



HHS Public Access

Author manuscript

Psychol Trauma. Author manuscript; available in PMC 2020 February 01.

Published in final edited form as:

Psychol Trauma. 2019 February ; 11(2): 156–164. doi:10.1037/tra0000404.

PTSD and Comorbid Depression: Social Support and Self-Efficacy in World Trade Center Tower Survivors 14–15 Years After 9/11

Shane W. Adams, M.A.^{a,b,*}, Rosemarie M. Bowler, Ph.D., M.P.H.^c, Katherine Russell, Ed.M., M.A.^d, Robert M. Brackbill, Ph.D., M.P.H.^e, Jiehui Li, MBBS, M.Sc.^e, and James E. Cone, M.D., M.P.H.^e

^aJohn Jay College of Criminal Justice of the City University of New York, Department of Psychology, New York, NY

^bThe Graduate Center of the City University of New York, Department of Psychology, New York, NY

^cSan Francisco State University, Department of Psychology, San Francisco, CA

^dCalifornia School of Professional Psychology at Alliant International University, San Francisco, CA

^eWorld Trade Center Health Registry, Division of Epidemiology, New York City Department of Health and Mental Hygiene, New York, NY

Abstract

Objective: Following the World Trade Center (WTC) terrorist attack in New York City, prevalence rates of posttraumatic stress disorder (PTSD) and depression remain elevated. Although social support and self-efficacy have been associated with PTSD, little is known about their differential effect on PTSD and depressive comorbidity.

Method: WTC tower survivors ($n = 1,304$) were assessed at Wave 1 (2003–4), Wave 2 (2006–7), Wave 3 (2011–12), and Wave 4 (2015–16).

Results: At Wave 4, 13.0% of participants had probable PTSD, a decrease from 16.5% at Wave 1. In addition, 4.1% (54) were identified as having PTSD alone, 6.8% (89) had depression alone, and 8.9% (116) had comorbid PTSD and depression. Of those with PTSD, 68.2% also had comorbid depression. WTC tower survivors with PTSD and comorbid depression reported greater PTSD symptom severity and were more likely to have had greater exposure to the events of 9/11 (aOR = 1.14) and lower self-efficacy (aOR = 0.85) than those with depression alone. Less perceived social support predicted only depression and not PTSD, whereas less perceived self-efficacy equally predicted having PTSD or depression (aOR = 0.76).

Conclusions: Findings indicate that self-efficacy may be more important to the severity and chronicity of PTSD symptoms than social support. Multivariate comparisons suggest that PTSD

*Corresponding Author: Shane W. Adams, 524 West 59th Street, Room 10.67.01, New York, NY, 10019; (262) 745-6862; shadams@jjay.cuny.edu.

with comorbid depression is a presentation of trauma-dependent psychopathologies, as opposed to depression alone following trauma, which was independent of trauma exposure and may be secondary to the traumatic event and posttraumatic response. Implications for assessment and treatment are discussed.

Comorbidity with posttraumatic stress disorder (PTSD) is more common than with any other psychological disorder (Koenen et al., 2008). In the National Comorbidity Survey – Replication (NCS-R), 42.8% of individuals with PTSD also had major depressive disorder (MDD) (Rojas, Bujarski, Babson, Dutton, & Feldner, 2014). In general, nearly half of those with PTSD are reported to have comorbid depression (Flory & Yehuda, 2015). Rates of PTSD and comorbid depression in individuals exposed to the World Trade Center terrorist attack on September 11, 2001 (9/11) are reportedly higher than national lifetime rates (Bowler et al., 2016; Caramanica, Brackbill, Liao, & Stellman, 2014; Chiu et al., 2011). In a sample of police officers who responded to 9/11, 12.9% of participants reported symptoms consistent with probable PTSD 10–11 years later (Bowler et al., 2016). Of those with PTSD, 72.4% also had comorbid depression and anxiety.

There are two theories as to why the rate of comorbidity between PTSD and depression is so high (Flory & Yehuda, 2015). First, comorbidity may be the result of diagnostic symptom overlap between PTSD and depression. In this case, PTSD and depression may appear comorbid because of an imprecise classification of shared symptoms. However, there is little support of this theory (Flory & Yehuda, 2015).

Alternatively, depressive comorbidity may be a trauma or stressor-related presentation that is distinct from depression alone and is specific to depression secondary to trauma. In this case, PTSD with comorbid depression could be considered a subtype of PTSD. There is some evidence for this theory. When examining PTSD alone and PTSD with comorbid depression, researchers have identified distinct risk factors and psychophysiological correlates, including worse neurocognitive functioning associated with comorbidity (Dekel, Ein-Dor, Rosen, & Bonanno, 2017; Flory & Yehuda, 2015). Generally, the comorbidity of PTSD and depression has been associated with many internalizing (e.g., negative affectivity, low extraversion) and externalizing (e.g., substance use) factors (Flory & Yehuda, 2015). Chiu and colleagues (2011) identified independent risk factors associated with depression and PTSD in firefighters who participated in 9/11 rescue and recovery efforts. Participants with problem alcohol use were uniquely predisposed to risk of depression and those who arrived earlier at the WTC site were uniquely predisposed to risk of PTSD. In the first months following terrorist attacks, rates of depression ranged from 20–30% in directly affected individuals (Salguero, Fernández-Berrocal, Iruarrizaga, Cano-Vindel, & Galea, 2011). Risk factors associated with depression included being a woman, having experienced more stressful situations before or after the attack, peritraumatic reactions during the attack, loss of psychosocial resources, and low social support.

Previous research has shown that the presence of psychiatric comorbidity heightens the burden of mental illness, including greater functional impairment and worse treatment prognoses than those without comorbid conditions (Caramanica et al., 2014; Flory & Yehuda, 2015; Galatzer-Levy, Nickerson, Litz, & Marmar, 2013; Hruska, Irish, Pacella,

Sledjeski, & Delahanty, 2014; Rojas et al., 2014; Shalev et al., 1998; Wilk et al., 2006). In particular, PTSD with comorbid depression is associated with greater PTSD symptom severity, poorer psychosocial functioning, and greater risk of chronicity (Hruska, Irish, Pacella, Sledjeski, & Delahanty, 2014; Shalev et al., 1998; Wilk et al., 2006). Among civilian and first-responder survivors of the WTC attacks, those with more than one mental health diagnosis (i.e., PTSD and depression) had greater impairment in mental and social functioning compared to those with only one diagnosis (Bowler et al., 2012; Caramanica, Brackbill, Liao, & Stellman, 2014; Stellman et al., 2008).

Social support has been identified as one of the most important protective factors against PTSD (Brewin, Andrews, & Valentine, 2000). Self-efficacy reflects a belief in one's capability to manage or control their well-being, thoughts, emotions, behaviors, and environment (Benight & Bandura, 2004; Jerusalem & Schwarzer, 1992). Perceived self-efficacy is central to human agency and involves cognitive and affective processes that can also affect one's perceptions of a traumatic event and their ability to cope following the event (Benight & Bandura, 2004).

Although both social support and self-efficacy have been associated with depression and PTSD severity (see Benight & Bandura, 2004; Luszczynska, Benight, & Cieslak, 2009), little is known about their differential effect on comorbid posttraumatic outcomes. The enabling hypothesis suggests that social support enables and enhances self-efficacy (Schwarzer & Knoll, 2007). Within this model, social support may facilitate increases in self-efficacy, which facilitate reductions in PTSD and depressive symptoms (Benight & Bandura, 2004; Schwarzer & Knoll, 2007). That is, social support is indirectly associated with PTSD as a result of enabling the direct relationship between self-efficacy and mental health outcomes. In this case, it may be that self-efficacy, rather than social support, facilitates one's ability to overcome and make meaning out of negative thoughts and emotions that may be particularly detrimental when PTSD and depression are comorbid (Benight & Bandura, 2004; Flory & Yehuda, 2015).

Alternatively, the cultivation hypothesis suggests that self-efficacy facilitates and maintains social support, which may bolster one's social resources and result in a reduction of PTSD symptoms (Schwarzer & Knoll, 2007). That is, social support is mainly responsible for reductions in PTSD and depressive symptoms. Finally, it is possible that there is a bi-directional relationship between social support and self-efficacy in that each informs the other and predicts mental health status (Schwarzer & Knoll, 2007).

In a study of the Oklahoma City bombing, self-efficacy was identified as a unique predictor of PTSD when equally considering depression (Benight et al., 2000). This effect was found independent of social support and several other factors, which would lend support to the enabling hypothesis and suggest that self-efficacy, not social support, is the primary mechanism behind mental health outcomes following a potentially traumatic event (Benight & Bandura, 2004). However, it is unclear what differential impact social support and self-efficacy may have when PTSD is comorbid with depression. Determination of the potentially differential effect of these mechanisms may help inform clinical interventions and targeted treatments following future mass traumas.

The WTC Health Registry (WTCHR), in an effort to assess the health sequelae in those exposed to the WTC disaster, surveyed individuals over four waves of data collection, spanning a period of 14–15 years post-9/11. Few studies have examined individuals from the estimated population of 15,410 WTC tower survivors, whose traumatic experiences were likely amplified due to the severity and proximity of trauma exposure (Averill et al., 2005). In addition, knowledge is limited about specific mechanisms associated with PTSD comorbidity, such as social support and self-efficacy, and many previous investigations have relied on lifetime diagnoses, rather than comorbidity related to a specific mass trauma (Flory & Yehuda, 2015).

The current study used a unique sample of WTC tower survivors to provide information about PTSD and comorbid depression in relation to social support and self-efficacy 14–15 years after a terrorist attack. It was hypothesized that the majority of those with PTSD, would also have comorbid depression. It was also hypothesized that self-efficacy would predict PTSD and depressive outcomes over and above social support given its relationship to perceived agency and the ability to cope with negative internalizing thoughts and behaviors.

Method

Participants

The sample includes WTC tower survivors who were enrolled in the WTC Health Registry (WTCHR) and participated at Wave 1 (2003–4), Wave 2 (2006–7), Wave 3 (2011–12), and Wave 4 (2015–16) of the study. Participants were recruited from lists provided by employers or the Port Authority (42%) or self-identified as the result of a large media campaign designed to recruit participants (58%). The sample of WTC tower survivors consisted of higher proportion of list-identified participants compared to the whole WTCHR cohort (Farfel et al., 2008).

Participants were required to have been physically present within WTC Towers 1 or 2 between the first plane's impact and subsequent WTC collapse and were required not have participated in rescue or recovery efforts following 9/11. In addition, participants must have been at least 18 years of age on 9/11, must not have reported doctor-diagnosis PTSD before 9/11, and must have completed the PTSD Checklist (PCL) at each wave of study.

At Wave 1, 2,298 WTC tower survivors were eligible participants. Of those who were eligible at Wave 1, 1,825 (79.4%) were eligible at Wave 2. Of those who were eligible at Wave 2, 1,755 (76.4%) were eligible at Wave 3, and 1,346 (58.6%) were eligible for all four waves of study. Because the goal of this study was to examine the comorbidity of PTSD and depression at Wave 4, participants must also have completed the Patient Health Questionnaire (PHQ-8) at Wave 4 of the study. This resulted in a final study sample of 1,304 participants. The current study sample included 56.7% of the Wave 1 sample and 8.5% of the estimated population of 15,410 tower survivors (Averill et al., 2005).

Those participants included at Wave 4 were compared to those who were not included at Wave 4 due to non-response (339, 19.3%) or missing PCL and PHQ-8 items (112, 6.4%)

using Pearson's chi-square and Cramer's V to indicate effect size. Those who dropped out of the study or had missing data were more likely to be non-White (31.1% vs. 24.5%, $p = .049$) and have less than four years of college education (37.4% vs. 29.9%, $p = .014$). In addition, non-participants had poorer general health (Cramer's $V = .15$, $p < .001$), were more likely than those who participated to have probable PTSD (22.0% vs. 16.7%, $p = .013$), depression (23.6% vs. 17.0%, $p = .002$), and to have avoidant symptoms (30.8% vs. 25.2%, $p = .021$). Specifically, non-participants were more likely to report symptoms of avoiding activities or situations that remind them of 9/11 (Cramer's $V = .12$, $p < .001$) and having lost interest in things they previously enjoyed (Cramer's $V = .10$, $p = .001$).

The study was approved by the Institutional Review Boards (IRB) at San Francisco State University and the NYC 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 and Procedures

All data were collected using standardized WTCHR surveys. Wave 1 (enrollment) was completed by interviews over the phone (95%) or in-person (5%). Waves 2, 3, and 4 surveys were completed using multimodal internet, paper, or phone interviews. Relevant survey items included information regarding socio-demographic characteristics, lifestyle characteristics, exposure, evacuation, life events, social support, self-efficacy, and mental health.

Perceived social support at Wave 4 was measured using five items from the Modified Social Support Survey (MSSS; CDC, 2000). Participants were asked to report how often they thought someone was available in times of social and emotional need. Items included having someone to take them to the doctor, to have a good time with, to hug them, to prepare their meals if unable, and to understand their problems. Responses were rated on a four-point scale and were summed to create a total score, with higher scores reflecting more social support. The five items of social support demonstrated excellent internal consistency, $\alpha = .91$.

Perceived self-efficacy was measured at Wave 4 using five items from the General Self-Efficacy Scale (GSE) (Schwarzer & Jerusalem, 1995). Items asked participants how well they can deal with unexpected problems and accomplish their goals. Responses were rated on a four-point scale and summed to create a total score with higher scores reflecting more self-efficacy. The five items of self-efficacy demonstrated excellent internal consistency, $\alpha = .90$.

An expanded exposure index from Wave 1, similar to Adams and Boscarino (2006) and Brackbill et al. (2013), was created to indicate participants' overall level of exposure. The index consisted of a sum of 23 possible events that participants could have experienced on 9/11. Items consisted of dust cloud exposure, the perception of being killed or seriously injured, horrific events witnessed (5 items; Farfel et al., 2008), building evacuation problems that included 11 items – fire, poor lighting, lack of communication with officials, smoke,

extreme crowding, panicky crowds, water in the stairs/lobby, blocked/locked exits, elevator not working, exhausted by stairs, pushed/tripped/fell), and injuries incurred on 9/11 (5 items; Farfel et al., 2008). Total scores ranged from 0–23.

The PTSD Checklist Stressor-Specific Version (PCL) (Weathers et al., 1993) was used to measure PTSD symptoms. The PCL is a validated and reliable self-reported measure using a 5-point scale to rate how much a participant was bothered by a symptom related to the events of 9/11 in the preceding 30 days (Blanchard et al., 1996). The 17 items of the PCL correspond to the three diagnostic criteria of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV*; 4th ed.; American Psychiatric Association, 2000). To ensure the highest diagnostic efficiency, diagnostic criteria for probable PTSD included a total PCL score ≥ 44 in addition to meeting the *DSM-IV* diagnostic criteria of at least one re-experiencing symptom, three avoidance symptoms, and two hyperarousal symptoms rated as “moderate” or higher (Blanchard et al., 1996). At Wave 4, the PCL demonstrated excellent internal consistency, $\alpha = .95$.

The eight-item Patient Health Questionnaire (PHQ-8) (Kroenke et al., 2009) was used to measure symptoms of depression. The PHQ-8 was administered in the WTCHR survey only at Waves 3 and 4. The PHQ-8 ($\alpha = .89$) has high clinical sensitivity and specificity (Kroenke et al., 2009). At Wave 4, the PHQ-8 demonstrated excellent internal consistency, $\alpha = .92$, and the recommended diagnostic criteria for probable depression of a total PHQ-8 score ≥ 10 was used (Kroenke et al., 2009).

Data analysis

Participants were categorized into one of four mutually exclusive probable diagnostic groups according to their mental health status at Wave 4: a) no PTSD or depression, b) PTSD alone, c) depression alone, d) PTSD with comorbid depression. All independent variables were compared between the diagnostic groups using chi-square tests and analysis of variance (ANOVA). Post hoc comparisons for continuous variables were adjusted using Bonferroni correction from multiple pairwise comparisons. Cramer’s V and partial eta-squared were used to measure effect size following statistical conventions. Multinomial logistic regression was used to identify predictors of diagnostic group membership at Wave 4. The “no PTSD or depression” group served as the reference or comparison category for analyses examining predictors of PTSD alone and depression alone. To help determine factors associated with an increased risk for comorbid PTSD with depression over having depression without PTSD, the comorbid group was compared to the depression alone group. All analyses were conducted in SPSS 24.

Results

The frequency and rate of probable PTSD for Waves 1–4 are shown in Figure 1. Of the participants ($n = 1,304$) who completed the PCL at all four waves of study, 170 (13.0%) had probable PTSD at Wave 4 (2015–16). This is a significant decrease from 16.5% in 2003–4 (Cochran’s $Q = 40.24$, $p < .001$). Of the total sample, 54 (4.1%) participants were identified as having PTSD alone, 89 (6.8%) with depression alone, and 116 (8.9%) with comorbid PTSD and depression (See Table 1). At each wave of study, the group with comorbid PTSD

and depression had significantly higher PCL scores than the group with PTSD alone ($p = .014$), indicating worse overall PTSD symptom severity (Figure 2).

Comparison of diagnostic groups

Characteristics of the four diagnostic groups were compared. Criteria for probable PTSD included a total PCL score ≥ 44 in addition to meeting the *DSM-IV* diagnostic criteria, and criteria for probable depression included a total PHQ-8 score ≥ 10 . Participants in the PTSD with depression group were younger than those without PTSD or depression (Table 1). Participant groups also differed by gender, ethnicity/race, marital status, education, and household income. There were a similar number of participants from both WTC towers within each group (Table 2). Overall, participants with PTSD, including the PTSD alone and the comorbid group had significantly greater exposure to the events of 9/11 than participants with depression alone or participants without PTSD or depression ($\eta^2 = .08, p < .001$)

Participants with depression, including the depression alone and comorbid PTSD and depression groups, reported having less social support than participants with PTSD alone or participants without PTSD or depression (Table 3). Participants with comorbidity had the lowest self-efficacy ratings compared to all other groups. Group differences in self-efficacy demonstrated a large effect ($\eta^2 = .26$).

Men in the comorbid group reported drinking at least five alcoholic beverages in one sitting more often than any other diagnostic group. Women in the comorbid and PTSD alone group reported drinking at least four alcoholic beverages in one sitting more than the group without PTSD or depression. Participants in the comorbid group reported the lowest quality of life when compared to all other groups and were more likely to be less physically active.

Predictors of diagnostic group membership

Multinomial logistic regression was used to examine predictors of PTSD, depression, and comorbid group membership when compared to the no PTSD or depression group (Table 4). Collinearity was examined and determined not to violate statistical assumptions. Overall, variables that predicted PTSD were distinct from those that predicted depression with the exception of self-efficacy. Lower self-efficacy predicted membership equally for the PTSD and depression groups (aOR = 0.76).

More recent life-threatening events, Latino ethnicity, initiating evacuation later, and higher exposure to the WTC events predicted having PTSD alone when compared to those without PTSD or depression. It is notable that neither physical activity nor social support predicted membership in the PTSD alone group. More recent life stressors, more social support, and less physical activity predicted having depression alone when compared to those without PTSD or depression. It is notable that neither recent life-threatening events, evacuation, nor exposure predicted membership in the depression alone group.

To help determine what factors predict the increased risk for comorbid PTSD with depression over having depression without PTSD following trauma, the depression alone group served as the reference category. Greater exposure to potentially traumatic events on 9/11 (aOR = 1.14) and lower self-efficacy (aOR = 0.85) were the only statistically

significant predictors of comorbid PTSD and depression when equally considering all other factors.

Discussion

In the current study, 13.0% of WTC tower survivors had PTSD and over two-thirds (68.2%) of those with PTSD had comorbid depression. Of the total sample, 4.1% had PTSD alone, 6.8% had depression alone, and 8.9% had PTSD with comorbid depression. Participants with comorbidity reported more severe PTSD symptoms than the PTSD alone group at all four waves of study. This indicates that, not only is PTSD with comorbid depression more common than PTSD alone following mass trauma, but the symptoms reported are more severe.

When examining each diagnostic group, unique predictors for PTSD and for depression were identified. More recent life-threatening events, later evacuation initiation, Latino ethnicity, and greater trauma exposure predicted having PTSD alone. More recent life stressors, less social support, and less recent physical activity predicted having depression alone. This demonstrates that overall trauma exposure predicts PTSD symptoms but not depressive symptoms following trauma, suggesting that depressive symptoms do not arise directly from trauma exposure and have a cause other than or secondary to the traumatic event (i.e., subsequent life stressors) or to the posttraumatic response itself (Jacobson, Norman, Nguyen, & Brackbill, 2018).

Less perceived self-efficacy and greater exposure to the events of 9/11 predicted comorbid PTSD and depression. Findings suggest that the degree to which a person believes they can handle difficult situations predicts both PTSD and depressive symptoms. This is contrary to social support, which predicted only depression. The unique predictive roles of self-efficacy and social support may suggest that individual characteristics such as self-efficacy may be more important to the maintenance and perception of PTSD symptoms than social and environmental factors. Current findings may support the theory that social support enables self-efficacy and that social support is only indirectly related to PTSD through perceived self-efficacy (Benight & Bandura, 2004; Schwarzer & Knoll, 2007). Therefore, clinical interventions that focus on enhancing self-efficacy and agentic thoughts and behaviors following a traumatic event may be more effective in the treatment of PTSD and depression than interventions focusing on social contexts and interpersonal relationships.

Findings from the current study indicate the importance of evaluating comorbid conditions during the assessment of PTSD so that the most appropriate treatment may be provided. Flory and Yehuda (2015) theorized that people with PTSD and comorbid depression may respond to trauma with internalizing behavioral, affective, and cognitive mechanisms. Negative affective style, including mood and cognitions, and internalizing behaviors (e.g., self-blame, guilt, sadness) may make the individual less likely to seek out social support or interactions (Flory & Yehuda, 2015). Decreased social support may result in decreased self-efficacy and increased negative affective styles and self-appraisals, which may result in greater symptom severity and chronicity (Brown et al., 2016; Schwarzer & Knoll, 2007). In a recent study, researchers demonstrated that increased perceptions of self-efficacy in

individuals with PTSD were positively associated with future-oriented thinking and better social problem solving, which are relevant to coping with PTSD and depression (Brown et al., 2016). Similarly, current findings suggest that those who are less self-efficacious may be less confident in their ability to cope with the distressing affective and cognitive processes of posttraumatic stress and are more likely to have comorbid PTSD and depression following trauma.

The current study and past studies lend empirical support to the theory that PTSD and comorbid depression may be phenotypically different from depression alone with increased symptom severity and unique risk factors (Dekel, Ein-Dor, Rosen, & Bonanno, 2017; Flory & Yehuda, 2015). Most notably, these conditions differ by severity of trauma exposure, which was uniquely associated with PTSD and comorbid depression and not depression alone following trauma. Tower survivors with PTSD and comorbid depression experienced more potentially traumatic events on 9/11 than did those with depression alone, likely affecting their comorbid psychiatric status 14–15 years later. This suggests that PTSD with comorbid depression is a presentation of PTSD and depressive symptoms that are both trauma-related psychopathologies, as opposed to depression alone following trauma, which was independent of trauma exposure and may be secondary to the traumatic event or posttraumatic response and largely dependent on subsequent stressors and social support (Jacobson, Norman, Nguyen, & Brackbill, 2018). In this case, specific interventions for the treatment of depression following trauma, such as those that emphasize mechanisms of social support or physical activity, may not be appropriate for treating PTSD with depression. However, results indicate that clinical interventions for PTSD that target the processing of traumatic experiences and enhancement of self-efficacy may be more effective in treating PTSD with comorbid depression.

Despite the strengths of this study, there were some inherent limitations. Because participants in the current study must have participated at all four waves, a substantial number of drop-outs and exclusions can be expected. Those people who dropped out of the study after Wave 3 were shown to have poorer general health and higher rates of PTSD. These participants were particularly more likely to have previously reported symptoms of avoiding things that reminded them of 9/11, which would include the current study. Therefore, it is likely that this is an underestimation of the true rate of PTSD and depression in the tower survivor population. Although this is a reflection of the inherent difficulties of conducting trauma research, we cannot rule out the possibility of a selection bias, such that those who participated at all four waves are different from those who did not. However, in a study of WTCHR enrollees, attrition did not result in a serious bias in findings of 9/11-related exposure and various health outcomes (Yu, Brackbill, Stellman, Ghuman, & Farfel, 2015). Further, all data are self-reported and those participants who self-identified for this study may have more problems than those who did not self-identify, representing a potential response bias.

Conclusion

Over the course of approximately 12 years, the rate of probable PTSD in tower survivors decreased by 3.5% from 16.5% two-to-three years after 9/11 (Wave 1), to 13.0% 14–15

years after 9/11 (Wave 4). WTC tower survivors with PTSD and comorbid depression had greater PTSD symptom severity, trauma exposure, and less self-efficacy. Findings from the current study indicate that perceived social support may relate only to depression and not PTSD, whereas self-efficacy is related to PTSD, depression, and comorbid outcomes following trauma. Factors associated with exclusive diagnoses of PTSD and of depression following trauma are largely unique to these disorders, whereas PTSD with comorbid depression share a trauma-related etiology and is largely dependent on one's perceived self-efficacy.

Acknowledgments

This study was in part supported by Cooperative Agreement Numbers 5U50/OH009739 and 1E11/OH009630 from the National Institute for Occupational Safety and Health (NIOSH) of the Centers for Disease Control and Prevention (CDC); U50/ATU272750 from the Agency for Toxic Substances and Disease Registry (ATSDR), CDC, which included support from the National Center for Environmental Health, CDC; and by the New York City Department of Health and Mental Hygiene (NYC DOHMH). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH-CDC.

References

- Adams R, & Boscarino J (2006). Predictors of PTSD and delayed PTSD after disaster: The impact of exposure and psychosocial resources. *Journal of Nervous and Mental Disease*, 194, 485–493. [PubMed: 16840844]
- APA American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.). Washington, D.C.
- Averill JD, Mileti DS, Peacock RD, Kuligowski ED, Groner N, Proulx G, ... Nelson HE. (2005). Occupant behavior, egress, and emergency communications: Federal Building and Fire Safety Investigation of the World Trade Center Disaster (NIST NCSTAR1–7) National Institute of Standards and Technology National Construction Safety Team Act Report (Vol. 17). Washington, DC.
- Benight CC, Freyaldenhoven R, Hughes J, Ruiz JM, Zoesche TA, & Lovallo W (2000). Coping self-efficacy and psychological distress following the Oklahoma City bombing: A longitudinal analysis. *Journal of Applied Social Psychology*, 30(7), 1331–1344. 10.1111/j.1559-1816.2000.tb02523.x
- Benight CC, & Bandura A (2004). Social cognitive theory of posttraumatic recovery: The role of perceived self-efficacy. *Behaviour Research and Therapy*, 42(10), 1129–1148. 10.1016/j.brat.2003.08.008 [PubMed: 15350854]
- Blanchard EB, Jones-Alexander J, Buckley TC, & Forneris CA (1996). Psychometric properties of the PTSD Checklist (PCL). *Behaviour, Research, and Therapy*, 34(8), 669–673. [https://doi.org/DOI: 10.1016/0005-7967\(96\)00033-2](https://doi.org/DOI:10.1016/0005-7967(96)00033-2) [PubMed: 8870294]
- Bowler RM, Adams SW, Gocheva VV, Li J, Mergler D, Brackbill R, & Cone JE (2017). Posttraumatic stress disorder, gender, and risk factors: World Trade Center tower survivors 10 to 11 years after the September 11, 2001 attacks. *Journal of Traumatic Stress*, 30(6), 564–570. 10.1002/jts.22232 [PubMed: 29131407]
- Bowler RM, Harris M, Li J, Gocheva V, Stellman SD, Wilson K, ... Cone JE. (2012). Longitudinal mental health impact among police responders to the 9 / 11 terrorist attack. *American Journal of Industrial Medicine*, 55(4), 297–312. 10.1002/ajim.22000. [PubMed: 22213367]
- Bowler RM, Kornblith ES, Li J, Adams SW, Gocheva VV, Schwarzer R, & Cone JE (2016). Police officers who responded to 9/11: Comorbidity of PTSD, depression, and anxiety 10–11 years later. *American Journal of Industrial Medicine*, 59(6), 425–436. 10.1002/ajim.22588 [PubMed: 27094566]
- Brackbill RM, Stellman SD, Perlman SE, Walker DJ, & Farfel MR (2013). Mental health of those directly exposed to the World Trade Center disaster: Unmet mental health care need, mental health treatment service use, and quality of life. *Social Science and Medicine*, 81, 110–114. [PubMed: 23337833]

- Brewin C, Andrews B, & Valentine J (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology*, 68(5), 748–766. [PubMed: 11068961]
- Brown AD, Kouri NA, Rahman N, Joscelyne A, Bryant RA, & Marmar CR (2016). Enhancing self-efficacy improves episodic future thinking and social-decision making in combat veterans with posttraumatic stress disorder. *Psychiatry Research*, 242, 19–25. 10.1016/j.psychres.2016.05.026 [PubMed: 27236589]
- Caramanica K, Brackbill RM, Liao T, & Stellman SD (2014). Comorbidity of 9/11-related PTSD and depression in the World Trade Center Health Registry 10–11 years postdisaster. *Journal of Traumatic Stress*, 27(6), 680–688. [PubMed: 25470556]
- Centers for Disease Control and Prevention (CDC). (2000). *Measuring healthy days: Population assessment of health-related quality of life*. Atlanta: Centers for Disease Control and Prevention.
- Chiu S, Niles JK, Webber MP, Zeig-Owens R, Gustave J, Lee R, ... Prezant DJ. (2011). Evaluating risk factors and possible mediation effects in posttraumatic depression and posttraumatic stress disorder comorbidity. *Public Health Reports*, 126(2), 201–209. [PubMed: 21387950]
- Dekel S, Ein-Dor T, Rosen JB, & Bonanno GA (2017). Differences in cortisol response to trauma activation in individuals with and without comorbid PTSD and depression. *Frontiers in Psychology*, 8, 797. [PubMed: 28572779]
- Farfel M, DiGrande L, Brackbill RM, Prann A, Cone J, Friedman S, ... Galea S. (2008). An overview of 9/11 experiences and respiratory and mental health conditions among World Trade Center Health Registry enrollees. *Journal of Urban Health*, 85(6), 880–909. [PubMed: 18785012]
- Flory JD, & Yehuda R (2015). Comorbidity between post-traumatic stress disorder and major depressive disorder: Alternative explanations and treatment considerations. *Dialogues in Clinical Neuroscience*, 17(2), 141–150. 10.3402/ejpt.v4i0.19979 [PubMed: 26246789]
- Galatzer-Levy IR, Nickerson A, Litz BT, & Marmar CR (2013). Patterns of lifetime PTSD comorbidity: A latent class analysis. *Depression and Anxiety*, 30(5), 489–496. 10.1002/da.22048 [PubMed: 23281049]
- Hruska B, Irish LA, Pacella ML, Sledjeski EM, & Delahanty DL (2014). PTSD symptom severity and psychiatric comorbidity in recent motor vehicle accident victims: A latent class analysis. *Journal of Anxiety Disorders*, 28, 644–649. [PubMed: 25124501]
- Jacobson M, Norman C, Nguyen A, & Brackbill R (2018). Longitudinal determinants of depression among World Trade Center Health Registry enrollees, 14–15 years after the 9/11 attacks. *Journal of Affective Disorders*, 229, 483–490. 10.1016/j.jad.2017.12.105 [PubMed: 29334643]
- Jerusalem M, & Schwarzer R (1992). Self-efficacy as a resource factor in stress appraisal processes In Schwarzer R (Ed.), *Self-efficacy: Thought control of action* (pp. 195–213). Washington, DC: Hemisphere.
- Koenen KC, Moffitt TE, Caspi A, Gregory A, Harrington H, & Poulton R (2008). The developmental mental-disorder histories of adults with posttraumatic stress disorder: A prospective longitudinal birth cohort study. *Journal of Abnormal Psychology*, 117(2), 460–466. [PubMed: 18489223]
- Kroenke K, Strine TW, Spitzer RL, Williams JBW, Berry JT, & Mokdad AH (2009). The PHQ-8 as a measure of current depression in the general population. *Journal of Affective Disorders*, 114(1–3), 163–173. 10.1016/j.jad.2008.06.026 [PubMed: 18752852]
- Luszczynska A, Benight CC, & Cieslak R (2009). Self-Efficacy and Health-Related Outcomes of Collective Trauma. *European Psychologist*, 14(1), 51–62. 10.1027/1016-9040.14.1.51
- Rojas SM, Bujarski S, Babson KA, Dutton CE, & Feldner MT (2014). Understanding PTSD comorbidity and suicidal behavior: Associations among histories of alcohol dependence, major depressive disorder, and suicidal ideation and attempts. *Journal of Anxiety Disorders*, 28(3), 318–325. [PubMed: 24681282]
- Salguero JM, Fernández-Berrocal P, Iruarrizaga I, Cano-Vindel A, & Galea S (2011). Major depressive disorder following terrorist attacks: A systematic review of prevalence, course and correlates. *BMC Psychiatry*, 11 10.1186/1471-244X-11-96
- Schwarzer R, & Jerusalem M (1995). Generalized Self-Efficacy scale In Weinman J, Wright S, & Johnston M (Eds.), *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp. 35–37). Windsor, UK: NFER-NELSON.

- Schwarzer R, & Knoll N (2007). Functional roles of social support within the stress and coping process: A theoretical and empirical overview. *International Journal of Psychology*, 42(4), 243–252. 10.1080/00207590701396641
- Shalev AY, Freedman S, Peri T, Brandes D, Sahar T, Orr SP, & Pitman RK (1998). Prospective study of posttraumatic stress disorder and depression following trauma. *American Journal of Psychiatry*, 155(1), 630–637. [PubMed: 9585714]
- Stellman JM, Smith RP, Katz CL, Sharma V, Charney DS, Herbert R, ... Southwick S. (2008). Enduring mental health morbidity and social function impairment in World Trade Center rescue, recovery, and cleanup workers: The psychological dimension of an environmental health disaster. *Environmental Health Perspectives*, 116(9), 1248–1253. 10.1289/ehp.11164 [PubMed: 18795171]
- Weathers FW, Litz BT, Herman DS, Huska JA, & Keane TM (1993). The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility In Annual Convention of the International Society for Traumatic Stress Studies. San Antonio, TX.
- Wilk JE, West JC, Narrow WE, Marcus S, Rubio-Stipec M, Rae DS, ... Regier DA. (2006). Comorbidity patterns in routine psychiatric practice: Is there evidence of underdetection and underdiagnosis. *Comprehensive Psychiatry*, 47(4), 258–264. [PubMed: 16769299]
- Yu S, Brackbill RM, Stellman SD, Ghuman S, & Farfel MR (2015). Evaluation of non-response bias in a cohort study of World Trade Center terrorist attack survivors. *BMC Research Notes*, 8, 42 10.1186/s13104-015-0994-2 [PubMed: 25889176]

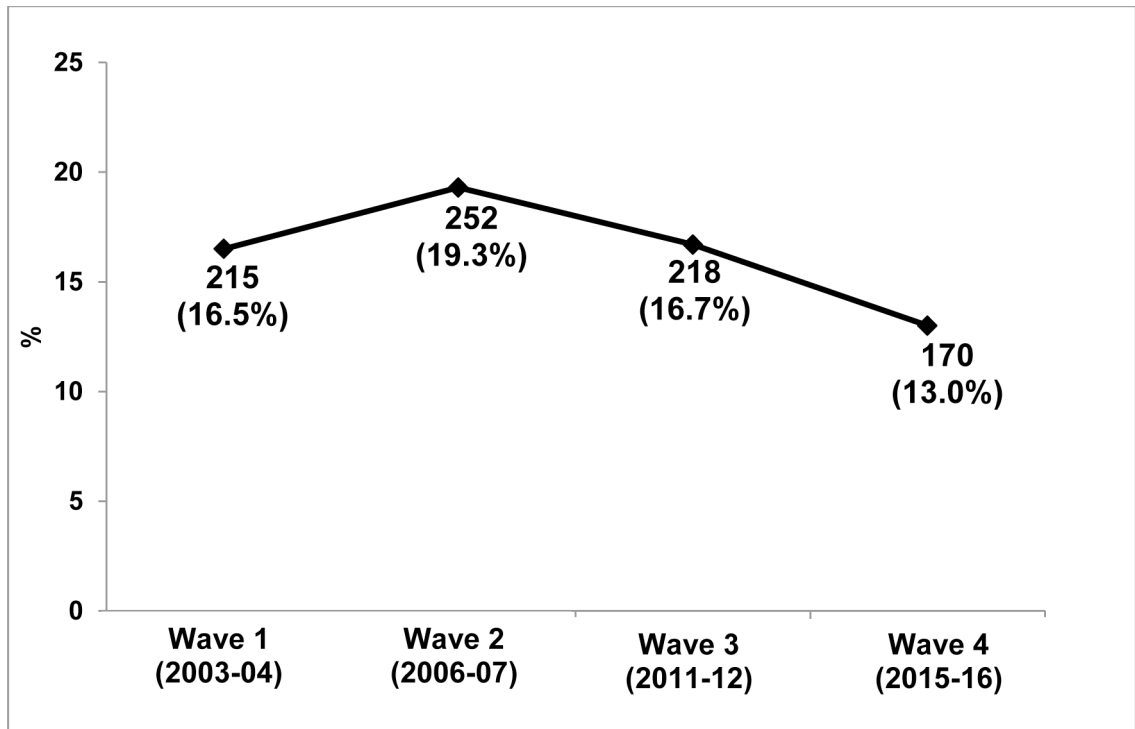


Figure 1.
Frequency and rate of probable PTSD in WTC tower survivors (Waves 1–4)

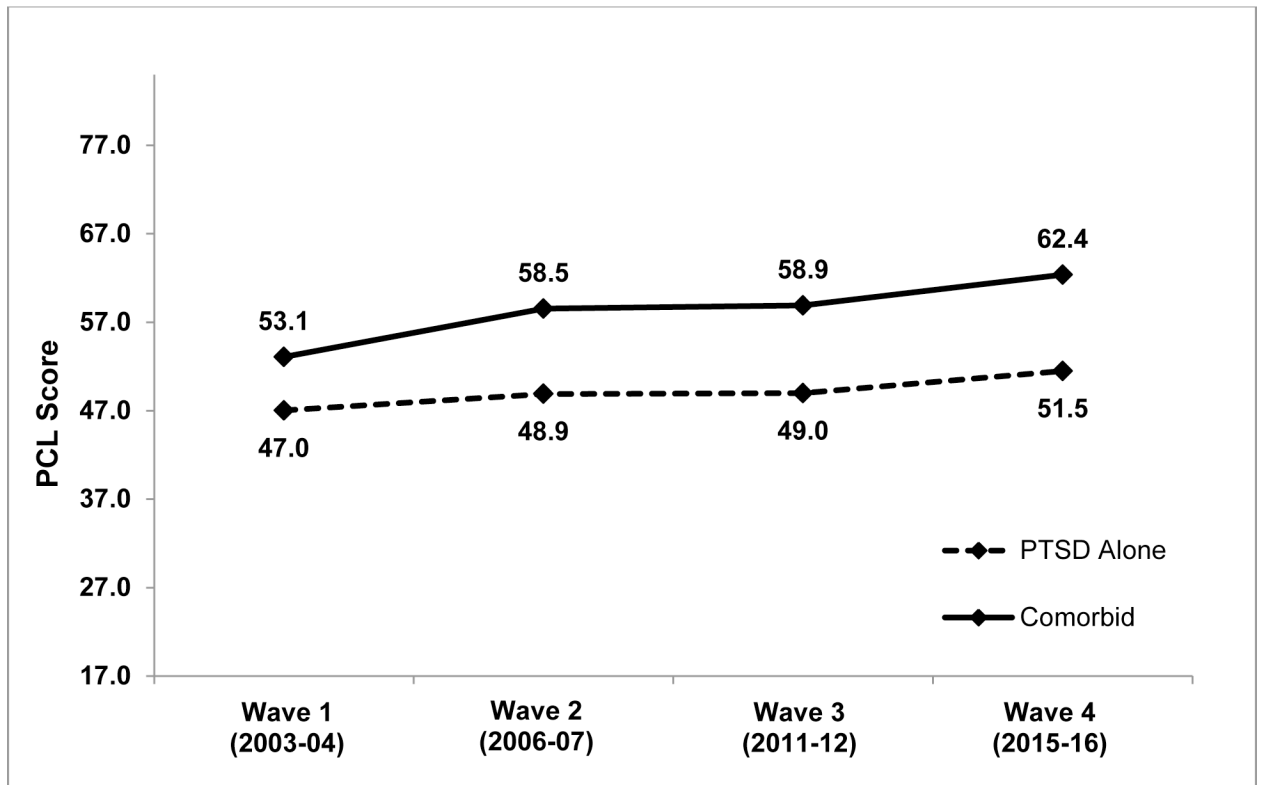


Figure 2.
Mean PCL scores for PTSD alone and comorbid PTSD-depression groups across four waves

Comparison of socio-demographics by PTSD, depression, and comorbid PTSD-depression among WTC tower survivors (n = 1304)

Table 1

Variable	No PTSD or Depression (n = 1045, 80.1%) ^a n (%)	PTSD Alone (n = 54, 4.1%) ^b n (%)	Depression Alone (n = 89, 6.8%) ^c n (%)	PTSD with Depression (n = 116, 8.9%) ^d n (%)	Effect Size V or η^2
Age at 9/11	M = 43.35 (SD = 10.7) ^d	M = 41.83 (SD = 11.8)	M = 41.99 (SD = 9.0)	M = 40.62 (SD = 9.1) ^a	$\eta^2 = .01$ *
Gender					
Women	408 (39.0)	30 (55.6)	49 (55.1)	62 (53.4)	V = .13 ***
Men	637 (61.0)	24 (44.4)	40 (44.9)	54 (46.6)	
Race/Ethnicity					
Black	74 (7.1)	5 (9.3)	15 (16.9)	10 (8.6)	V = .13 ***
Latino	71 (6.8)	14 (25.9)	7 (7.9)	24 (20.7)	
Asian/Other	75 (7.2)	4 (7.4)	7 (7.9)	13 (11.2)	
Non-Latino White	825 (78.9)	31 (57.4)	60 (67.4)	69 (59.5)	
Marital Status at Wave 4					
Never married	130 (12.5)	8 (15.1)	22 (24.7)	18 (15.5)	V = .11 ***
Widowed/Divorced	134 (12.9)	13 (24.5)	16 (18.0)	30 (25.9)	
Married/Living with partner	774 (74.6)	32 (60.4)	51 (57.3)	68 (58.6)	
Education at Wave 4					
Grade 12/GED	93 (9.0)	10 (18.5)	10 (11.2)	20 (17.2)	V = .12 ***
College 1–3 years	198 (19.1)	17 (31.5)	19 (21.3)	39 (33.6)	
College 4+ years	745 (71.9)	27 (50.0)	60 (67.4)	57 (49.1)	
Household income at Wave 4					
\$49,999	115 (11.8)	14 (26.4)	22 (26.2)	43 (39.8)	V = .16 ***
\$50,000 - \$99,999	230 (23.6)	17 (32.1)	24 (28.6)	35 (32.4)	
\$100,000 - \$149,999	217 (22.3)	10 (18.9)	17 (20.2)	16 (14.8)	
\$150,000+	412 (42.3)	12 (22.6)	21 (25.0)	14 (13.0)	

Note. ANOVA uses Bonferroni adjustment for multiple pairwise comparisons.

* $p < .05$.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

**
 $p < .01$,

 $p < .001$.

Effect size indicates difference between diagnostic groups. In cases where cells = 5 participants, exact p-values are used.

^aSignificantly different from “No PTSD or Depression” group.

^bSignificantly different from “PTSD alone” group.

^cSignificantly different from “Depression alone” group.

^dSignificantly different from “PTSD with Depression” group.

Table 2
 Comparison of exposure and evacuation characteristics by PTSD, depression, and comorbid PTSD-depression

Variable	No PTSD or Depression (<i>n</i> = 1045, 80.1%) ^a	PTSD Alone (<i>n</i> = 54, 4.1%) ^b	Depression Alone (<i>n</i> = 89, 6.8%) ^c	PTSD with Depression (<i>n</i> = 116, 8.9%) ^d	Effect Size
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>V</i> or η^2
WTC Building					
North Tower	535 (51.2)	32 (59.3)	50 (56.2)	71 (61.2)	<i>V</i> = .07
South Tower	510 (48.8)	22 (40.7)	39 (43.8)	45 (38.8)	
Time of evacuation initiation					
Between 1 st and 2 nd plane impact	855 (83.9)	37 (71.2)	72 (83.7)	83 (75.5)	<i>V</i> = .09*
During or after 2 nd plane impact	164 (16.1)	15 (28.8)	14 (16.3)	27 (24.5)	
9/11 exposure index (0–23)	<i>M</i> = 8.31 (<i>SD</i> = 3.4) ^{b,d}	<i>M</i> = 11.16 (<i>SD</i> = 3.8) ^{a,c}	<i>M</i> = 9.40 (<i>SD</i> = 4.2) ^{b,d}	<i>M</i> = 11.41 (<i>SD</i> = 3.7) ^{a,c}	η^2 = .08***

Note. ANOVA uses Bonferroni adjustment for multiple pairwise comparisons.

* *p* < .05,

** *p* < .01,

*** *p* < .001.

Effect size indicates difference between diagnostic groups.

^a Significantly different from “No PTSD or Depression” group.

^b Significantly different from “PTSD alone” group.

^c Significantly different from “Depression alone” group.

^d Significantly different from “PTSD with Depression” group.

Table 3
 Comparison of social support, self-efficacy, quality of life, and lifestyle characteristics by PTSD, depression, and comorbid PTSD-depression

Variable	No PTSD or Depression (n = 1045, 80.1%) ^d n (%)	PTSD Alone (n = 54, 4.1%) ^b n (%)	Depression Alone (n = 89, 6.8%) ^c n (%)	PTSD with Depression (n = 116, 8.9%) ^d n (%)	Effect Size V or η^2
Social support sum (0–20)	M = 15.07 (SD = 4.8) ^{b,c,d}	M = 12.36 (SD = 5.3) ^{a,d}	M = 10.94 (SD = 5.8) ^a	M = 9.88 (SD = 5.3) ^{a,b}	$\eta^2 = .11$ ^{***}
Self-efficacy sum (0–15)	M = 11.91 (SD = 2.4) ^{b,c,d}	M = 9.33 (SD = 2.8) ^{a,d}	M = 9.02 (SD = 2.7) ^{a,d}	M = 7.16 (SD = 3.3) ^{a,b,c}	$\eta^2 = .26$ ^{***}
How many times in last 30 days did you consume more than 5 alcoholic drinks in one sitting? (Men)	M = 1.36 (SD = 3.5) ^d	M = 2.92 (SD = 7.6) ^d	M = 2.48 (SD = 4.0) ^d	M = 6.72 (SD = 8.7) ^{a,b,c}	$\eta^2 = .10$ ^{***}
How many times in last 30 days did you consume more than 4 alcoholic drinks in one sitting? (Women)	M = 0.63 (SD = 1.8) ^{b,d}	M = 3.12 (SD = 6.1) ^a	M = 1.58 (SD = 4.4)	M = 3.46 (SD = 7.4) ^a	$\eta^2 = .08$ ^{***}
Number of days bothered by physical health? (0–30)	M = 3.18 (SD = 6.1) ^{b,c,d}	M = 6.27 (SD = 8.2) ^{a,c,d}	M = 10.20 (SD = 10.7) ^{a,b}	M = 12.30 (SD = 10.5) ^{a,b}	$\eta^2 = .16$ ^{***}
Number of days bothered by mental health? (0–30)	M = 3.50 (SD = 6.0) ^{b,c,d}	M = 10.40 (SD = 7.9) ^{a,c,d}	M = 14.95 (SD = 9.5) ^{a,b,d}	M = 19.57 (SD = 9.8) ^{a,b,c}	$\eta^2 = .38$ ^{***}
Number of days poor physical or mental health limited daily activities? (0–30)	M = 1.87 (SD = 4.4) ^{b,c,d}	M = 5.57 (SD = 7.3) ^{a,c,d}	M = 9.29 (SD = 9.3) ^{a,b,d}	M = 14.01 (SD = 10.0) ^{a,b,c}	$\eta^2 = .31$ ^{***}
How physically active are you?					
Not active at all	15 (1.4)	3 (5.6)	8 (9.0)	17 (14.8)	V = .19 ^{***}
Not active	206 (19.8)	21 (38.9)	33 (37.1)	48 (41.7)	
Somewhat active	548 (52.7)	23 (42.6)	40 (44.9)	42 (36.5)	
Very active	270 (26.0)	7 (13.0)	8 (9.0)	8 (7.0)	

Note. ANOVA uses Bonferroni adjustment for multiple pairwise comparisons.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Effect size indicates difference between diagnostic groups.

^aSignificantly different from “No PTSD or Depression” group.

^qSignificantly different from "PTSD alone" group.
^cSignificantly different from "Depression alone" group.
^pSignificantly different from "PTSD with Depression" group.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 4
Multinomial logistic regression results predicting PTSD, depression, and comorbidity (n = 964)

	PTSD Alone vs No PTSD or Depression		Depression Alone vs No PTSD or Depression		PTSD with Depression vs Depression Alone	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
Recent life stressors	1.01	0.69, 1.48	1.66 ^{***}	1.29, 2.14	1.18	0.88, 1.58
Recent life-threatening events	1.53 [*]	1.04, 2.26	1.37	0.94, 1.98	1.03	0.72, 1.48
Floor of building	1.00	0.99, 1.01	1.00	0.99, 1.01	0.99	0.98, 1.01
Age at 9/11	0.99	0.96, 1.03	1.00	0.97, 1.03	0.99	0.95, 1.03
Gender						
Women	1.45	0.69, 3.03	1.28	0.70, 2.33	0.58	0.27, 1.25
Men	1.00	-	1.00	-	1.00	-
Race/Ethnicity						
Black	0.85	0.25, 2.94	1.62	0.71, 3.68	0.47	0.15, 1.50
Latino	3.09 [*]	1.19, 8.02	0.70	0.22, 2.27	2.77	0.79, 9.77
Asian/Other	1.03	0.27, 3.90	0.65	0.20, 2.09	2.49	0.68, 9.13
Non-Latino White	1.00	-	1.00	-	1.00	-
Marital Status at Wave 4						
Never married	0.62	0.19, 2.06	0.93	0.38, 2.24	0.43	0.14, 1.35
Widowed/Divorced	0.75	0.27, 2.08	0.86	0.38, 1.97	0.85	0.31, 2.37
Married/Living with partner	1.00	-	1.00	-	1.00	-
Education at Wave 4						
Grade 12/GED	2.08	0.74, 5.85	0.98	0.38, 2.54	1.29	0.41, 4.11
College 1–3 years	1.18	0.49, 2.83	0.96	0.47, 1.99	1.45	0.60, 3.50
College 4+ years	1.00	-	1.00	-	1.00	-
Household income at Wave 4						
\$49,999	1.28	0.35, 4.67	1.33	0.51, 3.50	1.98	0.58, 6.78
\$50,000 - \$99,999	1.12	0.39, 3.21	0.83	0.36, 1.90	1.94	0.66, 5.67
\$100,000 - \$149,999	1.61	0.58, 4.42	1.40	0.63, 3.11	1.12	0.36, 3.54
\$150,000+	1.00	-	1.00	-	1.00	-
Time of evacuation initiation						

	PTSD Alone vs No PTSD or Depression		Depression Alone vs No PTSD or Depression		PTSD with Depression vs Depression Alone	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
Between 1 st and 2 nd plane impact	1.00	-	1.00	-	1.00	-
During or after 2 nd plane impact	2.26*	1.02, 5.00	1.12	0.53, 2.35	1.00	0.24, 4.19
9/11 exposure index	1.21***	1.10, 1.33	1.05	0.97, 1.13	1.14*	1.03, 1.27
Social support sum	0.99	0.92, 1.07	0.92**	0.87, 0.98	1.00	0.93, 1.08
Self-efficacy sum	0.76***	0.67, 0.87	0.76***	0.68, 0.85	0.85**	0.75, 0.96
How physically active are you?						
Not active at all	3.26	0.62, 17.09	5.01*	1.06, 23.62	1.32	0.22, 7.96
Not active	2.16	0.75, 6.21	4.72**	1.65, 13.51	0.72	0.17, 2.97
Somewhat active	1.01	0.36, 2.80	2.31	0.83, 6.43	0.78	0.19, 3.15
Very active	1.00	-	1.00	-	1.00	-

aOR = adjusted odds ratio;

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.