to military memories (Beckham et al., 1995). Our findings suggest that exposure to traumatic television images in the post-disaster period may be associated with a higher likelihood of cigarette dependence. However, although we selected for symptoms of cigarette dependence in the 4 months after the September 11 attacks, we cannot rule out the possibility that the observed association is explained by increased television viewing among persons with pre-existing cigarette dependence before September 11. Even if we were able to conclude that the exposure to traumatic television images preceded symptoms of cigarette dependence, it is still unclear whether viewing traumatic television images of the attacks acts as a primary event exposure or if television image exposure increases the likelihood of developing cigarette dependence by secondarily traumatizing those already exposed (Pfefferbaum, Pfefferbaum, & North, 2002). A longitudinal assessment would be necessary to clarify this association.

In our study, probable PTSD and depression co-occurred with symptoms of cigarette dependence in the 4 months after September 11, suggesting that co-morbidity may be a significant problem in the aftermath of a disaster. Similar findings have been documented in several epidemiologic studies (Farrell et al., 2001; Kandel, Huang, & Davies, 2001). We found that after adjusting for other variables in multivariable analyses, PTSD was not significantly associated with probable cigarette dependence. There have been few assessments of the relation between PTSD and cigarette dependence following exposure to traumatic events. A recent study found PTSD to be a significant risk factor for subsequent nicotine dependence following exposure to trauma (Breslau et al., 2003). However, that study did not adjust for life stressors or the degree of exposure to the trauma, vari-

ables we found to partially explain the association between probable cigarette dependence and probable PTSD after September 11. In our multivariable models, respondents with probable depression were almost three times as likely to have probable cigarette dependence after September 11. These results are consistent with past epidemiologic findings (Covey, Glassman, & Stetner, 1998; Currie, Hodgins, el-Guebaly, & Campbell, 2001). Our findings provide some early evidence that PTSD and depression may play different roles in the association between traumatic event exposure and cigarette dependence.

Because PTSD and depression have also been associated with increased cigarette use following exposure to traumatic events (Beckham et al., 1997; Vlahov et al., 2002), we stratified cases and non-cases by whether or not they increased their cigarette use since September 11. Upon stratification, we found that increased cigarette use since September 11 was associated with probable PTSD among cases and non-cases, but that increased cigarette use since September 11 was associated with probable depression only among cases. We found that stratification substantially weakened the association between probable cigarette dependence and probable PTSD but did not markedly weaken the association between probable cigarette dependence and probable depression. This again provides early evidence that the co-occurrences of cigarette dependence with PTSD and of cigarette dependence with depression may be explained by different mechanisms.

There are several limitations to this study. First, we did not have data on probable cigarette dependence before September 11. Although we were able to study probable cigarette dependence in the 4 months after September 11, we were not able to isolate incident cases or make comparisons with prevalence estimates taken before September 11. The fact that our 10.4% prevalence of probable cigarette dependence is not only comparable, but also plausibly higher than estimates from the NSDUH (Kandel et al., 1997), suggests that our measure may reflect important substance use pathology. Second, the economic down-

turn and the increased threat of subsequent terrorist activities (i.e., the anthrax mailings) may have increased the number of stressors faced by New Yorkers in the aftermath of the September 11 attacks. Therefore, stressors not directly related to the September 11 attacks may have been associated with probable cigarette dependence in our sample. Third, it is possible that anonymous telephone interviews for data collection may result in underreporting of probable cigarette dependence. However, telephone and in-person assessment of *DSM-III* Axis I disorders, including anxiety disorders and affective disorders, have been shown to result in comparable estimates of symptomatology (Paulsen, Crowe, Noyes, & Pfohl, 1988). Fourth, because little is known about the potential latency periods between exposure to traumatic events and cigarette dependence or between PTSD and depression and cigarette dependence, it is difficult to evaluate whether an interview 4 months after the attacks was best for studying these associations. Fifth, we conducted our study 4 months following September 11 using telephone interviews and identified cases of probable cigarette dependence. Probable cigarette dependence assessed in this manner cannot be equated to a full diagnosis of cigarette dependence assessed over a 12-month period and comparisons between the results of this study and others should be made with caution. Finally, since we assessed cigarette smoking only and did not ask about other forms of tobacco intake, therefore our measure of cigarette dependence cannot be equated to nicotine dependence.

With caveats considered, the co-occurrence of probable cigarette dependence with probable PTSD and depression 4 months after September 11 documented in our study suggests that the problems faced by persons in the general population after a massive disaster may extend beyond psychological symptoms. Our study suggests that different mechanisms may underlie the observed differences between the occurrence of probable cigarette dependence with probable PTSD and probable cigarette dependence with probable depression. Evidence shows that substance abuse and psychological disorders tend to mutually impede resolution and delay recovery, suggesting the importance of identifying persons with symptoms of cigarette dependence, PTSD, and depression in the early post-disaster period for possible intervention (Anda et al., 1990; Beckham et al., 1997; Zaslav, 1994). Future research should begin to assess the impact of specific characteristics of the social environment, such as social networks, the amount of available support resources, and changes in levels of social support, on the relation between cigarette dependence, increased cigarette use, and PTSD and depression after exposure to traumatic events. Furthermore, longitudinal work to elucidate the temporal association between exposure to traumatic events, PTSD and depression, and substance dependence may provide information on the etiology of these disorders and allow for more effective interventions in the aftermath of a disaster.

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