

Posttraumatic Stress Disorder, Gender, and Risk Factors: World Trade Center Tower Survivors 10 to 11 Years After the September 11, 2001 Attacks

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Ten to eleven years after the September 11, 2001 terrorist attacks, probable posttraumatic stress disorder (PTSD) was evaluated in 1,755 World Trade Center (WTC) evacuees based on data from the WTC Health Registry. Characteristics of men and women were compared and factors associated with PTSD symptom severity were examined using the PTSD Checklist (PCL). Compared with men ($n = 1,015$, 57.8%), women ($n = 740$, 42.2%) were younger and of lower socioeconomic status. Ten to eleven years after September 11, 2001, 13.7% of men and 24.1% of women met criteria for PTSD. Results indicated that when considered with all other variables (i.e., demographic, socioeconomic and social resources, exposure to the attacks, life events), gender was not a significant predictor of PTSD symptom severity. Being younger on September 11, 2001, unemployed, less educated, and/or having higher exposure to the attacks, unmet mental health care needs, and less social support predicted higher PCL scores for both genders ($\beta s = .077$ to $.239$). Demographic characteristics and socioeconomic resources ($\Delta R^2 = .113$) accounted for the largest amount of variance in PCL scores over and above exposure/evacuation, mental healthcare needs, and social support variables ($\Delta R^2 = .093$ to $.102$). When trends of unmet mental healthcare needs were analyzed, the most prevalent response for men was that they preferred to manage their own symptoms (15.1%), whereas the most prevalent response for women was that they could not afford to pay for mental health care (14.7%). Although the prevalence of probable PTSD in women tower survivors was approximately twice as high as it was for men, this is attributable largely to demographic and socioeconomic resource factors and not gender alone. Implications for treatment and interventions are discussed.

The September 11, 2001 terrorist attack on the World Trade Center (WTC) in New York City resulted in over 2,752 immediate deaths after two commercial airliners were deliberately flown into both WTC buildings causing their subsequent collapse (Groeger, Stellman, Kravitt, & Brackbill, 2013). The people most highly exposed to potentially traumatic events were the WTC survivors who evacuated WTC Towers 1 and 2, more commonly known as the North and South Towers, respectively. The World Trade Center Health Registry (WTCHR) was established in 2002 by the Agency for Toxic Substances and Disease Registry and the New York City Department of Health

and Mental Hygiene. The WTCHR has conducted three survey waves in an attempt to measure the longitudinal physical and mental health effects associated with the September 11, 2001 attacks. Wave 1 interviews and surveys were conducted in 2003 and 2004, Wave 2 in 2006 and 2007, and a third survey, Wave 3, in 2011 and 2012. An extensive literature exists on the health effects of residents and first responders, but there are few scientific reports that focus solely on the cohort of WTC tower survivors (Brackbill et al., 2006; DiGrande, Neria, Brackbill, Pulliam, & Galea, 2011; Gargano, Nguyen, DiGrande, & Brackbill, 2016). The majority of survivors of damaged or destroyed buildings (63.8%) experienced three or more psychologically traumatizing events with a large proportion (61.1%) having witnessed someone falling or jumping from the WTC towers (Brackbill et al., 2006). The authors found that 64.7% of the collapsed building survivors experienced new onset of depression, anxiety, or other emotional problems in 2003. During the same period, they also had an increased prevalence (10.7%) of

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serious psychological distress compared with New York City adults (5.0%).

DiGrande et al. (2011) examined the mental health status of 3,271 WTC tower survivors as reported in 2003 to 2004 (Wave 1). Of these participants, 96% reported at least one posttraumatic stress symptom and 15% had probable PTSD. Results indicated that women had an increased likelihood of PTSD when compared with men (22.4% vs. 9.9%), as did Hispanics and African Americans. Direct exposure risk factors associated with probable PTSD included being on a higher floor of the WTC, initiating evacuation late, being caught in the dust cloud (created from the collapse of the WTC towers), personally witnessing horror, and having sustained an injury. Low income was found to be the strongest risk factor associated with PTSD.

Gender differences in the prevalence of PTSD are well documented. Although men are more likely than women to experience traumatic life events, the lifetime prevalence of PTSD in U.S. women (9.7%) is roughly two times that of men (3.6%; Kessler et al., 2005). Women are also more likely to develop PTSD following exposure to severe traumas such as assault (36%) compared with men (6%; Breslau, 2002). Previous research of September 11, 2001 WTC tower survivors (Bowler et al., 2010; Bowler et al., 2016) demonstrated an increased prevalence of PTSD in women when compared with men and identified female gender as a risk factor for PTSD. These studies, like most trauma studies, did not utilize an analytical technique to elucidate potential reasons for the increased prevalence of PTSD in women. Furthermore, these samples were disproportionately comprised of male participants, as is the case with many first responder populations. The study of large representative samples of both men and women who were not first responders following a terrorist attack, such as in the current study, is rare. Many previous studies of September 11, 2001 tower survivors have reported differences in the rate of PTSD between genders but have not analyzed this trend or offered detailed explanations.

The objectives of the current study were to (a) identify differences between the demographic, socioeconomic, exposure, and evacuation characteristics, as well as the mental health status, treatment-seeking behaviors, and social support of men and women; (b) describe the rate of PTSD across the three waves; and (c) examine potential predictors of PTSD symptom severity 10 to 11 years after September 11, 2001. We hypothesized that (a) a larger proportion of women than men would include ethnic minorities, have lower household incomes, and less education; and (b) when considering other factors, gender would no longer be associated with PTSD. By addressing these objectives, we will elucidate potential reasons for increased rates of PTSD severity in women exposed to the September 11, 2001 attack.

Method

Participants and Procedure

Of the enrollees who had been in either of the WTC towers on 9/11, 42.0% were identified by lists provided by employers

or the Port Authority of New York and New Jersey, and the remainder were self-identified as a result of a large media campaign aimed at recruiting participants. A total of 4,207 tower survivors were enrolled in the WTCHR in 2003 and 2004. All data were collected using standardized WTCHR surveys. Wave 1 was completed by interviews over the phone (94.5%) or in person (5.5%). Wave 2 and 3 surveys were completed using multimodal internet, paper, or phone interviews. Participants were included in the current study if they were enrolled at Wave 1 (2003–2004) and subsequently participated in Wave 2 (2006–2007) and Wave 3 (2011–2012) of the WTCHR evaluations, had completed the PTSD Checklist (PCL) at each wave, and were located within WTC Towers 1 or 2 some time between the first plane's impact and subsequent WTC collapse. Additionally, they were required to be at least 18 years of age on September 11, 2001 and to have not participated in rescue or recovery efforts. This resulted in 1,765 civilian tower survivors who met the inclusion criteria. An additional 10 participants were excluded because they reported having been diagnosed with PTSD prior to the year of 2001, which left 1,755 participants for the current study.

At Wave 1, 2,295 (1,300 men and 995 women) tower survivors were eligible participants. At Wave 2, 1,825 of the tower survivors participated (79.5% response rate), including 1,056 men and 769 women. At Wave 3, 1,755 tower survivors (1,015 men and 740 women) had participated at all three waves (96.2% response rate from Wave 2 and 76.5% from Wave 1). This includes roughly 11.4% of the estimated population of 15,410 tower survivors (Averill et al., 2005).

The 1,962 excluded tower survivors were similar to 1,755 who were included in this study in terms of gender, location of WTC tower, time of evacuation initiation, dust cloud exposure, and the number of injuries and traumatic events witnessed on September 11, 2001. However, the excluded civilian tower survivors were more likely to be older (mean age = 42.7 vs. 39.5 years, $p < .001$), non-Hispanic White (73.8% vs. 57.7%, $p < .001$), and to have higher household incomes (31.3% vs. 23.8% for income > \$150,000, $p < .001$) than the included participants.

The study was approved by the Institutional Review Boards (IRB) at San Francisco State University and the New York City Department of Health and Mental Hygiene (DOHMH). The Centers for Disease Control and Prevention (CDC) and New York City DOHMH approved the overall registry protocols. A Federal Certificate of Confidentiality was obtained by the WTCHR, and oral informed consent was obtained from participants at enrollment.

Measures

The PTSD Checklist Stressor—Specific Version (PCL; Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Weathers, Litz, Herman, Huska, & Keane, 1993) was used to indicate PTSD symptom severity. The PCL is a validated and reliable self-reported measure using a 5-point scale and

asks the participant to rate how much they were bothered by a symptom related to the events of September 11, 2001 in the 30 days preceding response to the PCL (Blanchard et al., 1996; Ruggiero, Del Ben, Scotti, & Rabalais, 2003). The 17 items of the PCL correspond to the three diagnostic criteria of the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000). The PCL has high internal consistency, sensitivity, and strong convergent validity with the Clinician-Administered PTSD Scale (CAPS), which is considered the “gold standard” used in diagnostic interviews (Blake et al., 1990). Diagnostic criteria for probable PTSD included a total PCL score ≥ 44 in addition to meeting the *DSM-IV* diagnostic criteria of at least one reexperiencing symptom, three avoidance symptoms, and two hyperarousal symptoms rated as “moderate” or higher. Blanchard et al. (1996) reported that these criteria provide the highest diagnostic efficiency (0.90), sensitivity (0.94), and specificity (0.86). In the current study, scores on the PCL demonstrated excellent internal consistency (Cronbach’s $\alpha = .95$).

Social support was measured using five items from the Modified Social Support Survey (MSSS; Schwarzer, Cone, Li, & Bowler, 2016) using a 4-point scale. Items included emotionally or tangibly supportive situations such as having someone to take you to the doctor, to have a good time with, to hug you, to prepare your meals if unable, and to understand your problems. The five items of social support demonstrated excellent internal consistency (Cronbach’s $\alpha = .91$). Social support is concurrently described as the availability of social resources.

Two exposure and evacuation variables were created. The number of evacuation problems consisted of 11 possible complications during the evacuation process (e.g., fire/intense heat, being pushed/falling). The number of horrific events witnessed consisted of five possible events (e.g., people being injured/killed, people falling/jumping from the WTC buildings). Characteristics described as socioeconomic resources included the participants’ level of education, household income, and employment status.

Data Analysis

All data were analyzed using SPSS 24. Differences in the rate of probable PTSD across the three waves for men and women were analyzed using Cochran’s Q test. Differences between men and women regarding demographic, socioeconomic, and exposure characteristic were identified using chi-square and independent samples t tests. Hierarchical multiple linear regression analyses examined the variables as potential predictors of total PCL score, which was used to reflect PTSD symptom severity. To control for intermediate potentially traumatic events and life-stressors between September 11, 2001 and Wave 3 of the study, the number of recent life stressors and life-threatening events since the attacks were entered as control variables at Step 1.

Results

Comparisons Between Men and Women

The demographic and socioeconomic characteristics for men and women participants are presented in Table 1. On average, men were older at the time of the attacks, (mean age = 43.57 years, $SD = 10.68$) than women (mean age = 41.55 years, $SD = 10.77$), $t(1753) = 3.89$, $p < .001$. In addition, proportionally more men were White, married or living with their partner, had four years or more of college education, and higher household incomes compared to women. More women were unemployed due to health or other reasons. Following September 11, 2001, 30.6% of the total sample reported that they lost their job (i.e., not due to health or other reasons). There was no difference between men (32.0%) and women (28.7%) regarding the frequency of job loss. Among those with probable PTSD at Wave 3, 51.4% reported losing their job after the attack. However, there still was no significant difference between this rate among men (50.7%) and women (52.0%).

There were few gender differences in exposure and evacuation characteristics (Table 1). The number of survivors from each WTC tower was similar (51.82% for Tower 1 vs. 48.2% for Tower 2). The majority of participants evacuated between the first and second plane impact (81.4%). On average, it required 22.70 minutes to evacuate the WTC buildings. Although most tower survivors (61.9%) reported being exposed to the dust cloud, a larger proportion of women reported that they were exposed to the dust cloud during their evacuation and suffered more injuries than men.

Mental Health and Social Support

A higher proportion of women than men reported unmet mental health needs (20.6% vs. 11.8%, respectively) and a lower proportion of women than men reported having social support all the time (40.2% vs. 55.4%, respectively). Figure 1 shows the rates of PTSD by gender and the total sample across Waves 1, 2, and 3 of the study. A longitudinal comparison of probable PTSD across the three waves showed that men had significantly higher rates of PTSD at Wave 2 than at Wave 1 or 3, Cochran’s $Q = 23.22$, $p < .001$. For women, the prevalence of probable PTSD across the three waves remained consistent, Cochran’s $Q = 2.06$, $p = .357$. When *DSM-IV* symptom clusters from the PCL scale were analyzed, more women than men met criteria for reexperiencing (59.3% vs. 42.2%), avoidance (32.6% vs. 22.4%), and hyperarousal (49.5% vs. 35.7%).

More women than men (14.6% vs. 7.1%) from the total Wave 3 sample reported having sought treatment in the last 12 months for their trauma-related symptoms, $\chi^2(1, N = 1,745) = 25.86$, $p < .001$. This gender difference persisted when analyzing only those with probable PTSD. Whereas 40.1% of women with probable PTSD sought treatment for their related symptoms, only 29.7% of men sought treatment, $\chi^2(1, N = 315) = 3.66$, $p = .036$.

Table 1
Demographic, Socioeconomic, and Exposure Characteristic Comparison Between Men and Women at Wave 3

Variable	Men (<i>n</i> = 1,105)				Women (<i>n</i> = 740)				χ^2	<i>t</i>
	Mean	SD	<i>n</i>	%	Mean	SD	<i>n</i>	%		
Age on September 11, 2001 (years)	43.57	10.68			41.55	10.77				3.89***
Ethnicity									85.39***	
Black			37	3.6			109	14.7		
Hispanic			80	7.9			89	12.0		
Asian/Other			81	8.0			63	8.5		
White			817	80.5			479	64.7		
Marital Status (Wave 3)									143.82***	
Never married			97	9.6			170	23.1		
Widowed/Divorced			80	7.9			152	20.7		
Married/Cohabiting			832	82.5			413	56.2		
Education (Wave 1)									56.29***	
≤ Grade 12/GED			110	10.9			142	19.3		
College 1–3 years			141	13.9			165	22.4		
College ≥ 4 years			762	75.2			430	58.3		
Household income (Wave 3)									89.81***	
≤ \$75,000			253	26.2			328	47.5		
\$75,001 - \$149,999			326	33.8			200	28.9		
≥ \$150,000			386	40.0			163	23.6		
Employment status (Wave 3)									31.35***	
Not employed			115	11.3			156	21.1		
Retired			157	15.5			107	14.5		
Employed			743	73.2			477	64.5		
In dust cloud (yes)			602	59.7			479	65.1	5.30*	
No. injuries on September 11, 2001	0.60	0.93			0.87	1.11				5.43***
No. evacuation problems	4.07	2.41			4.08	2.34				n.s.
No. horrific events witnessed	2.88	1.40			2.80	1.41				n.s.

Note. Valid percentages shown, excluding missing cases. GED = General Educational Development, No. = number, n.s. = not significant.

* $p < .05$. ** $p < .01$. *** $p < .001$.

During the last 12 months before the Wave 3 study, 270 (15.5%) of the tower survivors reported having unmet mental health care needs, with significantly more women ($n = 152$, 20.6%) than men ($n = 118$, 11.8%) having unmet needs. When reporting why the participants' mental health care needs were unmet in those with PTSD, the most prevalent response for men was that they preferred to manage their own symptoms (15.1%), whereas the most prevalent response for women was that they could not afford to pay for mental health care (14.7%).

Predictors of PCL Score

Predictors of PTSD symptom severity at Wave 3, indicated by total PCL score, were examined using hierarchical multiple linear regressions (Table 2). Post-September 11, 2001 life-threatening events and significant stressors were included as control variables to help isolate the longitudinal effect of exposure to the attack. Overall, the predictive model showed

a large effect, accounting for 41.9% of the variance in PCL scores. Demographic and socioeconomic characteristics accounted for the most variance in PCL scores over and above exposure/evacuation, healthcare needs, and social support. It is notable that when considering all other variables, gender was *not* a significant predictor of PCL score. When considered with all other variables, being younger on September 11, 2001, having less education, and being unemployed were significant predictors of higher PCL scores. In addition, significant predictors of higher PCL scores included having experienced more injuries, more evacuation problems, and more horrific events witnessed on September 11, 2001. Having unmet mental health care needs and less social support also predicted higher PCL scores.

Discussion

Ten to eleven years after September 11, 2001, 18.1% of WTC tower survivors had probable PTSD. This rate is more than two

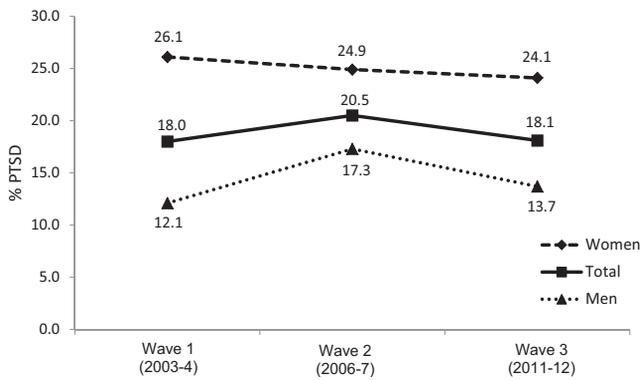


Figure 1. Rates of posttraumatic stress disorder (PTSD) for total group, men, and women across three waves of study. Chi-square comparison between men and women: Wave 1: $\chi^2(1, N = 1,755) = 56.52, p < .001$; Wave 2: $\chi^2(1, N = 1,755) = 14.86, p < .001$; Wave 3: $\chi^2(1, N = 1,755) = 31.03, p < .001$.

times greater than the lifetime prevalence of PTSD reported for the general population (6.8%; Kessler et al., 2005). As expected, more women (24.1%) than men (13.7%) met criteria for probable PTSD. The rate of PTSD in men fluctuated over time, whereas the rate of PTSD in women remained consistently elevated. Results indicated that when equally considered with all other variables (i.e., demographic, socioeconomic and social resources, September 11, 2001 attack exposure, life events), gender was not a significant predictor of PTSD symptom severity. This indicates that although the prevalence of probable PTSD is approximately twice as high for women tower survivors

compared with men, this is likely attributable to other factors and not gender alone. Notably, similar exposure variables (e.g., injuries, witnessing horrific events) identified by DiGrande et al. (2011) at Wave 1 continued to be identified as risk factors at Wave 3, demonstrating the chronic effect of trauma exposure on PTSD symptoms.

Demographic characteristics and the availability of socioeconomic resources were the largest predictors of increased PTSD symptom severity. This trend is supported by a multitude of reports in the literature. In a study of primary care patients 7 to 16 months after September 11, 2001, women had higher rates of PTSD than men, despite having lower levels of exposure to stressors during the WTC attack (Weissman et al., 2005). These differences were largely attributable to differences in marital status, having low income, and having fewer years of education. Similar to the current study, the gender disparity in PTSD rates became non-significant after controlling for these factors.

The availability of socioeconomic resources can mitigate psychological distress following trauma (Norris et al., 2002). In general, people with fewer resources may be marginalized and have less access to basic needs, such as a safe living environment and mental health treatment (DiGrande et al., 2008). Individuals with fewer socioeconomic resources may also not have the disposable income or spare time outside of work to access other environmental resources that may help alleviate PTSD symptoms in addition to improving social integration (e.g., vacation, gym membership, clubs/organizations).

Individuals with fewer socioeconomic resources, including fewer years of education and lower household incomes, are

Table 2
Hierarchical Multiple Regression Results Predicting Total PCL Score

Step	Predictor	ΔR^2	β
Step 1	Post-9/11 life-threatening events	.112***	.069**
	Recent life stressors		.095***
Step 2	Age on 9/11	.113***	-.116***
	Gender		.022
	Education (Wave 1)		-.077**
	Ethnicity		-.031
	Marital Status (Wave 3)		.019
	Household income (Wave 3)		-.049
	Employment status (Wave 3)		-.169***
Step 3	In dust cloud	.102***	.016
	Building floor		.002
	Injuries on 9/11		.176***
	Evacuation problems		.104***
	Horroric events witnessed		.137***
Step 4	Unmet mental healthcare needs	.093***	-.239***
	Social support sum		-.185***
	Total R^2	.419***	
	<i>n</i>	1,348	

Note. Final model: $F(16, 1347) = 60.02, p < .001$. 9/11 = September 11, 2001. Standardized regression coefficients shown from final model.

* $p < .05$. ** $p < .01$. *** $p < .001$.

more likely to have less job security, no matter the gender of the individual. In the current study, roughly half of those with probable PTSD lost their jobs after September 11, 2001, which demonstrates the importance of these resources following a potentially traumatic event. Interestingly, in the current study there was no difference in the prevalence of men and women who suffered job loss after September 11, 2001. This indicates that it is not necessarily the loss of socioeconomic resources following trauma but persistently fewer socioeconomic resources that helps explain the difference in PTSD symptom severity between men and women.

McLeod and Kessler (1990) described persons with fewer socioeconomic resources, including income, education, and occupational status, as having a “differential vulnerability” to mental health problems following stressful life events. Gallo and Matthews (2003) theorized that a lack of socioeconomic resources creates a stressful environment, which in turn depletes an individual’s capacity to manage additional stressors or traumas. If secondary stressors or traumas do occur, these individuals are increasingly vulnerable to develop negative emotions and cognitions, common symptoms of PTSD. These, in turn, may cause a disruptive pattern of hopelessness and poor coping mechanisms, which may result in long-term PTSD and the potential for comorbid disorders, including depression or substance abuse (Gallo & Matthews, 2003). In addition to these theories, Gavranidou and Rosner (2003) described a “downward spiral” in which a traumatic experience disproportionately results in greater symptomatology in women because women have fewer pretraumatic resources available to them. Individuals who were already experiencing stress related to socioeconomic difficulties may have suffered an exacerbation of these symptoms following the events of September 11, 2001 (Adams & Boscarino, 2006). In the WTC tower survivor population, these individuals were largely women who suffered more severe PTSD symptoms than their male counterparts. This pattern among WTC employees from 2001 is consistent with socioeconomic inequities experienced by women in the United States today and demonstrates the psychological risk associated with such inequities following acts of terrorism (U.S. Department of Labor, 2017).

Social support is another vital resource following trauma exposure. Results from the current study suggest that social support is important for men and women when predicting PTSD symptom severity. Brewin, Andrews, and Valentine (2000) suggest that a lack of social support is one of the major predictors of increased PTSD following a trauma, with higher levels of social support associated with lower rates of PTSD in women (Smith et al., 2011). Analogous results are reported by Pulcino et al. (2003) in their study of Manhattan residents 5 to 8 weeks after September 11, 2001. Among the women studied, PTSD rates increased significantly as social support decreased. Income has been positively associated with social support (Gallo & Matthews, 2003). Individuals, especially women in the current study, may have fewer social resources available to them due to socioeconomic constraints, especially a lack of

income. For example, those with few socioeconomic resources may have little time outside of work to socialize or may not socialize due to financial constraints. This in turn would likely impact received social support and result in increased social isolation, which may exacerbate negative emotions and cognitions. Therefore, interventions aimed to improve social support and integration may not be successful until more basic socioeconomic gains are made following trauma exposure.

Fewer men sought treatment for their trauma-related symptoms than women. The most prevalent reasons for unmet mental health care needs reported by men included preferring to manage their posttraumatic stress symptoms by themselves and thinking that nothing could help. The most prevalent reasons for unmet mental health care needs reported by women included not being able to afford care, having problems with scheduling, and childcare. This indicates that women who do not seek mental health treatment do not do so largely because they lack socioeconomic and social resources. Follow-up in people who screened positive for PTSD and did not seek treatment may encourage these men and women to seek available treatment. In addition, employment outreach programs and childcare services may encourage more women to seek mental health treatment and enable more social support and integration following acts of terrorism.

The main limitation of this study lies in the practical realities of terrorist attacks, resulting in self-reported data that precludes the examination of causal relationships. Moreover, some confounders are possible when employing variables such as unmet health needs, social support, and employment as putative predictors of PTSD because such predictors may themselves be due to the traumatic event and therefore cannot be completely disentangled from PTSD.

Contributing factors to PTSD symptom severity in the current study represent an incomplete list of potential factors with the cumulative effects observed as gender differences in the prevalence of PTSD. Other potentially contributing factors, such as personality characteristics, cultural values, appraisals, coping strategies, familial obligations (e.g., being a primary caregiver), and peritraumatic experiences, would also elucidate the relationships between gender and PTSD. Respondents may also have a potential response bias due to being in a self-identified group of WTCHR enrollees. Those who actively sought out the WTCHR may have been sicker than those who were recruited through lists (Brackbill et al., 2006).

Although the prevalence of probable PTSD is approximately twice as high for female WTC tower survivors compared with male WTC tower survivors, this is largely attributable to factors of demographic and socioeconomic resources and not gender alone. Individuals most susceptible to posttraumatic stress following trauma are likely to be women with few socioeconomic resources. Early outreach to these individuals for mental health screening and, if necessary, mental health treatment is crucial to limit the long-term and adverse psychological effects of terrorism. Findings from this study may be applied

to preventative programs in the immediate follow-up of future terrorist attacks and should encourage a closer examination of gender effects in future trauma research.

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