

# A Computerized, Self-Administered Questionnaire to Evaluate Posttraumatic Stress Among Firefighters After the World Trade Center Collapse

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The September 11, 2001, terrorist attacks on the World Trade Center (WTC) killed 2749 people. A vast, dangerous urban disaster site was created for thousands of rescue workers exposed to numerous physical, chemical, and psychological hazards,<sup>1–3</sup> resulting in well-documented physical health consequences.<sup>4–9</sup>

The Fire Department of the City of New York (FDNY) is the largest fire department in the world, with an annual workforce averaging 11 500 firefighters. On September 11, 2001, FDNY personnel were first-responders and victims, suffering a devastating number of fatalities, injuries, respiratory illnesses, and psychological injuries. During the collapse of the towers, 341 FDNY firefighters and 2 FDNY paramedics lost their lives. Nearly every FDNY firefighter worked at the WTC for varying time periods between September 11, 2001, and July 25, 2002. Among the many WTC rescue and recovery workers, FDNY firefighters arguably suffered the greatest exposures to the injured, the dying, the dead, human remains (many from their own colleagues), and potential life-threatening situations.

Studies of firefighters' mental health after rescue and recovery efforts are few in number and small in sample size.<sup>10–13</sup> After the Oklahoma City bombing in 1995, posttraumatic stress disorder (PTSD) was diagnosed for 34% of survivors<sup>13,14</sup> and 13% of firefighters.<sup>10</sup> After the WTC attack, an elevated PTSD risk, referred to as "probable PTSD,"<sup>15–17</sup> was reported for 37% of evacuees<sup>15</sup> and, depending on scoring methods, for 12% to 17% of FDNY firefighters and non-FDNY firefighters included in the WTC Registry,<sup>16</sup> as well as the 11% to 20% of non-FDNY rescue-recovery workers included in the Mt Sinai Coordinated WTC Medical Monitoring and Treatment Program.<sup>17</sup>

**Objectives.** We sought to determine the frequency of psychological symptoms and elevated posttraumatic stress disorder (PTSD) risk among New York City firefighters after the World Trade Center (WTC) attack and whether these measures were associated with Counseling Services Unit (CSU) use or mental health–related medical leave over the first 2.5 years after the attack.

**Methods.** Shortly after the WTC attack, a computerized, binary-response screening questionnaire was administered. Exposure assessment included WTC arrival time and "loss of a co-worker while working at the collapse." We determined elevated PTSD risk using thresholds derived from *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*, and a sensitivity-specificity analysis.

**Results.** Of 8487 participants, 76% reported at least 1 symptom, 1016 (12%) met criteria for elevated PTSD risk, and 2389 (28%) self-referred to the CSU, a 5-fold increase from before the attack. Higher scores were associated with CSU use, functional job impairment, and mental health–related medical leave. Exposure–response gradients were significant for all outcomes.

**Conclusions.** This screening tool effectively identified elevated PTSD risk, higher CSU use, and functional impairment among firefighters and therefore may be useful in allocating scarce postdisaster mental health resources. (*Am J Public Health.* 2009;99:S702–S709. doi:10.2105/AJPH.2008.151605)

We present new data on the psychological impact of exposure to the WTC disaster among the FDNY WTC firefighter cohort over the first 2.5 years after the attack. First, we described the cohort's psychological response as determined by a computerized self-administered questionnaire, use of the FDNY Counseling Services Unit (CSU), and verified, rather than self-reported, functional impairment as assessed by CSU-assigned mental health–related medical leave. Second, we determined whether psychological symptom scores reported within the first 6 months after September 11 were associated with elevated PTSD risk, CSU use, or CSU-assigned mental health–related medical leave. Third, we determined whether exposure–response gradients were significant for these outcomes.

## METHODS

The FDNY Health Services began seeing firefighters with conditions related to the WTC attack on September 11, 2001, and a Medical Monitoring Program began on October 6, 2001. Participants were seen during working hours without repercussions for nonparticipation. After receipt of a complete study description, written informed consent was obtained.

Between October 2001 and February 2002, the FDNY completed the first WTC monitoring examination of the entire workforce. The program included a computerized self-administered binary response questionnaire that ascertained a participant's arrival time at the WTC, self-reported medical symptoms, and asked the mental health–related questions that

were this study's focus. Trained personnel were available to assist participants.

**Cohort Description**

Demographics were obtained from the FDNY personnel database. FDNY rescue workers included firefighters, fire marshals, and emergency medical services health care workers. The following were excluded from the analysis: fire marshals and emergency medical service workers, because their work tasks and exposures were different from those of firefighters; the 341 firefighters killed on September 11; firefighters never at the WTC; firefighters who terminated or resigned during the study period (for reasons unrelated to

September 11); and female firefighters, because small numbers precluded gender-stratified analysis. After these exclusions, the cohort totaled 10 415, of which 8487 (81%) completed the questionnaire during the study period.

**The Questionnaire**

The questionnaire assessed exposure with the FDNY WTC Exposure Intensity Index<sup>4</sup> and an affirmative response to the question asking whether the participant had experienced the "loss of a co-worker while working at the collapse." The FDNY WTC Exposure Intensity Index<sup>4</sup> categorized exposure as follows: arriving the morning of September 11 was "severe exposure" (15%), arriving within the first 48 hours but

after the buildings' collapse as "moderate exposure" (73%), and arriving thereafter as "mild exposure" (13%).

The questionnaire included 16 psychological questions (Table 1), with each question beginning, "Since the disaster have you experienced any of the following . . .". The questions were derived from the PTSD Checklist–Civilian Version,<sup>18</sup> modified into binary "yes/no" format for simplicity of self-administration.

**Counseling Services Unit Referral**

The number of CSU referrals was based on annual data collected by the CSU. Frequency of CSU use was examined for the 2.5 years before and after the September 11 attack (March 10, 1999–March 10, 2004). During the first 2.5 years after the attack, the mental health questions were not used for diagnosis, referral, or duty determination. CSU counseling was free, voluntary, and confidential, and occurred predominantly by self-referral after extensive outreach. Trained CSU counselors performed psychological assessments; they changed duty status to medical leave (the term includes medical leave and "light" office duty) only if symptoms were of sufficient magnitude to reasonably interfere with the safe performance of a firefighter's duties. All participants and providers, including outreach providers and CSU counselors, were blinded to questionnaire results. This study did not include standardized treatment protocols or structured diagnostic psychiatric interviews.

**Data Analysis and Statistical Methods**

A descriptive analysis was performed to examine the demographic and questionnaire data; this analysis included the  $\chi^2$  test and the Cochran–Armitage test for trend for categorical data, analysis of variance and the Student *t* test for means of normal data, and the Wilcoxon rank sum test and median test (non-parametric tests) for mean rank and median scores of nonnormal data. Subanalyses were used to examine the effects of CSU use and exposure. Simple and multivariate stepwise logistic regression (entry criterion=0.15; retention criterion=0.05) was performed to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for associations between mental health questions and the following outcomes: PTSD prevalence, CSU use, and CSU-assigned

**TABLE 1—Prevalence of Symptoms of Posttraumatic Stress Disorder (PTSD) Among Firefighters After the World Trade Center (WTC) Attack, by Exposure Category: 2001**

PTSD Symptoms	Total, No. (%)	Exposure Category			P <sup>a</sup>
		Severe, No. (%)	Moderate, No. (%)	Mild, No. (%)	
Total	8487	1230 (14.49)	6169 (72.69)	1088 (12.82)	
Re-experiencing					
Flashback memories of the disaster (repeated disturbing images)	2465 (29.18)	681 (55.64)	1627 (26.50)	157 (14.48)	<.001
Nightmares or bad dreams related to WTC	2290 (27.11)	504 (41.18)	1612 (26.26)	174 (16.05)	<.001
Avoidance and numbing					
Distant from other people	1939 (22.95)	378 (30.88)	1411 (22.98)	150 (13.84)	<.001
Distant from friends or family	1805 (21.37)	361 (29.49)	1297 (21.13)	147 (13.56)	<.001
I feel numb	1770 (20.95)	358 (29.25)	1248 (20.33)	164 (15.13)	<.001
Dazed or detached from surroundings	1571 (18.60)	356 (29.08)	1103 (17.97)	112 (10.33)	<.001
Avoiding things or people that remind you of the disaster	1275 (15.39)	274 (22.78)	877 (14.56)	124 (11.73)	<.001
Difficulty remembering details of the disaster	871 (10.31)	285 (23.28)	551 (8.98)	35 (3.23)	<.001
Arousal					
Difficulty getting a good night's sleep	4106 (48.61)	747 (61.03)	2974 (48.44)	385 (35.52)	<.001
Unusual irritability	3144 (37.95)	594 (49.38)	2268 (37.65)	282 (26.68)	<.001
Feeling anxious or unusually restless	2913 (35.16)	586 (48.71)	2063 (34.25)	264 (24.98)	<.001
Difficulty concentrating	2963 (35.08)	554 (45.26)	2153 (35.07)	256 (23.62)	<.001
Difficulty falling asleep or staying asleep	2794 (33.08)	566 (46.24)	1973 (32.14)	255 (23.52)	<.001
Unusual anger	2024 (24.43)	412 (34.25)	1447 (24.02)	165 (15.61)	<.001
Functional impairment					
Difficulty functioning at home	1306 (15.77)	302 (25.10)	909 (15.09)	95 (8.99)	<.001
Difficulty functioning at work	773 (9.33)	198 (16.46)	518 (8.60)	57 (5.39)	<.001

Note. Symptom groups are from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*.<sup>20</sup> Prevalence was determined by firefighters' responses to questions that began, "Since the disaster have you experienced any of the following . . ." Percentages may vary because of small differences in the number of members answering individual questions. Exposure was defined as follows: severe was being at the collapse of the World Trade Center (WTC), moderate was being at the WTC at 3 to 48 hours after the collapse, and mild was being at the WTC 3 days and onward.  
<sup>a</sup>Cochran–Armitage test for trend.

mental health–related medical leave.<sup>19</sup> Covariates included demographic variables (race, rank, age, and years of service), levels of exposure, and a questionnaire response indicating “loss of a co-worker while working at the collapse.”

To identify groups of related mental health symptoms within the questionnaire, factor analysis with a promax rotation was performed with SPSS version 12.0 (SPSS Inc, Chicago, IL) on randomly selected records comprising one third of the study cohort. The analysis identified 4 symptom groups, explaining 53% of the total variance. The constructs represented by these symptom groups were consistent with *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)*,<sup>20</sup> criteria for PTSD (re-experiencing, avoidance and numbing, and arousal) and the required *DSM-IV-TR* qualifier of functional impairment. “Difficulty getting out of bed” was the one mental health question that dropped out of factor analysis and was removed from analyses. We then confirmed these same 4 symptom groups in factor analysis of the remaining cohort using the same methods.

All other analyses were performed with SAS version 8 (SAS Institute Inc, Cary, NC). To determine the association between questionnaire responses and PTSD, we calculated a total Q score on the basis of 14 questions (eliminating the 2 questions on functional impairment) so as to closely approximate the PTSD Checklist–Civilian Version and the approach used by Perrin et al.<sup>16</sup> Prior studies using the PTSD Checklist–Civilian Version found either or both of the following to be an indicator of probable PTSD: a threshold number of symptoms within each of the 3 *DSM-IV-TR* PTSD symptom groups (re-experiencing=1, avoidance and numbing=3, arousal=2) or a total symptom score of 44 or above. In the absence of confirmatory psychiatric interview, meeting either or both of these thresholds has been often described as “probable PTSD,”<sup>16,18,21–24</sup> but more accurately could be designated “elevated PTSD risk.” We used the same threshold values for reported symptoms within each of the 3 *DSM-IV-TR* groups and conducted a sensitivity-specificity analysis to determine the total Q score indicative of an elevated PTSD risk. Thus, as in the PTSD Checklist–Civilian Version, we had a score

based on the number of symptoms in each *DSM-IV-TR* group and a total score. To examine the usefulness of our screening instrument in identifying those with elevated PTSD risk, we explored its association with the need for mental health–related medical leave assigned by a mental health professional under the hypothesis that psychological symptoms plus verified functional impairment could suggest a condition consistent with PTSD.

We determined the association of the total Q score with CSU use and CSU-assigned mental health–related medical leave. A sensitivity-specificity analysis on the association of Q score with these 2 outcomes resulted in a Q score of 9 or above (specificity >90% and 89%, respectively).

## RESULTS

This male firefighter cohort had a mean age of 40 years (range=20–60 years) and a mean FDNY tenure of 12 years. Compared with questionnaire participants, nonparticipants had less exposure (7% vs 14% severe exposure;  $P<.001$ ), were older ( $42 \pm 7$  vs  $40 \pm 7$  years;  $P<.001$ ), and had higher rank (22% vs 19% were officers;  $P=.022$ ). Seventy-six percent of the cohort reported 1 or more psychological symptoms after the September 11 attack. Between October 2001 and February 2002, the most common symptoms reported in each symptom group were as follows: re-experiencing flashbacks (29%) and nightmares (27%); avoidance and numbing—feeling distant from others (23%) and from family or friends (21%); and arousal—insomnia (49%) and unusual irritability (38%). After September 11, 18% reported social or occupational functional impairment; 16% of the cohort reported difficulty functioning at home, 9% reported difficulty functioning at work, and both of these factors were greatest in the severely exposed group (Table 1).

The mean Q score was 3.78 out of a possible 14. A significant exposure gradient was demonstrated with a mean Q score of 5.44 (severe exposure), 3.68 (moderate exposure), and 2.46 (mild exposure;  $P<.001$ ). There was a significant exposure intensity gradient for each symptom and all symptom group frequencies ( $P<.001$ ; Table 1), the most pronounced of which was for re-experiencing (Figure 1).

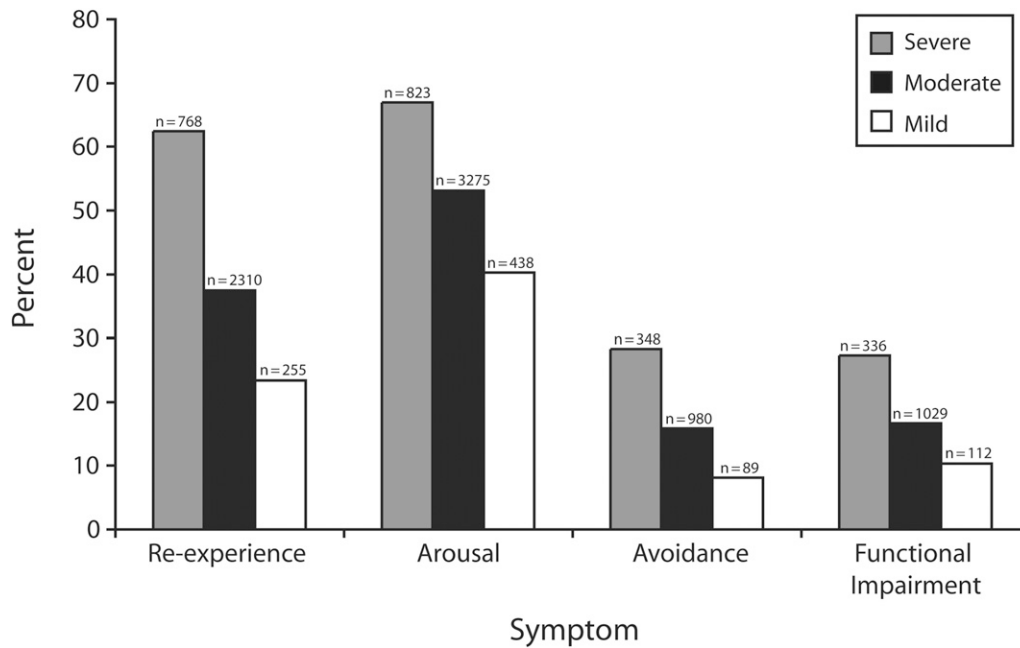
## Elevated Posttraumatic Stress Disorder Risk

A total of 1016 of 8487 firefighters (12%) responded affirmatively to a threshold number of questions within each *DSM-IV-TR* symptom group that indicated elevated PTSD risk. The percentage of firefighters reporting at least the threshold number of symptoms set forth in the *DSM-IV-TR* was 39%, 17%, and 54% for re-experiencing, avoidance and numbing, and arousal, respectively. Similar percentages were found for firefighters with moderate WTC exposure (Figure 1).

Seventy-two percent of those meeting the threshold for avoidance and numbing also met criteria for elevated PTSD risk, compared with only 30% and 22% for re-experiencing and arousal, respectively. There was a significant exposure–response gradient for elevated PTSD risk, with a prevalence of 24%, 11%, and 5% in the severe-, moderate-, and mild-exposure groups, respectively. Sensitivity-specificity analysis revealed that a total Q score of 9 or above was virtually interchangeable with an elevated PTSD risk as defined by *DSM-IV-TR* symptom group thresholds. A Q score of 9 or above represents the maximum sensitivity (82%) and, conditioned on that sensitivity, the maximum specificity (97%). Elevated PTSD risk based on a Q score of 9 or above was found for 1092 firefighters (13%) and similarly demonstrated a significant exposure intensity gradient, with a prevalence of 25%, 12%, and 5% in the severe-, moderate-, and mild-exposure groups, respectively. After we adjusted for FDNY tenure, firefighters self-reporting “loss of a co-worker while working at the collapse” were nearly 4 times more likely to have elevated PTSD risk (OR=3.71; 95% CI=2.93, 4.70;  $P<.001$ ).

## Counseling Services Unit

A total of 2389 of 8487 firefighters (28%) received CSU counseling in the 2.5 years after September 11—a 5-fold increase in use from the 2.5 years before the attack. Of the 522 firefighters who had received CSU services in the 2.5 years prior to September 11, 162 (31%) returned for CSU services in the 2.5 years after September 11. This returning group accounted for only 7% of those receiving CSU services after September 11. Members of the severe-exposure group were more likely to use



Note. DSM-IV-TR=Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.<sup>20</sup>

**FIGURE 1—Proportion of firefighters after the World Trade Center attack who scored at or above the threshold number of symptoms as stated in the DSM-IV-TR criteria for posttraumatic stress disorder, by exposure group: 2001.**

CSU services than were any other arrival group (OR=1.66; 95% CI=1.46, 1.88;  $P<.001$ ).

The mean Q score was greater among CSU users than among non-CSU users (4.93 vs 3.33, respectively;  $P<.001$ ). Each psychological symptom question was answered affirmatively by a significantly greater proportion of CSU users than by non-CSU users. A significant exposure gradient for each symptom ( $P<.001$ ) remained after stratification by CSU use.

For the cohort, simple logistic regression analysis demonstrated that firefighters with a Q score of 9 or above were more likely to use CSU services than were those with lower Q scores (OR=2.53; 95% CI=2.22, 2.89;  $P<.001$ ). Frequencies of CSU use among firefighters with a Q score of 9 or above were 37%, 19%, and 8% for severe, moderate, and mild exposure groups, respectively. Multivariate analysis demonstrated that this association of CSU use and WTC exposure, adjusted for FDNY tenure, exhibited a significant exposure–response gradient, with ORs of 2.80, 2.48, and 2.22 for the severe-, moderate-, and mild-exposure groups, respectively (Table 2). Multivariate analysis adjusted for FDNY tenure and self-reports of “loss of a co-worker while

working at the collapse” resulted in an OR of 2.56 (95% CI=2.24, 2.93;  $P<.001$ ). Use of a Q score of 9 or above resulted in a specificity of 90% and a sensitivity of 21% for CSU use.

### Mental Health–Related Medical Leave

A total of 1403 of 2389 firefighters (59%) counseled at the CSU required mental health–related medical leave as determined by a mental health professional. This proportion was even higher (67%) among the 462 firefighters who exhibited elevated PTSD risk and used the CSU. Among firefighters who used the CSU, those who were assigned mental health–related medical leave answered each mental health question affirmatively more frequently than did those who were not. Both CSU-using groups had a higher frequency of affirmative responses to each question than non-CSU users ( $P<.001$ ).

For the cohort, firefighters with a Q score of 9 or above were more likely to require mental health–related medical leave (OR=2.69; 95% CI=2.33, 3.11;  $P<.001$ ); the frequencies of this leave exhibited significant exposure–response gradients of 40%, 22%, and 8% (for severe, moderate, and mild exposure, respectively). Multivariate analysis demonstrated that this association, adjusted for FDNY tenure,

exhibited a significant exposure–response gradient (Table 2) and ORs of 2.87, 2.63, and 1.95 for severe-, moderate-, and mild-exposure groups, respectively. Multivariate analysis adjusted for FDNY tenure and self-reports of “loss of a co-worker while working at the collapse” resulted in an OR of 2.67 (95% CI=2.30, 3.09;  $P<.001$ ). Use of a Q score of 9 or above resulted in a specificity of 89% and a sensitivity of 24% for mental health–related medical leave.

A separate analysis of the association of Q score with CSU use and CSU-assigned mental health–related medical leave that used all 16 questions (because functional impairment was often the reason participants sought counseling) resulted in a Q score of 10 or above, with a specificity of greater than 90% and ORs 0.10 to 0.16 greater than the ORs reported for a Q score of 9 or above. However, given its similarity to results obtained using a Q score of 9 or above and for the sake of simplicity, we used 9 or above as our threshold for all outcomes.

### DISCUSSION

In the largest firefighter cohort studied to date, the Medical Monitoring Program

**TABLE 2—Adjusted Multivariate Logistic Regression Analysis of Use of Counseling Services Unit (CSU) or CSU-Assigned Medical Leave by Firefighters of the Fire Department of the City of New York (FDNY) After the Collapse of the World Trade Center: 2001**

	OR <sup>a</sup> (95%CI)	P
CSU use, all		
Q score ≥ 9	2.56 (2.24, 2.93)	<.001
Loss of a coworker on September 11	1.68 (1.34, 2.11)	<.001
Years of service	0.96 (0.96, 0.97)	<.001
CSU-assigned medical leave		
Q score ≥ 9	2.67 (2.30, 3.09)	<.001
Loss of a coworker on September 11	2.16 (1.69, 2.75)	<.001
Years of service	0.96 (0.95, 0.97)	<.001
CSU use, severe exposure <sup>b</sup>		
Q score ≥ 9	2.80 (2.14, 3.68)	<.001
Years of service	0.95 (0.94, 0.97)	<.001
CSU-assigned medical leave, severe exposure <sup>b</sup>		
Q score ≥ 9	2.87 (2.15, 3.84)	<.001
Years of service	0.94 (0.92, 0.96)	<.001
CSU use, moderate exposure <sup>b</sup>		
Q score ≥ 9	2.48 (2.11, 2.91)	<.001
Years of service	0.96 (0.96, 0.97)	<.001
CSU-assigned medical leave, moderate exposure <sup>b</sup>		
Q score ≥ 9	2.63 (2.20, 3.15)	<.001
Years of service	0.97 (0.96, 0.98)	<.001
CSU use, mild exposure <sup>b</sup>		
Q score ≥ 9	2.22 (1.28, 3.85)	.004
Years of service	0.96 (0.95, 0.98)	<.001
CSU-assigned medical leave, mild exposure <sup>b</sup>		
Q score ≥ 9	1.95 (1.02, 3.73)	.109
Years of service	0.96 (0.94, 0.98)	<.001

Note. The covariates rank (in the FDNY) and race were entered in the models and subsequently removed. Age and tenure were collinear.

<sup>a</sup>Adjusted by years of FDNY service as of September 11, 2001, and also for having “firefighters working with me during the collapse among the dead or missing.”

<sup>b</sup>Exposure was defined as follows: severe was being at the collapse of the World Trade Center (WTC), moderate was being at the WTC at 3 to 48 hours after the collapse, and minimal was being at the WTC 3 days and onward. Figures are adjusted by years of FDNY service as of September 11, 2001. Because exposure was determined by time of arrival and deaths of coworkers took place during the collapse on the morning of day 1, the stratified portion of this analysis did not incorporate deaths of coworkers.

computerized, self-administered mental health questionnaire provided a user-friendly screening tool for identifying those with psychological symptoms and elevated PTSD risk as well as predicting CSU use among FDNY firefighters and functional impairment severe enough for CSU-assigned mental health–related medical leave. Seventy-six percent reported at least 1 symptom, and 12% to 13% met criteria for elevated PTSD risk. Over the first 2.5 years after the September 11 WTC attack, 28%

received CSU counseling, a 5-fold increase from the 2.5 years before the attack. The mean Q score was greater among CSU users, and firefighters with a Q score of 9 or above were over 2.5 times more likely to use CSU and to need mental health–related medical leave. Self-reported psychological symptoms, elevated PTSD risk, CSU use, and mental health–related medical leave all followed an exposure–response relationship, with the greatest effect among those arriving at the WTC during the

morning of September 11. Firefighters self-reporting “loss of a co-worker while working at the collapse” were nearly 4 times more likely to have elevated PTSD risk and were over 2.5 times more likely to use CSU and require mental health–related medical leave than were those not reporting such a loss. By documenting the assignment of mental health–related medical leave by a mental health professional, this study is the first to show an association between postdisaster symptoms and verified, rather than self-reported, functional impairment.

Following human-made disasters,<sup>21–24</sup> psychological symptoms and probable PTSD are most frequent among survivors,<sup>14,15</sup> followed by rescue-recovery workers<sup>10–13,16,17</sup> and then other less-exposed populations.<sup>15,25–27</sup> Many studies report psychological symptoms, but most fall well below *DSM-IV-TR* criteria for psychiatric illnesses, and most do not report the presence or extent of functional impairment.<sup>21–24</sup> Structured psychiatric interviews reliably ascertain a PTSD diagnosis, whereas symptom questionnaires quantify symptoms and are more appropriate for screening for elevated PTSD risk or “probable PTSD.”<sup>23,28</sup> With an easy-to-use questionnaire, we demonstrated that a large cohort could be screened rapidly and that a threshold Q score could be determined with a specificity of 90% for CSU use and 89% for CSU-assigned mental health–related medical leave. This screening methodology could minimize the burden on scarce counseling resources of true negatives (i.e., those with no elevated risk of PTSD).

Two years after the WTC attack, the WTC Registry, using the PTSD Checklist–Civilian Version, interviewed 28 692 rescue-recovery workers, including 3232 firefighters (both FDNY and non-FDNY). The percentage of firefighters fulfilling *DSM-IV-TR* PTSD symptom group criteria was 39% for re-experiencing, 25% for avoidance and numbing, and 37% for arousal.<sup>16</sup> In our study of 8487 FDNY firefighters, which used questionnaires completed within 6 months after the attack, the percentage fulfilling *DSM-IV-TR* criteria was 39% for re-experiencing, 17% for avoidance and numbing, and 54% for arousal. The lower percentages reporting arousal symptoms in the WTC Registry may reflect the influence of non-FDNY firefighters not present at the collapse, or differences in the timing of the questionnaire’s administration.

Using the PTSD Checklist–Civilian Version, the WTC Registry reported elevated PTSD risk or “probable PTSD” for 14% or 17% of firefighters, depending on whether the threshold score was based on symptom count or *DSM-IV-TR* symptom group criteria.<sup>16</sup> For other WTC rescue-recovery workers, rates ranged from 8% to 25%.<sup>16</sup> Using similar scoring methodologies, the Mt Sinai Coordinated WTC Medical Monitoring and Treatment Program reported an elevated PTSD risk or “probable PTSD” rate of 11% to 20% among nonfirefighter rescue-recovery workers.<sup>17</sup> In our FDNY firefighter cohort, elevated PTSD risk was 13% on the basis of a Q score of 9 or above and 12% by a method based on *DSM-IV-TR* criteria. Analysis revealed that elevated PTSD risk as determined by Q score was virtually interchangeable with elevated PTSD risk determined by *DSM-IV-TR* criteria.

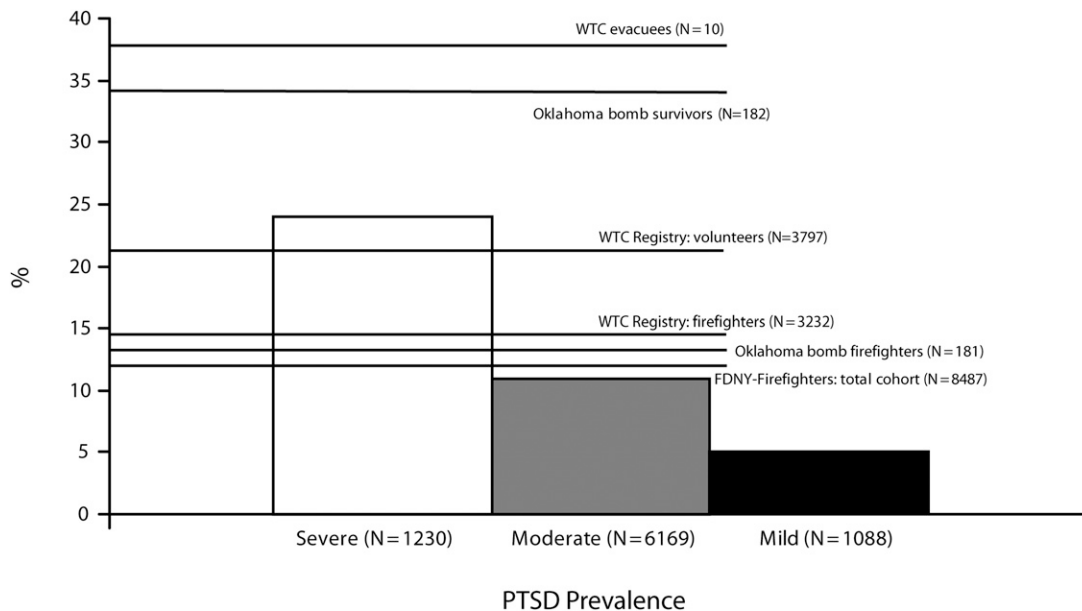
Psychological symptoms and psychiatric illnesses such as PTSD tend to be most dense at a disaster’s epicenter and less frequent as distance in space and time increases.<sup>23,29</sup> Exposure–response gradients for symptoms or “probable PTSD,” based on proximity or earliest arrival time, were found after the Oklahoma City

bombing,<sup>14</sup> the United Airlines DC-10 crash,<sup>11</sup> and the WTC attack.<sup>15,16,26,27</sup> The rate of elevated PTSD risk in our FDNY WTC firefighter cohort (12%–13%) was similar to previously published rates of PTSD<sup>10,14</sup> or “probable PTSD”<sup>11,16</sup> in other postdisaster firefighter cohorts (12%–17%), despite the use of different instruments, methodologies, and assessment time points (Figure 2). This similarity was surprising because, unlike in these other studies, FDNY firefighters were present during the collapse and faced the additional burden of losing 343 comrades—some actual family members—and many never recovered. This similarity disappears when firefighters are differentiated by exposure, with higher rates of elevated PTSD risk found among FDNY firefighters present during the collapse (severe exposure; Figure 2) and among those self-reporting loss of a co-worker while working at the collapse. None of the rates were as high as the rate reported for civilian WTC evacuees<sup>15</sup> or civilian Oklahoma City bombing survivors.<sup>10</sup> We speculate that this “relative” protective effect (i.e., resilience) among FDNY firefighters reflects career selection, training, and experience.<sup>30,31</sup> This conclusion is supported by lower rates of elevated PTSD risk, CSU use, and CSU-assigned

mental health–related medical leave as FDNY tenure increased, and it highlights the need for increased training and outreach to the least experienced firefighters.

Of firefighters with elevated PTSD risk who used CSU, 67% had functional impairment of sufficient magnitude to require mental health–related medical leave. The association between Q score and mental health–related medical leave demonstrated a significant exposure–response gradient. PTSD has been associated with functional impairment (social and occupational) among subjects in community samples,<sup>32</sup> war veterans,<sup>33</sup> female domestic violence survivors,<sup>34</sup> and WTC nonfirefighter rescue-recovery workers.<sup>17</sup>

After the Oklahoma City bombing, fewer than half of the 13% of firefighters with PTSD sought counseling.<sup>13</sup> Among FDNY firefighters at the WTC collapse, 55% of those meeting screening criteria for elevated PTSD risk did not seek CSU counseling. Interestingly, 80% of firefighters using CSU services after September 11 did not screen positive for elevated PTSD risk, and many in this group were judged to need mental health–related medical leave. Despite a 5-fold increase in CSU use after September 11



Note. Data was taken from the WTC Registry,<sup>16</sup> WTC Evacuee Study,<sup>15</sup> and the Oklahoma City bombing.<sup>10,13</sup>

**FIGURE 2—Prevalence of elevated risk of posttraumatic stress disorder (PTSD) among Fire Department of the City of New York firefighter exposure groups compared with prevalence found in other World Trade Center collapse studies (of firefighters and evacuees) and after the Oklahoma City bombing: 2001.**

and despite free treatment, confidentiality, and assurance of job security, barriers to mental health counseling remain.

### Strengths and Limitations

There were several study strengths. The questionnaire was administered to virtually all FDNY firefighters surviving the attack, thereby minimizing selection bias. In prior studies, the potential for sampling bias was substantial because no study was able to recruit more than one third of the total exposed rescue-recovery workforce, and recruitment was even lower for firefighters. Our computerized, self-administered questionnaire did not require time-consuming in-person interviews, thereby maximizing participation and data collection. Recall bias was reduced by administration of the questionnaire within 1 to 6 months after the WTC attack, compared with a lag time of years in other WTC studies.<sup>16,17</sup> Finally, to our knowledge, this is the first disaster study to link results of a mental health questionnaire with verified functional impairment.

There were also limitations. “Re-exposure,” caused by prolonged body-recovery efforts and frequent funerals, may have influenced results. The binary questionnaire format and lack of diagnostic psychiatric interviews precluded validation of diagnoses of any mental health disorders. The significant association, however, between elevated PTSD risk and verified mental health–related functional impairment suggests that the majority of respondents with elevated PTSD risk would have met the PTSD criteria of a diagnostic psychiatric interview. Finally, to what extent undetected or late-onset PTSD symptoms or other mental health conditions (e.g., depression, anxiety, or substance abuse) prompted CSU use and CSU-assigned mental health–related medical leave cannot be answered by the data because this study did not include an initial assessment of other conditions or longitudinal reassessment of PTSD risk. Together, these issues support the need for simple screening tools to repeatedly assess a variety of conditions in order to encourage counseling for those in need.

### Conclusions

After the WTC attack, a disaster of unprecedented magnitude, our computerized self-administered mental health questionnaire

provided a user-friendly screening tool for identifying those with psychological symptoms and elevated PTSD risk as well as for predicting FDNY CSU use and functional impairment requiring mental health–related medical leave. Significant exposure–response gradients, arrival time, and the loss of a co-worker while working at the collapse were associated with all outcomes: elevated PTSD risk, CSU use, and CSU-assigned mental health–related medical leave.

The FDNY now uses its online screening instruments to actively encourage CSU referrals. Scores above threshold prompt immediate referral to on-site mental health interviewers who conduct a diagnostic interview using the Diagnostic Interview Schedule.<sup>27</sup> Results determine whether counseling referrals are recommended. We believe this model will further reduce barriers to care, better utilize mental health treatment resources, and improve disaster preparedness. ■

### About the Authors

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### Contributors

Participant recruitment and data collection protocols were designed and executed by M. Corrigan, K.J. Kelly, C. Cammarata, I. Feirstein, and D.J. Prezant. The study was designed by R. McWilliams, H.M. Kipen, J.K. Schorr, and D.J. Prezant. Data were analyzed by R. McWilliams, D. Wartenberg, and W.K. Hallman. The article was written and prepared by R. McWilliams, J. Niles, K. Jones, L. Glass, and D.J. Prezant, and all authors reviewed, edited, and approved it.

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### Human Participant Protection

This study was approved by the institutional review board of Montefiore Medical Center.

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