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Police Officers Who Responded to 9/11: Comorbidity of PTSD, Depression, and Anxiety 10–11 Years Later

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Background *After the 9/11/2001 World Trade Center (WTC) attack, many police-responders developed PTSD and might be vulnerable to develop depression and/or anxiety. Comorbidity of PTSD, depression, and/or anxiety is examined.*
Method *Police enrollees (N = 1,884) from the WTC Health Registry were categorized into four groups based on comorbidity of PTSD, depression, and anxiety. DSM-IV diagnostic criteria for PTSD were used. Depression (PHQ-8) and anxiety (GAD-7) were assessed with standardized psychometric inventories. Multinomial logistic regression was used to identify putative risk factors associated with comorbidity of PTSD.*
Results *Of 243 (12.9% of total) police with probable PTSD, 21.8% had probable PTSD without comorbidity, 24.7% had depression, 5.8% had anxiety, and 47.7% had comorbid depression and anxiety. Risk factors for comorbid PTSD, depression, and anxiety include being Hispanic, decrease in income, experiencing physical injury on 9/11, experiencing stressful/traumatic events since 9/11, and being unemployed/retired.*
Conclusion *Nearly half of police with probable PTSD had comorbid depression and anxiety.* Am. J. Ind. Med. 59:425–436, 2016.

KEY WORDS: posttraumatic stress disorder; 9/11; police; comorbidity; risk factor

INTRODUCTION

The impact of the 9/11/2001 World Trade Center (WTC) terrorist attack on the mental health of first responders who rushed to the scene within minutes and days of the attack has been described extensively since the 9/11 attack occurred. Numerous research studies on first responders have reported mental health problems, including posttraumatic stress disorder (PTSD), depression, panic disorder, anxiety, and anger associated with 9/11 rescue and recovery work [Galea et al., 2002, 2003; Perrin et al., 2007; Farfel et al., 2008; Stellman et al., 2008; Baschnagel et al., 2009; Brackbill et al., 2009; Evans et al., 2009; Katz et al., 2009; Berninger et al., 2010; Bowler et al., 2010; DiGrande et al., 2011; Bowler et al., 2012; Ruggero et al., 2013].

Previous research has shown that psychiatric comorbidity is the rule rather than the exception for people with PTSD, and the presence of psychiatric comorbidity heightens the burden of mental illness, lowers psychosocial functioning, and is more likely to be chronic [Kessler et al., 2005; Wilk et al., 2006; Caramanica et al., 2014; Hruska et al., 2014]. Approximately, 75% of individuals with PTSD experience one or more comorbid disorders [Kaufman and Charney,

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2000] and are 80% more likely than those without PTSD to develop another mental disorder [APA, 2013]. There have been several reports on the prevalence or cumulative incidence of comorbid mental health conditions among first responders to the 9/11 events [Stellman et al., 2008; Wisnivesky et al., 2011; Bowler et al., 2012; Caramanica et al., 2014], but risk factors for having PTSD with comorbid mental health conditions of depression and anxiety specifically among police responders have not been well studied.

Police officers typically undergo a comprehensive and sensitive mental and physical health screening before working on the police force. Likely in part due to their stringent selection process, police enrollees had lower prevalence of PTSD than other first responders in the World Trade Center Health Registry (WTCHR) [Perrin et al., 2007; Bowler et al., 2012; Cone et al., 2015]. Although the police are accustomed to stressful work, the work at the WTC was likely even more traumatic than the daily stressors they encounter as police first responders.

Stellman et al. [2008] reported on the prevalence of mental health problems and their comorbidity among rescue and recovery workers evaluated at the WTC Medical Monitoring and Treatment Program up to 5 years post-9/11. The point-prevalence of PTSD declined from 13.4% at 10 months post-attack to 9.3% at 60 months. Stellman et al. [2008] also found that 8.8% of all of the rescue workers, including police officers, met criteria for depression and 5.0% for probable panic disorder. Approximately, half of those classified as having PTSD also were classified with either panic disorder, depression, or both [Stellman et al., 2008]. Subsequently, Wisnivesky et al. [2011] reported an overall 9-year cumulative incidence of PTSD (9.3%), depression (7.0%), and panic disorder (8.4%) among this same population with an overall rate of mental health comorbidity of 5.8% with combined PTSD, depression and panic disorder. The authors assessed overall rates of mental health disorders in rescue and recovery workers without undertaking further analyses to stratify the sample by established risk factors such as age, sex, race, or ethnic origin.

One can assume that not all officers are equally likely to suffer from PTSD but that a number of characteristics are associated with the development and persistence of symptoms. Those who are either female, belong to an ethnic minority group, and/or earn a lower income might be more vulnerable to develop PTSD [Bonanno et al., 2010; Bowler et al., 2010]. The same applies to those who were injured in the aftermath of the attack, and who were strained by critical life events in the time since 9/11 because an added burden of adversities may have prevented police responders' recovery from trauma.

Many previous studies of PTSD have focused only on depression as a comorbid disorder [O'Donnell et al., 2004; Caramanica et al., 2014; Contractor et al., 2015]. Among the general population, the highest rates of comorbidity are for the DSM-IV diagnoses of PTSD, depression, and anxiety [Kaufman and Charney, 2000; Brown et al., 2001]. Having anxiety and depression on top of PTSD would most likely add to the severity of PTSD. Therefore this study fills a gap in investigating anxiety with depression as comorbid with PTSD.

The objectives of this study are to: (i) examine the prevalence of comorbid probable posttraumatic stress disorder (PTSD), depression, and anxiety in police enrollees in the WTCHR 10–11 years after the attack; and (ii) determine which risk factors (demographic, trauma exposure, or stressful life events) are associated with having probable PTSD, PTSD with depression, and PTSD with both depression and anxiety. It is hypothesized that (i) the highest prevalence rate for PTSD will be for those police enrollees with comorbid depression and anxiety; (ii) it was hypothesized that demographic characteristics (i.e., lower age, female sex, ethnic minority, lower income), increased number of injuries and stressful life events would increase the prevalence for PTSD.

MATERIALS AND METHODS

The WTCHR, initiated in 2002, is a longitudinal health study of the residual long-term effects on residents and first responders to the WTC terrorist attack. As both a retrospective and prospective cohort study, the WTCHR included 30,665 first responders who worked in rescue and recovery after the attacks and were willing to volunteer to be WTCHR enrollees. Data were collected at three points in time with the first survey (Wave 1) administered between 2003 and 2004, the second survey (Wave 2) between 2006 and 2007, and the third survey (Wave 3) between 2011 and 2012.

Details of the method of data collection and mental health scales used have been described previously [Farfel et al., 2008; Bowler et al., 2010; Cone et al., 2015]. Briefly, data collected via interview and self-report with paper- and web-based questionnaires included sociodemographics, 9/11-specific "work exposure" questions, and both physical and mental health outcomes (including PTSD, depression, and anxiety).

Study Population

The current study was based on the police sample ($n = 2,204$) used in our previous report [Cone et al., 2015]. To be included, the participants must have responded to each of the Wave 1, 2, and the Wave 3 surveys and had complete PTSD data from each wave. All participants worked at least one shift in rescue and recovery from September 11, 2001 to June 30, 2002 at the WTC or other sites, or were involved in

the transportation of the debris. As this study focused on PTSD as well as depression and anxiety at Wave 3, 146 police enrollees were excluded from this analysis because they had resolved PTSD at Wave 3, as described in Cone et al. [2015], and an additional 174 police enrollees who met criteria for depression or anxiety at Wave 3 but not for PTSD, were also excluded to keep the reference group (having neither diagnosable PTSD nor depression and anxiety) free from any of the three mental health conditions. Thus, the final sample for this study was 1,884.

Study Variables

Probable PTSD was assessed using the event specific 17-item PTSD Checklist-civilian version [PCL; Blanchard et al., 1996] at each of the three waves. The PCL consists of 17 symptoms, each rated on a 5-point Likert scale describing how much the respondent had been bothered by that symptom in the previous month when regarding the events of 9/11: 1 (not at all), 2 (a little bit), 3 (moderately), 4 (quite a bit), or 5 (extremely). Probable PTSD (hereafter referred to as "PTSD") was defined as a PCL cut-off score of 44 or higher plus the presence of items describing symptoms, rated at least three or above in each of three DSM-IV domains with at least one re-experiencing symptom (DSM-IV criterion B; $\alpha = 0.90$), three avoidance symptoms (DSM-IV criterion C; $\alpha = 0.89$), and two hyperarousal symptoms (DSM-IV criterion D; $\alpha = 0.87$) [Smith et al., 1999]. Each symptom was assigned to one of three categories corresponding to DSM-IV diagnostic criteria (intrusion/re-experiencing, avoidance or numbing, and hypervigilance or hyperarousal). The sensitivity of the PCL is between 84% and 97%, specificity ranges between 87% and 90% and a positive predictive value is 97% [Weathers et al., 1993; Ventureyra et al., 2002; Ruggiero et al., 2003]. Blanchard has reported that the PCL $\geq$44 cutoff provides the greatest diagnostic efficiency at 0.90 with high levels of sensitivity (0.94) and specificity (0.86) [Blanchard et al., 1996]. As reported by Bowler et al. [2010] when applying the more conservative PCL cutoff score of $\geq$50 to the police enrollees at Wave 1, the risk factors for probable PTSD were similar to those when using the $\geq$44 cutoff. The use of the less stringent cutoff is additionally supported by findings showing that police had the lowest prevalence rate of probable PTSD among different 9/11 responder groups [Perrin et al., 2007].

Self-reported symptoms of anxiety and depression were measured using the 7-item Generalized Anxiety Disorder scale [GAD-7; Spitzer et al., 2006] and the 8-item Patient Health Questionnaire [PHQ-8; Kroenke et al., 2009] scale, respectively. Both the GAD-7 and the PHQ-8 items are self-rated with a 4-point Likert scale from 0 (not at all) to 3 (nearly every day) for the prior 2 weeks. The GAD-7 scale has items such as "Feeling nervous, anxious or on edge" and the PHQ-8 includes items such as having "Little interest or pleasure in doing things" with the same 4-point Likert scale as the GAD-7. Police responders were identified as "resilient" if they did not meet criteria for PTSD at the three survey waves and did not meet depression and anxiety criteria at Wave 3. Criteria for depression were met at Wave 3 if participants had a score of 10 or higher on the PHQ-8 or if they reported taking prescribed antidepressant medication. Similarly, participants were categorized as having anxiety at Wave 3 if they scored 10 or higher on the GAD-7, which is considered to reflect moderate levels of clinical anxiety by Spitzer et al. [2006]; or reported taking prescribed anti-anxiety medication. Both the PHQ-8 ($\alpha = 0.89$) and GAD-7 ($\alpha = 0.94$) have high clinical sensitivity (48–92%) and specificity (76–95%) [Spitzer et al., 2006; Kroenke et al., 2009]. Police respondents in this Wave 3 analysis were categorized into five groups: (i) PTSD without comorbidity, referring to police responders who met criteria for PTSD at Wave 3, but not for depression or anxiety; (ii) PTSD with depression, referring to police who met criteria at Wave 3 for both PTSD and depression, but not anxiety; (iii) PTSD with anxiety, referring to police who met criteria at Wave 3 for both PTSD and an anxiety disorder, but not depression; (iv) PTSD with depression and anxiety, referring to those who met criteria for PTSD and both a depression and anxiety disorder at Wave 3; and (v) resilient, referring to police responders who never met criteria for PTSD and did not meet depression or anxiety criteria at Wave 3.

Demographic characteristics (age, gender, ethnicity, current employment status, change in marital status, and annual household income), number of injuries sustained at 9/11, number of stressful life events, number of life threatening events since 9/11, and unmet mental health care needs were examined.

Enrollees were asked about experiencing stressful life events in the preceding year at the Wave 3 interview. Specifically, they were asked if they had experienced not being able to pay for basic necessities for 3 months or longer; serious family, job, or legal problems; caring for someone close with a life threatening illness; and having lost someone close to accidental death, murder, or suicide. The binary responses to these six questions (0 for "no," 1 for "yes") were summed into one variable, which was then categorized into: no life stressors, 1-to-2 life stressors, and 3 or more life stressors.

Additionally, enrollees were asked whether they experienced the death of a spouse/partner, a close family member, or a friend in the prior two months. Life threatening events since 9/11 were also investigated. Enrollees were asked if their life was threatened by a disaster, a life-threatening illness, a serious accident, an attack with a weapon, an attack without a weapon but with

intent to kill, unwanted sexual contact, a serious injury, or witnessing someone being seriously injured or violently killed. Responses on these eight questions were coded with 0 for "no" and 1 for "yes" and were summed to form the "number of life threatening events since 9/11" variable, which was further categorized into having experienced no life threatening events, 1-to-2 events, and more than 3 events.

At Wave 3, police enrollees were additionally asked to complete the Behavioral Risk Factor Surveillance System (BRFSS) Health-Related Quality of Life Module [Hennessy et al., 1994], in which participants are asked to state the number of days in the past 30 days when they experienced poor physical or mental health, as well as the number of days during which poor physical or mental health prevented them from engaging in their usual activities.

Police enrollees were asked if in the last 12 months there was ever a time when they needed mental health care or counseling but did not receive it (Yes or No). A positive response indicates having had unmet mental health care needs.

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.

Data Analysis

Data were analyzed using SPSS Version 22 [IBM Corporation, 2014]. All analyses used a two-tailed significance level of $P \leq 0.05$.

Cronbach's alpha (α) was used to determine the internal reliability for each of the three criteria scales of the PCL, the PHQ-8, and GAD-7. Descriptive statistics were obtained for each of the five study groups and for the four PTSD groups combined (all PTSD groups). Socio-demographic characteristics, 9/11 exposure, stressful life events, and unmet mental health care needs (UMHCN) were examined to determine if there was an association with PTSD alone or PTSD comorbid with both depression and anxiety. These factors have been associated with the PTSD trajectory in previous studies of the same population [Bowler et al., 2012; Cone et al., 2015].

To examine factors associated with PTSD alone and PTSD with comorbid depression and/or anxiety, multinomial logistic regression was used. The PTSD with comorbid anxiety group was excluded from these analyses due to small number of cases. Potential collinearity between nominal variables was assessed using χ^2 tests. The socio-demographic characteristics of age, sex, Hispanic ethnicity, change in marital status, change in household income, and current employment status were analyzed in one multinomial logistic regression model to assess the odds of predicted PTSD group membership. Separate multinomial logistic regression models were also performed for injuries sustained on 9/11, which is indicative of 9/11 exposure, and stressful life events in the past 12 months, adjusted for age, sex, Hispanic ethnicity, household income, and the death of a loved one within the last 2 months. Between-group analyses of variance were used to examine differences among the groups on PCL scores at each Wave 1, 2, and on Wave 3 BRFSS variables (poor physical health days, poor mental health days, and days when usual activities were prevented due to poor physical or poor mental health).

RESULTS

Of the 243 police officers who met criteria for PTSD at Wave 3, 53 (21.8%) were in the PTSD without comorbidity group (PTSD without diagnosable depression or anxiety); 60 (24.7%) were in the PTSD and comorbid depression group (PTSD and depression); 14 (5.8%) were in the PTSD and comorbid anxiety group (PTSD and anxiety); and 116 (47.7%) were in the PTSD with comorbid depression and anxiety group (PTSD, depression and anxiety). The remaining 1,641 enrollees were those without the three mental health conditions at Wave 3. Table I shows the means and standard deviations for the participants' age at 9/11, frequencies for socio-demographic variables, exposure, and stressful life events for all groups except for those having PTSD and anxiety due to small number of cases. The distribution of age at 9/11 was similar across all groups.

Mean PCL scores for each group over the three waves are shown in Figure 1. Police with PTSD and comorbid depression and anxiety had significantly higher mean PCL scores over the three waves compared to those in the other groups. At Wave 1, the mean PCL in those who had PTSD alone was not significantly different from that in those with PTSD and depression (mean difference = 2.14, $P = 0.681$), while the mean differences between any other two groups were significant ($P < 0.01$). Similar patterns were seen at Waves 2 and 3.

As shown in Figure 2, police officers with PTSD with comorbid depression and anxiety reported a greater mean number of days with poor physical health in the last 30 days (16.94 days) than the resilient referents (5.21 days, $P < 0.001$), and those having PTSD without comorbidity (11.04 days, $P < 0.001$). Those with PTSD and comorbid depression and anxiety also had the highest mean number of days with poor mental health (21.59 days), significantly more than all the other groups ($P < 0.001$). Police officers with PTSD and comorbid depression and anxiety also reported the highest mean number of days (17.25 days) on which poor physical or mental health prevented them from engaging in

TABLE I. Socio-Demographic Characteristics, 9/11 Exposure, and Stressful Life Events by Mental Health Comorbidity Among WTCHR Police Enrollees, Wave 3 ($N = 1{,}884$)

	All PTSD Groups (n = 243)				
	All PTSD groups[a]	1. PTSD w/o comorbidity	2. PTSD w/depression[b]	3. PTSD w/depression and anxiety[c]	4. Resilient referents[d]
	n (%)	n (%)	n (%)	n (%)	n (%)
Total	243 (100.0)	53 (21.8)	60 (24.7)	116 (47.7)	1641
Socio-demographic characteristics					
Age at 9/11	M = 38.8, SD = 7.0	M = 37.6, SD = 5.7	M = 39.0, SD = 7.1	M = 39.2, SD = 7.0	M = 37.9, SD = 7.3
Sex					
Female	46 (18.9)	12 (22.6)	10 (16.7)	22 (19.0)	192 (11.7)
Male	197 (81.1)	41 (77.4)	50 (83.3)	94 (81.0)	1449 (88.3)
Hispanic ethnicity					
Yes	45 (18.5)	14 (26.4)	5 (8.3)	25 (21.6)	231 (14.1)
No	198 (81.5)	39 (73.6)	55 (91.7)	91 (78.5)	1410 (85.9)
Change in marital status since enrollment					
Changed	33 (13.6)	9 (17.0)	4 (6.7)	18 (15.5)	178 (10.9)
Remained the same since W1	177 (72.8)	36 (67.9)	46 (76.7)	84 (72.4)	1265 (77.1)
Remained the same since W2	33 (13.6)	8 (15.1)	10 (16.7)	14 (12.1)	198 (12.1)
Change in household income since enrollment					
Increase in income	67 (27.6)	7 (13.2)	11 (18.3)	33 (28.5)	174 (10.6)
Decrease in income	54 (22.2)	17 (32.1)	14 (23.3)	32 (27.6)	634 (38.6)
Remained the same	112 (46.1)	27 (50.9)	32 (53.3)	48 (41.4)	752 (45.8)
Current employment status at Wave 3					
Unable to work due to health	57 (23.5)	6 (11.3)	13 (21.7)	38 (32.8)	64 (3.9)
Retired	75 (30.9)	14 (26.4)	19 (31.7)	37 (31.9)	448 (27.3)
Unemployed, etc.	11 (4.5)	1 (1.9)	3 (5.0)	7 (6.0)	18 (1.1)
Employed	100 (41.2)	32 (60.4)	25 (41.7)	34 (29.3)	1111 (67.7)
9/11 Exposure					
Injuries sustained on 9/11					
1	57 (23.5)	11 (20.8)	13 (21.7)	28 (24.1)	197 (12.0)
≥2	25 (10.3)	4 (7.6)	6 (10.0)	14 (12.1)	62 (3.8)
None	157 (64.6)	37 (69.8)	40 (66.7)	72 (62.1)	1374 (83.7)
Life events and UMHCN					
Life stressors in last 12 months					
1-to-2	104 (42.8)	23 (43.4)	24 (40.0)	50 (43.1)	365 (22.2)
≥3	27 (11.1)	4 (7.6)	5 (8.3)	17 (14.7)	18 (1.1)
None	110 (45.3)	26 (49.1)	30 (50.0)	48 (41.4)	1252 (76.3)
Life-threatening events since 9/11					
1-to-2	69 (28.4)	15 (28.3)	14 (23.3)	35 (30.2)	514 (31.3)
≥3	99 (40.7)	25 (47.2)	22 (36.7)	46 (39.7)	350 (21.3)
None	73 (30.0)	13 (24.5)	23 (38.3)	34 (29.3)	771 (47.0)
Experienced the death of someone close—last 2 months					
Yes	51 (21.0)	10 (18.9)	14 (23.3)	25 (21.6)	198 (12.1)
No	188 (77.4)	43 (81.1)	45 (75.0)	88 (75.9)	1406 (85.7)
UMHCN at Wave 3					
Yes	71 (29.2)	12 (22.6)	18 (30.0)	40 (34.5)	32 (2.0)
No	172 (70.8)	41 (77.4)	42 (70.0)	76 (65.5)	1605 (97.8)

[a]The group with comorbid PTSD and anxiety (n = 14) was included in this total of 243 cases, but was not presented in this table due to small numbers.
[b]Depression was defined if PHQ8 score ≥10 or reported prescribed medication use for the treatment of depression in the last 12 months.
[c]Anxiety was defined if GAD7 score ≥10 or reported prescribed medication use for the treatment of anxiety in the last 12 months.
[d]Resilient includes participants who did not meet criteria for PTSD at any wave and did not meet criteria for depression or anxiety at Wave 3.

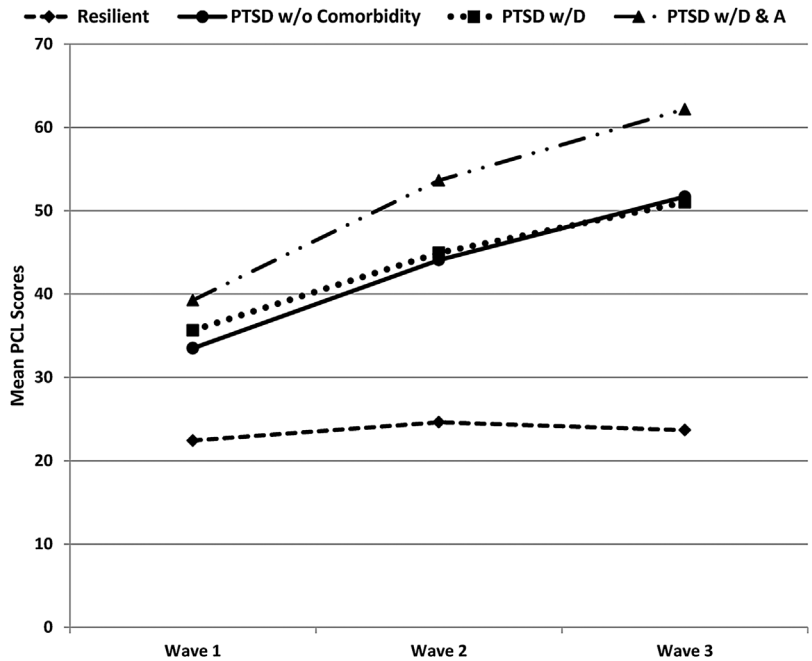

FIGURE 1. Mean PCL scores at Waves 1, 2, and 3 by study group at W3. "PTSD w/D" = PTSD with depression diagnosis; "PTSD w/D and A" = PTSD with both depression and anxiety diagnosis.

their usual daily activities when compared to all the other groups studied here ($P < 0.001$).

PTSD Without Comorbidity

Table II shows the adjusted odds ratios (aOR) and 95% confidence intervals (CIs) for having PTSD without comorbidity, PTSD with depression, and PTSD with both depression and anxiety in relation to potential risk factors. Compared to the resilient reference group, significantly elevated odds ratios for having PTSD without comorbidity were observed for women police enrollees, Hispanic, those unable to work due to poor health, those who sustained an injury as result of 9/11, and those who experienced more life stressors in the preceding year. Increased number of life-threatening events experienced since 9/11 was also associated with increased odds of having PTSD without comorbidity.

PTSD With Depression

Compared to the resilient reference group, the increased odds of having PTSD and depression were associated with employment status at Wave 3, 9/11 exposure, and stressful life events (Table II). Enrollees were more likely to have PTSD with depression if they were not employed due to health reasons, retired or unable to find a job, when compared to the reference group. The increased odds of

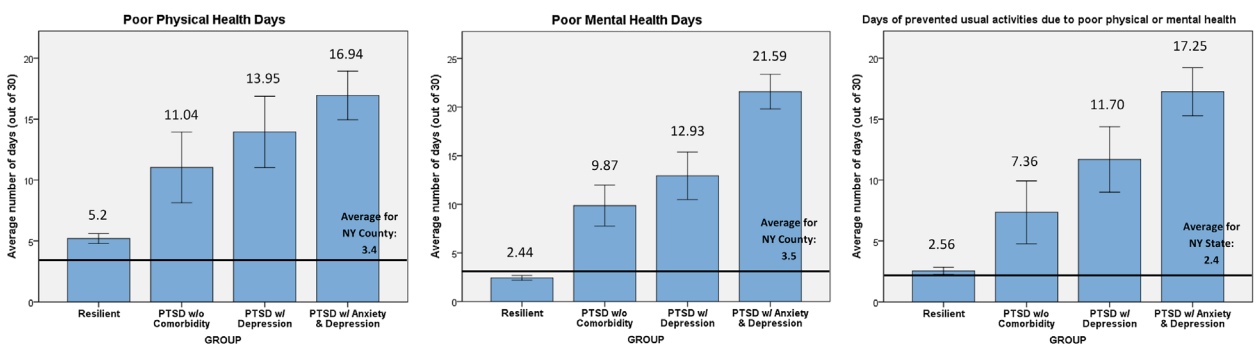

FIGURE 2. HRQOL results by study group at W3. Error bars represent 95%CI of the mean.

TABLE II. Multinomial Logistic Regression Results (Adjusted Odds Ratios, aOR) of Risk Factors for PTSD Group Compared to the Resilient[a]

	PTSD w/o comorbidity (n = 53)		PTSD w/depression (n = 60)		PTSD w/depression and anxiety (n = 116)	
	n	aOR (95%CI)	n	aOR (95%CI)	n	aOR (95%CI)
Socio-demographic characteristics[b]						
Age at 9/11	53	1.0 (0.9–1.0)	60	1.0 (1.0–1.0)	116	1.0 (1.0–1.0)
Sex						
Female	12	2.0 (1.0–4.0)	10	1.7 (0.8–3.5)	22	1.4 (0.8–2.5)
Male	41	1.0	50	1.0	94	1.0
Hispanic ethnicity						
Yes	14	2.1 (1.1–4.1)*	5	0.6 (0.2–1.6)	25	2.0 (1.2–3.3)**
No	39	1.0	55	1.0	91	1.0
Change in marital status since enrollment						
Changed	9	1.5 (0.7–3.4)	4	0.6 (0.2–1.8)	18	1.4 (0.8–2.5)
Remained the same since W2	8	1.3 (0.6–2.9)	10	1.2 (0.5–2.6)	14	1.0 (0.5–2.0)
Remained the same since W1	36	1.0	46	1.0	84	1.0
Change in household income since enrollment						
Increase in income	17	0.6 (0.3–1.2)	14	0.6 (0.3–1.1)	32	0.8 (0.5–1.4)
Decrease in income	7	0.9 (0.4–2.1)	11	1.2 (0.6–2.4)	33	1.9 (1.1–3.2)*
Remained the same	27	1.0	32	1.0	48	1.0
Current employment status at Wave 3						
Unable to work due to health	6	3.8 (1.5–9.8)**	13	7.9 (3.7–17.1)***	38	16.9 (9.6–29.8)***
Retired	14	1.2 (0.6–2.3)	19	1.7 (0.9–3.3)	37	2.3 (1.4–3.8)**
Unemployed	1	2.9 (0.4–23.1)	3	5.5 (1.2–26.3)*	7	14.0 (5.2–38.1)***
Employed	32	1.0	25	1.0	34	1.0
9/11 Exposure						
Injuries sustained on 9/11[c]						
≥2	4	2.9 (1.0–8.5)	6	3.5 (1.4–8.7)**	14	3.7 (1.9–7.5)***
1	11	2.2 (1.1–4.5)*	13	2.3 (1.2–4.5)*	28	2.4 (1.5–4.0)***
None	37	1.0	40	1.0	72	1.0
Life events and UMHCN						
Life stressors in last 12 months[c]						
≥3	4	9.4 (2.8–31.2)***	5	9.1 (3.0–27.6)***	17	16.5 (7.6–35.9)***
1-to-2	23	3.1 (1.7–5.7)***	24	2.7 (1.5–4.9)**	50	2.0 (2.0–4.9)***
None	26	1.0	30	1.0	48	1.0
Life-threatening events since 9/11[c]						
≥3	25	5.8 (2.8–12.2)***	22	2.5 (1.3–4.8)**	46	3.7 (2.3–6.1)***
1-to-2	15	2.2 (1.0–4.9)*	14	1.1 (0.5–2.1)	35	1.7 (1.0–2.8)
None	13	1.0	23	1.0	34	1.0
UMHCN at Wave 3[c]						
Yes	12	13.8 (6.5–29.6)***	18	21.8 (10.9–43.7)***	40	25.3 (14.4–44.4)***
No	41	1.0	42	1.0	76	1.0

[a]Using multivariate logistic regression, each PTSD group is compared to the Resilient reference group (n = 1,641).
[b]A multivariate analysis including all socio-demographic variables in the Table.
[c]Separate multivariate analysis was conducted for each of the variables under 9/11 exposure and stressful life events and UMHCN; each model adjusted for age, sex, Hispanic ethnicity, household income, and experiencing the death of someone close within the last 2 months.
*Significant at $P \leq 0.05$; **Significant at $P \leq .01$; ***Significant at $P < 0.001$.

having PTSD with depression was also associated with increased number of injuries on 9/11, life stressors in the preceding year, and life-threatening events experienced since 9/11.

PTSD With Depression and Anxiety

Forty-seven percent of police enrollees with PTSD have a comorbid diagnosis of both depression and anxiety

(Table II). In addition, compared to the resilient referent group, an increased likelihood for having PTSD with both comorbid depression and anxiety was observed for police enrollees of Hispanic ethnicity, those whose household income decreased since enrollment, as well as those unemployed due to health or retirement. Similar to those having PTSD with depression, the increased odds of having PTSD with both depression and anxiety was significantly associated with the increased number of injuries on 9/11, life stressors in the preceding year, and life-threatening events experienced since 9/11.

PTSD Comorbid Groups Compared to PTSD Without Comorbidity

Probable PTSD groups with depression and with both depression and anxiety were compared to the PTSD without comorbidity as the referent group using multinomial logistic regression. Table III shows the results of these analyses. When examining socio-demographic variables, the overall model fit was good, χ^2 (20) = 31.49, $P = 0.049$, accounting for 15.2% of the between group variance. However, when examining 9/11 exposure, stressful life events and UMHCN variables, the overall model was a poor fit for thee data. For this reason, only socio-demographic characteristics were examined when using the probable PTSD without comorbidity group as the referent category. Hispanic police enrollees are less likely to have probable PTSD with depression when compared to those with probable PTSD alone. Police enrollees who are unable to work due to health reasons are more likely to have probable PTSD with both depression and anxiety when also compared to those with PTSD alone.

Further analyses were conducted using univariate analysis of variance (ANOVA) to determine if the endorsement of PCL items by DSM-IV criteria (i.e., re-experiencing, avoidance, hyperarousal) differed between PTSD groups. Those with PTSD with both comorbid depression and anxiety reported higher scores on all three criteria of re-experiencing ($\eta^2_p = 0.10$), avoidance ($\eta^2_p = 0.23$), and hyperarousal ($\eta^2_p = 0.31$) than those with PTSD alone and PTSD with depression. Those with PTSD alone and PTSD with depression did not differ on any of the three criteria. This indicates that those with PTSD alone and those with PTSD with comorbid depression and depression with anxiety do not differ in the type of PCL items endorsed, but only in the severity of those reported items.

DISCUSSION

Police officers, including survivors of the WTC terrorist attack, have been shown to be extraordinarily resilient to trauma and have a lower prevalence of PTSD compared to other 9/11 first responders [Perrin et al., 2007; Bowler et al., 2012]. Moreover, in the current analysis, nearly half of those with PTSD had comorbid depression and anxiety 10–11 years after the attacks on 9/11. Factors that have been reportedly associated with PTSD in other 9/11-exposed populations were not only associated with PTSD among police enrollees but also associated with increased risk for comorbid depression and anxiety.

Previous studies [Shalev et al., 1998; O'Donnell et al., 2004; Caramanica et al., 2014] report that PTSD with comorbid depression was more frequent than PTSD alone. However, these studies did not examine comorbid anxiety. Therefore, this study highlights the importance of examining both depression and anxiety as comorbid diagnoses.

In our study, those police who have probable PTSD with comorbid depression and anxiety reported more severe PTSD symptoms, as indicated by their total PCL score. This pattern was consistent across all three Waves and is consistent with previous findings of increased symptom severity with comorbid disorders [Shalev et al., 1998; Brown et al., 2001; Kessler et al., 2005; Wilk et al., 2006; Caramanica et al., 2014; Hruska et al., 2014]. The overall severity of PTSD symptoms did not differ between those with PTSD without comorbidity and those with PTSD and depression. Contrary to our hypotheses, based on prior research age and sex were not associated with an increased risk of having a comorbid PTSD diagnosis in police enrollees.

PTSD with depression and anxiety was associated with other variables such as having a Hispanic ethnicity, a decrease in income, having experienced physical injury on 9/11, and having experienced stressful or traumatic events since 9/11. Being unemployed, unable to work due to health, or being retired was also associated with mental health comorbidity. There is some evidence that role change (which could include retirement or being unable to work due to a disability) is associated with greater functional impairment from PTSD symptoms [Cook, 2001]. Alternatively, individuals who are more functionally impaired due to comorbid mental health diagnoses, and subsequently have more severe PTSD symptoms, are unable to work outside the home and may concurrently have difficulties sustaining close relationships.

Examining the entire WTCHR registry sample, Caramanica et al. [2014] found that 10% of the sample met criteria for comorbid PTSD and depression, and they reported more days of poor physical and mental health, decreased satisfaction with life, poorer overall health, and unmet mental health needs compared to those with only a single condition. These recent findings are consistent with reports by Stellman et al. [2008] and Bowler et al. [2012], who describe chronic impairment in mental health and social functioning when additional mental health conditions are present.

In addition, a large percentage of this group was found to have unmet mental health care needs. Ghuman et al.

TABLE III. Multinomial Logistic Regression Results and Odds Ratios (OR) of Risk Factors for Comorbid PTSD Wth Depression and PTSD With Depression and Anxiety Groups Compared to the Reference Group of PTSD Without Comorbidity[a]

	PTSD w/depression (n = 60)	PTSD w/depression and anxiety (n = 116)
	OR (95%CI)	OR (95%CI)
Age at 9/11	1.0 (1.0–1.1)	1.0 (1.0–1.1)
Sex		
Female	1.0 (0.4–2.7)	0.8 (0.3–1.8)
Male	1.0	1.0
Hispanic ethnicity		
Yes	0.3 (0.1–0.9)*	0.9 (0.4–2.2)
No	1.0	1.0
Change in marital status since enrollment		
Changed	0.4 (0.1–1.5)	0.9 (0.3–2.5)
Remained the same since W2	0.9 (0.3–2.9)	0.8 (0.3–2.2)
Remained the same since W1	1.0	1.0
Change in household income since enrollment		
Increase in income	0.8 (0.3–2.0)	1.4 (0.6–3.2)
Decrease in income	1.3 (0.4–4.1)	2.4 (0.9–6.4)
Remained the same	1.0	1.0
Current employment status at Wave 3		
Unable to work due to health	2.0 (0.6–6.2)	4.5 (1.6–12.6)**
Retired	1.5 (0.6–3.8)	2.0 (0.9–4.6)
Unemployed	2.0 (0.2–24.8)	4.9 (0.6–43.3)
Employed	1.0	1.0

[a]Using multivariate logistic regression, each comorbid PTSD group is compared to the PTSD without comorbidity reference group (n = 53).
*Significant at $P \leq 0.05$; **Significant at $P \leq 0.01$; ***Significant at $P < 0.001$.

[2014] reported that "attitudinal barriers" including the desire to handle a problem without help or having concerns about the effectiveness of mental health care were likely relevant factors for those police officers who report having UMHCN. Police may purposefully avoid seeking mental health care due to concerns about violations in confidentiality, which could lead to negative consequences for performing their job by losing status among their peers or being demoted to a restricted work status. Future evaluations could investigate a cause and effect pathway among these variables.

The finding that increased number of days of poor mental and physical health was associated with increased comorbidity is consistent with the literature [Stellman et al., 2008; Bowler et al., 2012; Caramanica et al., 2014] describ-] describing decreased functioning with increased numbers of comorbid mental health diagnoses. Enrollees in all of the PTSD groups reported having more days of poor mental and physical health (Fig. 2) when compared to the average number of days of poor mental (3.5 days) and physical (3.4 days) health in New York County [Robert Wood Johnson Foundation, 2012].

PTSD comorbid with or without depression and/or anxiety was associated with a decrease in income over time, increased life stressors in the preceding 12 months, and more traumatic life events since 9/11 in this study, consistent with others [Caramanica et al., 2014]. Having additionally experienced not only a physical injury related to 9/11 but also post-9/11 stressful life events increased their level of PTSD. In this sample, physical injury and the number of injuries are associated with more severe PTSD symptoms. Having sustained injuries on 9/11 may lead to the inability to work for health reasons, job termination, or retirement. It is notable that the DSM-5 reports peritraumatic and posttraumatic factors of personal injury and adverse life events or other trauma related losses such as financial strain to be additional environmental stress factors [APA, 2013].

Strengths

This study has several strengths. The longitudinal data collected by the WTCHR allowed us to identify a large group of police responders who did not meet criteria for PTSD at any of the three time points (resilient). Moreover, our findings made clear that, along with PTSD, comorbid depression and anxiety are likely common byproducts of the

severe trauma experienced by first responders which appear in many to persist over time, particularly in those who have unmet mental health needs.

Limitations

This study also has several limitations, including potential self-selection bias and the fact that the data are self-reported. However, our use of validated health questionnaires and psychometrically sound scales, to measure PTSD, depression, and anxiety may reduce potential measurement errors in outcome variables. More objective clinical testing, with a comprehensive neuropsychological screening test battery and clinical interviews, would be useful in the future to determine an accurate assessment of the potentially wide-ranging neuropsychological and functional deficits that may be present in those with the all three conditions (PTSD, depression and anxiety). Due to the small number of people with PTSD and anxiety, this group could not be examined in multivariate analysis. Wide 95%CI for most of the risk factors also indicate the potential instability of the findings and longer follow-up of mental health to this exposed population is needed. Since the outcome has a prevalence greater than 10% when examining the relationship between the comorbid PTSD groups and PTSD without comorbidity (Table III), it is likely that the odds ratios overestimate the point estimates due to the use of multinomial logistic regression. Lastly, we did not collect information on additional risk factors such as family history of depression and other mental health conditions, childhood trauma or childhood depression and history of medication or drug use that may increase the risk of developing or triggering depression or other psychological symptoms. Moreover, the cross-sectional analysis of the putative risk factors cannot uncover the causal or temporal relationships that may be involved here.

CONCLUSIONS

Overall, even in a sample of police officers who are considered to be more resilient to the psychiatric sequelae of trauma compared to other first responders, significant comorbidity of depression, and anxiety was found. Comorbidity was associated with increased symptom severity and fewer days of good function per month. Risk factors for comorbid PTSD, depression and anxiety include a decrease in income over time, having experienced physical injury on 9/11, having experienced stressful or traumatic events since 9/11, and being unemployed, unable to work due to the health reasons, or retired. Recognition of these risk factors may serve to identify those trauma-exposed officers who would likely benefit from early outreach by mental health agencies. This may reduce the incidence of unmet mental care health needs later. The development of risk factors and causal antecedents of symptom trajectories need to be examined in future analyses of these data.

AUTHORS' CONTRIBUTIONS

All authors made substantial contributions to the conception or design of the paper; or the acquisition, analysis, or interpretation of data for the paper. All authors drafted the paper or revised it critically for important intellectual content. All authors provided final approval of the version to be published. All authors agree be accountable for all aspects of the paper in ensuring that questions related to the accuracy or integrity of any part of the paper are appropriately investigated and resolved.

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DISCLOSURE (AUTHORS)

The authors' of this manuscript do not have any conflicts, financial or personal gain from the publication of this manuscript. The authors' freedom to design, conduct, interpret, and publish research is not compromised by the funder and does not necessarily represent the views of

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