

Long-Term Course of Probable PTSD After the 9/11 Attacks: A Study in Urban Primary Care

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Although the short- and midterm psychological effects of the attacks on September 11, 2001 (9/11) have been well described, less is known about the long-term effects. This study examines the course of probable posttraumatic stress disorder (PTSD), its predictors and clinical consequences in a cohort of 455 primary care patients in New York City, interviewed approximately 1 and 4 years after 9/11. The rate of PTSD decreased from 9.6% to 4.1%. Pre-9/11 major depressive disorder emerged as the strongest predictor of PTSD, particularly late-PTSD. At follow-up, late-PTSD was associated with major depressive and anxiety disorders, and PTSD regardless of timing was associated with impaired functioning. Findings highlight the importance of ongoing evaluation of mental health needs in primary care settings in the aftermath of disasters.

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Disasters perpetrated with deliberate intent generate substantial mental health problems (Galea, Nandi, & Vlahov, 2005; Neria, Nandi, & Galea, 2008; Norris, Friedman, et al., 2002). The September 11, 2001 (henceforth 9/11) terrorist attacks, aimed at the destruction of two prominent national symbols—the World Trade Center and the Pentagon—caused substantial damage and massive loss of life. The magnitude of the destruction is widely believed to have had an immediate as well as long-term impact on mental and physical health (Brackbill et al., 2009; Holman et al., 2008; Neria et al., 2008). Yet a majority of studies on the mental health consequences of the 9/11 attacks have been cross-sectional or short-term (e.g., Digraude et al., 2008; Gross et al., 2006; Schlenger et al., 2002; Schuster et al., 2001) and only a few have assessed longitudinally the long-term course of the psychological effects (Adams, Boscarino, & Galea, 2006; Boscarino, Adams, & Galea, 2006; Galea et al., 2003; Richman, Cloninger, & Rospenda, 2008; Silver et al., 2002).

In the general population, the mental health effects of the 9/11 attacks appear to have declined with the passage of time (Galea et al., 2003; Silver et al., 2002). In one nationally representative Web-based panel study, the proportion of adults endorsing post-traumatic stress symptoms declined from 17% after 2 months to 6% after 3 months following the attacks (Silver et al., 2002). In a representative sample of adults residing in Manhattan, the overall prevalence of posttraumatic stress disorder (PTSD) fell from 7.5% 1 month after the attacks to 1.7% at 4 months and to less than 1% 6 months after 9/11 (Galea et al., 2003).

This pattern contrasts with a report of the psychological course of individuals with high exposure to the disaster. One large Web-based study of rescue and recovery workers and others in lower Manhattan reported an increasing prevalence of PTSD symptoms (Brackbill et al., 2009). The proportion of this sample screening positive for PTSD increased from 12.1% at 2–3 years to 19.5% at 5–6 years following the attacks.

The midterm course of 9/11 PTSD and its predictors, assessed 1 and 2 years after the attacks, were recently described by Boscarino and Adams (2009). Our study seeks to use a similar approach to describe the long-term course of PTSD, its predictors and clinical correlates, among a socioeconomically disadvantaged group of urban, low-income, primarily immigrant Hispanics for whom the impact of disasters may be especially high and persistent (Galea et al., 2005; Neria et al., 2008; Norris et al., 2002).

We report the results of a longitudinal cohort study approximately 1 and 4 years after the 9/11 attacks with patients from a group general medical practice that serves an urban, low-income, primarily immigrant population. By using information from repeated interviews and administrative medical records, we (a) estimate the prevalence and course of probable PTSD over time, including persistence, remission, and late-PTSD, (b) determine which demographic characteristics, 911-related exposures, and preexisting mental disorders predict the various courses of PTSD, and (c) estimate the associations between PTSD course and

current mental and physical health status and level of functioning at follow-up.

METHOD

Participants

We recruited 991 participants to a prospective longitudinal cohort study on the course of PTSD following the 9/11 attacks. The baseline assessment, conducted between December 2001 and January 2003, covered a range of psychiatric disorders including PTSD, exposure to trauma, and psychosocial functioning. The sample consisted of adult primary care patients attending the Associates in Internal Medicine practice of Columbia University Medical Center in New York City. The methods are described in detail elsewhere (Neria et al., 2006). Briefly, patients were systematically approached to determine their eligibility on the basis of the position of the seat they freely selected in the waiting room of the primary care practice. Every consecutive patient from the chairs in the back of the room to the front was screened for eligibility to obtain our recruitment goal of approximately 1,100 patients. Eligible patients were between 18 and 70 years of age, had made at least one prior visit to the practice, could speak and understand Spanish or English, were waiting for face-to-face contact with a primary care physician, and were in good enough general health to complete the survey. Of the 1,117 patients who met eligibility criteria, 991 participants consented to participate (response rate: 88.7%).

Our follow-up assessment included an extended interview administered by clinically trained, bilingual, and bicultural interviewers, conducted between January 2004 and May 2007. Of the 991 participants who participated at baseline, 716 (72.3%) had consented to be recontacted for follow-up. Consenters and non-consenters did not significantly differ with respect to background characteristics (gender, age, race/ethnicity, education, and income) or rates of current psychiatric disorders at baseline. We located 577 (80.6%) of the 716 participants. Of these, 474 (82.1%) completed follow-up interviews, 65 (11.3%) refused follow-up, 27 (4.7%) were deceased, and 11 (1.9%) were institutionalized or too ill to participate. The remaining 139 participants could not be located. Of the 474 patients who were interviewed at both baseline and follow-up, 19 were omitted from the current analyses because of missing PTSD status at one of the two time points. The analytic sample for this report consists of the remaining 455 participants, representing 46% of the original sample.

All assessment forms were translated from English to Spanish and back-translated by a bilingual team of mental health professionals, and were approved by the Hispanic Research and Recruitment Center at Columbia Presbyterian Medical Center. The Institutional Review Boards of Columbia Presbyterian Medical Center and the New York State Psychiatric Institute approved the study protocol and all participants provided informed written consent.

Measures

Gender, age, marital status, race/ethnicity, education, annual household income, employment status, and country of birth were assessed at baseline and follow-up. Baseline values of these sociodemographic variables were used for the current analyses. When a baseline value was missing, the follow-up value was imputed ($n = 2$ for marital status, $n = 3$ for education, and $n = 3$ for income).

At baseline, participants were asked to report their location during the 9/11 attacks. Response categories were graded by proximity to the World Trade Center: in lower Manhattan (below 14th Street); in New York City but not lower Manhattan; in the New York City area; in Washington, DC; in the United States; or outside of the United States. They were also asked "Did you know somebody who was killed by the World Trade Center disaster?" To ensure that we were identifying patients who had lost people close to them, we added two questions at follow-up: "Was your spouse or partner, any member of your family, or a close friend directly exposed to the disaster of September 11?" and "Did he/she lose his/her life [did either/any of them lose their lives]?" For the present analysis, we classified patients as having lost a loved one on 9/11 only if they both (a) reported at baseline that they knew somebody who was killed in the World Trade Center disaster and (b) answered "yes" to both of these follow-up questions.

The PTSD Check List-Civilian Version (PCL-C; Weathers, Kitz, Herman, Huska, & Keane, 1993), a self-report instrument that corresponds to the PTSD criteria according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; American Psychiatric Association, 1994), was used to screen for probable current 9/11-related PTSD. The utility of the PCL has been tested in multiple populations exposed to combat, terrorism, and motor vehicle accidents and has demonstrated good internal consistency, strong correlations with other PTSD scales, and high diagnostic efficiency (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Weathers et al., 1993). The PCL-C assesses the full domain of 17 posttraumatic stress symptoms in three areas: intrusion, avoidance and numbing, and hyperarousal.

The occurrence of each symptom as a result of the 9/11 attacks was queried for the 30 days prior to the interview and rated on a 5-point scale from *not at all* to *extremely* bothersome. Symptoms were considered endorsed if the participant indicated that he or she was bothered at least *moderately* (≥ 3 on the 5-point scale). To facilitate comparisons across studies, PTSD prevalence was calculated using a cutoff score of 44, which provides the highest level (.94) of diagnostic efficiency (Blanchard et al. 1996; DiGrande et al., 2008).

All participants were interviewed with the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID-I; First, Gibbon, Spitzer, & Williams, 2001) by experienced clinical interviewers. Diagnoses were classified into three major categories: (a) mood disorders: bipolar disorder, major depressive disorder,

dysthymic disorder, depressive disorder NOS (not otherwise specified), and mood disorders due to general medical condition; (b) anxiety disorders: generalized anxiety disorder, panic disorder, social phobia, specific phobia, anxiety disorder due to a general medical condition, and anxiety disorder NOS; and (c) substance-related disorders: alcohol/substance abuse or dependence; and alcohol/substance-induced mood, anxiety, or psychotic disorders. Suicidal ideation was assessed with an item from the PRIME-MD Patient Health Questionnaire (Spitzer et al., 1994) at both time points.

Physical and Mental Component Summary scores of the Medical Outcomes Study 12-Item Short Form Health Survey (SF-12; Ware, Kosinski, & Keller, 1996) were used to measure physical and mental health functioning. Impairment was evaluated with the 10-point self-rated social life and family life/home responsibilities subscales of the Sheehan Disability Scale (0 = *none*, 1–3 = *mild*, 4–6 = *moderate*, 7–9 = *marked*, 10 = *extreme*). Because less than one third of the patients were gainfully employed, the work subscale of the Sheehan Disability Scale was not used in the current analyses. Self-ratings of general health and emotional health were obtained with the following separate items: "In general, would you say your (health/emotional health) is: *excellent*, *very good*, *good*, *fair*, *poor*." For general health and emotional health, responses were dichotomized into fair/poor vs. good/very good/excellent.

To estimate the level of medical comorbidity in the year preceding the baseline and follow-up interviews, we calculated Charlson Index scores (Charlson, Pompei, Ales, & MacKenzie, 1987; Quan et al., 2005) using the International Classification of Diseases codes obtained from the computerized medical records database. The database captures all outpatient visits, emergency room visits, and inpatient stays at medical facilities affiliated with the Columbia University Medical Center.

Data Analysis

Following previous definitions of change in PTSD status between baseline and follow-up (e.g., Adams & Boscarino, 2006; Gray, Bolton, & Litz, 2004; North et al., 2004), we divided participants into four trajectory groups: (a) no PTSD (negative at both time points), (b) remitted PTSD (positive at baseline and negative at follow-up) (c) persistent PTSD (positive at baseline and at follow-up), and (d) late-PTSD (negative at baseline and positive at follow-up).

We compared sample-wide rates of probable PTSD at both time points using McNemar's test for matched pairs. To describe the distribution of PCL-C scores in each trajectory group, we calculated means and percentiles of baseline and follow-up scores. To insure that changes in PTSD caseness between the two time points were not due simply to minor changes in levels of PTSD symptoms, we calculated mean PCL-C change using Cohen's d as a measure of effect size. Because of the small size of the

persistent-PTSD group ($n = 5$), we were not able to compare it to the other trajectory groups.

In examining potential predictors of PTSD trajectory, we used multinomial logistic regressions with trajectory as the 3-level outcome (remitted PTSD vs. late PTSD vs. no PTSD). First, we assessed bivariate relationships between PTSD trajectory and variables related to demographic characteristics, 9/11-related trauma exposure, and pre-9/11 clinical status. In all regressions, we included two time span covariates (number of days) regardless of statistical significance, to attenuate potential bias resulting from differential time between the 9/11 attacks and each follow-up interview. Potential predictors whose bivariate associations with PTSD trajectory had p levels $\geq .25$ were removed from further consideration. We then created a model of PTSD trajectory by simultaneously entering all remaining potential predictors with bivariate $p < .25$. Omnibus tests significant at $p < .05$ were followed up with comparisons between each pair of PTSD trajectory groups.

In examining outcomes associated with PTSD trajectory, we used binary logistic regression for categorical outcomes such as mental disorders, and linear regressions for continuous outcomes such as SF-12 scores. The 3-level PTSD trajectory variable was the predictor, and we adjusted for variables related to demographic characteristics, 9/11-related trauma exposure, and pre-9/11 clinical status. To preserve statistical power for comparisons involving one or more small groups, we employed a backward elimination procedure. First, all of the following variables were entered as covariates: gender, age group, marital status, race/ethnicity, education, household income, employment status, country of birth, proximity to Ground Zero on 9/11/01, loss of a loved one on 9/11, witnessing the 9/11 attacks, pre-9/11 major depressive disorder, pre-9/11 anxiety disorder, pre-9/11 substance-related disorder, and Charlson Index score in the year prior to 9/11. If any of the covariates had $p \geq .25$, the covariate with the highest p was removed and the regression was rerun. This procedure was repeated until no remaining covariate had a p level $\geq .25$.

For all of the analyses described above, we used the propensity weighting method (Little & Rubin, 2002) to adjust for potential attrition bias at the second assessment. A logistic regression equation distinguishing participants who were ($n = 474$) or were not ($n = 517$) interviewed at follow-up was constructed using baseline variables available for all 991 participants, and predicted probabilities from this equation were used to construct weights (results available on request). The sum of the weights for the 474 follow-up participants was 991, and weights for the 455 participants with known PTSD status at both time points summed to 953. They comprise the analytic sample.

All analyses were conducted with SAS version 9 (SAS Institute Inc., Cary, NC). Weighted analyses were conducted with the SURVEYREG, SURVEYLOGISTIC, and SURVEYMEANS procedures; $p < .05$ (two-tailed) was considered statistically significant.

Table 1. Descriptive Characteristics and PTSD Status of the Follow-Up Sample

Characteristic	Unweighted n	Weighted % ^a
Gender		
Female	337	69.9
Male	118	30.1
Age, years		
18–44	113	27.1
45–54	150	31.3
55–64	128	26.6
65–70	64	15.1
Marital status		
Separated/divorced	210	44.0
Never married	74	6.6
Widowed	30	15.5
Married/cohabiting	141	33.9
Race/ethnicity		
Hispanic	386	84.9
Black, non-Hispanic	54	12.0
White/Other, non-Hispanic	15	3.1
Education		
≤ 8 th grade	187	40.3
> 8 th grade	268	59.7
Household income, annual		
$< \$6,000$	217	45.5
$\geq \$6,000$	238	54.5
Worker for pay	86	22.9
Immigrant ^b	340	75.4
PTSD ^c at baseline	47	9.6
PTSD ^c at follow-up	20	4.1

Note. PTSD = Posttraumatic stress disorder; PCL-C = Posttraumatic Stress Disorder Checklist-Civilian version.

^aBased on a propensity score weight to correct for bias due to unit nonresponse at follow-up. ^bBorn outside of the U.S. and Puerto Rico. ^cPTSD defined by PCL-C score of 44 or higher.

RESULTS

Overall, nearly three quarters of the participants were female and the mean age (SD) at baseline was 51.8 (10.8) years (Table 1). Most participants were members of racial or ethnic minority groups, poor, and of immigrant ancestry. In addition, a majority of the participants were not currently married. About 4 of 10 participants had completed 8 or fewer years of education and most participants reported they were not paid workers.

At baseline, approximately one year after the 9/11 attacks, the prevalence of current probable PTSD based on a cutoff score of 44 was 9.6% ($n = 47$). At follow-up, approximately 5 years after the attacks, 4.1% of the cohort ($n = 20$) met this criterion

Table 2. PCL-C Score Statistics and Rate of Meeting Selected *DSM-IV* PTSD Criteria Among the Four Trajectory Groups at Baseline and Follow-Up

PTSD trajectory group	Baseline						Follow-up						Change in mean PCL-C score
	PCL-C score statistic					Met <i>DSM-IV</i> PTSD criteria (%) ^a	PCL-C score statistic					Met <i>DSM-IV</i> PTSD criteria (%) ^a	Effect size ^b
	<i>M</i> ^d	<i>SD</i> ^d	Q1	<i>Mdn</i>	Q3		<i>M</i> ^d	<i>SD</i> ^d	Q1	<i>Mdn</i>	Q3		
PTSD remitted (<i>n</i> = 42)	51.9	10.0	46	51	58	90.3	26.4	12.6	17	28	34	2.1	3.15***
Late PTSD (<i>n</i> = 15)	26.9	12.4	18	25	37	0.0	51.9	10.3	47	49	59	89.8	3.00***
Chronic PTSD (<i>n</i> = 5)	50.4	11.7	44	46	58	37.0	49.5	7.9	45	48	53	79.4	0.13
No PTSD (<i>n</i> = 393)	23.1	9.6	17	21	27	2.4	20.6	8.0	17	18	22	1.0	0.42***

Note. PTSD = Posttraumatic stress disorder; PCL-C = PTSD Checklist-Civilian Version; Q1 = first quartile; *Mdn* = median; Q3 third quartile; *DSM-IV* = *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*. ^aDefined as positive on the PCL-C for ≥ 1 Criterion B symptoms, ≥ 3 Criterion C symptoms, and ≥ 2 Criterion D symptoms. Percentages are weighted for follow-up nonresponse. ^bCohen's *d* statistic calculated using weighted means and standard errors. ^cFrom an intercept-only regression on change scores that adjusted for unequal weighting. ^dMeans and standard deviations are weighted for follow-up nonresponse.

****p* < .001.

for current probable PTSD. This represents a significant decline in the prevalence of PTSD ($p < .001$). Of the cohort, 15.1% ($n = 69$) had 9/11-related PTSD at one or both time points. As can be seen in Table 2, most of the respondents with PTSD at baseline (89.3%; 42/47) had remitted from PTSD before follow-up, and most of the PTSD cases at follow-up (75.0%; 15/20) had late-PTSD. Only five participants met criteria for current PTSD at both time points.

We calculated effect sizes for change in PTSD symptom severity (PCL-C scores) in the four trajectory groups. Effect sizes in the PTSD-remitted and late-PTSD groups were very large ($d = 3.15$ and 3.00). On average, patients whose PTSD status differed between baseline and follow-up exhibited a change in PCL-C score of approximately three standard deviations (Table 2). By comparison, PCL-C scores in the group without PTSD at either time point showed much less change, an average decrease of less than one-half standard deviation ($d = 0.42$).

Of the 15 predictors we screened (i.e., gender, age group, marital status, race/ethnicity, education, household income, employment status, country of birth, proximity to Ground Zero on 9/11/01, loss of a loved one on 9/11, witnessing the 9/11 attacks, pre-9/11 major depressive disorder, pre-9/11 anxiety disorder, pre-9/11 substance-related disorder, and Charlson Index score in the year prior to 9/11), 5 had bivariate associations with PTSD trajectory at $p < .25$. These were pre-9/11 major depressive disorder, pre-9/11 anxiety disorder, proximity to Ground Zero on 9/11/01, pre-9/11 substance-related disorder, and gender. When these five predictors were entered simultaneously, pre-9/11 major depressive disorder emerged as the only statistically significant predictor of PTSD trajectory (Table 3). Pairwise tests revealed that pre-9/11 major depressive disorder was associated with 3 times the odds of having

remitted PTSD and 10 times the odds of having late PTSD, as compared to no PTSD (Table 3).

The PTSD trajectory was significantly associated with all of the mental health-related outcomes but not with physical functioning or medical comorbidity (Table 4). We were unable to assess the relationship between PTSD trajectory and substance-related disorder at follow-up because all 8 patients who were positive on this outcome were also positive for pre-9/11 substance-related disorder.

As compared to patients who had no PTSD, those who remitted from baseline PTSD had, at follow-up, more than 3 times the odds of having current suicidal ideation, and reported significantly worse mental health-related quality of life on the SF-12 and disability as measured by the Sheehan Disability Scale (Table 4).

As compared to patients without PTSD, those with late-PTSD had more than 6 times the odds of having major depression, more than 3 times the odds of having an anxiety disorder, and reported significantly worse mental health-related quality of life and disability. Respondents with late-PTSD also had more than 5 times the odds of current depression and more than 4 times the odds of current anxiety than patients who had remitted from baseline PTSD by follow-up (Table 4).

DISCUSSION

Following the 9/11 attacks, there was a significant decline in the prevalence of 9/11-related probable PTSD, from 9.6% approximately 1 year after 9/11 to 4.1% approximately 4 years after the attacks in this predominantly low-income, minority, primary care patient cohort. Although this pattern is consistent with most previous prospective 9/11 reports (e.g., Galea et al., 2003, Silver et al. 2002), our finding that most patients (89%) with baseline

Table 3. Multinomial Logistic Regression Predicting 9/11-Related PTSD Trajectory^a (Weighted Data)

Predictors ^b	Patients, weighted %			Remitted PTSD vs. no PTSD	Late PTSD vs. no PTSD	Late PTSD vs. remitted PTSD
	No PTSD (<i>n</i> = 393)	Remitted PTSD (<i>n</i> = 42)	Late PTSD (<i>n</i> = 15)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Gender						
Female	68.0	84.4	80.4	2.54 (0.95–6.83)	2.56 (0.64–10.17)	1.01 (0.19–5.25)
Male	32.0	15.6	19.6	1.00	1.00	1.00
Proximity to Ground Zero on 9/11						
In WTC/lower Manhattan	3.3	2.3	17.1	0.56 (0.05–6.49)	2.99 (0.24–37.62)	5.31 (0.27–04.11)
Elsewhere	96.7	97.7	82.9	1.00	1.00	1.00
Pre-9/11 major depressive disorder						
Yes	33.2	63.0	87.9	3.01 (1.45–6.26)***	10.18 (1.87–55.48)***	3.38 (0.56–20.41)
No	66.8	37.0	12.1	1.00	1.00	1.00
Pre-9/11 anxiety disorder ^d						
Yes	10.7	28.2	47.4	2.00 (0.85–4.77)	2.55 (0.68–9.65)	1.27 (0.30–5.47)
No	89.3	71.8	52.6	1.00	1.00	1.00
Pre-9/11 substance-related disorder ^e						
Yes	5.8	10.6	25.5	3.50 (0.77–15.86)	6.68 (0.69–64.39)	1.91 (0.19–19.50)
No	94.2	89.4	74.5	1.00	1.00	1.00

Note. Onset for pre-9/11 disorders was ascertained retrospectively with a clinician-administered SCID interview at follow-up. PTSD = Posttraumatic stress disorder; WTC = World Trade Center; CI = confidence interval.

^aMultinomial logistic regression with PTSD trajectory as the 3-level outcome, the five variables in the first column as simultaneous predictors, adjusted for number of days between 9/11/01 and first interview, and number of days between 9/11/01 and second interview. ^bThe five predictors chosen for the model were those having $p < .25$ when entered as the single predictor in a multinomial logistic regression with PTSD trajectory as the 3-level outcome, adjusted for number of days between 9/11/01 and first interview, and number of days between 9/11/01 and second interview. ^cEach test has $df = 2$. ^dIncludes generalized anxiety disorder, panic disorder, social phobia, specific phobia, anxiety disorder due to a general medical condition, and anxiety disorder not otherwise specified. ^eIncludes alcohol or substance abuse or dependence; and alcohol- or substance-induced mood, anxiety, or psychotic disorder.

*** $p < .001$.

PTSD remitted and most patients (75%) with PTSD at long-term follow-up had late-PTSD was not anticipated. Previous studies in populations exposed to terrorism found lower rates of late-onset PTSD, ranging from 9% (North, McCutcheon, Spitznagel, & Smith, 2002) to 21% (North et al., 2004) 3 years and 17 months after exposure, respectively. Yet our findings are in accord with a 2-year follow-up study among the general population in New York City after the 9/11 attacks, which found that 70% of the PTSD-positive cases at follow-up had late-onset PTSD (Adams & Boscarino, 2006). Direct comparisons with these studies, however, are constrained by differences in study populations, timeframes, and assessment measures.

We did not find robust demographic differences between the various PTSD trajectory groups. Previous studies have shown that female gender (Norris, Kaniasty, Conrad, Inman, & Murphy, 2002; North et al., 1999; North, Smith, & Spitznagel, 1994) and separated or divorced marital status (e.g., Weissman et al., 2005) increase risk for PTSD. We may not have found these differences because of the homogeneity of our sample. For example, a gender or

marital status effect on risk of PTSD might not be apparent among those with the modal cultural and socioeconomic background in our sample of urban, low-income, primarily immigrant patients.

In our sample, the most robust predictor of PTSD (both remitted and late) was pre-9/11 major depressive disorder. Major depressive disorder increased the risk of remitted PTSD 3-fold, and late PTSD 10-fold, as compared to no PTSD. This finding, which is consistent with previous studies (Norris & Murrell, 1988; North et al., 1999), suggests the potential role of predisaster mood disorders in increasing the risk of both short- and long-term PTSD above and beyond demographic risk factors, exposure, and other mental health problems. This finding suggests the need to develop ongoing and adequate resources in primary care settings aimed at following up trauma-exposed patients with a known history of depressive disorder over the long-term, to detect both early- and late-onset PTSD and to treat it appropriately when needed. Consistent with literature linking risk for PTSD with exposure severity (Galea et al., 2005; Neria et al., 2008; Norris et al., 2002), our data suggest that level of exposure to the attacks was associated

Table 4. Relationship of Mental and Physical Status at Follow-Up to Course of 9/11-Related PTSD (Weighted Data)

Status at follow-up	Patients, weighted %			Remitted PTSD vs. no PTSD	Late PTSD vs. no PTSD	Late PTSD vs. remitted PTSD
	No PTSD (<i>n</i> = 393)	Remitted PTSD (<i>n</i> = 42)	Late PTSD (<i>n</i> = 15)	Odds ratio (95% CI) ^a	Odds ratio (95% CI) ^a	Odds ratio (95% CI) ^a
Current mental disorders/symptoms						
Major depressive disorder						
Yes	21.7	42.6	81.5	1.24 (0.62–2.51)	6.87 (1.69–27.90)**	5.53 (1.24–24.65)*
No	78.3	57.4	18.5	1.00	1.00	1.00
Anxiety disorder ^b						
Yes	10.5	26.0	47.5	0.87 (0.26–2.91)	3.76 (1.34–10.51)*	4.30 (1.10–16.81)*
No	89.5	74.0	52.5	1.00	1.00	1.00
Suicidal ideation						
Yes	12.1	33.2	41.1	3.46 (1.36–8.81)**	2.72 (0.75–9.88)	0.79 (0.18–3.41)
No	87.9	66.8	58.9	1.00	1.00	1.00
				<i>B</i> (95% CI) ^c	<i>B</i> (95% CI) ^c	<i>B</i> (95% CI) ^c
Current health/functioning, mean (<i>SE</i>)						
Short Form Health Survey (SF-12) ^d						
Mental component summary	46.9 (0.6)	36.0 (1.8)	31.8 (2.7)	−6.10 (−9.82–2.37)**	−6.71 (−11.33–2.09)**	−0.61 (−5.93–4.70)
Physical component summary	40.0 (0.7)	35.4 (1.7)	37.9 (4.5)	−2.53 (−5.25–0.20)	−0.79 (−7.73–6.14)	1.73 (−5.48–8.94)
Modified Sheehan Disability Scale ^e	4.5 (0.3)	11.9 (0.8)	8.1 (1.3)	3.29 (1.55–5.02)***	3.38 (0.63–6.14)*	0.10 (−2.88–3.08)
Medical comorbidity in the year preceding follow-up						
Charlson Index score ^f	1.6 (0.1)	1.2 (0.2)	1.4 (0.5)	−0.43 (−0.93–0.08)	−0.27 (−1.23–0.69)	0.15 (−0.87–1.18)

Note. PTSD = Posttraumatic stress disorder; CI = confidence interval.

^aFrom a binary logistic regression with the current mental disorder/symptom as the outcome and PTSD trajectory group as the predictor, adjusted for number of days between 9/11/01 and first interview, number of days between 9/11/01 and second interview, and those variables from the following list remaining in the regression after backward elimination using a rule of $p > .25$: gender, age group, marital status, race/ethnicity, education, household income, employment status, country of birth, proximity to Ground Zero on 9/11/01, loss of a loved one on 9/11, witnessing the 9/11 attacks, pre-9/11 major depressive disorder, pre-9/11 anxiety disorder, pre-9/11 substance-related disorder, and Charlson Index score in the year prior to 9/11. All statistics are adjusted for the weighting of the data. ^bIncludes generalized anxiety disorder, panic disorder, social phobia, specific phobia, anxiety disorder due to a general medical condition, and anxiety disorder not otherwise specified. ^cFrom a linear regression with the current health/functioning variable as the outcome and PTSD trajectory group as the predictor, adjusted for number of days between 9/11/01 and first interview, number of days between 9/11/01 and second interview, and those variables from the following list remaining in the regression after backward elimination using a rule of $p > .25$: gender, age group, marital status, race/ethnicity, education, household income, employment status, country of birth, proximity to Ground Zero on 9/11/01, loss of a loved one on 9/11, witnessing the 9/11 attacks, pre-9/11 major depressive disorder, pre-9/11 anxiety disorder, pre-9/11 substance-related disorder, and Charlson Index score in the year prior to 9/11. All statistics are adjusted for the weighting of the data. ^dHigher scores are more favorable. ^eModified version of the scale omits the work item because it did not apply to the majority of the sample. Lower scores are more favorable. ^fCharlson Index scores were calculated on the basis of physician-listed ICD-9 codes in the computerized billing system for visits occurring during the 1-year period prior to the follow-up interview. Lower scores are more favorable.

* $p < .05$. ** $p < .01$. *** $p < .001$.

with late-PTSD. However, in our sample, the association was no longer predictive when pre-9/11 depression was taken into account.

Several studies indicate that 9/11 PTSD is linked to comorbid psychopathology (Adams, Boscarino, & Galea, 2006; Vlahov

et al., 2002, 2004, 2006). Our data extend this observation by indicating that both individuals who remit from early PTSD and individuals who develop late-PTSD are at increased risk for a host of comorbid disorders including depression, anxiety, suicidal ideation, and significant functional problems. Taken together,

these findings underscore the mental health needs of two groups that may be overlooked in the aftermath of terrorism and disasters: those who have remitted from early PTSD and those who had no PTSD in the early aftermath but subsequently developed PTSD.

This study has several limitations. It was undertaken with a sample from a general medical practice serving primarily low-income minority patients, and different patterns may exist in the general population or within primary care practices that serve higher-income populations. However, low-income patients represent a large and vulnerable patient group who often receive their mental health treatment in primary care. Self-report of traumatic exposure is subject to recall bias. However, the initial information about 9/11 exposure was ascertained within 7 to 16 months of the disaster. Our assessment of traumatic loss of a loved one did not specifically address the type of relationship lost (e.g., spouse, child). Because we used the PCL-C to assess probable PTSD, our prevalence rates may be elevated in relation to studies that use structured diagnostic assessments. Individuals with onset and offset of 9/11-related PTSD both occurring between the two time points would not be ascertained. In addition, incomplete participation at follow-up opens the results to concern over selection bias; however, we incorporated nonresponse-adjusted weights based on a detailed examination of attrition. Finally, it may be that other intervening factors (e.g., job loss, traumatic experiences unrelated to 9/11) might play a role in the long-term course of PTSD, which our study did not address.

Our findings have implications for future research and for prevention of mental health sequelae in the aftermath of disasters and terrorism. More longitudinal research is needed to determine the underlying psychosocial factors for a chronic course or late onset of PTSD and remission from PTSD in the general population and among low-income and immigrant groups. Because primary care patients from vulnerable populations may continue to be at risk for PTSD and related symptoms over a long period following large-scale traumatic events, although many recover from short-term PTSD, they are likely to manifest enduring symptoms and functional problems. Some of those who do not manifest early-PTSD develop late-PTSD, which similarly entails considerable mental health morbidity. To address the mental health needs of primary care populations following a disaster, primary care physicians and mental health professionals should assess disaster exposure, and pre- and postdisaster mental health problems. Timely intervention for patients with PTSD symptoms in the aftermath of large-scale disasters could prevent long-term and persistent mental health problems.

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