Psychopathology in 9/11 Responders Exposed to Hurricane Sandy: Examining the Interactive Effects of Exposure and Resilience

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Abstract:

World Trade Center (WTC) disaster responders were exposed to psychological trauma due to the September 11, 2001 terrorist attacks. As a result, many continue to suffer from symptoms of post-traumatic stress disorder (PTSD) and psychological distress which can worsen after exposure to subsequent traumatic events such as Hurricane Sandy. Preexisting data were obtained from a study group of anonymous WTC responders both before and after Hurricane Sandy. Statistical analyses concluded that higher levels of hurricane exposure were associated with increased symptoms of PTSD and distress following Sandy. It was also determined that 9/11 responders with high hurricane exposure levels who possessed increased adaptive coping skills prior to Sandy had lower distress symptoms post-Sandy. The results highlight the importance of adaptive coping skills in promoting resilience to psychological distress. Therefore, coping skills are an important therapeutic target for individuals at risk for exposure to trauma, such as disaster responders.

Personal Statement:

I was about two years old when 9/11 occurred, and while I was too young to understand what had happened that day, as I grew older, I would hear family members frequently discussing the tragedy, especially around each anniversary. My uncle would mention the loss of a close friend who was a first responder firefighter. I saw how personally affected he was when he would reminisce about their times together. My father remembered the toxic, grey fog that

consumed lower Manhattan, as he ran in desperation across the Brooklyn Bridge along with thousands of other shattered individuals, all fearing for their lives.

Approximately eleven years later, I experienced first-hand the catastrophe caused by Hurricane Sandy as a Long Island resident. Many people died, and countless families were left homeless as a result of storm damage, especially from flooding in coastal communities.

These horrific accounts, together with ongoing acts of terrorism worldwide, have motivated me to focus on those suffering from life-altering trauma. Accordingly, for the past two years, I have worked alongside a researcher at Stony Brook University's Department of Psychiatry who is studying the effects of multiple traumatic events on World Trade Center responders through the university's World Trade Center Health Program. Specifically, I wished to determine whether first responders, who were initially exposed to 9/11 and later to Hurricane Sandy, might be subjected to an increased incidence of psychopathology or whether the development of adaptive coping skills promoted resilience to subsequent traumatic events.

My background in mathematics and computer programming has been especially important in providing me with the ability to statistically analyze my research work. I have enjoyed learning how to interpret psychometrics in determining psychological impairment, as well as conduct analysis of covariance models in order to uncover relationships among psychological factors. This was achieved by utilizing the SPSS Statistics software package which was introduced to me to conduct my research.

Psychological research represents my ultimate intellectual challenge, combining my interests in both mathematics and science. The procedure of formulating a hypothesis, followed by extensive data analyses and, finally results is academically challenging. The hypothesis is either confirmed or refuted, but in either instance, immediate gratification is uncommon. Such a

process has taught me patience and perseverance, recognizing that failure may occur more often than success. However, fulfilling my desire to improve people's lives is well worth the effort.

Research Section:

Introduction:

Disasters, whether of natural or man-made origin, have resulted in the development of significant psychopathology. Some of the most common effects among individuals exposed to such trauma include the development of post-traumatic stress disorder (PTSD) and symptoms of psychological distress (Bromet et al., 2016; Agronick, Stueve, Vargo, & O'Donnell, 2007). Unfortunately, the majority of adults are exposed to at least one potentially traumatic event (PTE) in their lifetimes (Bonanno, 2005). A PTE is defined as being involved in a life-threatening event, including man-made and natural disasters, such as the World Trade Center (WTC) disaster and Hurricane Sandy respectively (Bonanno, Galea, Bucciarelli, & Vlahov, 2006). The level of exposure to disastrous events appears to be directly associated with the development of psychopathology in both traditional (police, fire, EMS personnel) and non-traditional (e.g. construction workers, electricians, transportation, and utility workers) responders, with non-traditional responders being at greatest risk (Bromet et al., 2016).

PTSD is considered to be a specific clinical diagnosis representing an extreme and chronic response to one or more traumatic stress events. PTSD differs from all other psychiatric disorders in that the symptom complex must be linked to some precipitating, external traumatic occurrence typically involving death, a threat of death, or serious injury. Such an experience results in the development of extreme fear, horror, or a sense of helplessness. As a result, three symptom groupings are required in order to make a diagnosis of PTSD: (1) involuntary

re-experiencing the trauma through nightmares or frequently disturbing thoughts; (2) loss of loving feelings; (3) increased arousal manifest by sleeping difficulties, loss of concentration, a constant state of tension or awareness (hypervigilance), or exaggerated startle response (Ozer & Weiss, 2004).

The PTSD checklist (PCL) was primarily utilized as a screening test for the presence of PTSD in soldiers returning from combat. The test showed good diagnostic efficiency in determining evidence of PTSD in combat troops. The test is, therefore, not only considered potentially useful as post-deployment screening measures for PTSD but in others involved in high risk occupations. Of interest is the importance in analyzing the avoidant behavior portion of the PTSD screening tests. The use of avoidance immediately following a traumatic event is thought to represent normal coping strategy. However, at later time periods, avoidance symptoms may be a predictor of PTSD symptomatology (Bliese et al., 2008).

Psychological distress is a nonspecific complex of symptoms rather than a defined mental illness which is utilized to identify mental health problems resulting in significant impairment in social, occupational, or academic functioning. The symptoms are often severe enough to require treatment. Accordingly, the Kessler Psychological Distress Scale (K-6) was developed to identify those with a high probability of mental illness with associated functional limitations, utilizing a minimum number of questions. The K-6 Scale is a measure of nonspecific psychological distress designed to identify individuals with mental disorders causing significant impairment in social, occupational, or educational functioning and severe enough to require mental health intervention (Pratt, Dey, & Cohen, 2007).

The unexpected and horrific attack of September 11, 2001 on the World Trade Center had far-reaching physical and psychological effects that are still being felt in American society

today. The immediate deaths of over almost 3,000 people, including those lost at the Pentagon and in the four hijacked airliners was just the beginning of the innumerable longer-term physical and psychological consequences of this terrorist act. According to the New York City Department of Health and Mental Hygiene, symptoms of PTSD were the most common health-related effect of the 9/11 attacks with the incidence approximately 4 times that seen in the general population. Risk factors for the development of PTSD post-9/11 included factors such as exposure to the dust cloud, injury, late evacuation, or witnessing death. Other factors also affected PTSD incidence and symptom severity. First responders who arrived at the disaster site immediately after the attack or those who worked longer at the site had a higher risk of developing PTSD. In addition, individuals who had concurrent traumatic experiences either before or immediately after 9/11, such as losing a job or being involved in other violent situations, were at a higher risk for developing PTSD (NYC 9/11 Health, 2016).

Hurricane Sandy was the largest hurricane ever recorded in the Atlantic Basin. The storm caused massive damage in both the New York metropolitan and Long Island regions, resulting in deaths as well as the destruction of thousands of homes and personal property losses. Many people were unable to obtain basic resources such as food and gasoline, and millions were left without electricity for extended periods of time. Forced evacuations were commonplace throughout the affected regions. Exposure to traumatic events, such as experiencing damage to one's home, fearing for one's safety, and witnessing human injury has been shown to have adverse psychological effects, including the development of PTSD symptoms (Cerdá et al., 2013; Galea, Nandi, & Vlahov, 2005; McLeish & Del Ben, 2008).

A large number of responders to the WTC disaster have suffered from both chronic physical and psychological symptoms, including PTSD and distress, both of which have been

associated with significant functional impairments. PTSD has been found to be one of the most prevalent disorders among responders to the WTC terrorist attack, with 9.7% of WTC responders reporting symptoms consistent with a current diagnosis of PTSD more than 10 years after the disaster (Bromet et al., 2016). Previous studies have shown that elevated PTSD symptom levels put individuals at increased risk for further psychopathology and impairment following exposure to another trauma (Zvolensky et al., 2015). This suggests that responders to the WTC disaster are at risk for an exacerbation of symptoms following exposure to Hurricane Sandy.

Adaptive coping skills have been shown to promote resiliency and are an established protective factor against the development of psychopathology (Johnson et al., 2011). Resilience appears to follow a pattern of mild psychological disruptions followed by a relatively rapid improvement in psychological health, generally occurring within a few months. Even when experiencing initial spikes in distress, characterized by difficulty concentrating, sleeplessness, or variations in feelings of well-being, resilient persons are able to continue functioning at near normal levels (Bonanno, 2005). Specifically, adaptive coping is hypothesized to promote resiliency in the face of adversity and may be an especially important mitigating factor for at-risk individuals such as WTC disaster responders who developed significant PTSD symptoms when subsequently exposed to Hurricane Sandy (Johnson et al., 2011).

Methods:

Acquisition of Data

All data utilized was de-identified and acquired through the World Trade Center Health Program (WTCHP) at Stony Brook University, the second largest of five Clinical Centers of Excellence in the New York metropolitan area (Bromet et al., 2016). Participants in the WTCHP included WTC responders who were subsequently exposed to Hurricane Sandy.

Procedure

This study used de-identified data from WTC responders who were recruited through the WTCHP using several techniques, including WTCHP registry mailers, referrals from WTCHP staff, and posting flyers at WTCHP offices. Eligibility criteria included response to the WTC disaster, either as a volunteer or as part of their job, living in an area affected by Hurricane Sandy, or ability to read and write demonstrated by their ability to provide informed written consent.

For the current study, participants completed self-report questionnaires regarding coping strategies and symptoms of psychopathology during the year prior to Hurricane Sandy as part of an annual health assessment for WTC-related symptomatology (T1). Data regarding Sandy-related psychopathology and Hurricane Sandy exposure was collected between 6 and 23 months (M = 16.60, SD = 3.18) following Hurricane Sandy via a self-report questionnaire (T2). All subjects were compensated for their participation in the study.

Measures

Posttraumatic Stress Disorder Symptoms:

PTSD Checklist for DSM-IV (PCL; Bliese et al., 2008) is a 17 item self-report questionnaire designed to assess severity of each symptom of DSM-IV PTSD over the previous month. Each item is rated on a 5-point Likert-type scale from 1 (Not at all) to 5 (Extremely) based on how much that symptom had bothered the participant over the past month. The total symptom severity score ranges from 17-85. The PCL provides a measure of overall PTSD symptoms severity. The PCL was administered at T1 and T2 to assess symptoms of WTC-related and Sandy-related PTSD respectively.

Psychological Distress Symptoms:

The Kessler Psychological Distress Scale (K6; Pratt, et al., 2007) is a self-report questionnaire that contains six items which assess the severity of distress symptoms. The K6 was administered at T2 to assess symptoms of Sandy-related psychological distress.

Coping Strategies:

The Response to Stressful Experiences Scale (RSES; Johnson, et al., 2011) is a 22 item self-report measure used to assess coping ability during and after life's most stressful events. Each item is scored from 0 (not at all like me) to 4 (exactly like me) with the final score being the sum of the scores for the 22 items. Overall scores, therefore, range from 0 to 88 and were dichotomized to reflect low (0-49) and high (50-88) levels of resiliency. The RSES was administered at T1 in order to assess coping strategies prior to Hurricane Sandy.

Hurricane Sandy Exposure:

The Hurricane Sandy Questionnaire was used to assess participants' level of exposure to Hurricane Sandy. Exposure to Hurricane Sandy was measured with ten items. The overall measure of Hurricane Sandy exposure ranges from 0 to 10, with higher scores reflecting higher levels of exposure. Overall level of exposure was then dichotomized; those who scored from 0-4 were considered to have low levels of Hurricane Sandy exposure, and participants who scored from 5-10 were placed in the high exposure category.

Data Analytic Strategy:

All statistical analyses were computed using the Statistical Package for the Social Sciences version 23 (SPSS; Florio, 1997). Preliminary analyses included bivariate correlations between predictor and outcome variables to determine the strength of these relationships. Primary analyses included two separate analysis of covariance models (ANCOVA). The independent variables in both models included the main effects of Hurricane Sandy exposure and

resiliency prior to Hurricane Sandy, as well as their interactive effects. Because prior levels of psychopathology are such a robust predictor of later psychopathology, we controlled for WTC-related PTSD symptoms prior to Sandy by including them as a covariate in both models. The dependent variables were Hurricane Sandy-related PTSD symptoms and post-Hurricane Sandy distress symptoms.

Results:

Sample Characteristics

Participants included 497 WTC responders also exposed to Hurricane Sandy. The majority of respondents were male (89.5%), Caucasian (82.7%), and college educated (67.2%) with an average age of 51.45 years (*SD* = 8.56 years)

Descriptive Data and Bivariate Correlations

Table 1. Means, standard deviations, and bivariate correlations between predictor and outcome variables.

Variable	1	2	3	4	*M*	*SD*
1. T1 Resiliency	--				64.11	13.45
2. Hurricane Sandy Exposure	-.04	--			3.39	3.37
3. T1 PTSD Symptoms	-.26**	.21**	--		29.75	14.09
4. T2 PTSD Symptoms	-.15**	.26**	.51**	--	19.87	6.75
5. T2 Distress Symptoms	-.22**	.27**	.45**	.52**	0.37	0.77

**p < .01. T1 = Time 1 (baseline health-monitoring visit). T2 = Time 2 (Hurricane Sandy Questionnaire Administered). T3 = Time 3 (follow-up health-monitoring visit).

Table 1 displays the results of the bivariate correlations between the variables. WTC- and Sandy-related PTSD symptoms were moderately correlated ($r = .51$, $p < .01$), suggesting that individuals with elevated symptoms of WTC-related PTSD also had increased Sandy-related PTSD symptoms. Furthermore, the correlations between T1 WTC-related PTSD Symptoms and T2 Distress Symptoms ($r = .45$, $p > .01$), as well as T2 Sandy-related PTSD and T2 Distress Symptoms ($r = .52$, $p < .01$) were both of moderate strength and magnitude suggesting overlap between the symptom dimensions. Because of the relationship between T1 and T2 symptoms,

T1 WTC-related PTSD symptoms were included as covariate in the ANCOVAs. Positive correlations also existed between Hurricane Sandy Exposures and T2 PTSD Symptoms (r = .26, p < .01) and T2 Distress Symptoms (r = .27, p < .01), meaning that increased levels of exposure were associated with increased symptoms of psychopathology, although these relationships were of weak strength. Statistically significant negative relationships existed between T1 Resiliency and T2 PTSD Symptoms (r = -.15, p < .01) and T2 Distress Symptoms, (r = -.22, p < .01), suggesting that adaptive coping skills were associated with fewer symptoms of psychopathology.

Analysis of Covariance Models

Hurricane Sandy-Related PTSD:

Table 2. One-way ANCOVA results with T2 Sandy-related PTSD symptoms as the dependent variable.

Source	SS	*df*	MS	*F*
T1 PTSD Symptoms	5146.60	1	5146.60	151.634***
Hurricane Sandy Exposure	222.46	1	222.46	6.554*
Resiliency	13.42	1	13.42	0.40
Hurricane Sandy Exposure * Resiliency	101.62	1	101.62	2.99

Note. R^2 = .271. ***p < .001. *p < .05. T1 = Time 1 (baseline health-monitoring visit). T2 = Time 2 (Hurricane Sandy Questionnaire Administered). ANCOVA = analysis of covariance.

The results of the ANCOVA with T2 Sandy-related PTSD symptoms as the dependent variable and WTC-related PTSD as the covariate are presented in Table 2. There was a significant main effect of Hurricane Sandy Exposure on Sandy-related PTSD (F = 6.55, p = .01), suggesting that increased hurricane exposure resulted in increased levels of Sandy-related PTSD. However, the effect of pre-Sandy resiliency was not statistically significant with regard to Sandy-related PTSD (F = 0.40, p = .53). Although the effect of the interaction between Hurricane Sandy Exposure and Resiliency on Sandy-related PTSD was not statistically significant, it was approaching significance (F = 2.99, p = .08). It is likely that the main effect

of pre-Sandy resiliency and the interactive effects of Hurricane Sandy Exposure and Resiliency did not reach statistical significance because of the overall low levels of Sandy-related PTSD.

Figure 1 displays the interaction between Hurricane Sandy Exposures and Resiliency and its effects on Sandy-related PTSD symptom severity. At low levels of hurricane exposures, there is little difference in the severity of PTSD symptoms between the low and high resiliency groups. However, at high levels of hurricane exposures, the high resiliency group has lower severity of PTSD symptoms than the low resiliency group, although this relationship did not reach statistical significance.

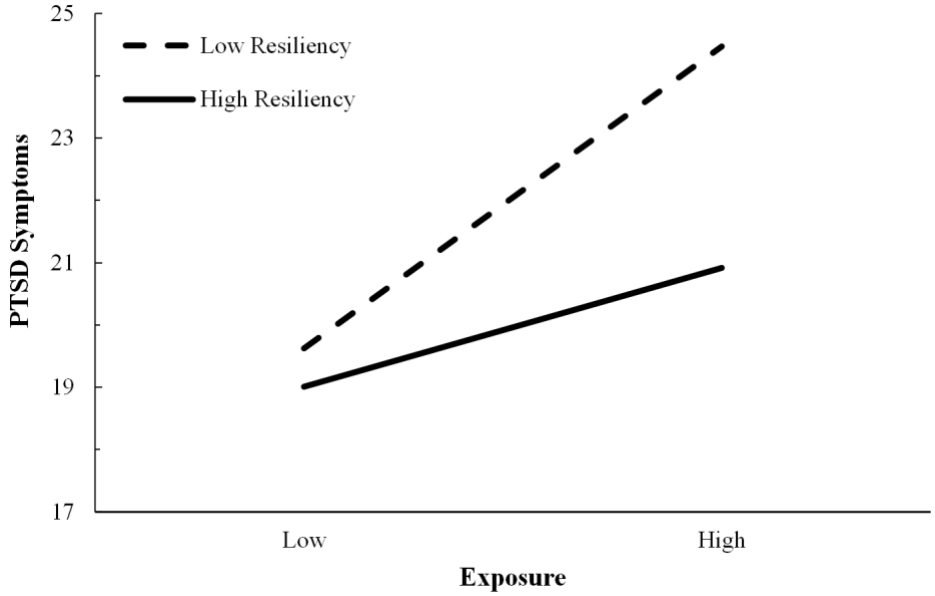

Figure 1. The Hurricane Sandy Exposures by Resiliency interaction and its effects on the severity of Sandy-related PTSD symptoms.

Hurricane Sandy-Related Distress:

Table 3. One-way ANCOVA results with T2 Sandy-related Distress symptoms as the dependent variable.

Source	SS	*df*	MS	*F*
T1 PTSD Symptoms	44.44	1	44.44	98.94***
Hurricane Sandy Exposure	11.53	1	11.53	25.81***
Resiliency	2.65	1	2.65	5.91*
Hurricane Sandy Exposure * Resiliency	4.51	1	4.51	10.06**

Note. R^2 = .245. ***p < .001. **p<.01. *p < .05. T1 = Time 1 (baseline health-monitoring visit). T2 = Time 2 (Hurricane Sandy Questionnaire Administered). ANCOVA = analysis of covariance.

The results of the ANCOVA with post-Sandy Distress Symptoms as the dependent variable and WTC-related PTSD as the covariate are displayed in Table 3. There were significant main effects of Hurricane Sandy Exposure (F = 25.81, p < .001) and Resilience (F = 5.91, p = .02) on Sandy-related Distress symptoms, meaning that increased hurricane exposure resulted in increased levels of Sandy-related Distress, and increased coping abilities prior to Hurricane Sandy decreased Sandy-related Distress symptom severity. Furthermore, the

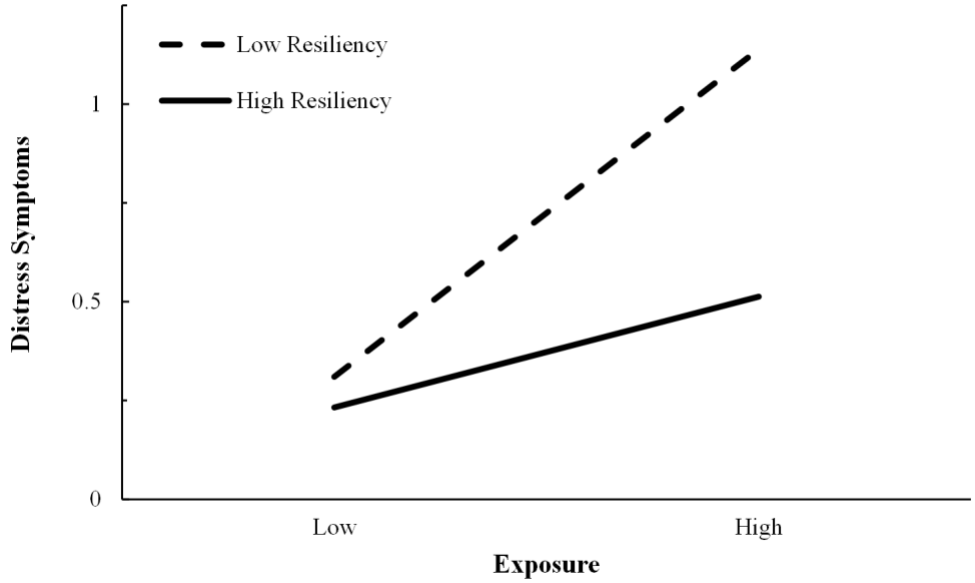

Figure 2. The Hurricane Sandy Exposures by Resiliency interaction and its effects on the severity of Sandy-related Distress symptoms.

interaction between Hurricane Sandy Exposure and Resiliency also had a significant effect on Sandy-related Distress symptoms (F =10.061 p = .002).

Figure 2 displays the effects of the interaction between Hurricane Sandy Exposure and Resiliency on Sandy-related Distress Symptoms. At low levels of hurricane exposures, there is little difference in the severity of distress symptoms between the low and high resiliency groups. However, at high levels of hurricane exposures, the high resiliency group had significantly lower distress symptoms than the low resiliency group.

Discussion:

The results of this study suggest that adaptive coping mechanisms are important for the development of resiliency to psychological distress, especially in the context of exposure to multiple traumatic events. Specifically, the degree of resiliency following Hurricane Sandy exposure had a significant effect on distress symptoms while controlling for WTC-related PTSD symptoms. This interaction approached significance with regard to Sandy-related PTSD symptoms, indicating that adaptive coping mechanisms may be shown to promote resilience, thereby reducing PTSD symptomatology (if the study was repeated using a different study population). The current study population lacked a high average PCL-IV score which may have contributed to the statistical insignificance.

These results are consistent with those of other studies which confirm that adaptive coping mechanisms are able to reduce PTSD and distress symptoms following trauma exposure. In a study conducted by M. Araya, and colleagues (2007) regarding the moderating abilities of coping and social support in a population of post-conflict displaced Ethiopians exposed to trauma, it was established that exposure to traumatic events was associated with higher distress symptomatology. This analysis concluded that adaptive coping methods may also

be beneficial in promoting resilience to psychological distress. However, the members of the research team did not have access to prior psychological data and were, therefore, unable to control for prior psychopathology (Araya, Chotai, Komproe, & de Jong, 2007). Relatedly, in a study of a population of Pakistani earthquake survivors, the authors noted that maladaptive coping mechanisms resulted in increased PTSD symptom severity as well as other adverse mental health outcomes (Feder et al., 2013).

This study establishes adaptive coping skills as an important mechanism in promoting resilience to PTSD and distress in disaster responders. These results indicate that coping skills are an important therapeutic target, especially for individuals at increased risk of multiple trauma exposures (e.g. disaster workers). Promoting the development of adaptive coping skills in disaster responders may increase resilience to trauma and protect against the development of symptoms of PTSD and distress.

As a result of the widespread and well-documented impairment associated with psychopathology stemming from exposure to trauma, it is important to screen for and monitor PTSD and distress symptoms. This is especially true among responders to disasters (e.g. police, fire, EMS personnel), who are at an increased risk for exposure to traumatic events. Future research should focus on identifying other psychological symptoms such as depression that could also be moderated by adaptive coping skills in the context of trauma exposure. Additionally, other possible targets for interventions in the treatment of PTSD and psychological distress in trauma survivors and those at risk for exposure to trauma should be investigated.

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