



## Trends of Probable Post-Traumatic Stress Disorder in New York City after the September 11 Terrorist Attacks

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The authors investigated trends in probable post-traumatic stress disorder (PTSD) prevalence in the general population of New York City in the first 6 months after the September 11 terrorist attacks. Three random digit dialing telephone surveys of adults in progressively larger portions of the New York City metropolitan area were conducted 1 month, 4 months, and 6 months after September 11, 2001. A total of 1,008, 2,001, and 2,752 demographically representative adults were recruited in the three surveys, respectively. The current prevalence of probable PTSD related to the September 11 attacks in Manhattan declined from 7.5% (95% confidence interval: 5.7, 9.3) 1 month after September 11 to 0.6% (95% confidence interval: 0.3, 0.9) 6 months after September 11. Although the prevalence of PTSD symptoms was consistently higher among persons who were more directly affected by the attacks, a substantial number of persons who were not directly affected by the attacks also met criteria for probable PTSD. These data suggest a rapid resolution of most of the probable PTSD symptoms in the general population of New York City in the first 6 months after the attacks. The psychological consequences of a large-scale disaster in a densely populated urban area may extend beyond persons directly affected by the disaster to persons in the general population.

disasters; disease progression; stress disorders, post-traumatic; terrorism

Abbreviations: CI, confidence interval; PTSD, post-traumatic stress disorder; SCID, Structured Clinical Interview for the *Diagnostic and Statistical Manual of Mental Disorders: DSM III-R*.

The September 11, 2001, terrorist attacks in New York City were the largest act of terrorism in US history. New Yorkers were affected by the attacks in many ways. Thousands of New Yorkers were relatives or friends of the approximately 2,800 people who died in the attacks. Many more saw the events in person or were affected by subsequent service delays and the economic slowdown in the city. Early postevent research has documented a substantial prevalence of psychological symptoms and probable psychological syndromes in New York City in the first months after the attacks. One study reported that 44 percent of Americans were bothered by at least one of five symptoms of post-traumatic stress disorder (PTSD) in the first 3–5 days after

September 11 (1). A population-based survey conducted 1 month after September 11 found that 7.5 percent of residents of Manhattan living south of 110th Street had symptoms consistent with a diagnosis of probable PTSD related to the attacks and that 9.7 percent of respondents had symptoms consistent with major depression (2). A Web-based epidemiologic survey reported a prevalence of probable PTSD of 11.2 percent in the New York City metropolitan area (3). This estimate was almost three times higher than estimates for the rest of the country. Thus far, there have been no studies of the changing prevalence of PTSD since September 11.

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To determine trends in the prevalence of probable PTSD in the general population of New York City after the September 11 attacks, we conducted three surveys in the first 6 months after the attacks. We used identical measures of probable PTSD in the three surveys to enable comparability. This study was designed 1) to estimate the changing prevalence of probable PTSD and subsyndromal PTSD using a validated PTSD screening instrument and 2) to assess the association of sociodemographic characteristics and key event exposures with acute and persistent probable PTSD.

## MATERIALS AND METHODS

### Sample

We conducted three household surveys by random digit dialing. The first survey was conducted between October 16 and November 15, 2001, the second survey was between January 15 and February 21, 2002, and the third survey was between March 25 and June 25, 2002. These surveys are referred to hereinafter as surveys 1, 2, and 3, respectively. The sampling frame for survey 1 included adult residents (18 or more years of age) of Manhattan living south of 110th Street. The sampling frame for survey 2 included all adults in New York City with an oversampling of residents of Manhattan living south of 110th Street to permit comparison between surveys. The sampling frame for survey 3 included all adults in the New York City metropolitan area with oversampling of residents of Manhattan south of 110th street and of New York City to permit comparison among surveys. In this paper, we limit our observations from survey 3 to two subgroups of residents, those in Manhattan south of 110th Street and those in New York City, for comparability with the first two surveys.

In all three surveys, we used random digit dialing to reach a person at a residential telephone number and to obtain verbal consent. The overall cooperation rate for the surveys was 64.3 percent for survey 1, 63.5 percent for survey 2, and 60.1 percent for the New York City sample of survey 3. As an illustration of how these rates were calculated, we highlight here sampling details for the New York City subsample in survey 3. In survey 3, we dialed a total of 18,633 phone numbers in New York City. Among these, 5,086 were identified as not in service, and 4,084 numbers were not valid for other reasons (e.g., fax lines or businesses). Of the 9,463 valid numbers, 2,708 were not answered on any of the 10 calls. From the remaining 6,755 numbers, 685 were never answered except by answering machines (messages were left), and 575 numbers were not eligible for other reasons (mainly languages other than English, Spanish, and Chinese or long-term health problems). We spoke with a total of 5,495 households; of these 1,805 were callbacks still not reached at the end of the study to complete the screening for eligibility. Among the 3,690 households with a resolved contact, 1,362 refused to complete the initial screening for the interviewing. Among the 2,328 screened, 117 persons screened out of the survey, and 2,211 were eligible for the study. There were 518 who were not interviewed because the quota for their gender and zone had been filled. We completed interviews with 1,530 of the remaining 1,693

persons, 71 refused after qualifying, and 92 were in callback status at study completion. The overall cooperation rate for the survey, calculated according to industry standards, was 60.1 percent. This cooperation rate is based on the sum of the number of completed interviews, quota outs, and screen outs (i.e., 1,530 + 518 + 117) divided by the sum of completed interviews, quota outs, screen outs, refusals, and premature terminations (i.e., 1,530 + 518 + 117 + 1,362 + 71).

Sampling weights were developed and applied to our data to correct potential selection bias related to the number of household telephones, persons in the household, and oversampling. Further discussions of the methods and results from survey 1 are published elsewhere (1, 4–6).

### Data collection

All interviews were conducted by trained interviewers who used a computer-assisted telephone interview system. Interviews were available in English and Spanish for the first two surveys and in English, Spanish, and Chinese for the third survey. All three surveys were approximately 35 minutes long, and the measures used were consistent among surveys to allow for comparison. The Institutional Review Board of the New York Academy of Medicine reviewed and approved these studies.

In all surveys, we asked respondents questions using a structured questionnaire. We asked questions about demographic characteristics (age, race/ethnicity, gender, yearly household income, education, and marital status), assessed proximity to the disaster site, and asked about September 11 event experiences. We asked about stressors (e.g., prior traumatic event experience, divorce, death in the family) in the respondent's lifetime, in the 12 months prior to September 11, and since September 11. We created a composite variable from the event experiences to identify people who were directly affected by the September 11 attacks. This variable included having been in the World Trade Center complex during the attacks, having been injured during the attacks, losing possessions or property, having a friend or relative killed, losing a job due to the attacks, or being involved in the rescue efforts. We measured perievent panic attack using a modified version of the Diagnostic Interview Schedule for panic attack (phrased to detect symptoms experienced during or shortly after the September 11 terrorist attacks) (7). We asked about panic symptomatology specifically "in the first few hours" after the events of September 11. The presence of four or more symptoms contributed to a diagnosis of perievent panic attacks.

We used the National Women's Study PTSD module to measure PTSD symptoms in each survey. The National Women's Study PTSD module was validated in a field trial against the PTSD module of the Structured Clinical Interview for the *Diagnostic and Statistical Manual of Mental Disorders: DSM III-R* (SCID) (8) administered by mental health professionals (9). In the field trial, interrater kappa coefficients were 0.85 for the diagnosis of lifetime PTSD and 0.86 for the diagnosis of current PTSD. Comparing the National Women's Study PTSD module with the SCID, we found that the kappa coefficient of the National Women's Study PTSD

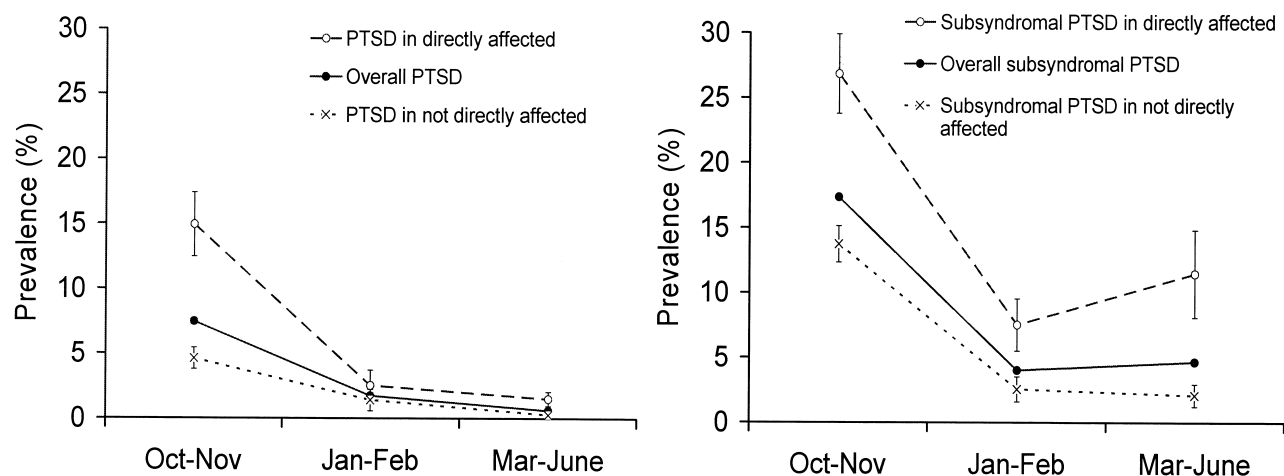
**TABLE 1. Comparison of survey 3 sample characteristics between March 25 and June 25, 2002, among residents from New York City and specifically Manhattan with characteristics among residents during the 2000 US Census**

	Manhattan south of 110th Street				New York City			
	Weighted %	Census estimate (%)	Chi-square	<i>p</i> value	Weighted %	Census estimate (%)	Chi-square	<i>p</i> value
<b>Age (years)</b>								
18–24	7.8	10.6	1.92	0.86	14.7	13.2	3.8	0.58
25–34	31.2	27.2			27.0	22.5		
35–44	20.2	19.8			19.6	20.8		
45–54	17.5	16.2			18.3	16.7		
55–64	11.1	11.3			11.2	11.3		
≥65	12.2	14.9			9.2	15.5		
<b>Gender</b>								
Male	52.2	47.2	1.01	0.31	44.1	46.2	0.18	0.67
Female	47.8	52.8			55.9	53.8		
<b>Race</b>								
White	61.4	65.1	5.5	0.24	35.8	38.7	3.31	0.51
African American	9.9	6.3			23.7	23.0		
Asian	8.2	12.5			6.3	10.1		
Hispanic	18.6	13.7			28.7	24.7		
Other	1.9	2.3			5.5	3.6		

module with SCID diagnosis of PTSD was 0.77 for lifetime PTSD and 0.71 for current PTSD (8, 9).

The National Women's Study PTSD module assesses the presence of criteria B, C, and D symptoms and determines the content for content-specific PTSD symptoms (e.g., content of dreams or nightmares). In all three surveys, we assessed current probable PTSD based on the presence of necessary PTSD criteria B, C, and D symptoms within the

previous 30 days. To measure probable PTSD that was related to the September 11 attacks, all reexperiencing symptoms (criterion B) and all content-specific (e.g., avoidance of thoughts or feelings) avoidance symptoms (criterion C) were required to be related to the September 11 attacks. A subset of avoidance symptoms and all the arousal symptoms (criterion D; e.g., being easily startled or jumpy) could be linked directly only to the attacks by time frame (occurrence since



**FIGURE 1.** Prevalence of probable post-traumatic stress disorder (PTSD) and subsyndromal PTSD in Manhattan south of 110th Street during the first 6 months after the September 11, 2001, terrorist attacks. All symptoms linked to the September 11 attacks were used when possible; all prevalences refer to current (previous 30-day) symptomatology. Vertical bars represent standard errors. "Directly affected" refers to persons who were in the World Trade Center complex during the attacks, were injured during the attacks, lost possessions or property, had a friend or relative killed, lost a job as a result of the attacks, or were involved in the rescue efforts. Oct-Nov, Jan-Feb, and Mar-Jun refer to ranges of months during the year.

**TABLE 2. Prevalence of probable PTSD,\* subsyndromal PTSD, and any PTSD symptom among residents living in Manhattan south of 110th Street and New York City, 2001–2002**

	Manhattan south of 110th Street				New York City†			
	Probable PTSD‡		Subsyndromal PTSD‡		Probable PTSD‡		Subsyndromal PTSD‡	
	Prevalence (%)	95% confidence interval	Prevalence (%)	95% confidence interval	Prevalence (%)	95% confidence interval	Prevalence (%)	95% confidence interval
1 month after September 11	7.5	5.7, 9.3	17.4	14.8, 20.0				
4 months after September 11	1.7	0.4, 3.0	4.0	2.2, 5.8	2.3	1.5, 3.1	4.8	3.7, 5.9
6 months after September 11	0.6	0.3, 0.9	4.7	2.5, 6.9	1.5	0.8, 2.2	5.3	3.7, 6.9

\* PTSD, post-traumatic stress disorder.

† The first survey, carried out 1 month after September 11, sampled only residents of Manhattan south of 110th Street.

‡ All symptoms linked to the September 11 attacks where possible; all prevalences refer to current (previous 30-day) symptomatology.

September 11). In the second and third surveys, we also assessed probable PTSD since September 11 that was related to the attacks.

We calculated the prevalence of subsyndromal PTSD according to the method of Blanchard et al. (10, 11). Persons who had symptoms consistent with criterion B and either criterion C or D were classified as having subsyndromal PTSD. The prevalence of current (past 30 days) subsyndromal PTSD was calculated in all three surveys.

### Statistical analyses

We report the prevalence of current probable PTSD and subsyndromal PTSD related to the September 11 attacks among respondents living in Manhattan south of 110th Street and New York City. We present data on the prevalence of probable PTSD and subsyndromal PTSD among residents of Manhattan living south of 110th Street in each of the three surveys stratified by whether respondents were directly affected by the attacks or not. We used chi-square tests to identify significant bivariate associations of sociodemographic characteristics and event exposures with probable PTSD since the September 11 attacks as assessed in survey 3. We also examined the associations of sociodemographic characteristics and event exposures with current probable PTSD assessed in survey 3 among persons who met criteria for probable PTSD after the September 11 attacks. We used multivariable logistic regression analyses to assess the adjusted relations between the variables that were statistically associated ( $p < 0.1$ ) with current probable PTSD assessed in survey 3 among persons who ever met the criteria for probable PTSD after the attacks.

## RESULTS

### Sample

Overall, we analyzed results on 988 adults in survey 1, 2,001 adults in survey 2, and 1,570 adults in survey 3. All adults in survey 1 were living in Manhattan south of 110th Street on September 11. All adults analyzed in surveys 2 and

3 were living in New York City on September 11. Among these, 506 and 854 were living in Manhattan south of 110th Street in surveys 2 and 3, respectively. Demographic characteristics of the adults in all three surveys were similar and comparable with demographic characteristics obtained from the 2000 US Census (12). For example, in the New York City subsample of survey 3, 55.9 percent of respondents were female, 35.8 percent of respondents were White, 28.7 percent were Hispanic, and 23.7 percent were Black. The mean age was 41 (standard deviation, 25) years. The Manhattan south of 110th Street subsample of survey 3 was 47.8 percent female, 61.4 percent White, 18.6 percent Hispanic, and 9.9 percent Black. The mean age was 43 (standard deviation, 27) years. Table 1 compares the survey demographics in survey 3 for the samples from Manhattan south of 110th Street and New York City with census demographic estimates to illustrate comparability of our sample with the general population.

### Prevalence of probable PTSD and subsyndromal PTSD

In Manhattan south of 110th Street, the overall current prevalence of probable PTSD related to the September 11 attacks was 7.5 percent (95 percent confidence interval (CI): 5.7, 9.3) in survey 1, 1.7 percent (95 percent CI: 0.4, 3.0) in survey 2, and 0.6 percent (95 percent CI: 0.3, 0.9) in survey 3. The prevalence of probable PTSD and subsyndromal PTSD was consistently higher among persons who were directly affected by the attacks compared with those who were not. Figure 1 shows the progression of probable PTSD and subsyndromal PTSD in Manhattan south of 110th Street stratified by whether participants were directly affected by the attacks or not.

Table 2 shows the prevalences of overall probable PTSD and subsyndromal PTSD in all three surveys. In all of New York City, 6 months after September 11, the overall prevalence of current probable PTSD related to the September 11 attacks was 1.5 percent (95 percent CI: 0.8, 2.2), and the prevalence of current subsyndromal PTSD was 5.3 percent (95 percent CI: 3.7, 6.9). Extrapolating to the total adult population of New York City, we found that approximately

**TABLE 3. Associations of sociodemographic characteristics with probable PTSD\* among residents of New York City 6 months after the September 11, 2001, terrorist attacks**

	No.	Probable PTSD since September 11 related to the September 11 attacks ( <i>n</i> = 1,570)				Current (past 30 days) probable PTSD related to the September 11 attacks among persons who developed PTSD ( <i>n</i> = 159)			
		No.	%	Chi-square	<i>p</i> value	No.	%	Chi-square	<i>p</i> value
Total	1,570	159	7.4			35	19.7		
Age (years)				2.21	0.82			4.28	0.51
18–24	157	10	6.8			3	23.3		
25–34	414	44	7.3			5	8.9		
35–44	329	37	6.7			13	38.1		
45–54	286	39	10.0			10	18.8		
55–64	175	16	7.1			2	14.1		
≥65	190	11	4.8			1	21.0		
Gender				0.04	0.83			1.44	0.23
Male	697	66	7.1			18	26.5		
Female	873	93	7.5			17	14.6		
Race/ethnicity				3.89	0.42			1.36	0.86
White	774	83	5.5			17	18.4		
African American	264	21	7.3			6	24.0		
Asian	118	11	5.8			1	25.8		
Hispanic	332	40	10.2			9	14.4		
Other	53	4	9.5			2	36.4		
Income (\$)				11.4	0.08			4.48	0.62
≥100,000	233	27	3.2			6	8.0		
75,000–99,999	119	12	11.1			2	10.6		
50,000–74,999	221	22	5.6			4	9.2		
40,000–49,999	110	6	6.0			1	9.6		
30,000–39,999	155	22	9.9			4	14.9		
20,000–29,999	161	12	4.7			5	33.8		
<20,000	303	37	12.8			8	24.8		
Education				6.13	0.19			6.04	0.20
Graduate work	282	38	10.3			7	14.5		
College degree	504	47	6.3			8	11.1		
Some college	273	26	7.3			5	6.4		
High school graduate/GED*	295	17	4.5			5	22.2		
Not high school graduate	207	31	12.1			10	40.0		

Table continues

91,000 persons met the criteria for probable PTSD and that 322,000 persons met the criteria for subsyndromal PTSD after September 11 (12).

#### Associations between sociodemographic and event exposure characteristics and probable PTSD

Table 3 shows the associations between sociodemographic characteristics and probable PTSD since September 11 among residents of New York City and the associations between sociodemographic characteristics and current probable PTSD among persons who developed probable PTSD

related to the September 11 attacks as measured in survey 3. Sociodemographic characteristics that were significant predictors of probable PTSD after the attacks were marital status (highest PTSD was 22.6 percent among persons who were members of an unmarried couple vs. the lowest PTSD that was 5.3 percent among persons who were married), social support (highest PTSD was 9.4 percent among persons with low social support vs. 3.6 percent among persons with high social support), number of previous lifetime traumatic events (highest PTSD was 15.1 percent among persons who had experienced ≥4 previous traumatic events vs. 2.5 percent among persons who had never experi-



TABLE 3. Continued

	No.	Probable PTSD since September 11 related to the September 11 attacks ( <i>n</i> = 1,570)				Current (past 30 days) probable PTSD related to the September 11 attacks among persons who developed PTSD ( <i>n</i> = 159)			
		No.	%	Chi-square	<i>p</i> value	No.	%	Chi-square	<i>p</i> value
Marital status				18.36	0.003			5.72	0.34
Married	541	50	5.3			11	12.3		
Divorced	165	24	19.6			7	15.0		
Separated	61	8	14.5			4	64.5		
Widowed	97	7	7.5			0	0.0		
Never married	633	58	5.3			11	17.3		
Unmarried couple	63	11	22.6			2	40.6		
Social support				8.59	0.01			0.33	0.85
High	553	36	3.6			8	25.0		
Medium	461	43	8.9			7	16.6		
Low	528	75	9.4			20	22.1		
Lifetime stressors before September 11				30.57	<0.0001			1.23	0.75
0	467	26	2.5			4	24.1		
1	371	30	4.1			5	30.1		
2–3	445	50	10.9			13	19.6		
≥4	287	53	15.1			13	14.2		
Life stressors 12 months before September 11				15.25	0.0005			0.10	0.95
0	891	54	3.7			8	30.4		
1	419	55	11.9			10	43.5		
≥2	260	50	12.4			17	26.1		
Life stressors since September 11				13.55	0.0002			0.01	0.91
No	1,406	128	6.0			8	20.61		
Yes	164	31	18.5			27	18.36		

\* PTSD, post-traumatic stress disorder; GED, general equivalency diploma.

enced traumatic events), number of recent stressors (highest PTSD was 12.4 percent among persons who had experienced ≥2 stressors in the previous 12 months vs. 3.7 percent among persons who had not experienced recent stressors), and number of other life stressors since September 11 (18.5 percent vs. 6.0 percent for persons who had not experienced other recent stressors).

Associations of event exposures with probable PTSD since September 11 among residents of New York City and with current probable PTSD among persons who developed probable PTSD related to the September 11 attacks as measured in survey 3 are shown in table 4. The event exposures that were significantly associated with probable PTSD since September 11 were living south of 14th Street in Manhattan (12.3 percent vs. 7.2 percent for persons living north of 14th Street), seeing the attacks in person (12.5 percent vs. 5.3 percent), being in the World Trade Center

complex at the time of the attacks (36.7 percent vs. 7.2 percent), being injured during the attacks (9.7 percent vs. 6.7 percent), being afraid of personal injury or death (11.8 percent vs. 5.9 percent), experiencing a perievent panic attack (21.5 percent vs. 4.2 percent), having a friend or relative killed (13.9 percent vs. 6.2 percent), being involved in the rescue effort (14.3 percent vs. 6.6 percent), and losing a job due to the attacks (24.3 percent vs. 6.1 percent). Among respondents who reported symptoms consistent with probable PTSD since September 11, 19.7 percent had current probable PTSD 6 months after the attacks. Among the respondents who reported symptoms consistent with probable PTSD after the September 11 attacks, the event exposures that were statistically associated with ongoing PTSD 6 months after the attacks were being afraid of personal injury or death (31.1 percent vs. 12.4 percent for persons who were not afraid of personal injury or death), experiencing a

**TABLE 4. Associations of event exposures with probable PTSD\* among residents of New York City 6 months after the September 11, 2001, terrorist attacks**

	No.	Probable PTSD since September 11 related to the September 11 attacks (n = 1,570)				Current (past 30 days) probable PTSD related to the September 11 attacks among persons who developed PTSD (n = 159)			
		No.	%	Chi-square	p value	No.	%	Chi-square	p value
Total	1,570	159	7.4			35	19.7		
Live in Manhattan south of 14th Street				8.32	0.004			0.06	0.81
No	901	69	7.2			18	19.8		
Yes	669	90	12.3			17	18.1		
Saw September 11 attacks in person				9.11	0.003			0.27	0.61
No	925	61	5.3			14	17.3		
Yes	633	94	12.5			20	22.6		
Was in World Trade Center complex during attacks				3.96	0.05			0.00	0.97
No	1,560	155	7.2			34	19.7		
Yes	10	4	36.7			1	18.9		
Was injured during attacks				12.5	0.0004			2.41	0.12
No	1,512	141	6.7			31	21.3		
Yes	51	17	29.7			3	6.3		
Fear of personal injury or death				5.96	0.01			3.42	0.07
No	1,111	87	5.9			14	12.4		
Yes	387	66	11.8			21	31.1		
Panic-event panic attack				32.73	<0.0001			2.94	0.09
No	1,292	73	4.2			14	11.3		
Yes	278	86	21.5			21	27.0		
Friend or relative killed				5.20	0.02			0.00	0.97
No	1,354	124	6.2			27	19.4		
Yes	216	35	13.9			8	19.8		
Lost possessions				2.73	0.10			0.09	0.77
No	1,481	136	7.1			30	19.4		
Yes	88	23	15.5			5	23.6		
Involved in rescue effort				5.97	0.01			0.32	0.57
No	1,380	124	6.6			24	18.4		
Yes	189	35	14.3			11	24.9		
Lost job as a result of September 11 attacks				15.66	<0.0001			3.78	0.05
No	1,457	129	6.1			24	14.3		
Yes	103	26	24.3			11	40.0		
Directly affected by attacks†				19.52	<0.0001			0.58	0.45
No	1,074	71	4.2			12	15.0		
Yes	496	88	14.7			23	22.8		

\* PTSD, post-traumatic stress disorder.

† Persons who were in the World Trade Center complex during the attacks, were injured during the attacks, lost possessions or property, had a friend or relative killed, lost a job as a result of the attacks, or were involved in the rescue efforts.

perievent panic attack (27.0 percent vs. 11.3 percent), and losing a job as a result of the attacks (40.0 percent vs. 14.3 percent).

In a multivariable-adjusted logistic regression model, the only significant predictor of current probable PTSD among persons who met the criteria for probable PTSD since the

attacks was losing a job as a result of the attacks (odds ratio = 4.61;  $p = 0.03$ ).

## DISCUSSION

Using data from three representative cross-sectional surveys of New York City in the first 6 months after the September 11 attacks, we showed that there was a relatively rapid decline in the prevalence of probable PTSD related to the September 11 attacks in the general population. This is one of the few studies that have estimated the mental health consequences of a large-scale disaster in the general population. Although we found that the prevalence of symptoms was consistently higher among persons who were directly affected by the attacks than among persons who were not directly affected by the attacks, a substantial number of the latter also met the criteria for probable PTSD related to the September 11 terrorist attacks. Specifically, 6 months after September 11, approximately two thirds of those persons who met the criteria for probable PTSD had been directly affected by the attacks, and one third was not directly affected by the attacks by our definition. This analysis suggests that the effects of a large-scale disaster in a densely populated urban area may be pervasive and may extend to persons in the general population.

Postdisaster longitudinal studies, primarily studying symptom progression among direct survivors of disasters, have reported more persistent PTSD symptoms compared with our findings in the general population of New York City. In a report about survivors of a mass shooting episode in Texas, only about one half of the PTSD cases identified at any time over a 3-year period after the shooting was in remission at the 3-year follow-up (13). In a follow-up of a group of litigant survivors of the Buffalo Creek dam collapse from 2 to 14 years after the disaster, about half of the cases of probable PTSD persisted in the long term (14). However, these studies are of direct victims of mass disasters, a subgroup that is substantially different from persons in the general New York City population who experienced the September 11 attacks. Persons who were in the World Trade Center complex or who were injured during the attacks are probably the groups most comparable with the survivors studied after most disasters. Because these groups represent a very small proportion of the New York City population, we recruited few of these persons in our general population surveys. We note, however, that the prevalence of probable PTSD related to September 11 among persons who were in the World Trade Center during the attacks was 36.7 percent in our study, comparable with the prevalence of PTSD among persons who were in or near the Murrah Federal Building that was the target of the Oklahoma City bombing (15).

Other studies among persons who experienced personal traumatic events have documented rapid symptom resolution in the first 6 months after traumatic event experiences. The National Comorbidity Survey showed a steep decline in PTSD symptoms in the first year after a traumatic event (16). Longer-term studies of the longitudinal course of PTSD, particularly among Vietnam War veterans, also suggest that only a third of PTSD cases persists chronically (17, 18).

Prospective studies of patients hospitalized because of a traumatic event, female rape victims, and persons who were affected by motor vehicle accidents have shown that more than half of the cases of PTSD remit in the first 3–6 months after onset (11, 19, 20).

In our assessments, we found that, although there was resolution of more than two thirds of the cases of probable PTSD in the first 6 months after September 11, 5.3 percent of the persons in New York City still met criteria for subsyndromal PTSD 6 months after September 11. Persons with subsyndromal symptomatology have been shown to have functional impairment accompanying their symptoms (21, 22). Reports from New York City service providers have documented continuing elevated use of mental health services in the New York City area in the first 6 months after September 11 (23). These results, taken together, suggest that clinically meaningful mental health consequences of the September 11 attacks may persist among New York City residents beyond the resolution of full syndromal PTSD.

The observation that persons who were directly affected by the attacks had a consistently higher prevalence of PTSD symptoms than persons who were not directly affected is consistent with current understanding of event exposure intensity and its relation to PTSD symptoms. For example, one postdisaster study of PTSD among employees of a hotel that was hit by a plane showed that employees who were onsite, and thus more directly affected by the event, had a higher prevalence and more prolonged duration of PTSD than offsite employees (24).

Recent research after the September 11 attacks has also documented PTSD symptoms among persons not directly affected by the attacks (1, 25). Persons living in New York City who were not directly affected by the attacks were likely indirectly affected through multiple avenues including word of mouth, watching the events in person or on television, and the disruption of services that was ubiquitous in New York City. Other research after September 11 and other disasters has suggested an association between television viewing and PTSD symptoms (3, 26, 27). These observations warrant further, more definitive, longitudinal evaluations.

Our observation that marital status and social support were predictors of PTSD onset after September 11 is consistent with findings from other research (28–30) and suggests that, in the general population, specific groups may be at particular risk of the psychological consequences of disasters and may warrant more focused screening. Previous authors have shown that predictors of recovery from PTSD are less apparent than predictors of PTSD after disasters (13, 31). Involvement in the rescue effort was a predictor of ongoing PTSD in this study, consistent with other research among rescue personnel (32). Our finding that perievent emotional reactions may be important predictors of PTSD in the short term and long term is consistent with previous work (2, 33, 34) and suggests that early interventions to address these emotional reactions may have the potential to reduce the incidence of PTSD after disasters (35). We found that job loss stemming from the September 11 attacks played a role in predicting both PTSD and symptom persistence. Job loss is likely accompanied by ongoing day-to-day adverse experiences that



have been shown to perpetuate PTSD symptoms (36). The importance of job loss for symptom persistence highlights the complex relations between individual experiences (i.e., the job loss itself) and features of the recovery environment (i.e., the availability of jobs) and suggests that societal factors may be important determinants of symptom persistence after disasters.

### Limitations

Several study limitations should be noted. We present results from three cross-sectional surveys carried out 1 month, 4 months, and 6 months after September 11. Although these surveys can provide a population estimate of the progression of psychological outcomes after this disaster, a definitive assessment of the prognosis of symptoms after a mass trauma can be obtained only from a cohort assessment. However, in the immediate aftermath of the September 11 attacks, it was not feasible to develop a protocol for participant recruitment that included disclosure of personal identifiers that would enable follow-up and to still launch the study described here in the first month after the attacks. Because starting the study quickly was considered a priority for this research, the currently described serial cross-sectional design with anonymous participant recruitment was chosen. We describe elsewhere in more detail other rationale and logistic difficulties encountered in establishing a rapid assessment of mental health in New York City in the first few months after September 11 (4). It is possible that our findings, rather than reflecting progression of PTSD in the general population, actually represent the remission of symptoms in some persons and the development of delayed symptoms in different persons. There are three reasons why this was unlikely to be the case. First, most studies of PTSD have found that there are few cases of delayed onset of PTSD with the overwhelming majority of cases starting immediately after the traumatic event (15). This suggests that persons who still reported PTSD symptoms 6 months after the event had symptoms that had been persistent since September 11 and that the results we report reflect resolution in some participants and persistent symptoms in others. Second, we used a validated PTSD measure with specifically worded questions to reflect prospective assessment in each survey. Thus, participants were asked first about symptoms since September 11 and subsequently asked about symptoms that were still present at the time of the interview. This suggests that persons who reported current probable PTSD in survey 3 had symptoms that had persisted since the attacks. Third, we have previously shown replicability of the estimates of PTSD since September 11 in these surveys with different periods of recall, suggesting that all three surveys were effectively measuring symptoms related to the events of September 11 (37).

Other potential limitations to this study include the potential impact of the case ascertainment measure used and sampling bias. With respect to the former, it is possible that, since the National Women's Study PTSD module is linked to event content only for content-specific

symptoms, our probable PTSD prevalence is an overestimate of the true burden of psychopathology. There are two reasons why this is unlikely to be the case. First, we report substantially lower prevalence of probable PTSD in the general population 1 month after September 11 than did the only other published representative population sample estimates of PTSD in New York City during the same time frame (3). Second, a comparison between the probable PTSD prevalence assessed using the PTSD symptom checklist as compared with the National Women's Study PTSD module, conducted on a subsample of 229 participants in survey 2, suggested that the National Women's Study PTSD module provides a conservative estimate of the prevalence of probable PTSD compared with the aforementioned checklist (38). With respect to sampling bias, it is possible that our telephone sampling selectively sampled persons who were different from the rest of the population. Comparison of our sample to census characteristics provides some reassurance in this regard. In addition, we were able to replicate our estimates of event exposure prevalence and symptom prevalences in each of the three surveys, suggesting that only systematic sampling bias present in all three surveys is plausible. One such possible bias may arise from persons with post-traumatic stress symptoms being less likely to participate in the survey. This would suggest that our reported prevalences are an underestimate of the true burden of psychopathology in the general population. Another possible source of sampling bias could have been out-migration of New York City residents. If New York City residents with post-traumatic stress symptoms were more likely to move out of the City after September 11, it is possible that our estimates of declining probable PTSD prevalence reflect fewer people remaining in the City with post-traumatic stress symptoms, also suggesting that our estimates are an underestimate of the true probable PTSD prevalence. However, we note that, although some residents did leave New York City after September 11, it is unlikely that this out-migration had a substantial impact on our population prevalence estimates. Moreover, it is difficult to generalize from these results to the context of other disasters. In the New York City post-September 11 context, other ongoing traumas (e.g., the anthrax threats) could have affected the prevalence and progression of symptoms detected in our surveys. Finally, our detection of predictors of ongoing PTSD was limited by the low statistical power available that precluded definitive assessments of the determinants of ongoing PTSD.

### Conclusions

The September 11 terrorist attacks were associated with an unprecedented loss of life and with a subsequent period of national concern about other potential terrorist attacks. In this context, the decline in probable PTSD cases in the general population is reassuring. However, there were a substantial number of cases of probable PTSD related to the September 11 attacks among New Yorkers who were not directly affected by the attacks. This highlights the importance of considering the effect of mass traumatic events on

the general population in public mental health planning. The absence of clear individual predictors of persistence of PTSD in this study suggests that there may be important unmeasured features of the recovery environment, such as economic uncertainty and the ongoing threat of terrorist attacks, that may influence the progression of symptoms in the postdisaster period. Future prospective studies should determine the prognostic role of these factors and the long-term progression of PTSD and comorbidity in the New York City metropolitan area.

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## REFERENCES

- Schuster MA, Stein BD, Jaycox LH, et al. A national survey of stress reactions after the September 11, 2001, terrorist attacks. *N Engl J Med* 2001;345:1507–12.
- Galea S, Ahern J, Resnick H, et al. Psychological sequelae of the September terrorist attacks in New York City. *N Engl J Med* 2002;346:982–7.
- Schlenger WE, Caddell JM, Ebert L, et al. Psychological reactions to terrorist attacks: findings from the National Study of Americans' Reactions to September 11. *JAMA* 2002;288:581–8.
- Galea S, Vlahov D, Resnick H, et al. An investigation of the psychological effects of the September 11th attacks on NYC: developing and implementing research in the acute post-disaster period. *CNS Spectrums* 2002;7:593–6.
- Vlahov D, Galea S, Resnick H, et al. Increased consumption of cigarettes, alcohol, and marijuana among Manhattan residents after the September 11th terrorist attacks. *Am J Epidemiol* 2002;155:988–96.
- Galea S, Resnick H, Ahern J, et al. Posttraumatic stress disorder in Manhattan, New York City, after the September 11th terrorist attacks. *J Urban Health* 2002;79:340–53.
- Centers for Disease Control and Prevention. Diagnostic Interview Schedule (DIS). In: Health status of Vietnam veterans. Supplement C: medical and psychological procedure manuals and forms. Atlanta, GA: Centers for Disease Control and Prevention, 1989:405–99.
- Spitzer RL, Williams JB, Gibbon M, et al. The Structured Clinical Interview for DSM-III-R (SCID). I. History, rationale, and description. *Arch Gen Psychiatry* 1992;49:624–9.
- Kilpatrick DG, Resnick HS, Freedy JR, et al. The posttraumatic stress disorder field trial: evaluation of the PTSD construct—criteria A through E. In: Widiger T, Frances A, Pincus H, et al, eds. *DSM-IV sourcebook*. Vol 4. Washington, DC: American Psychiatric Association Press, 1998:803–44.
- Blanchard EB, Hickling EJ, Vollmer AJ, et al. Short-term follow-up of post-traumatic stress symptoms in motor vehicle accident victims. *Behav Res Ther* 1995;33:369–77.
- Blanchard EB, Hickling EJ, Forneris CA, et al. Prediction of remission of acute posttraumatic stress disorder in motor vehicle accident victims. *J Trauma Stress* 1997;10:215–34.
- Bureau of the Census. Census summary tape, file 3A (STF3A). Washington, DC: US Department of Commerce, 2000.
- North CS, McCutcheon V, Spitznagel EI, et al. Three-year follow-up of survivors of a mass shooting episode. *J Urban Health* 2002;79:383–91.
- Green BL, Lindy JD, Grace MC, et al. Buffalo Creek survivors in the second decade: stability of stress syndromes. *Am J Orthopsychiatry* 1990;60:43–54.
- North CS, Nixon SJ, Shariat S, et al. Psychiatric disorders among survivors of the Oklahoma City bombing. *JAMA* 1999;282:755–62.
- Kessler RC, Sonnega A, Bromet E, et al. Posttraumatic stress disorder in the National Comorbidity Survey. *Arch Gen Psychiatry* 1995;52:1048–60.
- Kulka RA, Schlenger WE, Fairbank JA, et al. Trauma and the Vietnam War generation: report of findings from the National Vietnam Veterans Readjustment Study. New York, NY: Brunner/Mazel, 1990. (Brunner/Mazel Psychosocial Stress Series no. 18).
- O'Toole BI, Marshall RP, Grayson DA, et al. The Australian Vietnam Veterans Health Study. III. Psychological health of Australian Vietnam veterans and its relationship to combat. *Int J Epidemiol* 1996;25:331–40.
- Shalev AY, Freedman S, Peri T, et al. Prospective study of posttraumatic stress disorder and depression following trauma. *Am J Psychiatry* 1998;155:630–7.
- Rothbaum BO, Foa EB, Riggs DS, et al. A prospective evaluation of post-traumatic stress disorder in rape victims. *J Trauma Stress* 1992;5:455–75.
- Stein MB, Walker JR, Hazen AL, et al. Full and partial post-traumatic stress disorder: findings from a community survey. *Am J Psychiatry* 1997;154:1114–19.
- Marshall RD, Olfson M, Hellman F, et al. Comorbidity, impairment, and suicidality in subsyndromal PTSD. *Am J Psychiatry* 2001;158:1467–73.
- Wunsch-Hitzig R, Plapinger J, Draper J, et al. Calls for help after September 11: a community mental health hot line. *J Urban Health* 2002;79:417–28.
- Smith EM, North CS, McCool RE, et al. Acute postdisaster psychiatric disorders: identification of persons at risk. *Am J Psychiatry* 1990;147:202–6.
- Silver RC, Holman EA, McIntosh DN, et al. Nationwide longitudinal study of psychological responses to September 11. *JAMA* 2002;288:1235–44.
- Pfefferbaum B, Seale TW, McDonald NB, et al. Posttraumatic stress two years after the Oklahoma City bombing in youth geographically distant from the explosion. *Psychiatry* 2000;63:358–70.
- Ahern J, Galea S, Resnick H, et al. Television images and psychological symptoms after the September 11 terrorist attacks. *Psychiatry* 2002;65:289–300.
- Boscarino JA. Post-traumatic stress and associated disorders among Vietnam veterans: the significance of combat exposure and social support. *J Trauma Stress* 1995;8:317–35.
- Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult Clin Psychol* 2000;68:746–66.
- Bromet E, Sonnega A, Kessler RC. Risk factors for DSM-III-R posttraumatic stress disorder: findings from the National Comorbidity Survey. *Am J Epidemiol* 1998;147:353–61.
- McFarlane A. The longitudinal course of posttraumatic morbidity.

- ity: the range of outcomes and their predictors. *J Nerv Ment Dis* 1988;176:30–9.
32. Marmar CR, Weiss DS, Metzler TJ, et al. Longitudinal course and predictors of continuing distress following critical incident exposure in emergency services personnel. *J Nerv Ment Dis* 1999;187:15–22.
  33. Shalev AY, Peri T, Canetti L, et al. Predictors of PTSD in injured trauma survivors: a prospective study. *Am J Psychiatry* 1996;153:219–25.
  34. Harvey AG, Bryant RA. The relationship between acute stress disorder and posttraumatic stress disorder: a 2-year prospective evaluation. *J Consult Clin Psychol* 1999;67:985–8.
  35. Resnick HS, Kilpatrick DG, Dansky BS, et al. Prevalence of civilian trauma and PTSD in a representative national sample of women. *J Consult Clin Psychol* 1993;61:984–91.
  36. McFarlane AC. The aetiology of post-traumatic morbidity: predisposing, precipitating, and perpetuating factors. *Br J Psychiatry* 1989;154:221–8.
  37. Galea S, Boscarino J, Resnick H, et al. Mental health in New York City after the September 11 terrorist attacks: results from two population surveys. Chap 7. In: Manderscheid RW, Henderson MJ, eds. *Mental health, United States, 2001*. Washington, DC: US Government Printing Office, 2002.
  38. Galea S, Resnick H, Kilpatrick D, et al. Epidemiology of post-traumatic stress disorder in the general population after the September 11 terrorist attacks. *Clin Q* (in press).