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Comorbidity of 9/11-Related PTSD and Depression in the World Trade Center Health Registry 10–11 Years Postdisaster

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Many studies report elevated prevalence of posttraumatic stress disorder (PTSD) and depression among persons exposed to the September 11, 2001 (9/11) disaster compared to those unexposed; few have evaluated long-term PTSD with comorbid depression. We examined prevalence and risk factors for probable PTSD, probable depression, and both conditions 10–11 years post-9/11 among 29,486 World Trade Center Health Registry enrollees who completed surveys at Wave 1 (2003–2004), Wave 2 (2006–2007), and Wave 3 (2011–2012). Enrollees reporting physician diagnosed pre-9/11 PTSD or depression were excluded. PTSD was defined as scoring ≥ 44 on the PTSD Checklist and depression as scoring ≥ 10 on the 8-item Patient Health Questionnaire. We examined 4 groups: comorbid PTSD and depression, PTSD only, depression only, and neither. Among enrollees, 15.2% reported symptoms indicative of PTSD at Wave 3, 14.9% of depression, and 10.1% of both. Comorbid PTSD and depression was associated with high 9/11 exposures, low social integration, health-related unemployment, and experiencing ≥ 1 traumatic life event post-9/11. Comorbid persons experienced poorer outcomes on all PTSD-related impairment measures, life satisfaction, overall health, and unmet mental health care need compared to those with only a single condition. These findings highlight the importance of ongoing screening and treatment for both conditions, particularly among those at risk for mental health comorbidity.

Elevated rates of posttraumatic stress disorder (PTSD) and depression have been described among New York City (NYC) residents (Adams & Boscarino, 2011; Galea et al., 2002; Hobfoll, Tracy, & Galea, 2006) and rescue and recovery workers (Chiu et al., 2011; Stellman et al., 2008; Wisnivesky et al., 2011) exposed to the September 11, 2001 (9/11) disaster. The World Trade Center Health Registry (the Registry) has consistently yielded a prevalence of 10% or more of 9/11-related PTSD among adult rescue and recovery workers and lower Manhattan residents and area workers/passersby (Brackbill et al., 2009). PTSD is often comorbid with other mental health conditions such as generalized anxiety and depression (Gadermann, Alonso, Vilagut, Zaslavsky, & Kessler, 2012). In traumatized populations, comorbid PTSD and depression is associated with increased functional impairment, reduced quality of life, impaired life satisfaction, greater symptom severity, and disability relative to either condition alone (Ikin, Creamer, Sim, & McKenzie, 2010).

Few studies conducted among 9/11-exposed individuals provide estimates of the comorbidity of PTSD and depression or examine downstream issues related to quality of life and unmet mental health care need. A large telephone survey of English- and Spanish-speaking adults residing in Manhattan conducted 1–2 months post-9/11 found that 3.7% of respondents reported symptoms that met the criteria for both PTSD and depression (Galea et al., 2002). In a study of retired World Trade Center (WTC) exposed firefighters, more than 70% of PTSD and depression cases were co-occurring 4–6 years post-9/11 (Chiu et al., 2011). Up to 5 years post-9/11, 4.7% of WTC rescue and recovery workers other than firefighters reported probable PTSD plus either panic disorder or depression, and 1.7% reported probable PTSD plus both panic disorder and depression (Stellman et al., 2008); in the same longitudinal study, 5.1% of 9/11 rescue and recovery workers reported symptoms consistent with PTSD and depression 9 years postevent (Wisnivesky et al., 2011).

Risk factors for 9/11-related PTSD and depression were reported in several studies. Early arrival at the WTC site was a risk

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factor for PTSD (Chiu et al., 2011), whereas problem alcohol use, perievent panic attack, and predisaster psychological problems were associated with depression (Adams & Boscarino, 2011; Chiu et al., 2011); disability retirement and total loss of resources were risk factors for both PTSD and depression among NYC residents (Hobfoll et al., 2006) and firefighters (Chiu et al., 2011), respectively.

We are aware of only one study of rescue and recovery workers that has documented long-term depression up to 9 years post-9/11 (Wisnivesky et al., 2011). Long-term depression prevalence among others exposed to the 9/11 disaster remains unknown. The purpose of the current study was first to determine the long-term (10–11 years post-9/11) prevalence of PTSD, depression, and comorbid PTSD and depression among adult Registry enrollees, a diverse group of individuals directly exposed to the events of 9/11. Second, we sought to identify risk factors associated with having PTSD only, depression only, or both conditions. Third, we wanted to examine quality of life and unmet mental health care need among those with PTSD, depression, and both conditions. Last, we aimed to explore the relationship between poor mental health and PTSD-related impairment among enrollees with PTSD and comorbid PTSD and depression.

Method

Participants and Procedure

The study sample was drawn from the Registry, a cohort of 71,434 persons exposed to the WTC attacks on 9/11. Details of the cohort and recruitment methods have been published elsewhere (Brackbill et al., 2009; Murphy et al., 2007). The present study includes rescue and recovery workers and lower Manhattan area workers, passersby, and residents. There were two modes of Registry enrollment; list-identified enrollees (29.7%) were actively recruited from contact lists provided by governmental agencies, organizations, and employers, whereas self-identified enrollees (70.3%) contacted the Registry via phone or preregistered on a website in response to intensive outreach efforts. The Registry protocol was approved by the institutional review boards of the Centers for Disease Control and Prevention and the NYC Department of Health and Mental Hygiene.

Study Sample

A total of 36,104 adult enrollees completed Wave 1 (2003–2004), Wave 2 (2006–2007), and Wave 3 (2011–2012). Wave 1 data collection consisted of both computer-assisted telephone interviewing (CATI; 95%) and computer-assisted personal interviewing (CAPI; 5%). Waves 2 and 3 employed web, paper, and CATI surveys, with response rates of 68% and 63%, respectively. Enrollees with a self-reported professional diagnosis of PTSD ($n = 490$) or depression ($n = 2{,}685$) prior to 9/11, PTSD ($n = 229$) or depression ($n = 379$) with a missing date of diagnosis, or missing information on history of PTSD ($n = 1{,}004$) or depression ($n = 899$) diagnosis at Wave 2 were excluded. Enrollees missing PCL-17 item(s) ($n = 1{,}662$) or PHQ-8 item(s) ($n = 1{,}379$) at Wave 3 were also excluded, resulting in a final sample of 29,486.

Enrollees had the following characteristics: male (64.1%), aged 45–64 years (61.2%), non-Hispanic White (72.6%), married or living with a partner (71.5%), a college or postgraduate education (54.3%), employed (72.7%), self-identified enrollment source (75.4%), and household income > $75,000 (63.0%). Nearly half were rescue and recovery workers (48.8%; Table 1).

Measures

Probable PTSD was assessed in Registry Wave 1, 2, and 3 surveys using the PTSD Checklist-Civilian Version (PCL-17), a self-reported, 17-item scale that corresponds to the three PTSD symptom clusters (reexperiencing, avoidance, hyperarousal) as outlined in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., *DSM-IV*; American Psychiatric Association, 1994; Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Ruggiero, Del Ben, Scotti, & Rabalais, 2003); the psychometric properties of the PCL-17 have been reported elsewhere (Blanchard et al., 1996; Ruggiero et al., 2003). Respondents rated symptom severity on a 5-point scale from 1 = *not at all* to 5 = *extremely*; selected symptoms were queried as specific to 9/11 and all were current (within the last 30 days). As in previous Registry studies (Brackbill et al., 2009), enrollees with a PCL-17 score of ≥ 44 at Wave 3 were considered to have probable PTSD (hereafter referred to as PTSD).

An 8-item Patient Health Questionnaire (PHQ-8), introduced in Wave 3, assessed depression. Enrollees rated symptom severity in the last 2 weeks on a 4-point scale from 0 = *not at all* to 3 = *nearly every day*. The PHQ-8 consists of eight of the nine criteria on which a diagnosis of *DSM-IV* depression is based (Kroenke, Spitzer, & Williams, 2001). A cutoff score of 10 has been shown to have .88 sensitivity and .88 specificity for depression and typically represents clinically significant depression (Kroenke et al., 2001). Scores for each item were summed (range 0–24) and respondents with a PHQ-8 score of ≥ 10 at Wave 3 were considered to have depression.

A 4-level categorical variable was created based on enrollee responses to the PCL-17 and PHQ-8 at Wave 3: comorbid PTSD and depression (PTSD+, depression+), PTSD only (PTSD+, depression−), depression only (PTSD−, depression+), and no PTSD and no depression (PTSD−, depression−).

Exposure to 9/11 was defined with a summary measure used previously (Brackbill, Stellman, Perlman, Walker, & Farfel, 2013), and is modeled after work by Adams, Boscarino, and Galea (2006). As adapted by Brackbill et al. (2013), 9/11 exposure was categorized as *none/low* (0–1 exposures), *medium* (2–3), *high* (4–5), and *very high* (≥ 6). This scale covers several dimensions of 9/11-related exposure, including dust cloud exposure, injury, witnessing horror, bereavement, home evacuation, and others. Each item has been shown to be associated

Table 1
Sociodemographic Characteristics, 9/11 Exposures, and Experiences of Adult Registry Enrollees at Wave 3

	Overall sample		PTSD+		PTSD−	
	(n = 29,486)		Depression+ (n = 2,985)	Depression− (n = 1,504)	Depression+ (n = 1,407)	Depression− (n = 23,590)
Variable	n	%	%	%	%	%
Total	29,486	100.0	10.1	5.1	4.8	80.0
Gender						
Male	18,899	64.1	10.1	4.7	4.7	80.6
Female	10,587	35.9	10.2	5.9	4.9	79.0
Age group (years)[a]						
18–29	450	1.5	7.6	3.6	5.1	83.8
30–44	7,155	24.3	9.3	5.1	4.9	80.7
45–64	18,035	61.2	11.5	5.5	4.9	78.1
65+	3,846	13.0	5.4	3.7	3.9	87.0
Race/Ethnicity						
Non-Hispanic White	21,407	72.6	8.9	4.6	4.6	82.0
Non-Hispanic Black	2,724	9.2	11.6	6.7	4.6	77.1
Hispanic or Latino	3,031	10.3	17.5	7.1	5.2	70.2
Asian	1,447	4.9	8.6	4.8	5.9	80.7
Multiracial/other	877	3.0	13.3	6.4	7.3	73.0
Household income[a]						
≤ $25,000	2,123	7.6	25.3	6.8	7.6	60.3
$25,001–$50,000	3,541	12.6	15.4	6.7	6.1	71.8
$50,001–$75,000	4,719	16.8	11.8	6.0	5.5	76.7
$75,001–$150,000	11,131	39.7	8.3	4.9	4.6	82.2
$150,000+	6,519	23.3	4.8	3.8	3.1	88.3
Marital status[a]						
Married/living with partner	20,981	71.5	8.8	4.8	4.2	82.1
Divorced/separated	3,512	12.0	16.5	6.3	6.5	70.7
Widowed	780	2.7	12.3	6.4	5.4	75.9
Never married	4,066	13.9	10.8	5.3	6.1	77.9
Education[b]						
Less than high school	732	2.5	18.2	7.7	7.3	66.9
High school graduate/GED	5,255	17.9	13.8	5.9	5.3	75.1
Some college	7,433	25.3	12.4	5.8	5.1	76.7
College/postgraduate	15,923	54.3	7.4	4.4	4.4	83.8
Employment[a]						
Employed	21,357	72.7	7.9	4.9	4.5	82.6
Unemployed for reasons other than health	1,307	4.5	17.7	5.7	8.0	68.6
Unemployed for health reasons	961	3.3	50.4	8.6	8.4	32.6
Homemaker or student	891	3.0	9.7	4.2	5.7	80.5
Retired	4,855	16.5	9.9	5.1	4.0	81.0
Job loss[c]						
Job loss	1,497	5.1	25.3	5.9	8.6	60.2
No job loss	27,746	94.9	9.3	5.1	4.6	81.1
Enrollment						
List-identified	7,244	24.6	7.4	3.5	4.5	84.6
Self-identified	22,242	75.4	11.0	5.6	4.9	78.5

(*Continued*)

Table 1
Continued

	Overall sample		PTSD+		PTSD−	
	(n = 29,486)		Depression+ (n = 2,985)	Depression− (n = 1,504)	Depression+ (n = 1,407)	Depression− (n = 23,590)
Variable	n	%	%	%	%	%
Eligibility group						
Rescue and recovery worker	14,391	48.8	10.9	5.1	4.7	79.4
Lower Manhattan area worker/passerby	11,505	39.0	9.9	5.6	4.8	79.7
Lower Manhattan resident	3,590	12.2	7.8	3.5	5.2	83.5
9/11 exposure scale						
None/low (0–1 exposures)	7,410	25.1	3.8	1.6	4.4	90.2
Medium (2–3 exposures)	12,426	42.1	8.0	4.4	4.8	82.9
High (4–5 exposures)	6,916	23.5	14.7	7.6	5.4	72.4
Very high (6–11 exposures)	2,734	9.3	25.3	11.7	4.4	58.6
Social integration sources[d]						
None	356	1.2	38.8	9.3	7.0	44.9
1	1,836	6.2	24.0	7.8	7.7	60.4
2	13,283	45.1	10.5	5.4	5.3	78.8
3	8,567	29.1	8.4	4.6	4.3	82.8
4	5,413	18.4	5.4	3.9	3.2	87.5
Traumatic life events post-9/11						
0	19,683	67.1	7.7	4.4	3.9	84.0
1	5,397	18.4	11.3	5.7	6.2	76.9
> 1	4,261	14.5	19.7	7.6	6.8	66.0
Self-reported PTSD and depression[d]						
PTSD+ Depression+	2,536	8.6	43.4	12.0	7.4	37.2
PTSD+ Depression–	1,477	5.0	13.7	13.7	5.1	67.6
PTSD– Depression+	2,119	7.2	20.9	7.1	12.3	59.7
PTSD– Depression–	23,354	79.2	5.3	3.6	3.8	87.3
PTSD-impairment difficulties[a]						
Not at all	15,900	61.8	0.8	1.9	1.9	95.4
Somewhat	8,278	32.2	19.6	13.2	11.4	55.8
Very much	1,114	4.3	74.5	7.6	11.0	6.9
Extremely difficult	454	1.8	85.2	5.1	5.3	4.4

Note. 9/11 = September 11, 2001; PTSD = posttraumatic stress disorder; GED = general equivalency diploma. All percentages expressed as row percents. Percent missing not shown. Effective range of n: PTSD+ Depression+ n = 2,876–2,985; PTSD+ Depression– n = 1,458–1,504; PTSD– Depression+ n = 1,355–1,407; PTSD– Depression– n = 19,887–23,590. For all variables $p < .0001$.
[a]At Wave 3. [b]At Wave 1. [c]Enrollee who reported being employed at Wave 2 and reported being unemployed at Wave 3. [d]At Wave 2.

with physical and/or mental health outcomes in previous Registry studies.

Low levels of social integration were associated with PTSD in a previous Registry study (Brackbill et al., 2013). A social integration scale with a range of 0 to 4 was created by summing the number of positive responses to each of the following indicators from Wave 2: having one or more close friends; seeing, talking to, or e-mailing with friends or relatives at least 2–3 times per month; attending religious services at least 2–3 times per month; and being very or fairly active in the affairs of at least one volunteer group or organization (Brackbill et al., 2013).

We adjusted for post-9/11 traumatic life events, as PTSD can result from trauma other than the WTC disaster. Traumatic life event score at Wave 3 was based on endorsement of up to eight events or situations post-9/11, including being exposed to a natural or human-made disaster, a serious accident, attacked with or without a weapon, unwanted sexual contact, or

life-threatening illness. Items in which the respondent endorsed a post-9/11 trauma received a score of 1. All endorsed items were summed and categorized as none, 1, or > 1 traumatic life event post-9/11.

At Wave 2, enrollees were asked to report if they had ever been diagnosed with PTSD or depression by a doctor or other health professional, the year they were first diagnosed, and if in 2001, whether they were diagnosed pre-9/11. A 4-level categorical variable was created from their responses: comorbid diagnosed PTSD and depression (PTSD+, depression+), PTSD only (PTSD+, depression−), depression only (PTSD−, depression+), and no PTSD and no depression (PTSD−, depression−).

Enrollees who endorsed at least one PTSD symptom item on the PCL-17 at Wave 3 were asked to report how difficult those problems made it for them to do their work, take care of things at home, or get along with other people. PTSD symptom duration was dichotomized into experiencing or not experiencing any problems associated with a symptom continuously for one month in the past 12 months (Blanchard et al., 1996).

Life satisfaction at Wave 3 was measured on a 4-point scale from *very satisfied* to *very dissatisfied*. General health status was based on a self-rating of health from *excellent* to *poor* (Zahran et al., 2005).

Enrollees reported the number of days in the last 30 days in which their physical or mental health was "not good" at Wave 3. Physical and mental health responses were categorized as ≥ *14 days* or < *14 days of poor health* (Zahran et al., 2005).

Unmet mental health care need at Wave 3 was defined as a self-report of needing but not receiving mental health care or counseling in the preceding 12 months (Brackbill et al., 2013).

Data Analysis

Pearson χ^2 tests were used to test for significant associations between comorbid PTSD and depression and selected sociodemographic characteristics, 9/11 exposures and experiences, quality of life, and unmet mental health care need. Multinomial logistic regression was performed and adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were calculated to estimate the strength of the association between selected covariates and PTSD, depression, and comorbid PTSD and depression; no PTSD and no depression was used as the reference. All analyses were conducted using SAS Version 9.2 (SAS, 2008).

Results

Among adult enrollees 15.2% reported symptoms indicative of PTSD 10–11 years post-9/11 and 14.9% met criteria for depression; 10.1% experienced both. Prevalence of comorbid PTSD and depression varied by age, and was lowest among individuals ≥ 65 years (5.4%) and highest among those 45–64 years (11.5%; Table 1). The proportion of comorbid PTSD and depression was highest among Hispanics (17.5%) and those with income of ≤ $25,000 (25.3%), less than a high school education (18.2%), who were divorced or separated (16.5%), unemployed for reasons other than health (17.7%) or unemployed for health reasons (50.4%), who had experienced job loss between Waves 2 and 3 (25.3%), and who reported a professional diagnosis of both conditions by Wave 2 (43.4%) when compared to their counterparts (p values < .05). Rescue and recovery workers (10.9%) had the highest prevalence of comorbid PTSD and depression whereas residents (7.8%) had the lowest.

The prevalence of comorbid PTSD and depression increased with increasing number of 9/11 exposures, with the highest prevalence among those with very high (25.3%) 9/11 exposure. A gradient was also observed for social integration, as those with none (38.8%) or one (24.0%) source of social integration reported the highest prevalence of comorbid PTSD and depression. Post-9/11 trauma history was also strongly associated with the prevalence of comorbid PTSD and depression, and was elevated among enrollees who experienced 1 (11.3%) or > 1 (19.7%) traumatic life event after 9/11.

The *AOR*s of comorbid PTSD and depression were greater among rescue and recovery workers, *AOR* = 1.36, 95% CI [1.14, 1.62] and area workers/passersby, *AOR* = 1.33, 95% CI [1.12, 1.57] compared to residents (Table 2). A dose-response relationship was observed for the association between 9/11 exposures and comorbidity, with the greatest likelihood of comorbidity among enrollees with high or very high 9/11 exposures compared to those with none/low exposures, *AOR* = 3.19, 95% CI [2.73, 3.74]; *AOR* = 4.15, 95% CI [3.46, 4.97], respectively. Lack of social integration was significantly associated with increased odds of comorbidity, as individuals with none or one source of social integration were more likely to experience comorbid PTSD and depression, *AOR* = 7.53, 95% CI [5.43, 10.43]; *AOR* = 4.31, 95% CI [3.55, 5.23], respectively, compared to those with four sources. The likelihood of having comorbid PTSD and depression was elevated among enrollees who were unemployed for reasons other than health, *AOR* = 1.79, 95% CI [1.49, 2.15], or who were unemployed for health reasons, *AOR* = 4.57, 95% CI [3.76, 5.56] compared to those employed sometime during 2011–2012. The odds of comorbidity were also higher for individuals who had experienced one or more traumatic life events since 9/11, *AOR* = 1.42, 95% CI [1.26, 1.60]; *AOR* = 2.37, 95% CI [2.11, 2.66], respectively. Lastly, significant associations were observed between professionally diagnosed PTSD and depression at Wave 2 and comorbid PTSD and depression at Wave 3.

PTSD only and depression only groups showed similar patterns for social integration and post-9/11 trauma exposure, with elevated odds observed among those with no sources of social integration, *AOR* = 3.64, 95% CI [2.35, 5.63]; *AOR* = 3.24, 95% CI [2.02, 5.19], respectively, and > 1 traumatic life event after 9/11, *AOR* = 1.76, 95% CI [1.52, 2.05]; *AOR* = 2.07, 95% CI [1.77, 2.41], respectively. Employment status at Wave 3 was more strongly associated with depression status

Table 2
Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CIs) for Association Between PTSD, Depression, or Both, and Selected 9/11 Exposures and Experiences at Wave 3

	PTSD+				PTSD−	
	Depression+[a]		Depression−[a]		Depression+[a]	
	(n = 2,985)		(n = 1,504)		(n = 1,407)	
Variable	*AOR*	95% CI	*AOR*	95% CI	*AOR*	95% CI
Eligibility group						
Rescue and recovery worker	1.36	[1.14, 1.62]	1.61	[1.29, 2.02]	1.01	[0.83, 1.23]
Lower Manhattan area worker/passerby	1.33	[1.12, 1.57]	1.67	[1.35, 2.07]	1.10	[0.91, 1.33]
9/11 exposures						
2–3	1.83	[1.57, 2.13]	2.63	[2.13, 3.25]	1.09	[0.94, 1.27]
4–5	3.19	[2.73, 3.74]	4.58	[3.69, 5.69]	1.30	[1.10, 1.54]
6–11	4.15	[3.46, 4.97]	6.80	[5.36, 8.64]	1.04	[0.82, 1.32]
Social integration sources[a]						
None	7.53	[5.43, 10.43]	3.64	[2.35, 5.63]	3.24	[2.02, 5.19]
1	4.31	[3.55, 5.23]	2.44	[1.92, 3.10]	2.77	[2.17, 3.55]
2	1.84	[1.58, 2.15]	1.45	[1.22, 1.72]	1.63	[1.36, 1.96]
3	1.46	[1.24, 1.72]	1.13	[0.94, 1.36]	1.32	[1.08, 1.60]
Employment[b]						
Unemployed for reasons other than health	1.79	[1.49, 2.15]	1.05	[0.81, 1.37]	1.57	[1.25, 2.00]
Unemployed for health reasons	4.57	[3.76, 5.56]	2.00	[1.50, 2.65]	2.45	[1.85, 3.25]
Homemaker or student	1.05	[0.79, 1.40]	0.85	[0.59, 1.22]	1.29	[0.94, 1.78]
Retired	1.11	[0.96, 1.28]	0.99	[0.83, 1.18]	0.85	[0.70, 1.03]
Traumatic life events post-9/11						
1	1.42	[1.26, 1.60]	1.28	[1.11, 1.47]	1.58	[1.37, 1.81]
< 1	2.37	[2.11, 2.66]	1.76	[1.52, 2.05]	2.07	[1.77, 2.41]
Self-reported PTSD and depression[a]						
PTSD+ Depression+	9.82	[8.69, 11.10]	4.56	[3.88, 5.36]	3.51	[2.92, 4.23]
PTSD+ Depression–	2.74	[2.29, 3.28]	3.86	[3.22, 4.61]	1.74	[1.35, 2.24]
PTSD– Depression+	4.50	[3.92, 5.17]	2.42	[2.00, 2.94]	4.10	[3.51, 4.81]

Note. 9/11 = September 11, 2001; PTSD = posttraumatic stress disorder. Adjusted for gender, age group, race/ethnicity, income, marital status, education, enrollment, and interview mode at Wave 3. Reference for each variable is as follows: eligibility group = Lower Manhattan resident; 9/11 exposure scale = none/low (0–1 exposures); social integration = 4 sources; employment = employed; traumatic life events post-9/11 = 0; self-reported PTSD and depression diagnosis = PTSD– depression −.
[a]At Wave 2. [b]At Wave 3.

than PTSD status, as those who were unemployed due to reasons other than health or unemployed for health reasons had a greater likelihood of depression only, *AOR* = 1.57, 95% CI [1.25, 2.00]; *AOR* = 2.45, 95% CI [1.85, 3.25], respectively, when compared to individuals with no PTSD or depression. In contrast, 9/11 exposure and eligibility group was associated more strongly with PTSD than depression; significantly higher odds of PTSD were observed across all levels of 9/11 exposure when compared to those with depression only.

On virtually all measures of PTSD-related impairment, quality of life, and perceived unmet mental health care need, poorer outcomes were observed among those with comorbid PTSD and depression when compared to those with only one condition (Table 3). For example, among those with comorbid PTSD and depression, enrollees frequently reported PTSD symptom duration of > 1 month (82.0%), low levels of life satisfaction, fair (44.1%) or poor (23.6%) overall health, ≥ 14 poor physical (49.1%) or mental (74.0%) health days in the last 30 days, and perceived unmet mental health care need (40.2%) in the year prior.

For those with PTSD only and comorbid PTSD and depression, the mean number of poor mental health days increased with increasing difficulty functioning (Figure 1). At every PTSD-related impairment level, however, the mean number of poor mental health days was significantly higher in the comorbid group than in the PTSD only group.

Table 3
Quality of Life and Unmet Mental Health Care Need Among Adult Registry Enrollees With PTSD, Depression, or Both at Wave 3

	PTSD+				PTSD−	
	Depression+		Depression−		Depression+	
	(n = 2,985)		(n = 1,504)		(n = 1,407)	
Variable	n	%	n	%	n	%
PTSD-impairment difficulties						
Not at all	129	4.3	295	19.7	304	21.9
Somewhat	1,625	54.7	1,094	73.1	941	67.7
Very much	830	27.9	85	5.7	122	8.8
Extremely difficult	387	13.0	23	1.5	24	1.7
PTSD symptom duration (months)						
> 1	2,429	82.0	843	56.4	822	59.1
≤ 1	535	18.1	652	43.6	568	40.9
Life satisfaction						
Very satisfied	104	3.5	167	11.2	66	4.7
Satisfied	1,137	38.6	1,010	67.6	747	53.4
Dissatisfied	1,266	43.0	295	19.7	502	35.9
Very dissatisfied	437	14.8	23	1.5	84	6.0
General health						
Excellent	20	0.7	37	2.5	20	1.4
Very good	147	5.0	222	14.8	164	11.7
Good	793	26.8	619	41.4	549	39.2
Fair	1,306	44.1	538	35.9	512	36.6
Poor	698	23.6	81	5.4	155	11.1
Poor physical health days						
≥14	1,446	49.1	354	23.9	474	34.0
<14	1,497	50.9	1,130	76.2	921	66.0
Poor mental health days						
≥14	2,179	74.0	523	35.2	742	53.3
>14	765	26.0	964	64.8	650	46.7
Prior 12 month unmet mental health care need						
Yes	1,182	40.2	324	21.8	378	27.1
No	1,762	59.9	1,165	78.2	1,016	72.9

Note. PTSD = posttraumatic stress disorder. All percentages expressed as row percents. Percent missing not shown. Effective range of n: PTSD+ Depression+ n = 2,943–2,985; PTSD+ Depression– n = 1,484–1,504; PTSD– Depression+ n = 1,390–1,407. p value for PTSD only versus depression only. PTSD symptom duration was not significant; PTSD-related impairment $p = .002$; for all other variables $p < .001$.

Discussion

More than a decade after 9/11, 10.1% of adult Registry enrollees in the present study showed comorbid PTSD and depression. Based on an estimated 409,000 individuals directly exposed to the events of 9/11 using Registry eligibility groups (Murphy et al., 2007), 10–11 years after 9/11 a possible 41,000 individuals in total are projected to suffer from comorbid PTSD and depression, and 16,000 individuals with comorbid PTSD and depression are projected to report unmet mental health care need.

When compared to individuals with PTSD or depression only, those with both conditions were more likely to report a high number of 9/11 exposures and experience poorer outcomes on measures of employment, social integration, quality of life, and perceived unmet mental health care need. In both the comorbid PTSD and depression and PTSD only groups, the mean number of poor mental health days increased with increasing PTSD-related impairment. Although 9/11 exposure and eligibility group was associated with having PTSD only, no significant relationship was observed in the group with depression only.

In the present study, several quality of life indicators were far worse among enrollees with comorbid PTSD and depression. Health-related unemployment emerged as the largest individual factor associated with PTSD and depression comorbidity,

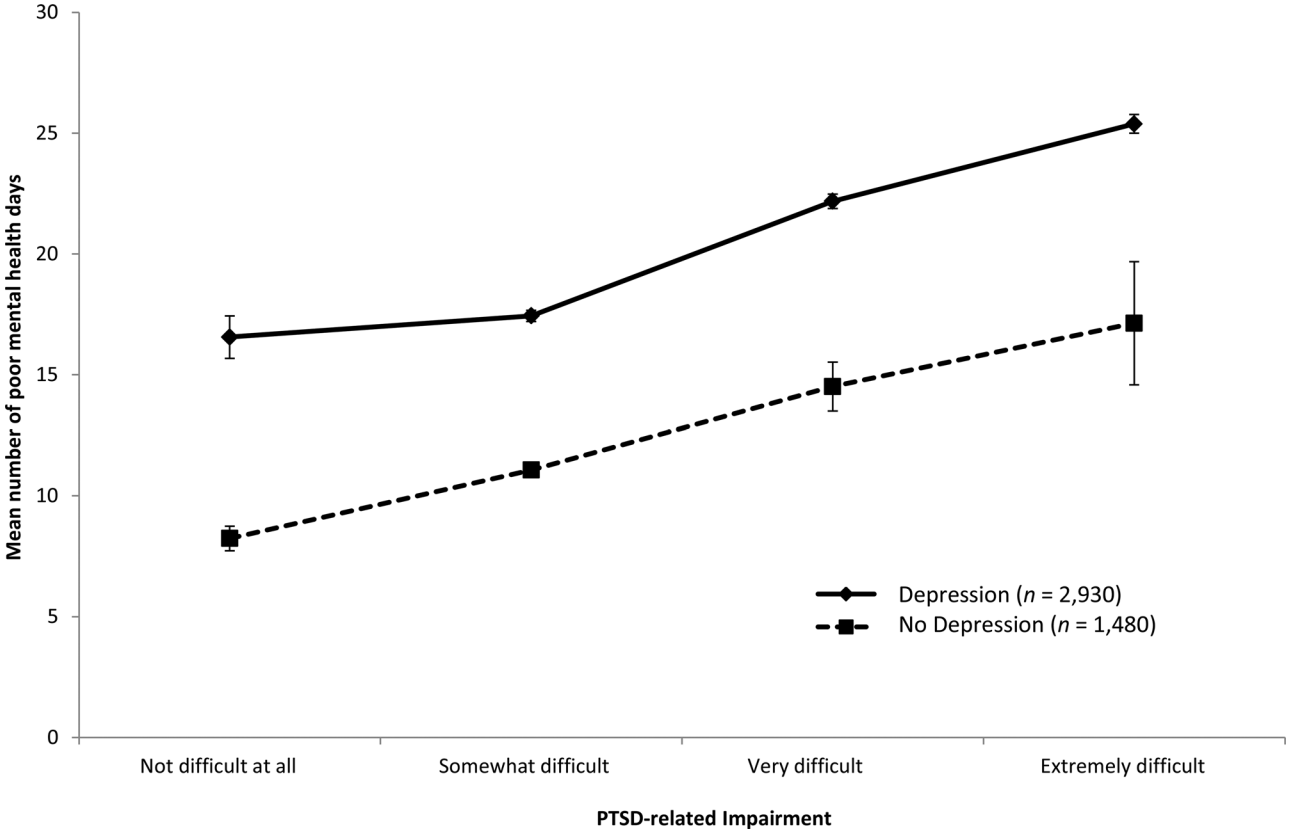

Figure 1. Mean number of poor mental health days in the prior 30 days among adult Registry enrollees with posttraumatic stress disorder (PTSD) and with or without depression by PTSD-related impairment at Wave 3. Error bars represent standard error.

suggesting that loss of social and economic resources and reduced access to health care leads to worsening PTSD and depression in a cyclical chain of events.

It is important to note that the psychopathologies examined are differentially associated with 9/11-related factors. Specifically, we observed a significant dose-response relationship between degree of 9/11 exposure and PTSD, but not depression. Chiu et al. (2011) reported similar results for 9/11-exposed firefighters. Our data suggest that there may be different mechanisms for the emergence of PTSD and depression as a result of exposure to trauma; major depression may emerge after PTSD, as dysthymia symptoms of PTSD are a prelude to depression.

Study strengths include the large sample size and use of validated instruments (PCL-17 and PHQ-8); although the latter do not yield clinical diagnoses of PTSD and depression, respectively, use of self-report measures is appropriate in large cohort studies where clinical assessment is not feasible. Additionally, the Registry contains a wide range of data on 9/11 exposures and individual characteristics, including a history of traumatic life events experienced before and after 9/11 obtained at Wave 3. In contrast to other studies that examined comorbid PTSD and depression among distinct subgroups of affected individuals, enrollees represent a diverse group of persons with varying degrees of 9/11-related exposure and comprise individuals who lived or worked in close proximity to the WTC site, as well as rescue and recovery workers.

Several limitations must be considered. Loss to follow-up occurred between Registry survey waves, as 63% of the original adult cohort completed the Wave 3 survey. Persons who reported PTSD symptoms at Wave 1 were less likely to complete Wave 2 and 3 surveys; this nonresponse may be related to avoidance tendencies or behavioral dysfunction and suggests the possibility of underestimation (Brackbill et al., 2009). We do not know if individuals with depression were more or less likely to complete Wave 3, as the PHQ-8 was not administered at Waves 1 or 2. Furthermore, enrollees for whom there were missing items on the PCL-17 or PHQ-8 at Wave 3 were excluded from our analysis, which may have biased results. Moreover, we did not employ clinical diagnostic measures for PTSD and depression; we can only interpret self-report of PTSD and depression symptoms as probable. Selection bias is an additional limitation given that self-identified enrollees were more likely to report mental health symptoms and 9/11 exposures (Brackbill et al., 2009). Finally, data on 9/11 exposures were self-reported and were collected 2–3 years after 9/11 and therefore may be subject to recall bias.

Adults who were directly and highly exposed to the events of 9/11 represent the population at greatest risk for debilitating, comorbid mental health outcomes. High prevalences of PTSD,

depression, and comorbid PTSD and depression among adult Registry enrollees 10–11 years post-9/11 demonstrate the need for continued mental health symptom surveillance beyond a decade postdisaster. Additionally, these findings highlight the importance of ongoing screening and treatment for both PTSD and depression, as comorbid individuals have greater impairment, reduced quality of life, severe health symptoms and outcomes, and greater unmet mental health care need.

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