

Chronic Probable PTSD in Police Responders in the World Trade Center Health Registry Ten to Eleven Years After 9/11

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Background Police enrolled in the World Trade Center Health Registry (WTCR) demonstrated increased probable posttraumatic stress disorder (PTSD) after the terrorist attack of 9/11/2001.

Methods Police enrollees without pre-9/11 PTSD were studied. Probable PTSD was assessed by Posttraumatic Stress Check List (PCL). Risk factors for chronic, new onset or resolved PTSD were assessed using multinomial logistic regression.

Results Half of police with probable PTSD in 2003–2007 continued to have probable PTSD in 2011–2012. Women had higher prevalence of PTSD than men (15.5% vs. 10.3%, $P = 0.008$). Risk factors for chronic PTSD included decreased social support, unemployment, 2+ life stressors in last 12 months, 2+ life-threatening events since 9/11, 2+ injuries during the 9/11 attacks, and unmet mental health needs.

Conclusion Police responders to the WTC attacks continue to bear a high mental health burden. Improved early access to mental health treatment for police exposed to disasters may be needed. Am. J. Ind. Med. 58:483–493, 2015. © 2015 Wiley Periodicals, Inc.

KEY WORDS: 9/11 disaster; posttraumatic stress disorder; DSM-IV diagnosis; police; mental health

INTRODUCTION

A range of physical and mental health consequences for first responders to the 9/11 World Trade Center (WTC)

terrorist attack has been identified, including probable posttraumatic stress disorder (PTSD) [Benedek et al., 2007; Stellman et al., 2008; Bowler et al., 2010, 2012; Perlman et al., 2011; Pietrzak et al., 2013]. PTSD is a widely reported outcome of 9/11 in many occupational groups who were involved in rescue and recovery, ranging from construction workers to firefighters [Wisnivesky, 2011]. Police responders to the WTC attacks had lower rates of PTSD and other mental health disorders, compared to the level of PTSD reported among other first-responders and non-traditional rescue workers of New York City [Perrin et al., 2007; Bowler et al., 2010; Luft et al., 2012]. Police officers undergo comprehensive and rigorous pre-employment psychological screenings and their careful selection for employment may be associated with officers' greater resilience and result in the prevention of adverse psychological symptoms after exposure to trauma [Alexander and Wells 1991; Stellman et al., 2008].

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Nevertheless, a small percentage (8.3%) of 4,017 police officers (582 women and 3,435 men) experienced continuing distress and met full DSM-IV criteria for PTSD at the World Trade Center Health Registry (Registry) baseline survey [Bowler et al., 2010], approximately 2 to 3 years after 9/11. The cause for this may have been their work as first responders in the rescue and recovery efforts and later cleanup of the site after the WTC attacks, which included recovering human body parts. A meta-analysis shows that the police officers' risk of PTSD associated with various 9/11 exposures is similar to the risk seen for other occupational groups [Liu et al., 2014].

The longitudinal course of PTSD symptoms in first responders to the WTC attacks has been documented by a few research groups, including the Registry and the World Trade Center Health Program (WTCHP). In the Registry's Wave 2 study [Bowler et al., 2012] 5–6 years after the terrorist attacks, the prevalence of PTSD among police enrollees was 16.5%, significantly higher than they reported 2–3 years after the attacks. Wisnivesky et al., [2011] reported the increase in cumulative incidence of PTSD among police in the WTCHP over time to be from 2.5% two years after the attacks to 6.3% six years after the attacks. However, the annual incidence of PTSD peaked in the 4th year after 9/11 and stabilized afterward [Wisnivesky et al., 2011]. The WTCHP reported four distinct PTSD symptom courses in police responders over three time points using a finite mixture modeling procedure, with the most common being "resistant" (77.8%), and 3 smaller groups: delayed onset (8.5%), recovering (8.4%), and severe chronic (5.3%) [Pietrzak et al., 2013]. Furthermore, our previous study [Bowler et al., 2010] revealed significant sex differences in PTSD.

Continued surveillance of 9/11-exposed individuals suggests that large numbers of persons continue to exhibit a range of serious mental health problems including PTSD, but the scope of the problem remains to be fully quantified and understood. Factors that influence the longitudinal trajectory of PTSD symptoms in WTC terrorist attack survivors include magnitude of exposure, ongoing stressors [Galea et al., 2008], event-related loss of spouse or job, and low social support [Perlman et al., 2011; Bowler et al., 2012]. Effects of PTSD among Registry police enrollees were also found to be buffered by high levels of social integration at Wave 2, five to six years post-9/11 [Schwarzer et al., 2014].

The aim of the present study was to examine the prevalence of continued or resolved PTSD in men and women police enrollees in the Registry who completed all of the assessment instruments in Waves 1 (2003–4), 2 (2006–7) and 3 (2011–12). This study also examined the factors associated with continued or resolved PTSD, including unmet health care needs and social support.

MATERIALS AND METHODS

Data Source and Study Sample

The study population includes police responders to WTC attacks who were enrolled in the Registry cohort. Details about the Registry and its enrollment and follow-up survey are provided elsewhere [Farfel et al., 2008; Brackbill et al., 2009]. Between June 2011 and March 2012, the Registry conducted the Wave 3 survey among adult enrollees to collect updated physical and mental health information for monitoring the health status of the Registry enrollees through web (45%), paper (41%), and phone interview (14%) [Ghuman et al., 2014].

Inclusion criteria for this data analysis are consistent with previous Registry reports on the police sub-cohort [Bowler et al., 2010; Bowler et al., 2012]. To be included, police enrollees must have worked at least one shift between September 11, 2001, to June 30, 2002 at the WTC or related sites, or have been involved in the transportation of the debris between the WTC site and barges. In addition, this study is limited to enrollees who did not report pre-9/11 PTSD, and who completed the Wave 3 survey including the 17 item PTSD Checklist–Civilian Version (PCL).

The study was approved by the Institutional Review Board (IRB) at the NYC Department of Health and Mental Hygiene (DOHMH), and the IRB at San Francisco State University, San Francisco. The Centers for Disease Control and Prevention and New York City DOHMH IRBs approved the overall Registry protocols. A Federal Certificate of Confidentiality was obtained, and oral informed consent was obtained from participants at enrollment.

Study Variables

The outcome variable was probable posttraumatic stress disorder ("PTSD"), which was assessed at each of three waves using a combination of PCL and DSM IV criteria. The PCL is a 17-item self-reported symptom scale derived from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychiatric Association, 1994) with 3 diagnostic symptom domains and criteria for re-experiencing, avoidance, and hyperarousal related to the trauma. All the symptom items referring to re-experiencing and half of those referring to numbing and avoidance contained event-specific wording (e.g., "as a result of the WTC disaster"). Each item is scored from 1 (not at all) to 5 (extremely). Responses to the 17 items were summed and probable PTSD was defined as meeting a cutoff score of 44 on the PCL, with at least one re-experiencing symptom (DSM-IV criterion B), three avoidance symptoms (DSM-IV criterion C), and two hyperarousal symptoms (DSM-IV criterion D) [Smith et al., 1999]. The PCL has relatively high

levels of sensitivity (94–97%) and specificity (86–99%) as well as positive predictive value (70–97%) [Weathers, 1993] [Ventureyra, 2002; Ruggiero, 2003]. Blanchard has reported that the PCL ≥ 44 cutoff provides the highest level of diagnostic efficiency at 0.94 [Blanchard et al., 1996].

The independent variables included number of injuries as a result of the 9/11 attacks (e.g., any of the following five items reported at Wave 1: having a cut, abrasion or puncture wound; sprain or strain; burn; broken bone or dislocation; and concussion or head injury), which is one of the strongest predictors of PTSD among responders [Liu et al., 2014]. Other independent variables included current employment status, perception of having good social support, total number of life threatening events since 9/11 (e.g., disaster, accidents, attacks with or without weapon, unwanted sexual contact, violence, illness), number of life stressors (e.g., personal living situation, problems at home or work, legal problems, serious illness, or death in the family) and a report of unmet mental health needs in the last 12 months prior to the Wave 3 interview. Demographic variables used in the analysis include age on 9/11, gender, race and ethnicity, change in household gross income from 2003–4 to 2011–12, change in marital status from 2003–4 to 2006–7, and 2006–7 to 2011–12, and current smoking status in 2011–12.

Received social support included emotional and tangible aspects and was measured by five items collected at Wave 3. The items asked whether someone was available, when needed, to take them to the doctor, have a good time with, hug them, prepare meals, and understand their problem. Each item was scored on a 5-point scale: 0 for “none of the time,” 1 for “a little,” 2 for “some,” 3 for “most” or 4 for “all of the time”; all five items were summed up into a total score ranging from 0 to 20. The total scores of received social support were then grouped into 4 categories: 0–5 points for none or little support, 6–10 for some, 11–15 for most and 16–20 for all of the time.

Data Analysis

All data analyses were performed using SAS software (SAS Institute, Cary, NC, v9.2). The frequency distribution and PTSD prevalence at Wave 3 by socio-demographics, perception of having good social support, life threatening events, and stressors were described. Changes in PTSD prevalence and mean PCL scores from Wave 2 to Wave 3 were examined in the total sample and for men and women separately. The percentage meeting criteria for PTSD and its components between groups were compared using Pearson uncorrected χ^2 test. Significance was set at a 2-sided P value of less than 0.05.

Associations of potential predictors with trajectories of PTSD in multiple categories were further examined in bivariate and multivariate analyses using multinomial logistic regression. Multinomial logistic regression is an extension of binary logistic regression that allows for more

than two categories of the dependent or outcome variable. Multicollinearity was evaluated with simple correlations among the independent variables. The trajectories of probable PTSD that were assessed over 3 waves were categorized into six subgroups based on the presence of PTSD in each wave. “Chronic” was defined if the police enrollees met “PTSD” criteria over three time points, “Delayed PTSD (Wave 2)” if they met criteria at Waves 2 and 3, “New onset at Wave 3” if they only met criteria at Wave 3, “Recovered” if they met criteria at Wave 1 and/or Wave 2 only, “Relapsed” if they met criteria at Wave 1 and Wave 3, and “Resilient” if they did not meet criteria at any of the three waves. The multivariate analyses focused on all but “relapsed” group due to the small number in that group.

RESULTS

Of the original 4,091 police responders enrolled in the Registry in Wave 1 (2003–04); 3,049 (74.5%) participated in the Wave 2 survey (2007–08); and 2,394 (78.5% of 3,049 Wave 2 participants; 58.5% of 4,091) continued to respond to the Wave 3 survey in 2011–12. Among 2,394 individuals who participated in all three Registry Waves, 153 (6.4%) with missing PCL items, and 37 (1.5%) with pre-9/11 PTSD were excluded; the remaining 2,204 (53.9% of 4,091) police enrollees were included in this data analysis.

Compared to those included in this analysis, those excluded due to non-response or missing data were more likely to be younger (median age on 9/11/2001: 36 vs. 38 years, $P < 0.001$), female (15.8% vs. 13.4%, $P < 0.05$), and Hispanic (18.1% vs. 15.0%; $P < 0.01$), but they had similar WTC dust exposures (55.6% vs. 57.9%, $P > 0.05$).

The socio-demographic characteristics of the 2,204 study subjects are shown in Table I. In the study sample, 81.9% were between 25 and 44 years old on 9/11, 86.6% were males, 74.7% were non-Hispanic whites, 63.6% were currently employed, 90.8% were not current smokers, and 75.9% remained in the same marital status since enrollment. Although over half of the police enrollees (54.7%) reported having received social support all of the time, 17.1% reported having some or little received social support. Over half (55.6%, $n = 1226$) of the police enrollees reported having experienced at least one life threatening event after the 9/11 disaster; and 29.8% reported having at least one significant stressor in last 12 months prior to the Wave 3 interview. Half ($n = 150$) of those who suffered with probable PTSD at Wave 1 (2003–04) or at Wave 2 (2006–07) ($n = 296$) continued to report symptoms indicative of probable PTSD at Wave 3 (2011–12).

PTSD prevalence at Wave 3 by socio-demographics is also listed in Table I. A total of 243 police enrollees met criteria for probable PTSD, representing 11.0% of the study sample. PTSD prevalence increased as the level of received

TABLE I. Socio-Demographics of the Study Subjects and Prevalence of Probable PTSD (n = 2,204)

Characteristics	Total*		PTSD at Wave 3	
	No.	%	No.	Prevalence
Total	2204		243	11.0
Age on 9/11, years				
18-24	37	1.7	3	8.1
25-44	1805	81.9	197	10.9
45-69	362	16.4	43	11.9
Median (range)	38 (19-68)			
Gender				
Male	1908	86.6	197	10.3
Female	296	13.4	46	15.5
Race/Ethnicity				
White (non-Hispanic)	1646	74.7	177	10.8
Black (non-Hispanic)	132	6.0	11	8.3
Hispanic	331	15.0	45	13.6
Asian	51	2.3	1	2.0
Multiracial	26	1.2	5	19.2
Unknown	18	0.8	4	22.2
Change in household gross income since enrollment				
Remained the same range	907	41.2	104	11.5
Increased	820	37.2	67	8.2
Decreased	285	12.9	54	19.0
Change in marital status				
Remained the same status since W1	1672	75.9	177	10.6
Remained the same status since W2	280	12.7	33	11.8
Changed from married/partner to separated/divorced/widowed	111	5.0	18	16.2
Changed from separated/divorced/widowed/ never married to married	101	4.6	11	10.9
All others	40	1.8	4	10.0
Current smokers at wave 3				
Yes	186	8.4	25	13.4
No				
Former	613	27.8	62	10.1
Never	1388	63.0	153	11.0
Current employment status at Wave 3				
Employed	1401	63.6	100	7.1
Unable to work because of health	164	7.4	57	34.8
Retired	602	27.3	75	12.5
All others (unemployed, homemaker, or unknown)	37	1.7	11	29.7
Having social support				
All of the time	1205	54.7	69	5.7
Most	609	27.6	81	13.3
Some	254	11.5	60	23.6
None or little	123	5.6	32	26.0
Number of events threatened your life since 9/11				
None	970	44.0	73	7.5
1 to 2	686	31.1	69	10.1
>=3	540	24.5	99	18.3
Number of life stressors in last 12 months**				
None	1540	69.9	110	7.1

(Continued)

TABLE I. (Continued.)

Characteristics	Total*		PTSD at Wave 3	
	No.	%	No.	Prevalence
1 to 2	594	27.0	104	17.5
≥3	62	2.8	27	43.6
Report of unmet mental health care needs at Wave 3				
Yes	140	6.4	71	50.7
No/not applicable	2060	93.5	172	8.4
PTSD in previous 2 waves				
Wave1 +Wave2+	73	3.3	53	72.6
Wave1 –Wave2+	190	8.6	86	45.3
Wave1 +Wave2 –	33	1.5	11	33.3
Wave1 –Wave2 –	1908	86.6	93	4.9

*The sum may not add up to the total due to missing.

**The six life stressors in last 12 months are as follows: could not pay for food, housing or other basic necessities for 3 months or longer; serious problems at work or lost a job; serious family problems; took care of a close family members or friend with a serious or life threatening illness; serious legal problem; or lost someone close to you due to accidental death, murder or suicide.

social support decreased (from 5.7% to 26.0% in the group with the least support). The prevalence of probable PTSD increased with the number of life stressors in the last 12 months prior to Wave 3 interview (from 7.1% to 43.6% in those who mentioned at least three of six potential stressors). Relatively high PTSD prevalence was also seen among those unable to work because of health (34.8%), and those with unmet mental health care needs (50.7%).

PTSD prevalence varied significantly by gender at Wave 3 (15.5% in women vs. 10.3% in men, $P = 0.008$). Table II shows changes in PTSD and its three subscales from Wave 2 to Wave 3 by gender. There were no statistically significant changes in overall PTSD prevalence from Wave 2 to Wave 3 for either men or women. However, the percentages of subscales on intrusion and hypervigilance declined significantly from Wave 2 to Wave 3 among men, intrusion symptoms from 37.3% in Wave 2 to 32.3% in Wave 3

TABLE II. Probable PTSD* and Three Subscales by the Time of Survey and Gender

	Wave 2		Wave 3	
	No.	Prevalence (95%CI), %	No.	Prevalence (95%CI), %
Total (n = 2204)				
Probable PTSD	263	11.9 (10.6–13.3)	243	11.0 (9.7–12.3)
Intrusion	845	38.3 (36.3–40.4)	742	33.7 (31.7–35.6)**
Avoidance	447	20.3 (18.6–22.0)	429	19.5 (17.8–21.1)
Hypervigilance	760	34.5 (32.5–36.5)	663	30.1 (28.2–32.0)**
Women (n = 296)				
Probable PTSD	44	14.9 (10.8–18.9)	46	15.5 (11.4–19.7)
Intrusion	133	44.9 (39.2–50.6)	125	42.2 (36.6–47.9)
Avoidance	72	24.3 (19.4–29.2)	81	27.4 (22.3–32.5)
Hypervigilance	120	40.5 (34.9–46.2)	101	34.1 (28.7–39.6)
Men (n = 1908)				
Probable PTSD	219	11.5 (10.0–12.9)	197	10.3 (9.0–11.7)
Intrusion	712	37.3 (35.1–39.5)	617	32.3 (30.2–34.4)**
Avoidance	375	19.7 (17.9–21.4)	348	18.2 (16.5–20.0)
Hypervigilance	640	33.5 (31.4–35.7)	562	29.5 (27.4–31.5)**

*Defined as PCL ≥ 44 and all three DSM-IV criteria.

**P value < 0.01.

TABLE III. Adjusted Odds Ratios and 95% Confidence Intervals From Multinomial Logistic Regression of PTSD Trajectory, Compared to Resilient Group^{*}

Variables	Chronic PTSD (n = 53, 2.4% ^{**})		Delayed onset at Wave 2 (n = 86, 3.9% ^{**})		New onset at Wave 3 (n = 93, 4.2% ^{**})		Recovered (n = 146, 6.6% ^{**})	
	No. (%)	Adjusted OR (95%CI)	No. (%)	Adjusted OR (95%CI)	No. (%)	Adjusted OR (95%CI)	No. (%)	Adjusted OR (95%CI)
Age group at 9/11, years								
18–44	36 (67.9)	referent	71 (82.6)	referent	83 (89.3)	referent	124 (84.9)	referent
45–69	17 (32.1)	2.3 (1.2–4.6)	15 (17.4)	1.9 (1.5–1.7)	10 (10.8)	0.6 (0.3–1.3)	22 (15.1)	0.9 (0.6–1.5)
Gender								
Male	44 (83.0)	referent	73 (84.9)	referent	76 (81.7)	referent	115 (78.8)	referent
Female	9 (17.0)	1.1 (0.5–2.6)	13 (15.1)	0.8 (0.4–1.6)	17 (18.3)	1.3 (0.7–2.5)	31 (21.2)	1.9 (1.2–3.1)
Hispanic								
No	42 (79.3)	referent	72 (83.7)	referent	76 (81.7)	referent	120 (82.2)	referent
Yes	11 (20.8)	1.9 (0.9–4.0)	14 (16.3)	1.1 (0.6–2.2)	17 (18.3)	1.2 (0.7–2.0)	26 (17.8)	1.3 (0.8–2.0)
Household gross income at Wave 3								
≥75K	37 (69.8)	referent	58 (67.4)	referent	57 (61.3)	referent	101 (69.2)	referent
<75K	14 (26.4)	0.9 (0.4–1.8)	25 (29.1)	1.2 (0.7–2.1)	31 (33.3)	2.0 (1.2–3.4)	40 (27.4)	1.6 (1.0–2.5)
Having social support								
All of the time	14 (26.4)	referent	29 (33.7)	referent	23 (24.7)	referent	55 (37.7)	referent
Most	16 (30.2)	2.0 (0.9–4.5)	20 (23.3)	1.5 (0.8–2.7)	38 (40.9)	3.5 (2.0–6.1)	53 (36.3)	2.1 (1.4–3.2)
Some	16 (30.2)	4.1 (1.8–9.5)	20 (23.3)	2.5 (1.3–4.8)	24 (25.8)	3.6 (1.9–6.9)	25 (17.1)	2.3 (1.3–3.8)
Little or none	7 (13.2)	3.0 (1.0–8.7)	16 (18.6)	4.5 (2.1–9.6)	8 (8.6)	2.6 (1.04–6.5)	12 (8.2)	2.1 (1.04–4.3)
Current employment status at Wave 3								
Employed	15 (28.3)	referent	32 (37.2)	referent	48 (51.6)	referent	82 (56.2)	referent
Unable to work because of health	18 (34.0)	15.8 (7.0–35.4)	20 (23.3)	8.0 (4.1–15.6)	16 (17.2)	3.7 (1.9–7.3)	21 (14.4)	2.7 (1.5–4.8)
Retired	16 (30.2)	2.9 (1.3–6.4)	31 (36.1)	2.5 (1.5–4.5)	25 (26.9)	1.3 (0.8–2.2)	39 (26.7)	1.1 (0.7–1.7)
All others (unemployed, homemaker, or unknown)	4 (7.6)	13.4 (3.6–50.9)	3 (3.5)	3.6 (0.9–14.4)	4 (4.3)	2.9 (0.8–10.1)	4 (2.7)	2.2 (0.7–7.0)
Number of life stressors in last 12 months								
None	18 (34.0)	referent	44 (51.2)	referent	44 (47.3)	referent	94 (64.4)	referent
1 to 2	25 (47.2)	2.1 (1.1–4.3)	34 (39.5)	1.2 (0.7–2.0)	42 (45.2)	1.7 (1.0–2.7)	46 (31.5)	1.0 (0.7–1.5)
≥3	9 (17.0)	10.5 (3.9–28.5)	7 (8.1)	3.2 (1.2–8.3)	7 (7.5)	3.2 (1.2–8.5)	6 (4.1)	1.5 (0.6–3.8)
Number of events threatened your life since 9/11 ^{**}								
None	15 (28.3)	referent	27 (31.4)	referent	845 (46.6)	referent	52 (35.6)	referent
1 to 2	16 (30.2)	1.2 (0.6–2.7)	28 (32.6)	1.3 (0.7–2.3)	574 (31.6)	1.0 (0.5–1.9)	43 (29.5)	1.2 (0.8–1.8)
≥3	21 (39.6)	2.4 (1.1–5.2)	30 (34.9)	1.9 (1.1–3.5)	390 (21.5)	3.3 (1.9–5.6)	51 (34.9)	2.1 (1.4–3.3)
Number of injuries sustained during the 9/11 attacks								
None	30 (56.6)	referent	53 (61.6)	referent	70 (75.3)	referent	98 (67.1)	referent
One	13 (24.5)	2.1 (1.01–4.5)	25 (29.1)	2.7 (1.6–4.6)	15 (16.1)	1.1 (0.6–2.0)	35 (24.0)	2.3 (1.5–3.5)
Two or more	10 (18.9)	4.6 (2.0–11.1)	6 (7.0)	1.8 (0.7–4.6)	7 (7.5)	1.4 (0.6–3.4)	13 (8.9)	2.4 (1.3–4.7)
Report of unmet mental health care needs at Wave 3								
No	38 (71.7)	referent	61 (70.9)	referent	66 (71.0)	referent	131 (89.7)	referent
Yes	15 (28.3)	7.3 (3.3–15.8)	25 (29.1)	10.8 (5.9–19.8)	27 (29.0)	9.5 (5.3–16.9)	15 (10.3)	2.8 (1.5–5.3)

^{*}In multivariate analysis, each PTSD group compared to the resilient group (no PTSD at any of the 3 waves, n = 1,815), adjusted for variables shown in this table.^{**}Percentage of total sample (n = 2204).

TABLE IV. Adjusted Odds Ratios (OR) for Association of Selected Stressors With PTSD Trajectory Relative to Resolved Group^a

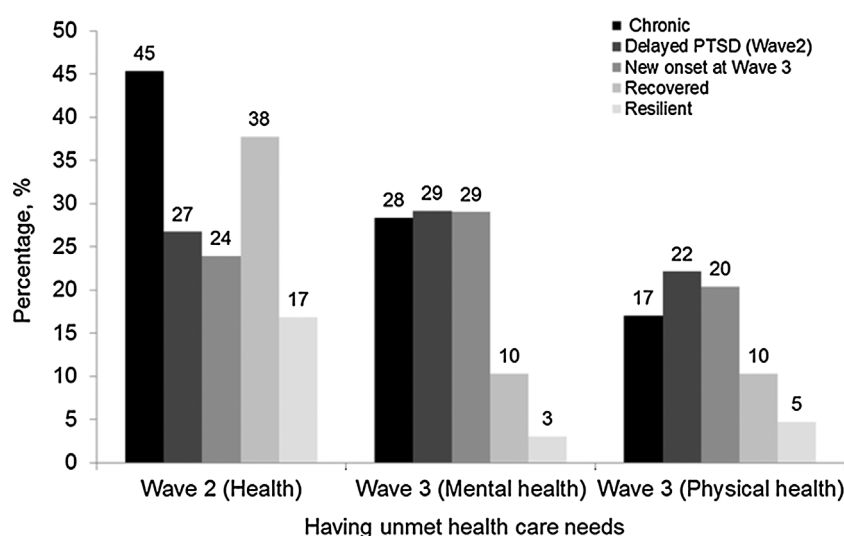
Variables	Chronic PTSD (n = 53)		Delayed onset at Wave 2 (n = 86)		New onset at Wave 3 (n = 93)	
	Adjusted OR	95%CI	Adjusted OR	95%CI	Adjusted OR	95%CI
Having social support						
All of the time	1.0		1.0		1.0	
Most	1.1	0.5–2.8	0.7	0.4–1.5	1.8	0.9–3.5
Some	2.0	0.8–5.2	1.2	0.6–2.8	1.8	0.8–4.1
Little or none	1.3	0.4–4.5	2.1	0.8–5.6	1.2	0.4–3.6
Current employment status at Wave 3						
Employed	1.0		1.0		1.0	
Unable to work because of health	6.5	2.5–16.9	2.8	1.2–6.3	1.5	0.7–3.4
Retired	2.7	1.1–6.6	2.1	1.1–4.3	1.1	0.6–2.2
All others (unemployed, homemaker, or unknown)	5.6	1.1–28.5	1.6	0.3–8.3	1.4	0.3–6.7
Number of life stressors in last 12 months						
None	1.0		1.0		1.0	
1–2	2.6	1.2–5.6	1.3	0.7–2.4	2.1	1.2–3.9
>2	9.4	2.7–33.2	2.4	0.7–8.2	2.6	0.8–8.7
Report of unmet mental health care needs at Wave 3						
No	1.0		1.0		1.0	
Yes	2.6	1.03–6.4	3.6	1.7–7.7	3.4	1.6–7.1

^aIn multivariate analysis, each PTSD group compared to the recovered group (n = 146), adjusted for age, gender, Hispanic ethnicity, household income and variables shown in this table.

($P < 0.01$), and hypervigilance symptoms from 33.5% in Wave 2 to 29.5% in Wave 3 ($P < 0.01$, Table II). Among women, changes in the three PTSD subscales from Wave 2 to Wave 3 were not statistically significant ($P > 0.05$).

To assess factors associated with the various courses of PTSD, we compared the resilient group with “chronic” (n = 53), “delayed PTSD (Wave 2)” (n = 86), “new onset at

Wave 3” (n = 93), and “recovered” (n = 146) PTSD groups, respectively (Table III). The “relapsed” group of 11 police was not included in the multivariate analysis. Compared with the “resilient” group (n = 1815), each of the other PTSD trajectory groups was significantly associated with decreased level of received social support, being “unable to work because of health,” life threatened events since 9/11, and

**FIGURE 1.** Prevalence of police having unmet health care needs by PTSD categories and survey waves.

having unmet mental health needs, after adjusting for age, gender, race/ethnicity, and household gross income. In addition, “chronic PTSD” was significantly associated with older age, having an increased number of life stressors in last 12 months and sustaining an injury as a result of the 9/11 attacks. “Delayed PTSD (Wave 2)” was significantly associated with >2 life stressors in the last 12 months, and injury. “New onset at Wave 3” was associated with life stressors in last 12 months in a dose-dependent manner. Enrollees classified as “recovered PTSD” were more likely to be female, and to have reported fewer life stressors.

When the “resilient” group was removed from the multivariate analysis, and the “recovered” group was used as a control group (Table IV), having unmet mental health needs remained as a significant predictor of the “chronic,” “delayed PTSD (Wave 2),” or “new onset at Wave 3” PTSD group. Having life stressors in last 12 months also remained significantly associated with “chronic” or “new onset at Wave 3” PTSD group. However, the levels of received social support and number of injuries were no longer significantly associated with any of the other PTSD groups. The number of life threatened events since 9/11 was not associated with “recovery” PTSD in bivariate analysis, therefore was not included in the multivariate analysis.

To describe the role of unmet health care needs in the group with continued PTSD, the distribution of having unmet health care needs by PTSD subgroups and by Waves is displayed in Figure 1. While the police enrollees with “chronic,” “delayed PTSD (Wave 2),” or “new onset at Wave 3” consistently reported a high proportion of unmet health care needs in Wave 2 and Wave 3, enrollees in the “recovered” PTSD group reported a much lower proportion of unmet mental health care needs in Wave 3 compared to unmet health care needs reported in Wave 2 (37.7% in Wave 2 vs. 10.3% in Wave 3; $P < 0.01$), even though mental health was not specified in Wave 2. Even when mental and physical health needs were combined, the “recovered” PTSD group reported a much lower proportion of unmet health care needs than the “chronic,” “delayed PTSD (Wave 2),” or “new onset at Wave 3”. Upon further looking into the use of WTC health program among 146 enrollees of the “recovered” PTSD group, 45.9% reported not having received services from any WTC health program at Wave 3, a 21% decrease from the 58.2% at Wave 2.

DISCUSSION

Ten to eleven years after the WTC disaster, half of those who suffered with probable PTSD at Wave 1 or Wave 2 continued to present symptoms indicative of probable PTSD. Chronic and delayed onset PTSD were significantly associated with older age at the time of exposure, life

stressors in preceding year, unmet mental health care need, and lower levels of received social support.

Pietrzak [2013] similarly reported that among police responders in the WTCHP, longitudinal PTSD symptoms were best characterized by four classes. Age in that study was associated with chronic and recovering PTSD. Other reported predictors included sex (for delayed-onset and recovering trajectories), Hispanic ethnicity for chronic PTSD, lower education (chronic or delayed-onset), and comorbid depression, anxiety or PTSD prior to 9/11 for chronic, delayed-onset, and recovering trajectories.

Our data also suggest that older age is associated with chronic PTSD relative to either “resilient” or “recovered” police. This is consistent with prior studies by Kessler et al. [1995] who found that PTSD risk among men was highest among 45–54 year old, although among women they found the highest risk to be between ages 25–34. Norris et al. [2002] reported a curvilinear relationship with age, where U.S. middle-aged participants had a higher risk of PTSD than younger participants, who in turn had a higher risk of PTSD than older people.

Increased number of life stressors in the last 12 months was significantly associated with chronic PTSD, delayed onset at Wave 2 and new onset PTSD at Wave 3 in the current study, which is consistent with a previous study by Galea [2008]. Galea and his colleagues found a significant association between ongoing stressful life events and PTSD symptoms over time in a large population-based cohort. Life stressors in the preceding year may play a role in complicating the on-going stress as well as in triggering a new onset of PTSD. We observed a significant association between new onset PTSD at Wave 3 and greater than 3 life stressors in the prior 12 months and greater than 3 life-threatening events since 9/11. These findings, along with the observed lack of a significant association with number of injuries sustained during 9/11, suggest that 9/11 may be playing a lesser role among the 93/2204 (4%) with new onset probable PTSD at Wave 3, ten to eleven years after the terrorist attacks and their aftermath.

Enrollees with “chronic” or “delayed PTSD (Wave 2)” were more likely to be “unable to work because of health” or to be “retired.” At Wave 3, 7.4% of the police participants were unable to work because of health reasons (Table I), of whom 34.8% had PTSD at Wave 3. These findings are not unexpected since unemployment is known to be associated with PTSD [Davidson et al., 1991; Schnurr et al., 2009]. This represents a steep cost to both individuals and society of the aftermath of the trauma endured as a result of the 9/11 attacks. It is possible that the potentially violent nature of police work makes it more challenging for police officers to return to their jobs after suffering a traumatic event such as the 9/11/01 WTC attack.

Multiple studies have identified female gender as being associated with higher risk of PTSD after trauma exposure

[Bowler et al., 2010; Brackbill et al., 2014]. The change in PTSD prevalence among men but not among women from Wave 2 to Wave 3 suggests that PTSD among men improved more quickly than among women (Table II). This may be accounted for in part by the significant decrease in intrusion and hypervigilance in men but not in women. Avoidance symptoms remained stable, consistent with previous research showing that avoidance plays an important role in the stability of PTSD over time [Soloman et al., 2009]. Hypervigilance, which includes hyperarousal, is generally an acute reaction to a trauma, but continued hyperarousal is a less common occurrence. Hyperarousal symptoms include trouble sleeping, feeling irritable, having difficulty concentrating, being very watchful or on guard, or feeling jumpy and easily startled. Hyperarousal is among the first symptoms to emerge after a trauma [Bremner et al., 1996], and is thought to be important in PTSD due to its relationship to neurological processes that impact the course of the disorder [Newport and Neweroff, 2000]. Hyperarousal symptoms have been found to predict the occurrence of PTSD [Schell et al., 2004; Andrews et al., 2009; Solomon et al., 2009]. Those with PTSD and high hyperarousal symptoms show lower overall improvement in PTSD symptoms over time [Schell et al., 2004]. Intrusion, and re-experiencing the trauma, have also been shown to impact the course of higher PTSD symptoms over time, although not as strongly as hyperarousal [Schell et al., 2004].

The alleviation or recovery of PTSD and other mental health problems among exposed population is closely related to the traumatized individuals' access to health care. Barriers preventing affected people from seeking help for their mental problem were recognized in the aftermath of 9/11 [Stuber et al., 2006]. The prevalence of unmet mental health care needs was nearly 20% among exposed individuals with a mental health diagnosis and symptoms indicative of PTSD 5–6 years after the WTC attacks [Brackbill et al., 2013], and nearly 50% among those with very high levels of severe symptoms 10–11 years after 9/11 in the same affected population [Ghuman et al., 2014]. Consistent with other studies, we found that having unmet mental health care needs is significantly associated with having PTSD in various PTSD symptom categories. Nevertheless, we found that a decrease in reporting unmet mental health care needs was associated with recovered PTSD. Improving the utilization of existing WTC health programs among those suffering from PTSD should be advised and encouraged.

Social support refers to the function and quality of social relationships, assessable through measures of instrumental, emotional and appraisal support. Social integration, on the other hand, refers to the structure and quantity of social relationships and can be calculated based on questions assessing the number of roles a participant observes in the society and the frequency of these interactions. Our previous

studies in police enrollees have suggested being socially integrated is a protective factor for continued PTSD 6–7 years after the exposure [Bowler et al., 2012], and buffers stress [Schwarzer et al., 2014]. In this study, we examined social support and found that low level of social support was significantly associated with continued PTSD and new PTSD 10 years after the disaster, consistent with other studies [Galea et al., 2002]. However, when comparing with the “recovered” group instead of “resilient” group, the level of social support was no longer a significant protective factor for continued or new onset PTSD. This finding suggests that social support appears to play a significant role in the development of PTSD, but may not be as significant in recovering from PTSD. Although a great deal of empirical evidence in the last decades has underscored the unfavorable effects of lack of support on mental health, one needs to consider also reciprocal relationships and take into account that poor mental health can lead to deterioration of social relationships, reversing the causal direction that was hypothesized in the present paper.

This study has several limitations. Response bias may be a limitation, since the Wave 3 survey was completed by only 58.5% of the original participants, although the Wave 3 participants did not significantly differ in reporting dust cloud exposure or number of witnessed traumatic events or number. All data were self-reported, and those missing PCL items were excluded, which may have biased results. We excluded a relatively small number of enrollees with a history of pre-9/11 PTSD, to improve clarity of interpretation, although their inclusion did not alter our findings. Data on exposures following 9/11/01 were self-reported and collected two to three years after exposure occurred, and therefore may be subject to recall bias. Finally, we did not collect information on additional risk factors such as history of childhood trauma or peritraumatic dissociation, which have been previously considered as risk factors for PTSD [Ozer et al., 2003; Marmar et al., 2006].

In summary, resilience continues to be the most common trajectory of PTSD among police over a ten-to-eleven year observation period. This is supported by a large body of literature documenting the capacity of human beings to restore health and normal functioning after a trauma [deRoos-Cassini et al., 2010], including the 9/11 attack [Bonanno et al., 2006]. Social support and social integration both appear to be important to prevent PTSD, and reduce the risk of developing symptoms of PTSD during a critical period of time after a disaster. Registry reports of unmet mental health care needs persist and the enduring human cost of this tragedy cannot be ignored. The longitudinal study conducted by the Registry provides a unique opportunity to investigate the long-term mental and physical health impact of a major urban trauma. Hopefully the knowledge gained will be applied in future traumas and disasters to lessen their impact not only on first responders but the communities involved.

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