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Cigarette smoking and 9/11-related posttraumatic stress disorder among World Trade Center Health Registry enrollees, 2003–12

Alice E. Welch *, John P. Jasek, Kimberly Caramanica, Mariana C. Chiles, Michael Johns

New York City Department of Health and Mental Hygiene, 42-09 28th Street, Queens, NY 11101, USA

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ABSTRACT

Objective. Numerous studies have observed higher rates of smoking among adults with mental health conditions. We examined posttraumatic stress disorder (PTSD) and smoking over a 7–9 year period among adults with firsthand exposure to the 9/11 attacks enrolled in the World Trade Center Health Registry.

Method. Data were collected at three waves: W1 (2003–04), W2 (2006–07), and W3 (2011–12). Enrollees aged ≥25 at W1 and who completed all three waves (n = 34,458) were categorized by smoker-type: non-smoker, non-daily (smoked some days in last 30 days), light (1–10 cigarettes per day (CPD)), or heavy (11 + CPD). Enrollees who smoked at W1 but not W3 were considered to have quit. PTSD was defined as a score of ≥44 on the PTSD Checklist—Civilian Version.

Results. Smoking declined significantly from W1 (12.6%) to W3 (9.2%). Smoking prevalence was higher among enrollees with PTSD. In multivariable models, odds of quitting were 25–39% lower among heavy, light, and non-daily smokers with PTSD compared to those without.

Conclusion. PTSD was associated with reduced odds of quitting regardless of smoker-type. Disaster-exposed smokers with PTSD are likely in need of more supportive services in order to abstain from smoking.

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Introduction

Multiple studies have reported a strong association between smoking and mental health conditions including depression, anxiety, non-specific psychological distress, and posttraumatic stress disorder (PTSD) (Cook et al., 2014; Fu et al., 2007; Lawrence et al., 2011; Vanable et al., 2003). Adults with mental health conditions, including PTSD, smoke at rates twice as high as those in good mental health (Lasser et al., 2000; Feldner et al., 2007; Lawrence et al., 2009; Morris et al., 2014). Despite recent declines in smoking prevalence in the general population, smoking rates have not declined similarly among those with poor mental health (Cook et al., 2014). Though smokers with poor mental health attempt to quit at levels comparable to other smokers, they appear to be less successful (Fu et al., 2007; Lawrence et al., 2011; Morris et al., 2014).

The September 11, 2001 (9/11) terrorist attack on the World Trade Center (WTC) in New York City (NYC) resulted in elevated rates of PTSD and depression among exposed persons immediately and for years post-disaster (Brackbill et al., 2009; Galea et al., 2002). Population-based studies following 9/11 have found increased smoking rates among those directly exposed with or without current PTSD symptoms (Vlahov et al., 2002, 2004a, 2004b; Wu et al., 2006). Becker and Murphy (1988) theorize that psychosocial stress reduces the likelihood that current smokers will quit and makes former smokers more susceptible to relapse and more likely than current smokers to increase cigarette consumption. In a review of studies on smoking, traumatic exposure(s) and PTSD, Feldner et al. (2007) noted elevated rates of smoking (current and lifetime) and nicotine dependence among persons exposed to traumatic events compared to persons without traumatic exposure; however, in multiple studies, PTSD was related to current smoking beyond the effects of the traumatic exposure itself. PTSD can be an impediment to successful quitting (Fu et al., 2007; Morris et al., 2014). Smokers with PTSD are more likely to relapse than smokers without PTSD (Beckham et al., 2013; Zvolensky et al., 2008). Hapke et al., (2005) found that trauma exposed persons with PTSD were significantly less likely to quit than individuals with no history of traumatic exposure; there was no significant difference in the odds of quitting among trauma exposed persons without PTSD compared to individuals with no history of traumatic exposure. Smoking and the reduced probability of quitting among trauma exposed persons with PTSD are characterized by two distinct smoking motivations (Feldner et al., 2007). Trauma exposed persons with PTSD may smoke in response to trauma-related cues (Beckham et al., 1996, Beckham et al., 2005) and may be more likely smoke in order to reduce negative affect (e.g., anger, contempt, guilt, fear) (Calhoun et al., 2011; Dedert et al., 2012; Feldner et al., 2007).

The high burden of PTSD among persons directly exposed to 9/11 and other disasters may increase the probability of continued smoking

* Corresponding author at: NYC Department of Health and Mental Hygiene, 42-09 28th Street, 7th Floor, Queens, NY 11101, USA.
E-mail address: awelch1@health.nyc.gov (A.E. Welch).

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and relapse, while hindering smoking cessation among this group. Using data from the WTC Health Registry (Registry), we examined smoking prevalence and the association between PTSD and quitting over a 7–9 year period among a cohort with firsthand traumatic exposure. Based on previous studies, we hypothesized that enrollees with 9/11-related PTSD would be more likely to smoke and less likely to quit than persons without PTSD.

Methods

Data source

The Registry is a cohort study of 71,431 individuals directly exposed (firsthand, in-person exposure) to the events of 9/11 in NYC and was designed to monitor the physical and mental health effects of 9/11 for at least twenty years. Details on Registry eligibility criteria, recruitment methods, and findings have been published elsewhere (Brackbill et al., 2009; Farfel et al., 2008; Murphy et al., 2007). In summary, Registry enrollees comprise rescue/recovery workers and volunteers; lower Manhattan residents; area workers; passers-by; and school children and staff. The Wave 1 (W1) baseline survey (2003–04) included 68,802 adult enrollees (Farfel et al., 2008). Adult enrollees were resurveyed at Wave 2 (W2; 2006–07; n = 46,602 (68%); Brackbill et al., 2009) and at Wave 3 (W3; 2011–12; n = 43,134 (63%)). The Registry protocol was approved by the institutional review boards of the Centers for Disease Control and Prevention (CDC) and NYC Department of Health and Mental Hygiene.

Study sample

This analysis was limited to enrollees who completed survey Waves 1, 2, and 3 (n = 36,252). Given that over 90% of smokers initiate smoking before age 26 years (U.S. Department of Health and Human Services, 2014), we excluded enrollees who were under age 25 years at W1 (n = 1,138) to focus on established smokers. We also excluded enrollees who were missing age at W1 (n = 2) or had incomplete information on PTSD at W1 and W3 (n = 654), resulting in a final sample of 34,458.

Smoking behaviors

At W1 enrollees were asked if they had smoked at least 100 cigarettes in their lifetime. At each wave, enrollees were asked if they smoked cigarettes every day, some days, or not at all and the number of cigarettes smoked per day (CPD). Based on these questions, smoking status was categorized as either heavy smoker (smoked ≥100 cigarettes and currently smokes 11+ CPD), light smoker (smoked ≥100 cigarettes and currently smokes 1–10 CPD), a non-daily smoker (smoked ≥100 cigarettes and smokes some days), former smoker (smoked ≥100 cigarettes but did not smoke currently), or never smoker (did not smoke ≥100 cigarettes and did not smoke currently) at each wave. Enrollees who smoked at W1 but not at W3 were considered to have quit smoking.

Posttraumatic stress disorder

Symptoms of probable PTSD were assessed at each wave using the PTSD Checklist—Civilian Version (PCL), which was adapted to 9/11. The PCL is a self-reported, 17-item scale corresponding to the DSM-IV symptom criteria (Blanchard et al., 1996; Ventureyra et al., 2002; Weathers et al., 1993). We used a score of 44 or greater to define cases of probable PTSD, which is recommended for use among civilians (sensitivity = 0.944, specificity = 0.864, diagnostic efficiency = 0.900; Blanchard et al., 1996), hereafter referred to as PTSD. Enrollees with missing PCL items and a score from the remaining items that could only be compatible with a total score of 43 or less or 44 or greater were categorized accordingly (n = 613 at W1, n = 1141 at W3). Otherwise, PTSD was considered missing.

Demographic characteristics

We included demographic variables that were associated with cigarette smoking in previous studies: age, gender, race/ethnicity, education, and household income; information on these variables was collected at W1.

Analysis

We examined demographic characteristics at W1, PTSD and smoker type at W1 and W3, and calculated age-adjusted prevalence of smoking at W1 and W3 using the United States 2000 Standard Population. We cross-tabulated smoker types at W1 and W3 to assess the relationship between W1 cigarette consumption and W3 smoker type. Chi-square tests were used to test for significant bivariate associations between quitting smoking by W3 and demographic characteristics, PTSD, and W1 smoker type. We used logistic regression to calculate adjusted odds ratios (AOR) to estimate the strength of the association between quitting at W3 and PTSD at W3 in separate models for each smoker type (non-daily, light daily, heavy daily), adjusting for gender, age, race/ethnicity, income, educational attainment, and PTSD at W1. Analyses were conducted using SAS (version 9.2; Cary, NC) and SAS-callable SUDAAN (RTI International, Research Triangle Park, NC).

Results

The largest proportion of enrollees was male (62.3%), age 45 to 64 years at W1 (48.5%), non-Hispanic white (72.1%), had a 2002 household income of at least $50,000 (68.0%), and had attended some college or higher (79.0%; Table 1). There was a significant trend in PTSD prevalence, increasing from W1 (14.3%) to W3 (17.1%; Table 2).

We observed a significant downward trend in the adjusted prevalence of smoking from 12.6% at W1 to 9.2% at W3 (Table 1). At both waves, the largest proportion of smokers was non-daily smokers (39.7% and 38.9%, respectively) and the smallest proportion was light smokers (34.2% and 24.1%, respectively). Enrollees with PTSD had a higher prevalence of smoking at W1 (18.7%) and W3 (15.4%) when compared to enrollees without PTSD (11.6% and 7.9%, respectively).

Table 2 displays the relationship between consumption at W1 and W3. We found that W1 non-daily smokers were more likely to have quit by W3 (54.2%) compared to light (37.4%) and heavy (34.6%) smokers. W1 heavy smokers were more likely to remain heavy smokers (46.8%) than to become light (10.1%) or non-daily smokers (8.5%) by W3; roughly similar proportions of W1 light smokers became heavy (16.3%) or non-daily smokers (16.9%) by W3.

Of W1 smokers overall, 42.7% had quit smoking by W3 (Table 3). Quitting was more frequent among enrollees who were male, age 25 to 44 years, non-Hispanic white, had higher income or education, did not have PTSD at W1 or W3, and were non-daily smokers compared to their counterparts.

Table 4 shows the adjusted odds ratios for quitting smoking at W3 stratified by W1 smoker type. Among heavy smokers, the odds of quitting were 31% higher for males compared to females (AOR: 1.31; 95% CI: 1.03–1.66). The odds of quitting were 29% lower among black non-daily smokers than white non-daily smokers (AOR: 0.71; 95% CI: 0.51–0.97). Among heavy and non-daily smokers, the odds of quitting were 24% and 33% lower for those with income less than $50,000 compared to those with income of $50,000 or more (AOR: 0.76; 95% CI: 0.59–0.98 and AOR: 0.67; 95% CI: 0.54–0.84, respectively).

PTSD at W3 was associated with decreased odds of having quit smoking at W3 irrespective of W1 smoker type. Heavy smokers with PTSD at W3 had 39% lower odds of having quit compared to heavy smokers without PTSD (AOR: 0.61; 95% CI: 0.46–0.80); light smokers with PTSD at W3 had 32% lower odds of quitting compared to light smokers without PTSD (AOR: 0.68; 95% CI: 0.48–0.95); and non-daily smokers with PTSD at W3 had 25% lower odds of quitting compared to non-daily smokers without PTSD (AOR: 0.75; 95% CI: 0.59–0.95).

Discussion

In this study of 34,458 persons directly exposed to the WTC disaster we observed a significant decrease in the smoking prevalence from 2003–04 to 2011–12. At Waves 1 and 3 the largest proportion of smokers were non-daily smokers, who were the most likely to have quit smoking by W3. As in previous studies (Feldner et al., 2007), the

Table 1
Demographic characteristics, posttraumatic stress disorder (PTSD), and smoking characteristics of Registry enrollees age 25 and over[a] who completed survey Waves 1, 2, and 3, 2003–2012, N = 34,458.

Characteristics	N (%)	95% CI
Gender		
Male	21,475 (62.3)	61.8–62.8
Female	12,983 (37.7)	37.2–38.2
Wave 1 age		
25–44	16,233 (47.1)	46.6–47.6
45–64	16,714 (48.5)	48.0–49.0
65+	1511 (4.4)	4.2–4.6
Race/ethnicity		
Non-Hispanic white	24,846 (72.1)	71.6–72.6
Non-Hispanic black	3279 (9.5)	9.2–9.8
Hispanic or Latino	3675 (10.7)	10.3–11.0
Asian	1668 (4.8)	4.6–5.1
Multiracial/other	990 (2.9)	2.7–3.0
2002 household income		
Less than $50,000	7963 (23.1)	22.7–23.6
$50,000 or greater	23,439 (68.0)	67.5–68.5
Not reported	3056 (8.9)	8.6–9.2
Wave 1 education		
HS Grad/GED or less	7197 (21.0)	20.5–21.4
Some college or higher	27,150 (79.0)	78.6–79.5
Probable PTSD at Wave 1[b]		
Yes	4939 (14.3)	14.0–14.7
No	29,519 (85.7)	85.3–86.0
Probable PTSD at Wave 3[b]		
Yes	5877 (17.1)	16.7–17.5
No	28,581 (82.9)	82.5–83.3
Smoking status at Wave 1[c]		
Current	4786 (12.6)	12.3–13.0
Former	10,238 (31.6)	30.9–32.2
Never	19,334 (55.8)	55.2–56.5
Smoking status at Wave 3[c]		
Current	3444 (9.2)	8.9–9.6
Former	11,658 (35.8)	35.2–36.5
Never	18,768 (54.9)	54.3–55.6
Smoker type at Wave 1		
Heavy	1726 (36.1)	34.8–37.5
Light	1155 (24.2)	23.0–25.4
Non-daily	1898 (39.7)	38.3–41.1
Smoker type at Wave 3		
Heavy	1260 (37.0)	35.4–38.6
Light	821 (24.1)	22.7–25.5
Non-daily	1325 (38.9)	37.3–40.5

[a] Age at Wave 1.
[b] Score of ≥44 on the PTSD Checklist (PCL).
[c] Age-adjusted to U.S. Standard Population, 2000.

Table 2
Changes in cigarette consumption from Wave 1 to Wave 3 among Registry enrollees[a], 2003–2012 (N = 4678).

	Total	W3 smoker type[b]			
		Heavy N = 1108	Light N = 683	Non-daily N = 872	Quit N = 2015
Total (row %)		N (%)	N (%)	N (%)	N (%)
W1 smoker type[b]					
Heavy	1690	791 (46.8)	171 (10.1)	144 (8.5)	584 (34.6)
Light	1127	184 (16.3)	331 (29.4)	190 (16.9)	422 (37.4)
Non-daily	1861	133 (7.2)	181 (9.7)	538 (28.9)	1009 (54.2)

[a] Enrollees 25 years of age and over at W1 who completed all three survey waves and who self-identified as current smokers at Wave 1.
[b] Heavy: smoked ≥11 cigarettes per day; light: smoked ≤10 cigarettes per day.

Table 3
Characteristics of Wave 1 current smokers[a] who did and did not quit smoking by Wave 3, N = 4717.

Characteristics	Quit smoking by Wave 3		p-Value
	Yes N (%)	No N (%)	
Total	2016 (42.7)	2701 (57.3)	
Gender			
Male	1301 (43.6)	1682 (56.4)	NS
Female	715 (41.2)	1019 (58.8)	
Wave 1 age			
25–44	1106 (45.0)	1353 (55.0)	0.0040
45–64	878 (40.2)	1308 (59.8)	
65+	32 (44.4)	40 (55.6)	
Race/ethnicity			
Non-Hispanic white	1477 (44.0)	1877 (56.0)	0.0119
Non-Hispanic black	160 (35.5)	291 (64.5)	
Hispanic or Latino	245 (41.7)	342 (58.3)	
Asian	73 (42.7)	98 (57.3)	
Multiracial/other	61 (39.6)	93 (60.4)	
Wave 1 income			
Less than $50,000	495 (36.4)	866 (63.6)	<0.0001
Not reported	147 (44.0)	187 (56.0)	
$50,000 or greater	1374 (45.5)	1648 (54.5)	
Wave 1 education			
HS Grad/GED or less	560 (38.4)	899 (61.6)	<0.0001
Some college or higher	1453 (44.8)	1794 (55.3)	
Probable PTSD at Wave 1[b]			
Yes	382 (37.2)	645 (62.8)	<0.0001
No	1634 (44.3)	2056 (55.7)	
Probable PTSD at Wave 3[b]			
Yes	417 (34.8)	782 (65.2)	<0.0001
No	1599 (45.5)	1919 (54.6)	
Smoker type at Wave 1			
Heavy	584 (34.2)	1122 (65.8)	<0.0001
Light	422 (37.1)	717 (63.0)	
Non-daily	1009 (54.1)	857 (45.9)	

[a] Enrollees 25 years of age and over at W1 who completed all three survey waves and who self-identified as current smokers at Wave 1.
[b] Score of ≥44 on the PTSD Checklist (PCL).

prevalence of smoking was greatest among enrollees with PTSD, and in multivariable analyses the likelihood of quitting by W3 was lower among enrollees with PTSD. Among all enrollees, smoking decreased 27% from W1 to W3; the decrease in smoking was almost twice as large among enrollees without PTSD (32%) compared to enrollees with PTSD (18%).

The prevalence of smoking among enrollees overall and among enrollees with PTSD was lower than or comparable to the smoking prevalence among persons age 25 and older in NYC in years corresponding to W1 and W3. In 2004, the prevalence of smoking in NYC was 18.4% compared to 12.6% among all enrollees and 18.7% among enrollees with PTSD at W1; in 2012, the prevalence in NYC was 16.0% compared to 9.2% among all enrollees and 15.4% among those with PTSD at W3 (NYC Community Health Survey, data not shown). Registry enrollees reported higher than average income and educational attainment, both of which are associated with lower smoking prevalence (U.S. Department of Health and Human Services, 2014; Centers for Disease Control and Prevention (CDC), 2012). Additionally, large proportions of the Registry population work in professions associated with lower rates of smoking, including health care, social assistance, public service, and administration work; finance and insurance; and professional, scientific, and technical services as reported in a 2014 study examining smoking trends by occupation (Syamlal et al., 2014).

The observed increase in PTSD prevalence over time is consistent with previous Registry studies, in which, depending on the sub-population under consideration, PTSD prevalence has remained stable or increased.

Table 4
Multivariable logistic regression results for the association between selected characteristics and having quit smoking by Wave 3 (Ref = No) among Wave 1 current smokers[a], stratified by Wave 1 smoker type.

Characteristic	Wave 1 smoker type		
	Heavy smokers	Light smokers	Non-daily smokers
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Gender			
Male	**1.31 (1.03–1.66)**	0.89 (0.69–1.15)	0.98 (0.81–1.20)
Female	Ref	Ref	Ref
Wave 1 age			
25–44	0.94 (0.41–2.16)	0.54 (0.24–1.19)	1.54 (0.59–4.05)
45–64	0.96 (0.42–2.20)	**0.44 (0.20–0.99)**	1.33 (0.51–3.49)
65 +	Ref	Ref	Ref
Race/ethnicity			
Non-Hispanic white	Ref	Ref	Ref
Non-Hispanic black	1.05 (0.65–1.70)	0.68 (0.46–1.00)	**0.71 (0.51–0.97)**
Hispanic or Latino	1.09 (0.76–1.56)	0.82 (0.58–1.17)	1.11 (0.83–1.48)
Asian	0.65 (0.29–1.49)	0.71 (0.40–1.27)	1.12 (0.71–1.78)
Multiracial/other	1.01 (0.54–1.91)	0.77 (0.39–1.52)	0.82 (0.49–1.37)
Wave 1 income			
Less than $50,000	**0.76 (0.59–0.98)**	0.85 (0.64–1.14)	**0.67 (0.54–0.84)**
Not reported	0.99 (0.66–1.49)	**0.58 (0.34–0.99)**	1.29 (0.88–1.88)
$50,000 or greater	Ref	Ref	Ref
Wave 1 education			
HS Grad/GED or less	1.17 (0.95–1.45)	1.09 (0.83–1.44)	1.06 (0.85–1.33)
Some college or higher	Ref	Ref	Ref
Probable PTSD at Wave 1[b]			
Yes	1.28 (0.96–1.70)	0.80 (0.57–1.13)	0.92 (0.71–1.20)
No	Ref	Ref	Ref
Probable PTSD at Wave 3[b]			
Yes	**0.61 (0.46–0.80)**	**0.68 (0.48–0.95)**	**0.75 (0.59–0.95)**
No	Ref	Ref	Ref

[a] Enrollees 25 years of age and over at W1 who completed all three survey waves and who self-identified as current smokers at Wave 1.
[b] Score of ≥44 on the PTSD Checklist (PCL).

Although we have a large proportion of enrollees whose PTSD has resolved over time, there is a larger proportion with delayed-onset PTSD (Brackbill et al., 2009).

Consistent with previous studies, we found a high prevalence of smoking and decreased odds of quitting among those with PTSD over time (Cook et al., 2014; Fu et al., 2007; Lawrence et al., 2011; Morris et al., 2014; Vanable et al., 2003). Dedert et al., (2012) found that smokers with PTSD were more likely to report increased cravings and negative affect than those without PTSD during early phases of abstinence, which may explain why enrollees with PTSD were less likely to quit smoking. As a stimulant, nicotine may exacerbate PTSD symptoms; reduced nicotine exposure may lead to decreased hyperarousal symptoms as well as reactivity and avoidance related to traumatic cues (Calhoun et al, 2011; Dedert et al., 2014). Smokers with PTSD may be reluctant to consider quitting because they are more likely to believe that smoking will alleviate negative affect (Calhoun et al., 2011) and be concerned with cravings (Dedert et al., 2012).

Persons with 9/11 exposure, PTSD, or both face increased risk for numerous conditions also associated with smoking (U.S. Department of Health and Human Services, 2014), such as cardiovascular disease (Ahmadi et al., 2011; Boscarino, 2008; Jordan et al., 2011; Jordan et al., 2013; Spitzer et al., 2009), certain cancers (Li et al., 2012; Zeig-Owens et al., 2011), respiratory problems (Brackbill et al., 2009; Maslow et al., 2012; Nair et al., 2012), and diabetes (Agyemang et al., 2012; Boyko et al., 2010; Miller-Archie et al., 2014). The combination of 9/11 exposure and PTSD makes smokers exposed to 9/11 a particularly vulnerable subgroup with increased risk for myriad negative health outcomes. As such, this group would benefit from quitting smoking, but likely needs considerable support in order to be successful (Fu et al., 2007).

Since 2008, the Registry has conducted several rounds of direct outreach to enrollees who reported smoking, prioritizing those with PTSD, and offering free nicotine replacement therapy kits and brief counseling. In 2012, the Registry provided information about and offered referrals to a clinical trial of a smoking cessation program designed exclusively for 9/11 exposed persons with PTSD symptomatology. We encourage providers and other organizations working with disaster exposed populations, such as "Tobacco Free with FDNY" implemented after 9/11 by the Fire Department of New York (Bars et al., 2006), to include smoking cessation support in their outreach, education, and treatment plans. Providers and other organizations should reinforce the potential mental health benefit of quitting (i.e., reduction in symptoms of hyperarousal, reactivity, and avoidance) and provide guidance on managing symptoms of withdrawal, craving, and negative affect during early phases of abstinence.

In our study, just over one-third of smokers were non-daily smokers. This proportion is similar to that seen at the NYC population-level (Sacks et al., 2012), but higher than the proportion at the national level (Centers for Disease Control and Prevention (CDC), 2011). We also found that non-daily smokers were more likely to quit smoking than daily smokers. Similar to previous research on smoking trajectories (Levy et al., 2009), we found that non-daily smokers were less likely to increase their consumption (i.e., become a daily smoker) than light smokers (i.e., become a heavy smoker). The increasing proportions of non-daily smokers observed in our study may represent the effect of comprehensive tobacco control policies implemented in NYC in 2002 (Kilgore et al., 2014), which has been associated with decreased cigarette consumption (Coady et al., 2012). Historically, cessation resources such as pharmacotherapy have excluded non-daily smokers (Fiore et al., 2008); however, as the group most likely to quit smoking, non-daily smokers may benefit from access to cessation services and education campaigns.

Strengths and limitations

This study has limitations, including loss to follow-up between survey waves and self-reported data. Our assessment of PTSD was based on a self-administered questionnaire, not clinical diagnostic measures of PTSD. Although the PCL is a widely used survey instrument, we can only interpret self-report of PTSD symptoms as probable and we may have overestimated symptom prevalence. Consistent with a previous Registry study (Caramanica et al., 2014), in our study population, approximately two-thirds of enrollees with PTSD also reported symptoms consistent with depression on the Patient Health Questionnaire (PHQ-8); the two measures were highly correlated (Spearman's Rho = 0.62; $p < 0.0001$). Additionally, half of enrollees with PTSD reported symptoms consistent with both depression and generalized anxiety disorder (GAD-7; Spitzer et al., 2006). As such, the lower odds of quitting among enrollees with PTSD may be, in part, attributable to depressive and/or anxiety symptoms. Finally, we did not have information as to when the enrollees last smoked regularly, smoking status prior to 9/11, or recent quit attempts.

Among the strengths of this analysis are its large sample size and period of observation. Registry enrollees represent a population with varying degrees of direct 9/11 exposure. Finally, Registry data used in this study were obtained 10 to 11 years after 9/11; this time point represents the furthest observation point on post-9/11 smoking to date and updates previous studies which showed increases in smoking post-9/11.

Conclusion

Our findings may be applicable to those affected by other disasters and who suffer from PTSD, whether disaster-related or not. Disaster exposed smokers, especially those with PTSD, are at greater risk for adverse health outcomes including cardiovascular disease, cancer,

respiratory disorders, and diabetes. This group merits special attention in order to address their smoking behavior, and might benefit greatly from PTSD-specific smoking cessation interventions, including counseling and educational materials furnished by their primary, mental health, or post-disaster care provider. Health care providers should discuss the impact of nicotine on PTSD symptoms as well as strategies to manage cravings, withdrawal, and negative affect during early phases of abstinence. This analysis did not examine either smoking initiation among never smokers or relapse among former smokers, although this population is at-risk for both phenomena. This as well as evaluations of PTSD-specific cessation interventions represent areas for future study.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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