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Mental and Physical Health Consequences of the September 11, 2001 (9/11) Attacks in Primary Care: A Longitudinal Study

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Abstract

The magnitude of the September 11, 2001 (9/11) attacks was without precedent in the United States, but long-term longitudinal research on its health consequences for primary care patients is limited. We assessed the prevalence and exposure-related determinants of mental disorders, functioning, general medical conditions and service utilization, 1 and 4 years after the 9/11 attacks, in an urban primary care cohort ($N = 444$) in Manhattan. Although the prevalence of posttraumatic stress disorder (PTSD) and levels of functional impairment declined over time, a substantial increase in suicidal ideation and missed work was observed. Most medical outcomes and service utilization indicators demonstrated a short-term increase after the 9/11 attacks (mean change of +20.3%), followed by a minor decrease in the subsequent year (mean change of −3.2%). Loss of a close person was associated with the highest risk for poor mental health and functional status over time. These findings highlight the importance of longitudinal assessments of mental, functional, and medical outcomes in urban populations exposed to mass trauma and terrorism.

The attacks of September 11, 2001 (9/11) were unprecedented in their devastation, resulting in almost 3,000 fatalities and extensive environmental damage. The magnitude of the destruction is widely believed to have had an immediate as well as long-term impact on mental and physical health (Norris et al., 2002). Yet, only few studies have assessed longitudinally the effects of the 9/11 attacks on mental and physical health of exposed individuals.

In the general population, the mental health effects of the 9/11 attacks appear to decline with the passage of time (Neria, DiGrande, & Adams, 2011). In one nationally representative study, the proportion of adults reporting posttraumatic stress disorder (PTSD) declined from 17% after 2 months to 5.8% after 3 months following the attacks (Holman, Silver, McIntosh, Poulin, & Gil-Rivas, 2008). In representative samples of adults residents in New York City (NYC), the prevalence of PTSD fell from 7.5% one month after the attacks to 1.7% at 4 months and to less than 1% 6 months after 9/11 (Galea et al., 2003). In a mid-term

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longitudinal survey of adults living in NYC, prevalence of PTSD declined from 5.0% at 1 year after 9/11 to 3.8% at 2 years after the attacks (Adams & Boscarino, 2006).

Several adverse physical health effects have been documented due to exposure to irritant dust, smoke, and gaseous combustion materials. Respiratory (Brackbill et al., 2009; Lin, Jones, Reibman, Morse, & Hwang, 2010) and cardiovascular (Holman et al., 2008) problems markedly increased following the attacks, with more modest increases of gastroesophageal reflux, obesity, sleep apnea, and dermatological conditions (Green et al., 2006). However, much of the research on post-9/11 physical health outcomes is limited to cross-sectional design or short-term follow-up data and few medical outcomes. Moreover, despite increasing evidence that urban and ethnic populations are at increased risk for a range of disaster-induced mental health problems (e.g., Norris et al., 2002), only few studies to date have studied urban primary care populations exposed to mass trauma (Neria et al., 2006, 2008, 2010).

To address these gaps in knowledge, the current study sought to assess a range of mental, physical, functional, and service utilization outcomes, 1 and 4 years after 9/11, and examine their longitudinal course and associations with 9/11 exposure to trauma (direct and indirect) and loss separately in a cohort of urban primary care patients in northern Manhattan. We hypothesized that (a) the rates of mental disorders would exceed previously reported rates of these disorders in the community due to the demographic characteristics of this cohort; (b) rates of mental, physical, functional, and service utilization outcomes would decline over time; and (c) patients who experienced direct exposure or 9/11 loss would exhibit worse mental and physical health outcomes compared to indirectly exposed patients.

Method

The study was conducted at a group practice of the Division of General Medicine, Columbia University Medical Center in New York City that serves approximately 20,000 patients each year with more than 80,000 annual visits. The institutional review boards of Columbia University Medical Center and the New York State Psychiatric Institute approved the study protocol.

Participants

Most of the participants were women; the mean age (*SD*) at baseline was 51.8 (10.8) years (Table 1). A majority was members of racial or ethnic minority groups, poor, had an immigrant ancestry, and were not currently married; more than half had completed at least 8 years of education. With the exception of gender and education, the sociodemographic distribution was comparable across the exposure groups. Directly exposed patients included the greatest proportion of males and were more likely to have greater than an eighth-grade education than the other two groups.

In the entire sample, the unweighted mean length of time between September 11, 2001 and the baseline interview was 11 months (*SD* = 3; range = 7–16), and the unweighted mean length of time between 9/11 and the follow-up interview was 55 months (*SD* = 6; range = 40–69).

Procedure

We recruited a systematic sample of patients for the baseline assessment between December 2001 and January 2003. As described elsewhere (Neria et al., 2006, 2010), eligible patients were ages 18 to 70 years, had made at least one previous visit to the practice, could speak and understand English or Spanish, were waiting for face-to-face contact with a physician, and were capable of completing the survey. Consecutive prospective subjects were

approached to determine eligibility based on the position of the seat they freely selected in the waiting room of the practice. Of the 1,117 patients who met eligibility criteria, 991 (88.7%) consented to participate in the baseline study interview and to review of their hospital records. Of these, 716 (72.2%) consented to be recontacted for a follow-up interview. Consenters and nonconsenters did not differ significantly in demographic characteristics or rates of mental or general medical disorders (Neria et al., 2006). At follow-up (January 2004–May 2007), these 716 patients were mailed an invitation for a face-to-face interview in English or Spanish, per participant preference at Columbia University Medical Center. We offered participants a small monetary compensation to cover their transportation expenses and potential loss of work hours. Nonresponders were mailed a second invitation, then telephoned, and if nonresponsive were assigned a home visit. Of the 716 eligible for follow-up, 139 (19.4%) could not be located and were lost to follow-up despite consistent and systematic efforts to contact them. No significant differences were found in baseline demographic characteristics and mental health status between the contacted sample (n = 577) and patients lost to follow-up (n = 139). Of the 577 patients, 65 refused to participate in the follow-up assessment. The remaining 512, who were either reinterviewed (n = 474), found to be deceased (n = 27), or unavailable due to illness or institutionalization (n = 11), represent 72% of the follow-up sample of 716, and 52% of the baseline sample of 991. Of the 474 subjects who were reinterviewed, 444 patients (93.7%) provided sufficient data about 9/11 exposure and comprise the analytic sample.

Measures

Gender, age, marital status, race/ethnicity, education, annual household income, employment status, and country of birth were assessed at baseline. Participants were asked to report their exposure to the 9/11 attacks, including their geographic location during the attacks, and whether they experienced the loss of a loved one (“spouse or partner, any member of your family, or a close friend”). Subjects were partitioned into three exposure groups: (a) direct exposure, i.e., was in the World Trade Center or below 14th Street in Manhattan on 9/11; was evacuated due to 9/11; directly witnessed the attack on the World Trade Center, its collapse, or the smoke after the disaster; or was involved in the recovery and rescue; (b) loss exposure, i.e., knew someone close who died in the World Trade Center on 9/11; and (c) indirect exposure, i.e., met none of the criteria used to define the direct exposure and loss exposure groups. Subjects who experienced both loss and direct exposure were placed in the loss exposure group because previous research has suggested that the experience of loss may have different effects than direct exposure to trauma (e.g., Neria et al., 2008). This decision was supported by our data. Among the 77 subjects exposed to loss, most (77%; n = 59) did not also experience direct exposure, while the rest did. We compared these two subgroups on all study outcomes and found no significant differences (all ps > .05).

Screens of Psychiatric Disorders and Function—Trained interviewers screened subjects at baseline and follow-up for major depressive disorder (MDD), generalized anxiety disorder (GAD), panic disorder, and alcohol use disorder using the PRIME-MD Patient Health Questionnaire (Spitzer et al. 1994). A drug use disorder module patterned after the PHQ alcohol use disorder module was also administered. Because of low prevalence, drug and alcohol use disorder were combined. The PTSD Checklist-Civilian Version (PCL-C; Weathers, Litz, Herman, Huska, & Keane, 1993) was used to screen for current 9/11-related PTSD. Participants were asked, “Thinking of your experience and response to the World Trade Center attack, please tell me how much you have been bothered by the following problems in the last month?” Each of the 17 items was rated on a 5-point scale (1 = *not at all*, 2 = *a little bit*, 3 = *moderately*, 4 = *quite a bit*, and 5 = *extremely*). Symptom endorsement was defined by being bothered at least *moderately* (≥3). Posttraumatic stress

disorder prevalence was calculated using a cutoff score of 44, which was found to have the highest diagnostic efficiency in one study (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996). Suicidal ideation was assessed by endorsement of "thoughts that you would be better off dead or thoughts of hurting yourself in some way" at least several times in the past week.

Physical and Mental Component Summary scores of the Medical Outcomes Study 12-Item Short Form (SF-12; Ware, Kosinski, & Keller, 1996) measured 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 (SDS; 0 = *none*, 1–3 = *mild*, 4–6 = *moderate*, 7–9 = *marked*, 10 = *extreme*; Leon, Shear, Portera, & Klerman, 1992). Functional impairment was defined as ≥7. Patients were also asked how many days in the past month they had missed work (paid or unpaid) or school. Missed work (yes/no) was defined as missing 7 or more days of these activities.

All assessment forms were translated from English to Spanish and back-translated by a bilingual team of mental health professionals.

Administrative Health Record Review—We used hospital administrative records to examine health service utilization and physicians' recorded diagnoses during three 12-month periods: (a) the 12 months before 9/11, (b) the 12 months after 9/11, and (c) the 12 months before each subject's follow-up interview. For each period, we classified subjects as having versus not having received at least one diagnosis of diabetes mellitus (*ICD-9-CM* code 250), hypertensive disease (*ICD-9-CM* codes 401–405), another disease of the circulatory system (*ICD-9-CM* codes 390–398 and 410–459), a disorder of lipoid metabolism (for example, hypercholesterolemia; *ICD-9-CM* code 272), and a respiratory disease (*ICD-9-CM* codes 460–519). We summed the number of outpatient visits, emergency department visits, and hospital admissions during these periods. Emergency department visits and hospital admissions were relatively infrequent and were therefore dichotomized prior to analysis (i.e., any vs. none). Service utilization was further partitioned into visits/stays that included at least one mental disorder diagnosis (*ICD-9-CM* codes 290–319) and visits/stays that did not include any mental disorder diagnoses.

Data Analysis

First, we compared the exposure groups on baseline characteristics using binary logistic regressions. Those characteristics significantly associated with exposure group were used as control variables in subsequent analyses. Second, we compared the exposure groups on changes in rates of five psychiatric disorders, suicidal ideation, mental and physical functioning, and functional impairment. We used a generalized estimating equations (GEE) framework to adjust for the correlation between repeated measures over time. In these models, we tested the interaction between time (baseline vs. follow-up) and exposure group, and if it was not statistically significant, we reran the model with main effects for time and exposure group, but without the interaction term. In all models, we included two time-span covariates to attenuate potential bias resulting from differential time between the 9/11 attacks and each interview (i.e., number of days between 9/11 and the first interview, and number of days between 9/11 and the second interview).

Third, we compared the exposure groups on medical diagnoses and health care utilization gleaned from the administrative database during three year-long periods: the year before 9/11, the year after 9/11, and the year before each participant's follow-up interview. We used a GEE framework, and time was entered as a 3-level categorical variable, allowing us to test two successive slopes for each outcome.

Unless otherwise noted, we used the propensity weighting method (Little & Rubin, 2002) in all analyses to adjust for potential attrition bias at follow-up. 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. Weights for the 474 reinterviewed subjects summed to 991 (the n at baseline); weights for the analytic sample of 444 summed to 924. For all tests, $p < .05$ (two-tailed) was considered statistically significant.

Results

Mental Disorders, Functioning, and Service Utilization

Main Effects of Time—In the entire sample, the rates of positive screens for MDD, GAD, alcohol or drug use disorders, and panic disorder did not change from baseline to follow-up, the rate of PTSD showed a significant decline (10% to 4%, $p < .001$), while the rate of suicidal ideation significantly increased (5% to 16%, $p < .001$; Table 2). Significantly fewer patients reported being functionally impaired (SDS ≥ 7) at follow-up as compared to baseline ($p = .022$), but there was a significant increase in the extent of missed work ($p = .027$; Table 3).

There was a significant change over the three year-long time points in ICD-9-CM clinical diagnoses of hypertensive disease, other diseases of the circulatory system, disorders of lipoid metabolism, and diabetes mellitus (Table 4). Between the year before 9/11 and the year following 9/11, there was a significant increase in hypertensive disease, $\chi^2(1, N = 361) = 11.47$, $p < .001$, other diseases of the circulatory system, $\chi^2(1, N = 361) = 19.31$, $p < .001$, and diabetes, $\chi^2(1, N = 361) = 7.37$, $p = .007$, but there was no significant change between the first and second year post-9/11 (ps were .787, .055, and .127, respectively). The increase in lipoid metabolism disorders between the year before 9/11 and the year following 9/11 was not significant, $\chi^2(1, N = 361) = 3.15$, $p = .076$; however, there was a significant increase the first and second year post-9/11, $\chi^2(1, N = 361) = 30.72$, $p < .001$.

Service utilization rates across the three time points also showed significant changes over time (Table 5). Between the year before 9/11 and the year following 9/11, there was a significant increase in number of mental-health related outpatient visits, $\chi^2(1, N = 361) = 20.93$, $p < .001$, general medical outpatient visits, $\chi^2(1, N = 361) = 29.18$, $p < .001$, and any type of outpatient visit, $\chi^2(1, N = 361) = 34.15$, $p < .001$. Between the first and second year post-9/11, the number of mental-health related outpatient visits did not change ($p = .689$), but the number of general medical outpatient visits decreased significantly, $\chi^2(1, N = 361) = 66.76$, $p < .001$, as did the number of outpatient visits for any reason, $\chi^2(1, N = 361) = 52.60$, $p < .001$. The rate of general medical emergency department visits did not change in the year following 9/11 ($p = .288$), but decreased significantly between the first and second year post-9/11, $\chi^2(1, N = 361) = 7.96$, $p = .005$. Inpatient stays for all reasons combined were equally likely between the year before 9/11 and the year following 9/11 ($p = .988$), then decreased significantly between the first and second year post-9/11, $\chi^2(1, N = 361) = 5.99$, $p = .014$. When looking only at mental health-related stays, however, the pattern was different, with a significant increase in the year following 9/11, $\chi^2(1, N = 361) = 6.93$, $p = .009$ and a leveling off between the first and second year post-9/11 ($p = .325$).

Main Effects of Exposure Group—In aggregate over time, the loss-exposed group had significantly higher rates of PTSD than the directly exposed, $\chi^2(1, N = 444) = 9.12$, $p = .003$, and indirectly exposed groups, $\chi^2(1, N = 444) = 8.75$, $p = .003$, had significantly higher rates of suicidal ideation than the directly exposed, $\chi^2(1, N = 444) = 7.07$, $p = .008$, and

indirectly exposed groups, $\chi^2(1, N = 444) = 9.23$, $p = .002$, and had significantly higher rates of MDD than the indirectly exposed group, $\chi^2(1, N = 444) = 10.51$, $p = .001$ (Table 2).

Averaged across time, the loss-exposed group was significantly more impaired than the other two groups (Table 3). Compared to the directly exposed group, the loss-exposed group had worse mental functioning, $\chi^2(1, N = 444) = 15.37$, $p < .001$, greater functional impairment, $\chi^2(1, N = 444) = 21.46$, $p < .001$, and missed more work, $\chi^2(1, N = 444) = 5.34$, $p = .021$. Similarly, compared to the indirectly exposed group, the loss-exposed group had worse mental functioning, $\chi^2(1, N = 444) = 18.87$, $p < .001$, greater functional impairment, $\chi^2(1, N = 444) = 12.45$, $p < .001$, and missed more work, $\chi^2(1, N = 444) = 8.78$, $p = .003$.

The exposure groups did not differ in rates of ICD-9-CM diagnoses (Table 4), but across time, directly exposed patients made significantly more outpatient visits (for any reason) than did indirectly exposed patients, $\chi^2(1, N = 361) = 7.30$, $p = .007$ (Table 5).

Interactions Between Exposure Group and Time—Although the rates of alcohol or drug use disorder were similar in the sample at baseline and follow-up (11%), there was a significant time × exposure group interaction (Table 2). The directly exposed group showed a decrease over time (20% to 10%), while the other two groups showed a modest increase (loss-exposed: 15% to 17%; indirectly exposed: 6% to 10%). A similar pattern was seen with physical functioning: whereas the directly exposed and loss-exposed groups fared better at follow-up than at baseline, the indirectly exposed group fared worse at follow-up (Table 3). Note that for physical functioning, the main effects, although statistically significant, are not fully interpretable in the presence of the statistically significant interaction effect (Table 3). There were no significant group × time interactions with regard to ICD-9-CM diagnoses or service utilization.

Discussion

This longitudinal cohort study of mostly low-income immigrant primary care patients in NYC had five main findings: (a) 9/11-related mental health burden in this urban primary care cohort was substantial and exceeded estimates from community samples (e.g., Adams & Boscarino, 2006; Galea et al., 2003); (b) although PTSD and functional impairment significantly declined during the first 4 years after 9/11, screen positive rates of other common mental disorders remained unchanged, and rates of suicidal ideation and missed days of work significantly increased; (c) an increase occurred in rates of hypertension, other circulatory diseases, and diabetes in the year after the 9/11 attacks, followed by stabilization, whereas lipoid diseases increased later in the follow-up; (d) a post-9/11 increase was also observed in mental and medical outpatient visits and mental inpatient stays, followed by stabilization in mental outpatient and inpatient visits and a decrease in medical outpatient visits; and (e) loss of a close person in the 9/11 attacks was generally associated with the greatest risk for poor mental health in a range of outcomes including PTSD, MDD, suicidal ideation, functional impairment, and missed work.

In general, and consistent with findings from previous studies documenting increased vulnerability in minority populations following disasters (e.g., Soeteman et al., 2009), we observed elevated and enduring risk for mental health problems in this low-income minority cohort. Yet, our data suggest a range of different trajectories across outcomes. Although the decline in PTSD symptoms follows an expected extinction-learning trajectory (Neria & Sullivan, 2011), and is consistent with findings from community studies (e.g., Galea et al., 2003), less expected was the absence of a corresponding decrease in other mental disorders, and the increase in missed work. Importantly, we also observed a substantial increase in

suicidal ideation over time. In the loss-exposed group, for example, suicidal ideation increased from 9% at baseline to 29% at follow-up. This finding seems to be unique to this cohort. Previous findings among victims of Hurricane Katrina suggest only a modest increase in likelihood of suicidal ideation (Kessler et al., 2008).

Although previous 9/11 studies have singled out direct exposure as especially detrimental to a host of mental health outcomes, particularly PTSD (Neria et al., 2011), data from this cohort suggest that the effect of direct exposure was limited to a transient increase during the first year after 9/11 in levels of outpatient visits and mental health-related inpatient stays. The findings may be explained by the composition of the direct exposure group in this study. Although previous 9/11 studies have usually combined direct and loss exposure together, we opted to separate the two to distinguish between the effects of loss and the effects of direct exposure to trauma. We found that patients who experienced loss in this cohort exhibited more enduring and substantial mental health burden compared to patients with either direct or indirect exposure. This pattern suggests that traumatic loss due to malicious intent may be especially debilitating and enduring, with multiple mental health effects that should be assessed and addressed over the long term (Neria et al., 2007; Neria et al., 2008). Overall, the different trajectories revealed here underscore the importance of a longitudinal measurement of several outcomes to provide a fuller and more accurate clinical picture in the aftermath of mass trauma.

Although previous research indicated an increase in respiratory (Brackbill et al., 2009) and cardiovascular (Holman et al., 2008) conditions, we did not observe such changes in this cohort, perhaps due to minimal exposure to contaminants. However, our data revealed an increase in hypertension and diabetes in the year after the 9/11 attacks, followed by stabilization. Although these findings might be attributed to nonspecific aging of the cohort (Hajjar & Kotchen, 2003), the increase in diabetes, disorders of lipoid metabolism and hypertension, previously documented in trauma-exposed populations (e.g., Pietrzak, Goldstein, Southwick, & Grant, 2010), might be attributed to the high 9/11-related stress experienced by the patients in this cohort (Holman et al., 2008).

Consistent with this pattern, we also found an increase directly after 9/11 in both mental and medical outpatient visits as well as in mental inpatient stays. However, this increase was relatively short-term, and was followed by either a significant decrease (e.g., in medical outpatient visits) or in a lack of change over time (e.g., in mental outpatients and inpatients visits).

The current study has several limitations. First, it was undertaken in a general medical practice serving primarily low-income minority patients. Different patterns may exist within other low-income populations, the general population, or primary care practices serving higher-income populations. Second, PTSD prevalence was determined based on a PCL cutoff score of 44. A different choice for cutoff score (e.g., 50) would have produced different prevalence estimates. Third, the length of time between the 9/11 attacks and the baseline and follow-up interviews varied. However, times to interviews were included as covariates in the analyses. Fourth, the dropout rate of this sample was relatively high. However, no significant differences were observed between recontact consenters and nonconsenters in baseline demographic characteristics and outcomes (Neria et al., 2006), and nonresponse-adjusted weights were used based on attrition characteristics.

Our findings have clinical implications. Primary care patients from vulnerable populations are at risk for a wide range of enduring mental and medical problems following mass trauma, despite an expected decrease in PTSD symptoms. To appropriately address the needs of urban low-income ethnic populations following mass trauma, ongoing assessments,

and management and treatment portfolios should be developed, aiming to address a range of postdisaster health problems and to their observe course, and to prevent enduring mental and general medical problems over time.

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Table 1

Descriptive Characteristics of the Total Sample and WTC Exposure Subgroups

Variable	Total sample (N = 444)		Weighted% for type of exposure			
	n	Weighted%[a]	Direct[b] (n = 96)	Loss[c] (n = 77)	Indirect[d] (n = 271)	χ^2
Gender						7.6*
Female	329	70	61	65	75	
Male	115	30	39	35	25	
Age (years)						7.7
18–4	108	26	28	28	25	
45–54	145	31	29	35	30	
55–64	127	27	23	31	28	
65–70	64	16	20	6	17	
Marital status						10.0
Separated/divorced	207	45	41	57	43	
Never married	72	16	12	15	17	
Widowed	29	7	6	3	8	
Married	136	33	41	25	33	
Race/ethnicity						6.7
Hispanic	375	84	77	85	87	
Black, non-Hispanic	54	12	19	11	10	
White/other, non-Hispanic	15	3	4	5	3	
Education						8.3*
≤8th grade	180	40	29	35	45	
>8th grade	264	60	71	65	55	
Annual household income						1.2
<$6,000	209	45	49	43	43	
≥$6,000	235	55	51	57	57	
Worker for pay						3.9
Yes	83	23	25	14	24	
No	361	78	75	86	76	
Immigrant[e]						3.7
Yes	331	75	68	78	77	
No	113	25	32	22	23	

Note. WTC = World Trade Center.

[a] Based on a propensity score weight to correct for bias due to unit non-response at follow-up.

[b] In the WTC or below 14th Street, being evacuated, or being involved in rescue and recovery, but excluding loss exposure.

[c] Knowing someone close who died in the WTC on 9/11 (includes 18 who also experienced direct exposure).

[d] Experienced neither direct or loss exposure.

[e] Born outside of the United States and Puerto Rico.

*$p < .05$.

**$p < .01$.

***$p < .001$.

Table 2

Weighted Percent Positive for Current Psychiatric Disorders and Suicidal Ideation as a Function of Time and Type of Exposure

Disorder/symptom	1 Year After 9/11				4 Years After 9/11				χ^2
	Total (*N* = 444)	**Direct exposure (*n* = 96)**	**Loss exposure (*n* = 77)**	**Indirect exposure (*n* = 271)**	**Total (*N* = 444)**	**Direct exposure (*n* = 96)**	**Loss exposure (*n* = 77)**	**Indirect exposure (*n* = 271)**	
PTSD	10	4	17	10	4	4	10	3	
Time									11.1***
Exposure type									8.4*
Time × Exposure Type									2.9
MDD	22	16	33	20	18	18	27	15	
Time									2.9
Exposure type									8.6*
Time × Exposure Type									3.0
GAD	13	10	22	11	9	9	14	8	
Time									3.8
Exposure type									5.3
Time × Exposure Type									0.4
AUD/DUD	11	20	15	6	11	10	17	10	
Time									3.6
Exposure type									2.4
Time × Exposure Type									8.6*
Panic disorder	4	6	5	3	5	5	8	4	
Time									1.3
Exposure type									2.6
Time × Exposure Type									1.3
Suicidal ideation	5	4	9	4	16	11	29	15	
Time									32.6***
Exposure type									6.7*
Time × Exposure Type									0.2

Note. Overall unweighted *N* = 444. All data are weighted.

PTSD = Posttraumatic stress disorder; MDD = major depressive disorder; GAD = generalized anxiety disorder; AUD/DUD = alcohol or drug use disorder.

All effects are adjusted for gender, education, the number of days between 9/11 and the baseline interview, and the number of days between 9/11 and the follow-up interview.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Weighted Percent Positive or Level for Health Functioning, Impairment, and Work Loss

	1 Year after 9/11								4 Years after 9/11								
	Total (*N* = 444)		Direct exposure (*n* = 96)		Loss exposure (*n* = 11)		Indirect exposure (*n* = 271)		Total (*N* = 444)		Direct exposure (*n* = 96)		Loss exposure (*n* = 77)		Indirect exposure (*n* = 271)		
Health/functioning measure	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	χ^2
Mental health level (*M*, SE)	45.3	0.6	47.4	1.3	42.0	1.4	45.3	0.8	45.2	0.6	46.6	1.2	39.7	1.4	46.1	0.8	
Time																	0.1
Exposure type																	17.4***
Time × Exposure Type																	3.5
Physical health level (*M*, SE)	39.8	0.6	40.9	1.2	35.0	1.5	40.6	0.7	39.2	0.6	42.4	1.3	36.8	1.4	38.5	0.8	
Time																	8.3**
Exposure type																	7.1*
Time × Exposure Type																	8.7*
Any functional impairment (*n*,%)	161/428	35	24/94	21	39/72	54	98/262	36	128/417	29	21/91	20	29/70	43	78/256	28	
Time																	5.2*
Exposure type																	18.3***
Time × Exposure Type																	0.8
Any missed work (*n*,%)	186	41	44	42	38	49	104	38	220	48	42	40	46	61	132	47	
Time																	4.9*
Exposure type																	8.8*
Time × Exposure Type																	2.9

Note. All means, standard errors (SEs), percentages, and chi-square tests are based on weighted analyses. All *n*s presented are the unweighted *n*s. For the cell counts for functional impairment, we have provided the denominators because there were some missing data for this variable. Level of mental health and physical health were measured with the Mental and Physical Component Summary scores of the Medical Outcome Study (MOS) 12-item Short Form Health Survey (SF-12); higher scores are more favorable. Functional impairment (measured with the Sheehan Disability Scale [SDS] as described in the Method) and missed work were assessed for the preceding month.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 4

Weighted Percent of Patients With Selected Medical Diagnoses During Three Year-Long Periods in Temporal Relation to 9/11

	9/12/00 to 9/11/01								9/12/01 to 9/11/02								1 Year before follow-up								
	Total (*N*=361)		Direct exposure (*n* = 77)		Loss exposure (*n* = 61)		Indirect exposure (*n* = 223)		Total (*N*=361)		Direct exposure (*n* = 77)		Loss exposure (*n* = 61)		Indirect exposure (*n* = 223)		Total (*N*=361)		Direct exposure (*n* = 11)		Loss exposure (*n* = 61)		Indirect exposure (*n* = 223)		
Medical diagnosis	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	**χ^2**
Hypertensive disease[b]	212	57	45	55	38	59	129	57	241	67	57	73	36	57	148	67	246	67	55	71	40	65	151	67	
Time																									15.9***
Exposure type																									1.2
Time × Exposure Type																									4.1
Other circulatory diseases[c]	237	64	52	64	42	66	143	63	274	75	60	77	44	71	170	76	256	70	57	74	40	65	159	70	
Time																									18.3***
Exposure type																									0.6
Time × Exposure Type																									2.2
Disorders of lipoid metabolism[d]	83	22	17	20	12	18	54	24	96	26	21	28	15	22	60	27	159	43	39	51	24	35	96	42	
Time																									43.7***
Exposure type																									2.3
Time × Exposure Type																									2.6
Diabetes mellitus[e]	101	28	25	33	21	34	55	24	115	33	30	41	23	38	62	28	129	35	32	42	25	42	72	31	
Time																									13.6**
Exposure type																									2.8
Time × Exposure Type																									0.9
Diseases of the respiratory system[f]	123	33	23	28	24	38	76	34	120	32	22	27	19	32	79	35	114	31	26	32	17	29	71	31	
Time																									0.7
Exposure type																									0.3
Time × Exposure Type																									3.6

Note. All percentages and chi-square tests are based on weighted analyses. All *n*s presented are the unweighted *n*s. Data are from hospital administrative records during the specified year-long periods. These analyses include the 361 subjects from the sample who were both locatable in the electronic records system and considered to be residing in the hospital system catchment area during all three periods examined.

[a] All effects are adjusted for gender and education. Pairwise comparisons between exposure groups are described in the Results and were made only when the omnibus test was significant at $p < .05$.

[b] ICD-9-CM codes 401–405.

[c] ICD-9-CM codes 390–459 (excluding 401–405).

[d] ICD-9-CM code 272.

[e] ICD-9 code 250.

[f] ICD-9-CM codes 460–519.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 5

Weighted Number of Outpatient Visits or Percentage of Patients with Any Emergency Room or Inpatient Service Utilization During Three Year-Long Periods in Temporal Relation to 9/11

	9/12/00 to 9/11/01								9/12/01 to 9/11/02								1 Year before follow-up								
	Total (N = 361)		Direct exposure (n = 11)		Loss exposure (n = 61)		Indirect exposure (n = 223)		Total (N = 361)		Direct exposure (n = 11)		Loss exposure (n = 61)		Indirect exposure (n = 223)		Total (N = 361)		Direct exposure (n = 77)		Loss exposure (n = 61)		Indirect exposure (n = 223)		
Medical Diagnosis	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	χ^2
Outpatient[b] (*M*, SE)																									
Any diagnosis	11.3	0.6	13.2	1.5	12.9	2.0	170.2	0.6	13.3	0.6	16.5	1.7	13.8	1.6	12.0	0.6	11.0	0.7	11.0	1.3	12.3	1.8	10.6	0.8	
Time																									56.6***
Exposure type																									7.0*
Time × Exposure																									2.4
Any mental diagnosis	1.2	0.2	1.4	0.4	1.8	0.4	1.00	0.2	1.7	0.2	1.8	0.4	2.1	0.5	1.5	0.2	2.6	0.4	2.0	0.7	4.4	1.3	2.3	0.5	
Time																									20.8***
Exposure type																									4.1
Time × Exposure																									3.4
Only medical diagnoses	10.1	0.6	11.8	1.5	11.1	1.8	9.2	0.5	11.7	0.5	14.7	1.6	11.7	1.4	10.5	9.5	8.4	0.5	9.0	1.1	7.9	1.0	8.3	0.6	
Time																									60.7***
Exposure type																									5.2
Time × Exposure																									1.9
Emergency department (*n*,%)																									
Any diagnosis	157	42	37	43	27	44	93	41	166	45	39	47	27	44	100	45	125	35	33	42	21	35	71	32	
Time																									8.1*
Exposure type																									1.8
Time × Exposure																									1.1
Any mental diagnosis	13	3	4	4	1	2	8	3	8	2	4	4	0	0	4	2	15	4	3	3	4	7	8	4	
Time																									3.0
Exposure type																									1.3
Time × Exposure																									_[c]
Only medical diagnoses	151	40	35	42	26	42	90	40	163	44	38	46	27	44	98	44	121	33	33	42	20	33	68	30	
Time																									8.0*
Exposure type																									1.9
Time × Exposure																									1.7
Inpatient (*n*,%)																									
Any diagnosis	86	23	21	25	16	25	49	22	83	23	27	34	8	14	48	21	59	16	19	24	8	16	32	13	
Time																									8.0*

	9/12/00 to 9/11/01								9/12/01 to 9/11/02								1 Year before follow-up								
	Total (*N* = 361)		Direct exposure (*n* = 11)		Loss exposure (*n* = 61)		Indirect exposure (*n* = 223)		Total (*N* = 361)		Direct exposure (*n* = 11)		Loss exposure (*n* = 61)		Indirect exposure (*n* = 223)		Total (*N* = 361)		Direct exposure (*n* = 77)		Loss exposure (*n* = 61)		Indirect exposure (*n* = 223)		
Medical Diagnosis	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	***M* or *n***	**SE or%**	χ^2
Exposure type																									4.3
Time × Exposure																									5.4
Any mental diagnosis	16	4	4	4	1	3	11	5	33	8	16	18	2	3	15	6	28	7	8	8	4	7	16	6	
Time																									8.4 *
Exposure type																									4.4
Time × Exposure																									8.1
Only medical diagnoses	75	20	17	21	15	23	43	20	56	16	13	18	7	12	36	16	37	11	11	17	5	11	21	9	
Time																									11.2 **
Exposure type																									1.1
Time × Exposure																									2.7

Note. All means, standard errors (SEs), percentages, and chi-square tests are based on weighted analyses. All *n*s presented are the unweighted *n*s. Data are from hospital administrative records during the specified year-long periods. These analyses include the 361 subjects from the sample who were both locatable in the electronic records system and considered to be residing in the hospital system catchment area during all three periods examined.

[a] All effects are adjusted for gender, education, and a dichotomous variable representing presence versus absence (1 vs. 0) of PTSD at either or both interviews (see Table 2 for definition). Pairwise comparisons between exposure groups are described in the Results and were made only when the omnibus test was significant at $p < .05$.

[b] Before analysis, the number of outpatient visits was transformed to correct a high positive skew (number of visits → log [number of visits + 1]). The mean (SE) number of outpatient visits shown in this table are the untransformed values.

[c] Could not be calculated due to sparse data.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

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