

Mental Health of Workers and Volunteers Responding to Events of 9/11: Review of the Literature

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ABSTRACT

Background: Disaster workers responding to the events of September 11th were exposed to traumatic events. No study has systematically investigated the diverse mental health status and needs of the heterogeneous population of disaster workers responding to the events of September 11th.

Methods: Using PubMed and Medline and the search terms of “September 11, 2001” or “September 11” or “9/11” or “WTC” or “World Trade Center”, the authors reviewed all articles that examined the mental health outcomes of workers at one of the three September 11th crash sites or the Fresh Kills landfill in New York City.

Results: In total, 25 articles met study inclusion criteria, often using different methodologies. The articles described varying degrees of mental health symptomatology, risk factors for adverse mental health outcomes, and utilization of mental health services.

Conclusions: The mental health needs of workers exposed to the events of September 11th ranged from little to no care to pharmacotherapy. A range of risk factors, including exposures at the WTC site and occupational activities, impacted on

these needs but the role of specific mental health interventions was less clear. These findings suggest the need for a future program for disaster workers consisting of an accessible mental health treatment service supported by comprehensive postdisaster surveillance and emphasis on pre-disaster mental wellness. A number of areas for further consideration and study were identified, including the need for a more diverse exploration of involved responder populations as well as investigation of potential mental health outcomes beyond post-traumatic stress disorder (PTSD). *Mt Sinai J Med* 75:115–127, 2008. © 2008 Mount Sinai School of Medicine

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The September 11th, 2001 attacks on the World Trade Center (WTC) and Pentagon, as well as the plane crash in Shanksville, Pennsylvania, have had a profound effect on the health of Americans.¹ There has also been a good deal of attention paid to those who were directly exposed to the attacks: people who worked in the WTC or the Pentagon, those who live or work in downtown Manhattan, those who lost a loved one in the attacks, and first responders who assisted in the rescue and recovery efforts.

Extensive literature dating back many decades has consistently documented that both manmade and natural disasters are associated with psychopathology of varying frequency, duration, and nature in people exposed to these events.^{2–4} Typically, the psychological aftermath of a disaster is conceptualized as arising out of a combination of the exposure itself combined with other factors such as prior psychiatric history and extent of postdisaster psychosocial support. Common psychopathological outcomes include

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major depression, post-traumatic stress disorder, and possibly substance use problems.⁴ Intentional acts of violence, such as those that occurred on September 11th, are often cited as associated with greater psychological distress than natural or unintentional disasters.⁵ Disasters of mass violence are difficult for victims to comprehend and assimilate, which creates feelings of helplessness and anxiety, and exposes one's vulnerabilities.³ On the other hand, others have debated whether manmade or intentional events do in fact lead to greater psychological distress than natural occurrences or instead to different types of distress and concerns.²

As their effects radiate out, disasters like September 11th create a community of affected individuals, what Wright *et al.* refers to as a "disaster community" touched by catastrophe.⁶ This community consists of progressively broader rings of affected populations radiating out from a central core of the bereaved next of kin. Disaster workers and volunteers such as those who responded to the September 11th terrorist attacks are a prominent component of this overall community, encompassing what Wright called the "service" and "support" providers whose membership in the disaster community lies just beyond the ring of the bereaved. Disaster workers deserve special attention because they are highly exposed members of the disaster community and are thus at risk for developing mental health sequelae as a result of their efforts.^{4,6} They will be the focus of this paper.

A number of studies have examined the impact of disaster work on responders. Disaster and rescue workers who responded to the fatal crash of a United Airlines flight experienced higher rates of acute stress disorder immediately after their involvement 13 months later compared with a nonexposed comparison group.⁷ Volunteer disaster workers working with the dead after an explosion on the *USS Iowa* were found to be more likely to have PTSD as well as other symptoms of distress if they identified with the deceased as a friend.⁸ Five months following a major building explosion in North Carolina, mild distress responses were noted among first responders; 80% of first responders had at least one symptom of PTSD and 10% had eight symptoms, with on-site staff having more symptoms than hospital-based staff.⁹ On the other hand, studies of firefighters who responded to the Oklahoma City bombing and of police officers involved in recovery efforts after an oil rig explosion did not find significant elevations in rates of PTSD or psychological distress.^{10,11}

In light of this literature, an examination of the mental health effects of September 11th in particular

on disaster workers seems especially important for a number of reasons. First, September 11th responders were subjected to severe, ongoing exposure: some witnessed the scene in the immediate aftermath, some lost coworkers in the disaster, some worked directly with bereaved or searching family members, and many of them stayed at the WTC site for many months, working long shifts in the recovery effort. Second, perhaps as many as 40,000 people have been estimated to have participated in rescue and recovery efforts at Ground Zero in New York City, which reflects a responder population many magnitudes larger than anything previously reported. Finally, whereas prior disaster worker literature has involved isolated reports from disparate disasters; in contrast, the scope and duration of the September 11th rescue and recovery response provides an opportunity to examine the effects of one particular event in one community on many responder populations.

In fact, studies on September 11th have examined diverse populations of workers, such as American Red Cross employees, as well as various types of psychopathology, such as PTSD or alcohol abuse. The purpose of this paper is to review the published literature on the mental health of workers responding to the September 11th disasters. By synthesizing what is known about this population, we hope to shape a more extensive body of information about disaster worker's mental health than has been available to date. In doing so, we hope to inform future research and planning toward mitigating the mental health impact of disasters on responders in the future.

METHODS

Studies relating to the events of September 11th, 2001 were deemed eligible for this study if they included the following: original articles or abstracts published between September 2001 and January 2008, inclusion of study subjects considered workers or volunteers at any one of the three crash sites (New York City, NY, World Trade Center; Arlington, VA, The Pentagon; Shanksville, PA), and an analysis of outcomes and exposures related to mental health. There were no restrictions in terms of language, sample size or study design. Studies that did not include analyses of mental health were not included in the study; nor were studies that included individuals that worked at any one of the three sites prior to September 11th, 2001, but not afterwards. Thus, a worker was defined as any individual who spent time at the three crash sites, or at Fresh Kills Landfill (the major collection

crisis care for people
helping animals (ie., oil spill
volunteers)?

and sorting site for debris from the WTC in Staten Island, NY), in a capacity to do work-related activities at any point during or after the events of September 11th, 2001.

Articles included in the present review were identified using MEDLINE and the PubMed database of the National Library of Medicine. The following search terms were used: “September 11, 2001” or “September 11” or “9/11” or “WTC” or “World Trade Center”. Two independent researchers (CBB and NASL) reviewed this initial list of titles and abstracts to determine whether an article met the parameters for inclusion. Each of these selected articles was read in full to confirm inclusion eligibility. References cited in these papers that had not been retrieved through database searches, were also evaluated for inclusion. Eventual inclusion of articles was based on consensus between the two researchers and a final review of this consensus by a third researcher (CLK).

The following information was extracted from each of the relevant articles: study design and other study characteristics, such as duration of study; type of population included, demographic variables and work-related duties at the crash sites; sample size of cohort; study test measures used (diagnostic and screening tools); exposures to sites, time worked; other characteristics relevant to one’s mental status (social and environmental); mental health outcomes of interest; methods of statistical analysis.

RESULTS

Study Background and Subject Demographics

A review done on all articles published between September 2001 and January 2008 revealed 484 articles in total. Of these, only 25 met the inclusion criteria necessary for this study (Table 1). Studies assessed included 19 cross-sectional, 3 cohort, 2 qualitative and 1 case-series. Utility and disaster workers were the focus of eight studies. Loosely defined rescue and recovery workers were included in four studies. American Red Cross (paid and volunteer) staff were the subject of four studies. Other study subjects included New York City (NYC) Police and Fire Department employees, sanitation drivers, NYC transit employees, iron workers, relief workers, mortuary workers, canine search and rescue workers, and other volunteers.

The 25 studies reported on a combined 122,448 individuals, of which 87,341 were defined as workers.

Eight studies also provided comparative assessments of 5,260 unexposed workers.

Of the 16 studies that assessed age, the average age ranged from 35.6 to 56.8 years old. The great majority of study subjects were of white males. In 10 of 17 studies the majority of subjects were male, and in 14 of 15 studies the majority of subjects were white.

Among the 25 studies, 9 provided data on education status. Percentages of subjects with some college or more ranged from 36% among utility workers to 79% among a cohort of American Red Cross paid and volunteer staff.

Most subjects were married or in a committed relationship. Among 10 studies where this variable was assessed, rates ranged from 51% to 84%.

Studies used varying diagnostic and screening tools to measure similar symptoms, making comparisons between the studies difficult. Additionally, among studies that used the same measures, modifications were often made to the measure itself. Studies also varied in their scoring procedures and interpretation of same measures. However, these differences do not entirely negate comparability.

Exposures and Mediating Factors

The 25 studies examined a variety of exposures related to September 11th (see Table 2). The majority of articles ($n = 17$) defined exposure as work related to September 11th, including deployment to one of the three sites and exposure to disaster stimuli. Other factors of interest included: **prior mental health treatment, mental health symptomatology, and prior traumatic exposure, including sexual abuse** as a child.

Two articles studied specific exposures to morbid or disturbing images of September 11th, such as witnessing one or both planes hitting the towers, seeing people jump from buildings, witnessing the building collapse, seeing bodies or body parts amid the debris. One of these studies examined exposure to emotionally difficult tasks, such as working with survivors and families of the deceased, as well as exposures to personal threats such as feelings of physical danger or sustaining an injury. One study examined a treatment modality. Specifically, the authors looked at male disaster workers who were exposed to virtual reality therapy for persistent PTSD, as compared with a similar group who received no such intervention.

Findings from Research Studies

The articles reported a host of psychopathological outcomes, including post-traumatic stress disorder

Table 1. Overview of Cohort in Studies Meeting Criteria for Inclusion in Review.

No.	Author (date of publication)	Total	Exposed	Un-exposed	Description	Mean Age (±SD)	White (%)	Male (%)	College (%)	Married/ Cohabiting (%)
1	Jayasinge, Giosan, Difede <i>et al.</i> (2006)	328	328	-	Utility workers	45 (9)	100	71.3	49.7	82.7
2	Gross, Neria, Tao, <i>et al.</i> (2006)	1,355	1,131	224	Union and NYC sanitation workers	-	-	-	-	-
3	Evans, Giosan, Patt, <i>et al.</i> (2006)	626	-	-	Disaster/utility relief workers	44.7 (9.4)	66.5	93.1	54.6	75.2
4	Dowling, Moynihan, Genet <i>et al.</i> (2006)	28,232	-	-	New York City Police Department workers	-	-	-	-	-
5	Jayasinge, Spielman, Cancellare <i>et al.</i> (2005)	174	174	-	Utility workers	43.01 (8.77)	67.3	97.6	53	82.8
6	Tapp, Baron, Bernard <i>et al.</i> (2005)	269	88	181	NYC transit workers	45	41	85	12.3	-
7	Johnson, Langlieb, Teret <i>et al.</i> (2005)	332	332	-	Clean-up and recovery workers	-	-	-	-	-
8	Smith, Katz, Holmes <i>et al.</i> (2004)	1,138	-	-	Rescue and recovery workers	41 ^a	58	91	-	-
9	Banauch, McLaughlin, Hirschorn <i>et al.</i> (2002)	11,336	-	-	Fire Department of New York City workers	-	-	-	-	-
10	Alvarez & Hunt (2005)	114	82	32	Canine SAR handlers	43	96	43	-	73
11	Covell, Essock, Felton <i>et al.</i> (2006)	36,672	13,584	-	Rescue and recovery workers	-	-	-	-	-
12	Difede, Cukor, Patt, <i>et al.</i> (2006)	17	9	8	Disaster workers with diagnosed PTSD	“mostly middle age”	-	-	-	-
13	Donahue, Jackson, Shear <i>et al.</i> (2006)	229	76 ^b	153 ^b	Project Liberty service recipients	E: 46 (10.9); U: 45.9 (14.7)	E: 76; U: 57	E: 36; U: 31	-	-

14	Elhai, Jacobs, Kashdan, <i>et al.</i> (2005)	3,015	408	2,607	American Red Cross paid and volunteer staff	56.8 (12.5)	92.6	36	78.6	67.3
15	Fullerton, Ursano, Reeves <i>et al.</i> (2006)	89	-	-	Disaster workers	35.6 (11.9)	85	77	78	57
16	Gaher, Simons, Jacobs <i>et al.</i> (2005)	374	-	-	American Red Cross paid and volunteer staff	55.56 (12.24)	92.59	36.37	-	-
17	Galea, Vlahov, Tracy <i>et al.</i> (2004)	2,616	280	2334	Adults in New York City tri-state area	-	53.4	46.2	62.8	50.8
18	Katz, Smith, Silverton <i>et al.</i> (2006)	8	-	-	Rescue and recovery workers	-	-	62.5	-	-
19	Leck, Difiede, Patt <i>et al.</i> (2006)	2,122	-	-	Utility workers	45	66.8	100	35.9	73.9
20	Long, Meyer & Jacobs (2006)	3,055	2667	202	American Red Cross paid and volunteer staff	56.8 (12.5)	93	36	79	67
21	Simons, Gaher, Jacobs <i>et al.</i> (2005)	779	-	-	American Red Cross paid and volunteer staff	56.82 (12.07)	92	36	-	-
22	Zimering, Gulliver, Knight <i>et al.</i> (2006)	109	-	-	Relief workers	44.1 (9.26)	88.5	85.3	-	84
23	Levin, Herbert, Skloot <i>et al.</i> (2002)	97	-	-	Ironworkers	-	-	-	-	-
24	Peterson, Nicolas, McGraw <i>et al.</i> (2002)	>400	-	-	Mortuary workers	-	-	-	-	-
25	Perrin, Digrande, Wheeler <i>et al.</i> (2007)	28,692	-	-	Rescue and recovery workers	-	-	-	-	-

^a median age.

^b 22 exposed (E) involved in rescue effort; 27 unexposed (U) involved in rescue effort.

Table 2. Study Design, Mediating Factors and Outcomes Measured in Each of the Studies Under Review.

No.	Study Design	Study Duration (post-September 11th)	Primary Exposure/Risk Factor	Outcome
1	Cross-sectional	12–21 mo	Stressors	Treatment utilization
2	Cross-sectional	20–24 mo	Work conducted on WTC site	PTSD and other psychological sequelae
3	Cross-sectional	21–25 mo	Anger	Distress and social/occupational functioning
4	Cross-sectional	15–27	September 11th, 2001	Behavioral, emotional, physical & cognitive reactions
5	Cross-sectional	–	Physiological and psychological stressors	Treatment utilization
6	Cross-sectional	7.5 mo	Dust exposure & Ground Zero activities	Physical and mental health symptoms
7	Qualitative	6–21 mo	Clean-up and recovery at WTC disaster site	Open-ended response
8	Cross-sectional	10–15 mo	Rescue and recovery work at WTC	Mental health sequelae
9	Cross-sectional	11 mo	Response to WTC attacks	Injuries and illnesses
10	Cross-sectional	7.75 mo	Deployment to the WTC, Pentagon or PA	Psychological sequelae
11	Cross-sectional	24 mo	Rescue and recovery work	Treatment utilization/
12	Cohort	–	VR enhanced treatment	PTSD (measured in CAPS score)
13	Cohort	18–24 mo	Enhanced counseling	Psychological sequelae
14	Cross-sectional	12 mo	Mental health service use prior to September 11th	Treatment utilization
15	Cross-sectional	2 weeks	Disaster exposure to September 11th	Perceived safety
16	Cross-sectional	12–17 mo	Trait negative affect, coping motives	Alcohol-related problems
17	Cross-sectional	6 mo	Involvement in rescue effort	PTSD
18	Case series	–	Ground Zero rescue & recovery work	Mental health needs
19	Cross-sectional	–	Childhood sexual abuse (CSA)	Psychological sequelae
20	Cross-sectional	12 mo	Disaster stimuli	Psychological distress
21	Cross-sectional	12 mo	PTSD symptomatology	Alcohol use
22	Cross-sectional	6–8 mo	Exposure to disaster site	PTSD
23	Cross-sectional	5 mo	Exposure to WTC site for at least 3 days	Physical and psychological symptomatology
24	Qualitative	–	Model for psychological intervention	–
25	Cohort	24–8 mo	Rescue and recovery work at WTC/occupation	PTSD

and post-traumatic stress symptoms (PTSD/PTSS), major depressive disorder (MDD), panic disorder (PD), alcohol abuse and dependence, and generalized anxiety disorder (GAD; see Table 3). Functional impairment was also measured. However, each of the authors used different diagnostic and screening tools and established unique criteria and cut-off points for defining similar outcomes.

Rates of Mental Health Problems among Those Exposed to September 11th

Several articles compared rates of mental health problems in exposed and unexposed workers. A study of Fire Department of New York City (FDNY) rescue workers, found a 17-fold increase in what was described as “stress-related incidents” among workers in the 11 months following the attacks (1,277 vs 75), as compared to the 11 months prior to September 11th.¹²

For articles that compared PTSD prevalence in exposed and unexposed groups, all articles but one¹³ found that first responders exposed to September 11th were more likely to suffer from PTSD than their unexposed counterparts.^{1,14,15} Rates of depression in those exposed with PTSD (71.8%) and those exposed without PTSD (51.4%) were also statistically significant (OR = 16.25; 95% CI: 11.07, 23.85, $p < 0.0001$).¹⁴ Another article, comparing two groups of disaster workers, one with indirect and the other with direct exposures to the WTC site found no statistical difference in measures of depressive symptoms (using the State-Trait Personality Inventory-form Y: STPI-Y) between the two groups.¹³ Ross notes a current prevalence rate of depression of 16.1% in exposed workers, compared to 4.4% in unexposed workers.¹⁴ Evans *et al.* found an average Beck Depression Index score of 13.9 among exposed workers (a value above the accepted cut-off score of 12).^{16,17} Exposure to the September 11th disaster, as well as exposure to the “dust cloud,” were positively associated with depressive symptoms, with odds ratios (ORs) of 2.31 (95% CI: 1.04, 5.15) and 2.48 (95% CI: 1.12, 5.51), respectively.¹⁸ One article found a significant difference between rates of unspecified “alcohol use” among exposed and nonexposed workers (6.8% vs 3.9%) workers.¹⁴ In case-control studies of exposed and unexposed workers, one article found a significantly higher prevalence of anxiety among exposed workers (7.2% vs 1.5%);¹⁴ while another article found no significant difference in anxiety scores on the STPI-Y test between workers directly exposed to the WTC and those with indirect exposure.¹³

Perrin *et al.*, relying on data from the WTC Health Registry of the New York City Department of Health and Mental Hygiene, compared PTSD rates among the different occupations involved in the September 11th response and found that PTSD rates were lowest in police officers (6.2%) and highest in unaffiliated volunteers.²⁶ Performing tasks not common for one’s occupation led to increased rates of PTSD.

Many articles reported cross-sectional prevalence rates of mental health problems in exposed worker cohorts. Levin *et al.* reported a rate of psychological distress among exposed iron workers of 70%.¹⁹ Prevalence of PTSD and PTSS among first responder populations ranged from 8%¹⁸ to 22.5%.²⁰ Only one article reported a cross-sectional depression prevalence, which was 5.6%.²¹

Rates of excessive/hazardous drinking were found to be 3.2% among exposed NYPD officers²² and 5% among American Red Cross workers.²³ A single article found that 9.5% of first responders replied “yes” to one of the four CAGE questions.²¹ The four “CAGE questions” are a widely used screening tool to identify significant alcohol problems based on details of consumption, and answering affirmatively to one of the four questions indicates that the respondent deserves follow-up while positive answers to two or more questions is highly consistent with a significant drinking problem.²⁴ Gaher and colleagues found low levels of drinking and drinking-related problems in a group of American Red Cross workers, as mean drinks per week equaled 4.92 (SD = 4.81). The authors found an association between negative affect and higher number of alcohol-related problems. This association was mediated by the use of alcohol to cope with the situation.²⁵

Cross-sectional surveys of anxiety yielded a current prevalence of 5.9%²¹ and 11.7%²² when measured by clinician assessment and self-report, respectively. Patients with depression (mean = 8.09, SD = 2.73 vs mean = 10.12, SD = 1.87, $p = 0.002$) and PTSD (mean = 7.6, SD = 2.62 vs mean = 10.17, SD = 1.83, $p = 0.0001$) were more likely to have a lower perceived safety.²⁰ One article found a current prevalence of panic disorder of 5.8%.²¹

Exposures and Mediating Factors Pre-September 11th

Several pre-September 11th risk factors were studied, including character traits, past events or trauma, or psychosocial supports. Gaher *et al.* studied the relationship between trait negative affect (an intrapersonal variable that indicates high tendencies

Table 3. Percent of Study Subjects (prior to September 11th and at Current Time of Study) with Mental Health Symptomatology and Mental Healthcare Use.

Author (date of publication)	MH Utilization ^a		PTSD/PTSS ^a		MDD ^a		PD ^a		Alcohol Abuse		GAD ^a		Function	
	Prior	Current	Prior	Current	Prior	Current	Prior	Current	Prior	Current	Prior	Current	Prior	Current
Jayasinge, Giosan, Difede <i>et al.</i> (2006) ^a	20.4	48	-	-	-	26.2	-	26.2	-	-	-	26.2	-	-
Gross, Neria, Tao, <i>et al.</i> (2006)	-	-	-	13.5	-	16.1	-	7.2	-	6.8	-	-	-	-
Evans, Giosan, Patt, <i>et al.</i> (2006)	-	-	-	12.5	-	-	-	-	-	-	-	-	-	-
Dowling, Moynihan, Genet <i>et al.</i> (2006)	-	-	-	-	-	-	-	-	-	3.2 ^c	-	-	-	-
Jayasinge, Spielman, Cancellare <i>et al.</i> (2005) ^b	28.7	42.5	-	81.6	30.2	42	30.2	42	-	-	30.2	42	-	-
Tapp, Baron, Bernard <i>et al.</i> (2005)	-	34 ^d	1.9	8	1.5	12	-	-	-	-	-	-	-	-
Smith, Katz, Holmes <i>et al.</i> (2004)	3.2	51 ^e	-	19.7	-	5.6	-	5.8	-	9.5	-	5.9	-	13-15
Simons, Gaher, Jacobs <i>et al.</i> (2005)	-	-	-	-	-	-	-	-	-	5	-	-	-	-
Alvarez & Hunt (2005)	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Elhai, Jacobs, Kashdan, <i>et al.</i> (2005)	13.5	10.7	-	-	-	-	-	-	-	-	-	-	-	-
Difede, Cukor, Patt, <i>et al.</i> (2006)	-	-	-	100	-	-	-	-	-	-	-	-	-	-
Galea, Vlahov, Tracy <i>et al.</i> (2004)	-	-	-	11.9	-	-	-	-	-	-	-	-	-	-
Zimering, Gulliver, Knight <i>et al.</i> (2006)	-	-	-	11	-	-	-	-	-	-	-	-	-	-
Perrin, Digrande, Wheeler, <i>et al.</i> (2007)	-	-	-	12.4	-	-	-	-	-	-	-	-	-	-

^a MH = mental health; PTSD = post-traumatic stress disorder; PTSS = post-traumatic stress symptoms; MDD = major depressive disorder; PD = panic disorder; GAD = generalized anxiety disorder.

^b Combined rate for PTSD, MDD, PD.

^c Combined rate for excessive alcohol, illegal and prescription drug use.

toward worry, anxiety, and depression) and alcohol coping motives.²⁵ The authors reported that among American Red Cross workers, negative affect was associated with higher degrees of alcohol problems, especially among younger participants. Leck *et al.* found that among male disaster workers, those exposed to childhood sexual abuse (CSA) were more likely to endorse higher scores on the BDI and the Clinician Administered PTSD Scale.²⁷

For transit workers who reported experiencing or witnessing a prior (pre-September 11th) traumatic event, depressive symptoms were significantly associated with both witnessing September 11th (OR = 3.94; CI 95%: 1.27, 12.17) and knowing a WTC victim (OR = 3.75; CI 95%: 1.18, 11.94). Additionally, those with low perceived social support showed a significant association between knowing a WTC victim and post-traumatic stress symptoms (OR = 16.41; CI 95%: 2.14, 722.96).¹⁸ Among canine search and rescue (SAR) workers, those with a previous mental disorder were more likely to report symptoms of depression PTSD, anxiety, or general psychological distress, ($F_s(1,60) > 10$, $p_s < .05$, $d_s > .67$) and they were more likely to meet the criteria for a current diagnosis ($\chi^2(1, n = 60) = 5.64$, $p < .05$).¹⁵ Dog handlers that were FEMA (Federal Emergency Management Agency) certified, were less likely to report PTSD symptomatology, than those who were not FEMA certified ($p < 0.05$)

September 11th or Peri-event

The vast majority of articles studied exposures to September 11th-related events. Gross and colleagues reported that disaster workers suffered from significantly higher rates of PTSD, depression, panic disorder, and alcohol use when compared with unexposed workers.¹⁴ Among workers exposed to September 11th, those who experienced personal loss or exposure to death or remains were significantly more likely to suffer from PTSD. Among canine SAR workers, those who were exposed to the September 11th tragedy reported more symptoms of psychological distress, PTSD, and peritraumatic dissociation than those who were not exposed to 9/11. Among exposed canine SAR workers, PTSS was significantly associated with high **peritraumatic dissociation** and low interpersonal support. Anxiety was associated with low interpersonal support and low relationship satisfaction. Psychological distress as measured by the Brief Symptom Inventory (BSI) was significantly associated with high peritraumatic dissociation, low interpersonal support, and low relationship satisfaction.¹⁵

Among transit workers, exposure to the “dust cloud” was found to be a risk factor for both depressive symptoms and PTSS, although this latter relationship was not significant among women.¹⁸ When perceived social support was controlled for, depressive symptoms were significantly associated with witnessing 9/11 trauma.

Simons *et al.* reported that American Red Cross workers exposed to September 11th who scored higher on the IES-R (indicating greater post-traumatic symptoms) were more likely to report a change in alcohol consumption, greater weekly consumption, and greater hazardous consumption.²³ These associations were stronger for those disaster workers who displayed hyperarousal symptoms (as opposed to avoidance or intrusion symptoms).

A study of disaster relief workers reported that workers developed PTSD symptomatology as a result of direct trauma (i.e. witnessing the attacks) more often than indirect trauma (i.e. hearing survivor narratives). However, there was evidence of indirect trauma causing the symptomatology of PTSD at a rate of 4.6%.²⁸

In the WTC Health Registry cohort, earlier start date at Ground Zero and longer duration of work were significant risk factors for development of PTSD in all occupations except police.²⁶

Post-September 11th

The impact of post-September 11th treatment modalities was studied by several authors. Virtual reality was found to be effective for the treatment of refractory PTSD in male disaster workers.²⁹ Among recipients of Project Liberty services, those who received enhanced treatment services (in addition to baseline crisis counseling) reported significant improvement in function, fewer symptoms of depression and grief, and marginally less traumatic stress. This result is relevant to our review as significantly greater proportions of enhanced services recipients were involved in rescue efforts when compared to those who received only crisis counseling.³⁰ Mortuary workers at the Pentagon exposed to critical incident stress management (CISM) responded positively to the intervention.³¹ Workers implemented some of the recommendations suggested by the CISM teams, and there was a very low rate of removal of personnel from mortuary duty. However, this data was entirely qualitative; symptomatology was not measured psychometrically.

Mental Health Services

Of 25 studies, 6 addressed the utilization of mental health services. Among 174 disaster workers deployed to the WTC site, who accepted referrals for psychotherapy, less than half (42.5%) attended at least one psychotherapy session.³²

In a separate study, Jayasinghe and colleagues report that 48% of 328 utility workers deemed in need of mental health services, accepted mental health/psychotherapy referrals after work at the World Trade site. Similar percentages of study participants chose to "consider" (28%) and decline (24%). Decision to accept vs decline mental health screening services was positively associated with current PTSD (OR = 1.12; CI 95%: 1.04, 1.21; $p < .01$), depressive symptoms (OR = 1.07; CI 95%: 1.00, 1.12; $p < .05$) and previous mental health treatment (OR = 2.85; CI 95%: 1.16, 7.03; $p < .05$).³³

In a cohort of transit workers, 16% agreed when asked if they thought supportive counseling would be helpful.¹⁸ Among rescue and recovery workers accessing medical services at the Mount Sinai School of Medicine, only 2% has previously received mental health services despite 51% having met screening thresholds for significant psychological distress or disorder.²¹ In a study of Project Liberty clients, 13% of rescue and recovery workers sought referral for psychotherapy.³⁴

Mental health service use among American Red Cross Workers post-September 11th was also assessed.³⁵ Among all study subjects ($n = 3015$), 13.5% utilized mental health services prior to September 11th, while only 10.7% accessed similar services after September 11th. Subjects who did not seek mental health services pre-September 11th were 50% more likely to seek mental health services post 9/11, while those who did access services prior to September 11th were 80% less likely. Thus, prior mental health services did not predict individual use post-September 11th.

DISCUSSION

The mental health outcomes of individuals who worked at sites related to the September 11th, 2001, attacks were varied across studies. However, most studies noted substantial rates of PTSD and MDD symptoms. Among the majority of studies, exposure to events at the WTC was associated with greater rates of overall mental health symptomatology. Little research has documented mental health service utilization among WTC workers. No studies to date have assessed the quality of such services and outcomes over time.

Rates of PTSD among individuals who worked at the WTC ranged from 8% in transit workers¹⁸ and 22.5% among a cohort of disaster workers.²⁰ The difference in rates of PTSD between the two groups is difficult to address, though may correspond to differing levels of exposure. Hypothetically, disaster workers, who worked onsite would have greater exposure over a potentially longer time period to trauma than transit workers whose primary duties were peripheral to the WTC site. However, it is difficult to quantify levels of exposure from each of these two studies.

The range of PTSD risk among September 11th workers were all well above reported lifetime prevalence of PTSD in the general population. In Scandinavia, lifetime prevalence of PTSD is 5.6, while in the United States the risk is slightly higher -7.8.^{36,37} Overall, women are far more likely to develop PTSD, as lifetime prevalence among men and women in the United States is 5% and 10.5%, respectively.³⁷ The majority of rates of PTSD among September 11th workers concerned males, thus the difference among the general population and September 11th workers may be even more pronounced.

However, the range of PTSD did not surpass the estimated risk reported just after the events of September 11th. Based on average risks associated with the Oklahoma City rescue workers, the estimated risk of PTSD among exposed September 11th rescue workers was 24%.³⁸

Exposure to the events of September 11th among workers at each of the sites was also associated with MDD. However, this association was mixed, as only one of two studies noted an association between MDD and exposure status.¹⁴ Furthermore, the 5.6% prevalence of MDD among individuals seeking treatment at the Mount Sinai School of Medicine, was little different than the 12-month prevalence rate of 5.28 (among the general US population), reported by Hasin and colleagues.³⁹

In the immediate aftermath of September 11th several mental health programs were established with the intention of providing free screening, referral and treatment services. Six studies report on this process. In those studies examining service utilization, September 11th workers generally were reluctant to utilize screening and referral mental health services. Surprisingly, studies assessing treatment use prior to September 11th conflicted on whether previous mental health treatment was predictive of post September 11th treatment use. Many individuals responding to September 11th may have been reluctant to seek services given the larger cultural and social context in which they work.

This review of the literature on the mental health of September 11th first responders and volunteer workers has revealed several avenues for research and planning. Since 2001, 25 studies have addressed the mental health needs of workers at the WTC, encompassing a far larger number of studies and of subjects than has ever previously been available for any other disaster. However, most of this literature was limited to one first responder group (e.g. American Red Cross workers, transit workers, ironworkers, etc) or a single psychiatric outcome (e.g. PTSD). Future research in this area should study a broader cross-section of first responders from various organizations, occupations, and disaster sites and take regard of various psychiatric outcomes. Quantitative outcomes should include not just PTSD but also major depression, alcohol use disorders, general distress, psychiatric symptoms, and psychosocial impact of the disaster and these disorders.

A mental health registry akin to the WTC Health Registry that begins sooner than two years after an event, as did this registry, and follows all responder groups longitudinally and across a span of mental health outcomes would provide the most comprehensive model for future monitoring of mental health status among responders. It would also assure uniformity of data collection methods, while capturing a substantial pool of subjects like that reflected in the 25 studies in this paper.

This disaster mental health registry should also possess ready availability of epidemiological expertise for prompt and expert analysis of data, thereby assuring rapid turnaround of these analyses for shaping available services in “real time.” The public health impact of such analyses would be substantial and immediate if the putative surveillance program were paired with an accessible and specialized treatment resource such as that provided at the Mount Sinai School of Medicine.^{21,40} In this way, surveillance and research can inform not only future disasters but the current one as well.

While several studies of the 25 reviewed documented factors associated with referral for psychiatric treatment, only a few provide an indication as to whether individuals who are offered referral services partake in treatment. There is no indication as to whether individuals who are actually offered referral services partake in treatment. Further, no studies have assessed the successes of treatment programs with September 11th worker populations over time. Given the paucity of longitudinal research on mental health outcomes among September 11th workers it is difficult to formulate conclusions about

best practices for providing care and treatment to these individuals.

To the large scale tandem of surveillance and treatment of disaster workers which we are proposing for future disasters should also be added a third component, a more mentally healthy and robust disaster workforce. The range of exposure and other risk factors associated with workers' mental health responses to September 11th suggests that further study and policy making should be devoted to fostering circumstances favorable to avoiding adverse psychological sequelae from disaster work. These may include considering responders' personal histories and psychological coping styles, devising means of limiting disaster exposure (such as limits on work hours), and promoting protective post-disaster conditions such as interpersonal support. Once again, potentially significant aspects of the post-disaster conditions that warrant special attention are the utilization, nature and outcome of short and long term mental health interventions.

None-the-less, so long as large scale disasters occur at a pace that outstrips research endeavors, the September 11th literature points to several possible measures available for preventing the likelihood of significant mental health sequelae and maximizing worker resilience in the future. The literature from September 11th underscores the mental health benefits of deploying and utilizing responders who are maximally trained and organized and called upon to do what they are trained to do. Ensuring better access to routine mental health services pre-disaster may also be protective. The deployment and utilization of future disaster workers should be guided, as much as possible, by regular monitoring of workers' exposure, including duration of work, in a manner akin to monitoring radiological exposure.

Finally, all but two^{40,41} of the 25 articles conducted a quantitative assessment that used some form of psychometric diagnostic or screening tool. While quantitative assessments are useful in assessing the magnitude of psychopathological outcomes among disaster workers, they do little to capture either the experience of the attacks themselves, or the psychological distress that followed. For example, while it is important to study the rate of PTSD in a disaster worker population, it is equally important to evaluate the experience and manifestations of PTSD among disaster workers, i.e. the images that dominate their flashbacks, the noises that trigger a startle response, etc. In addition, standardized psychometric tools such as the BAI or the PCL fail to address the underlying thought processes behind mental illness. Using the BAI to assess a first responder's anxiety level, for example, does not

reveal, whether that anxiety is caused by memories of the attack, fear of a future attack, or worries over September 11th-related health problems. As much of the psychotherapeutic enterprise around PTSD in particular relies on a theoretical model wherein avoided and often dissociated traumatic memories need to be re-integrated into a meaningful and less painful state of awareness and recall,⁴² so too should the research enterprise better examine the thought processes and experiences underlying symptomatology.

Qualitative study of psychopathology among this unique group may deepen our understanding of psychological responses to disasters. Qualitative studies, focused on the experience of September 11th as much as the psychological outcomes, will reveal the commonalities of the disaster experience and will allow the mental health community to better understand and serve clients who are recovering from such trauma.

The major limitation of this study is its reliance on 25 studies using often disparate methods of assessment and different sub-populations of September 11th disaster workers. However, its strength lies in its composite view of the mosaic of findings among the largest number of studies about disaster workers from one disaster available in the scientific literature. This composite has yielded a prescription of how best to identify, track, and treat disaster related mental illness in future disaster workers.

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