Research Article

PREVALENCE AND PREDICTORS OF POSTTRAUMATIC STRESS SYMPTOMS IN UTILITY WORKERS DEPLOYED TO THE WORLD TRADE CENTER FOLLOWING THE ATTACKS OF SEPTEMBER 11, 2001

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Background: *Recent attention has begun to be focused on the effects of disaster recovery work on nonrescue workers. The goal of this study was to assess the prevalence and predictors of posttraumatic stress disorder (PTSD) and related symptoms in a population of utility workers deployed to the World Trade Center (WTC) site in the aftermath of 9/11.* **Methods:** *Utility workers deployed to the WTC site were screened at their place of employment between 10 and 34 months following the WTC attacks, utilizing both structured interviews and self-report measures. PTSD symptoms were assessed by the CAPS and the PCL; co-morbid disorders were also assessed. 2,960 individuals with complete CAPS and PCL data were included in the analyses.* **Results:** *Eight percent of participants had symptoms consistent with full PTSD, 9.3% with subthreshold PTSD, 6% with MDD, 3.5% with GAD, and 2.5% with panic disorder. Although risk factors included psychiatric and trauma history, 51% of individuals with probable PTSD had neither; subjective perception of threat to one's life was the best predictor of probable PTSD. Extent of exposure predicted 89% of PTSD cases in those without a psychiatric or trauma history, but only 67% of cases among those with both.* **Conclusions:** *Nonrescue workers deployed to a disaster site are at risk for PTSD and depression. Extent of exposure affected the most vulnerable workers differently than the least vulnerable ones. These results suggest that the relationship among predictors of PTSD may be different for different vulnerability groups, and underscore the importance of screening, education, and prevention programs for disaster workers. Depression and Anxiety 0:1–8, 2010.* © 2010 Wiley-Liss, Inc.

Key words: *posttraumatic stress disorder; PTSD; predictors; September 11, 2001; 9/11; disaster workers; world trade center*

INTRODUCTION

This report describes the prevalence and predictors of posttraumatic stress disorder (PTSD) and related symptoms in a population of nonrescue disaster workers deployed to the World Trade Center (WTC) following the attacks of September 11, 2001. The effects of terrorism and disaster have been studied in civilians[1–4] and more recently in first-responder emergency services personnel.[5–7] However, the effect of occupational exposure on nonrescue disaster relief and recovery personnel has been less studied[8–10] despite the large number of nonrescue workers that

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are engaged in rescue and recovery operations. It is important from a public health perspective to describe and document mental disorders in nonrescue disaster workers so that adequate education, prevention, and treatment programs may be established in anticipation of future need.

Studies to-date have documented rates of PTSD between 9 and 35%[5,11–14] as well as high rates of subsyndromal PTSD[15,16] among a diversity of disaster workers. These studies have relied primarily on self-report data: a cost-effective approach as clinicians are not required for their administration, but one that may lead to an under-identification of symptoms and may be unduly influenced by social desirability.[17] Few post-disaster studies employ in-person interviews[5,12,18,19] or collect data in the workplace,[5,11,12] nor have the utility of self-report instruments been evaluated. Given the logistics of assessing large numbers of people post-disaster, studies have also been limited by sampling bias, i.e., by including data only from participants who respond to mailings or phone interviews. To our knowledge there have been no studies on nonrescue disaster workers that employ in-depth clinical interviews and examine predictors of PTSD.

Four reports of the psychological consequences of WTC attacks on nonrescue disaster workers have been disseminated since the attacks 9 years ago, all assessing PTSD symptoms with a standardized self-report measure. Smith et al.[20] described symptom endorsement in a mixed sample of 1,138 rescue and nonrescue workers. Probable rates of PTSD based on symptom endorsement in the PCL were cited at 20%, with rates at 13% when functional impairment or significant clinical distress was considered for qualification. Gross et al.[21] reported a probable PTSD rate of 13.5% based on a survey mailed to 6,649 nonrescue disaster workers with a response of 22 to 34%. Katz et al. screened 124 ironworkers with the PCL and found 18.5% screened positive for PTSD, defined as having a score of 43 or higher. Risk factors for screening positive for PTSD symptoms included excessive alcohol use in the period since 9/11, having a friend, family member, or colleague who was injured or killed during the attacks, and experiencing a significant life event in the 6 months following 9/11. Perrin et al.[22] reported probable rates of PTSD of approximately 20% among 4,498 construction or engineering workers, which was significantly greater than rates for police officers. This study found exposure-related variables (i.e., evacuating from the tower, witnessing the attacks and sustaining an injury) and work-related variables (i.e., operating heavy equipment, being part of the search and rescue effort, earlier start date and longer duration of time working) were significant risk factors for the development of PTSD. These authors conclude that workers with less disaster training were at greater risk for the development of PTSD.

By having the unusual opportunity of screening all utility workers deployed to the WTC site at their place of employment, we were afforded in-person access to an entire population, and the time to conduct a more thorough examination, using both structured interviews and self-report measures. Thus, we were able to overcome some methodological limitations of earlier studies and address some extant questions regarding the public health implications of terrorism on disaster workers.

A primary focus of this study was to explore the effects of disaster work on nonrescue workers following an event in which they were involved as part of their day-to-day occupational responsibilities. In light of the DSM-IV[23] emphasis on exposure, we were particularly interested to determine if it would emerge as the strongest predictor of PTSD. As prior trauma and psychiatric history have been shown to be among the most reliable premorbid predictors of PTSD in other trauma populations,[24] we were also interested to know whether these variables would significantly increase the odds of developing symptoms consistent with a PTSD diagnosis. If so, this finding would have implications for the identification and preparation of vulnerable workers deployed to disaster sites. Finally, we were interested to know whether extent of exposure would differentially affect vulnerable and nonvulnerable (those without a trauma or psychiatric history) workers. We hypothesized that those with the greatest exposure, a prior trauma history and prior psychopathology, would be most likely to develop PTSD.

METHOD

DATA COLLECTION AND SAMPLE

The interviews were piggybacked onto annual fitness-for-duty evaluations, for all utility workers who were deployed to work at the WTC, and occurred on site at the employer's headquarters. All employees of the company receive annual fitness-for-duty evaluations. Those deployed to the WTC site were specially screened during these visits for WTC-related disability. Part of the screening included meeting with our independent psychologists who screened for symptomatology and offered free confidential treatment for any symptoms. Individual results from the interview remained completely confidential from the company who received only overall statistics reflecting rates of symptomatology. Thus the arrangement resulted in being able to reach a great number of participants, while maintaining confidentiality from the employer. The interviews, which began in July 2002, were conducted between 10 and 34 months following the WTC attacks (mean = 19.2+/−4.9 months post 9/11), with 95% of the sample screened within 26 months after the attacks. Use of these screening records for research purposes was approved by our Institutional Review Board.

The interviews, which were conducted by doctoral level psychologists, included the Clinician-Administered PTSD Scale (CAPS),[25] the Traumatic Events Interview,[26] the Structured Clinical Interview (SCID) for the DSM-IV screen, selected modules of the SCID DSM-IV[27] (major depression, panic disorder, and generalized anxiety disorder modules), and a WTC exposure interview. Self-report measures included widely-used instruments with well-established psychometric properties including the Beck Depression Inventory (II),[28] Brief Symptom Inventory,[29] and PTSD Checklist (PCL).[30] Only two percent of those approached refused to participate.

STATISTICAL ANALYSES

All analyses were conducted on data from 2,960 interviews of utility workers deployed to work at the WTC site as part of their occupational duties. Although 3,350 workers were interviewed, only 3,182 were administered both the CAPS and the PCL, and we chose to include only those who had complete CAPS and PCL data in the statistical analyses, yielding the final *N* of 2,960. The excluded individuals ($n = 222$) did not differ on any demographic variables or on measures of psychopathology from those included in the analyses.

Means and frequencies were calculated for demographic information and for exposure variables. Frequency of exposure was assessed for each exposure variable, and a composite exposure score was calculated by adding number of exposure variables endorsed for each subject. DSM-IV-TR symptoms of PTSD and subsyndromal PTSD were calculated using both the CAPS and PCL; both measures were administered with instructions to consider exposure to the WTC attacks and Ground Zero as the referent. For the CAPS, the well-established original F1I2 scoring rule[31] was used. For the PCL, items with a score of 3 ("moderately") or higher were counted as symptoms. For both the CAPS and PCL a probable PTSD diagnosis was then determined by following the DSM-IV-TR criteria, which require at least one reexperiencing symptom (Criterion B), at least three avoidance and numbing symptoms (Criterion C), and at least two hyperarousal symptoms (Criterion D). The subsyndromal rule[32] required only that Criterion B plus either Criterion C or Criterion D be met. Although the subsyndromal criteria are less stringent than the full DSM-IV TR criteria, several studies have documented that subsyndromal PTSD is associated with clinically significant impairment and predicts delayed-onset PTSD.[33,34] Rates of PTSD utilizing the cut-off score of 50 on the PCL, recommended for optimal sensitivity and specificity,[35] were calculated, as well as rates of PTSD using alternate cut-off scores on the PCL. For the general analyses reported in the results, PTSD symptomatology is defined as meeting criteria for clusters B, C, D, E, and F on the CAPS.

To calculate interrater reliability a psychologist with 10 years experience using the CAPS made independent ratings while observing interviews. Intraclass correlations[36] ranged from .98–.99 for the three symptom cluster severity scores and CAPS total severity.

To examine the influence of prior psychiatric and trauma history with the extent of the participant's exposure, the sample was divided into four vulnerability groups: (1) past trauma and past psychiatric history; (2) past trauma history but no past psychiatric history; (3) past psychiatric history but no past trauma history; and (4) no past trauma or psychiatric history. Differences on CAPS severity scores between vulnerability groups were assessed using a one-way ANOVA with Tukey post hoc tests. Linear regressions were conducted to identify predictors of CAPS severity scores, and logistic regressions were conducted to determine odds ratios of developing PTSD for each variable of interest, controlling for demographic variables.

RESULTS

CHARACTERISTICS OF THE SAMPLE

Most participants were male (96.9%), White (66.2%), and married or cohabitating (75.4%). Eighteen percent (17.9%) identified themselves as Black, 12.8% as Hispanic, and 1.2% as Asian. Almost all completed high school (97.9%) and many had completed some college (52.6%). The mean age was 45.2 years ($SD = 9.6$). Thirty-nine percent had a trauma history, and 14.5% had a prior psychiatric history.

EXTENT OF EXPOSURE TO THE WTC ATTACK

Exposure was measured utilizing the WTC Exposure Questionnaire, developed by a panel of trauma experts to assess both occupational exposure through performance of disaster work as well as personal exposure to the attacks (e.g., loss of loved ones). Extent of exposure to the WTC attack and its aftermath varied among these disaster workers (Table 1). Seventy-eight workers (2.6%) were at the WTC at the time of the attack, while a total of 285 (9.6%) arrived on September 11, some while the attacks were occurring. The mean number of days worked at the site was 23.3 ($SD = 38.3$). A substantial minority (29%) reported believing that their lives were in danger at some time while they were working at the site. Duties and location of work at the WTC site varied considerably. Workers largely responded in their typical roles, and responsibilities included working both on the street and entering buildings; work location spanned the WTC site and the surrounding area. Notably, workers did not volunteer for deployment to the area but were chosen by the company based on best allocation of resources.

The exposure variables of presence at the site during the attacks, arriving at the site on September 11, and number of days worked there did not show significant univariate associations with PTSD.

PTSD PREVALENCE

The CAPS yielded PTSD prevalence estimates of 8.0% and, using the cluster scoring method, the PCL yielded an estimate of 9.5%. Notably, however, PCL prevalence using the cut-off score of 50 was 5.4%, an underestimation of PTSD as compared to the CAPS. A cut-off score of 44 on the PCL, recommended for diagnostic efficiency,[35] yielded results similar to the cluster scoring method, with prevalence PTSD rates of 9.3%, whereas a cut-off score of 45 resulted in rates of 8.2%—the closest to the CAPS estimation.

Prevalence estimates for subsyndromal PTSD were 9.3% for both the CAPS and the PCL using the cluster scoring method. Cumulative prevalence estimates for PTSD and subsyndromal PTSD were 17.3% for the CAPS and 18.8% for the PCL using the cluster scoring method. The mean CAPS severity score fell within the moderate severity range ($M = 52.6$, $SD = 14.3$) for probable PTSD and just between the mild and moderate ranges ($M = 30.2$, $SD = 9.8$) for subsyndromal PTSD. Among those who had symptoms consistent with PTSD, 50.4% fell within the moderate severity range, 26.2% had severe PTSD, and 3.8% fell in the extreme severity range.[37]

COMORBID PSYCHOPATHOLOGY

Six percent (6.4%) of the sample were diagnosed with current major depression, 3.5% were diagnosed with a current generalized anxiety disorder and 2.5% were diagnosed with current panic disorder. Thirty-nine

TABLE 1. Mean CAPS score by exposure variable

Exposure variable	Number Yes	Percent Yes	CAPS score Yes M(SD)	CAPS score No M(SD)	P-value	Effect size[a]
Personal exposure						
Witnessed events south of Canal St	125	5.0	14.06(17.70)	12.99(16.11)	*.47*	.06
Knew someone in WTC vicinity	529	40.5	13.56(17.64)	9.83(13.97)	<.001	.23
Knew someone injured in attacks	44	3.4	14.98(16.27)	11.18(15.58)	.11	.24
Knew someone killed in attacks	534	40.9	14.04(17.56)	9.54(13.91)	<.001	.28
Attended memorials/funerals	289	22.8	14.66(17.98)	10.06(14.18)	<.001	.28
Occupational exposure						
Worked at site on September 11	285	27.7	13.17(16.48)	10.62(15.58)	.01	.16
Worked at site during first week	788	71.2	12.35(16.58)	9.60(14.32)	.01	.18
Worked at site entire first month	428	43.1	12.60(16.60)	10.32(15.33)	.03	.14
Participated in Bucket Brigade	50	4.3	20.36(23.96)	10.68(14.88)	<.001	.49
Visited Pile	1,007	82.9	11.76(16.15)	9.28(13.30)	.04	.17
Worked at Ground Zero	823	67.7	12.02(16.35)	9.71(13.99)	.02	.15
Saw bodies	91	3.1	22.53(20.63)	12.76(15.83)	<.001	.53
Saw body bags	485	16.4	14.20(17.21)	12.83(15.85)	*.08*	.08
Saw body parts	165	5.6	18.68(19.97)	12.73(15.76)	<.001	.33
Saw people jumping	30	1.0	23.80(23.52)	12.93(15.92)	<.001	.54
Was disturbed by smell at site	675	22.8	14.45(17.87)	12.64(15.50)	.01	.11
Subjective exposure						
Felt like life was in danger	864	29.2	18.56(18.83)	10.79(14.20)	<.001	.47

Note: Numbers in italics are ns.
[a]Effect sizes are presented to give the reader additional context for the findings. According to Cohen's (1988) conventions for comparisons of two means, an effect size of .2 is considered a small effect, .5 is a medium effect, and .8 is a large effect. Because the size of the effect is independent of power and *P*-value, it provides valuable information regarding the relative importance of the effect.

percent (38.8%) of those with symptoms consistent with PTSD had a current major depression, 14% had current GAD, and 10.5% also had current panic disorder. Twenty-six percent (25.6%) of those with subsyndromal PTSD had a current major depression, 11.4% had current GAD, and 7% had current panic disorder.

VULNERABILITY TO PTSD

When subjects were divided into vulnerability groups, significant differences between CAPS severity scores emerged (no vulnerability group ($M = 9.6$, $SD = 13.0$), past trauma only ($M = 14.9$, $SD = 16.7$), past psychiatric history only ($M = 21.3$, $SD = 22.0$), both past psychiatric and past trauma ($M = 25.0$, $SD = 19.9$) ($F(3, 2{,}960) = 95.97$, $P < .001$)). Games-Howell post hoc analyses revealed that the no vulnerability group differed from all others and the past trauma group differed from all other groups on CAPS scores (all P's $< .001$). However, the past psychiatric only group was not different from the group with both a psychiatric and trauma history.[1]

[1]Tests of homogeneity revealed significant differences between the groups (Levene = 79.04, $P < .001$), this is not surprising in light of the difference in the group sizes. Games-Howell, a post hoc procedure based on the q-statistic distribution, is recommended in these instances.[38]

PREDICTORS OF PTSD

Linear regression analyses showed several variables that significantly predicted probable PTSD severity (Table 2) including prior trauma, prior psychopathology, and exposure.

Prior trauma and psychiatric history together explain about 8% of the variance, whereas the exposure variables explain another 8%. Logistic regression analyses similarly implicated these variables as contributors to the diagnosis of PTSD (Table 3). Notably, those who perceived their lives to be in danger were twice as likely to report symptoms consistent with a diagnosis of PTSD as the overall sample.

A close examination of how extent of exposure affected each of the vulnerability groups is noteworthy. The most vulnerable group (i.e., those with a psychiatric and trauma history) was affected differently than the other three groups (Table 4). The set of exposure variables correctly predicted 89% of the cases in the least vulnerable group, but only 67% of the cases among the most vulnerable. Perception of threat to oneself emerged as the best predictor and was also a consistent predictor of PTSD across the three less vulnerable groups. The patterns were similar for the linear and logistic regressions (only the logistic regressions are presented due to space constraints).

TABLE 2. Linear regression of exposure variables on CAPS Total Severity Score ($N = 2{,}960$)

Predictor variable	*B*	SE
Step 1		
Age	0.09**	0.04
Gender	4.08*	1.89
Race	0.29	0.67
Education	−0.26	0.65
Marital status	−0.14	0.75
Step 2		
Trauma history	4.95***	0.63
Psychiatric history	10.81***	0.88
Step 3[a]		
Knew someone in WTC	2.32***	0.61
Knew someone injured	0.78	1.48
Knew someone killed	2.21***	0.62
Felt life in danger	5.87***	0.70
Ever have to evacuate	0.23	0.68
Participated in Bucket Brigade	3.43**	1.34
Work at Ground Zero	1.28	0.71
See bodies	3.94**	1.26
See body bags	0.96	0.68
See body parts	2.96**	0.95
Disturbed by smell at site	0.26	0.72

Note: Step 1: $R^2 = .01$, $F = 2.51$, $P < .05$. Step 2: $R^2 = .08$, $F = 116.17$, $P < .001$. Step 3: $R^2 = .08$, $F = 21.49$, $P < .001$, Overall model: $R^2 = .16$, $F = 28.00$, $P < .001$.

[a]The number of available exposure variables was reduced by retaining only the relatively high-frequency items. A separate stepwise regression was completed on these variables and *CAPS Total Severity Score*; all of the exposure items were retained in the model.

*$P < .05$; **$P < .01$; ***$P < .001$.

TABLE 3. Logistic regression of exposure variables on rates of probable PTSD[a] ($N = 2{,}701$)

Predictor variable	β	Standard error	Odds ratio
Trauma history	0.60	.12	1.83***
Psychiatric history	1.05	.14	2.87***
Knew someone in WTC	0.28	.12	1.32*
Knew someone injured	0.03	.27	1.03
Knew someone killed	0.31	.12	1.37*
Felt life in serious danger	0.78	.13	2.19***
Ever have to evacuate	0.11	.14	1.12
Participated in Bucket Brigade	0.32	.23	1.38
Worked at Ground Zero	0.29	.16	1.34
See bodies	0.05	.22	1.05
See body bags	0.43	.13	1.53**
See body parts	0.37	.16	1.45*
Disturbed by smell at site	−0.16	.14	0.85
Percentage correct predictions	84%		
Nagelkerke (pseudo) R^2	.170		
χ^2 (*df*)	247.68***		

[a]Based on CAPS F1/I2 scoring rule.

*$P < .05$; **$P < .01$; ***$P < .001$.

DISCUSSION

This report of the psychiatric consequences of terrorism in a population of nonrescue disaster relief and recovery workers used well-validated standardized clinical interviews as well as self-report measures as the basis for documentation of mental disorders consequent to the disaster. Notably, rates of probable PTSD were comparable (18.75% higher for the PCL) between clinician administered and self-report measures when using the cluster scoring method of the PCL, but less so (32.5% lower for the PCL) when using a standard cut-off score of 50 on the PCL. There was a 43.15% difference in PTSD prevalence between the scoring methods of the PCL, indicating that studies relying on the PCL self-report measure and the 50 cut-off score may underestimate PTSD prevalence. Utilizing the recommended cut-off score of 44 yielded rates similar to those of the cluster scoring method with prevalence at 9.3%, and a cut-off score of 45 resulted in prevalence rates of 8.2% which are comparable to the CAPS. As recommended cut-off scores in different populations span a large range, using a cut-off score of 35 and 40 was also calculated, with PTSD prevalence rates at 18.6 and 12.7%, respectively.

Almost 20% of those deployed to work at the WTC reported symptoms consistent with a diagnosis of full or subsyndromal PTSD. Those with probable PTSD or subsyndromal PTSD showed a clear pattern of impairment on self-report measures that was consistent with the clinical evaluations. Three groups of variables predicted severity of PTSD symptoms: premorbid characteristics of the workers, the nature of their exposure to the WTC, and their subjective perception of threat. Consistent with the extant empirical literature,[24] prior trauma and psychiatric history predicted the development of probable PTSD. However, it is notable that slightly more than half of those who reported symptoms consistent with a diagnosis of PTSD did not have a trauma history or prior psychiatric diagnosis.

The empirical literature documents that extent of exposure is a predictor of PTSD following trauma.[13,24] As our primary interest was in determining the effect of exposure on nonrescue disaster workers, we classified exposure variables into three groups: occupational exposure, personal exposure, and subjective perception of exposure. Notably, the single best predictor was the subjective perception of danger to oneself, not occupational or personal exposure. The simplest objective quantifier of extent of occupational exposure, e.g., number of days worked at the site, did not predict probable PTSD. It is especially noteworthy that those disaster workers with neither a psychiatric nor a trauma history who perceived threat to their life were twice as likely to report symptoms consistent with PTSD as those who did not perceive such danger. In the overall sample, perception of life threat and psychiatric history were almost equally robust predictors of PTSD.

TABLE 4. Predictors of PTSD divided by vulnerability group (dependent variable: probable PTSD)

	Vulnerability group											
	No trauma or psychiatric history ($n = 1{,}462$)			Past trauma history ($n = 840$)			Past psychiatric history ($n = 197$)			Both trauma and psychiatric history ($n = 176$)		
	B	SE	OR	*B*	SE	OR	*B*	SE	OR	*B*	SE	OR
Knew someone in WTC	.57	.18	1.76**	.22	.19	1.25	0.06	0.37	1.07	−0.24	.35	0.79
Knew someone injured	.10	.44	1.10	−.68	.47	0.51	1.15	0.70	3.17	1.78	.78	5.93*
Knew someone killed	.27	.18	1.31	.10	.19	1.11	1.06	0.37	2.89**	0.60	.34	1.82
Feel life in serious danger	.66	.19	1.93***	.90	.20	2.46***	1.25	0.39	3.47**	0.46	.36	1.59
Ever have to evacuate	.01	.19	1.01	.08	.21	1.09	−.025	0.40	0.98	−0.04	.39	0.96
Participated in Bucket Brigade	.50	.33	1.65	.40	.35	1.50	−2.30	1.16	0.10*	0.19	.64	1.21
Worked at Ground Zero	.09	.22	1.10	.07	.23	1.08	0.29	0.48	1.34	0.70	.48	2.10
See bodies	.20	.30	1.22	.37	.34	1.45	−0.31	0.71	0.73	0.43	.61	1.54
See body bags	.54	.20	1.72**	.19	.21	1.20	0.58	0.38	1.79	0.42	.39	1.52
See body parts	.30	.23	1.35	.45	.26	1.57	−0.05	0.50	0.96	0.13	.48	1.15
Disturbed by smell at site	.10	0.19	1.10	−.41	.24	0.67	0.05	0.37	1.05	−0.87	.41	0.42*
Percentage correct predictions	88.9%			80.7%			75.6%			66.5%		
Nagelkerke (pseudo) R^2	.09			.11			.25			.19		
χ^2 (*df*)	67.00(11)***			58.16(11)***			37.20(11)***			26.61(11)**		

*$P < .05$; **$P < .01$; ***$P < .001$.

The most vulnerable workers, i.e., those with both a psychiatric and a trauma history, appear to have been affected differently by their WTC exposure than the less vulnerable workers. Perception of life threat was not the best predictor of probable PTSD in this group, and the set of exposure variables predicted significantly fewer cases of PTSD among the most vulnerable workers compared to the other vulnerability groups. It is difficult to explain why the factors that emerged as the best predictors for the high risk group, i.e., knowing someone who was injured on 9/11 and being disturbed by the smell at the site, were significant. These results suggest that their exposure was not as important in mediating the development of probable PTSD.

The 8% base rate for full PTSD may seem low given the extensive nature of the worker's exposure. However, previous studies suggest that any spontaneous remission of PTSD occurs within the first 8 months to 1 year after a traumatic event, thereafter, symptoms do not remit without treatment.[7,39] As these workers were evaluated at least nine months postevent, it is unlikely that their symptoms would have remitted without intervention. Thus, these rates reflect more of a probable chronic PTSD and prevalence would likely have been much higher closer to the actual trauma. It is also notable that more than twice the base rate, or about one in five workers, reported symptoms consistent with either full or sub-threshold PTSD by clinical interview or self-report. This is especially noteworthy in light of studies showing that those with subsyndromal PTSD often develop chronic PTSD.[34] Furthermore, the proportion with probable full or subsyndromal PTSD in this predominantly male population is three to four times higher than the 5% lifetime prevalence of PTSD found for males in the National Co-morbidity Survey.[38] The high rates of self-reported depression, anxiety, and functional impairment associated with subsyndromal PTSD in this study as well as the association between subsyndromal PTSD and chronic PTSD suggest that treatment should be offered as readily to this group as to those who met full criteria for PTSD. Thus, about 20% of the workers were in need of PTSD treatment. These data highlight the importance of having screening and treatment services readily available to disaster workers in the years following a disaster.

Given the host of studies documenting the social, medical, and occupational costs of PTSD, our data suggest that screening and evaluation of occupationally exposed workers should be a mandatory part of fitness-for-duty evaluations. If all affected workers are required to be screened, then no one particular individual need worry about the stigma of seeking psychiatric evaluation and treatment.

A strength of the design of this study was its use of both self-report and clinician-administered measures. The utility of self-report measures in comparison to standardized interviews has been questioned in

previous studies.[40] However, the logistical difficulties inherent in organizing large-scale clinical assessments following terrorism or other disasters have usually precluded such endeavors. We found about the same rates of probable PTSD using both well-validated structured interviews and self-report instruments. Though our study appears unaffected by sampling bias as we had only a two percent refusal rate, it is unclear whether there was an effect of conducting the interviews in the workplace on reported symptoms. Certainly it was convenient for the participants, but it is possible that some were less forthcoming about their experiences because of concern about their confidentiality or because they did not wish to become distressed where they might be seen by their peers. Additionally, as substance abuse was not formally assessed, it is possible that psychiatric history and co-morbidities have been underestimated. In the final analysis, sociodemographic characteristics, premorbid psychiatric and trauma history, and extent of exposure variables, predicted only 16% of the variance in the symptoms of probable PTSD. This suggests that other variables that were not assessed in this screening project played an important role in the development of PTSD. Unfortunately, the time constraints dictated by conducting the evaluations on work-time precluded the addition of assessment measures that were not focused on the patient's psychiatric status, but might be of theoretical interest (e.g., coping style, social support).

CONCLUSIONS

In conclusion, our study confirms the findings of previous studies showing that psychiatric history, trauma history, and extent of exposure are predictors of PTSD, but suggests different contributions of these variables for different risk groups. Most importantly, our results highlight the importance of developing and implementing clinical research protocols to determine whether it is possible to prepare vulnerable workers in occupations at-risk a priori so as to ameliorate the effects of trauma exposure.

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