Published in final edited form as:

J Affect Disord. 2018 April 01; 230: 7–14. doi:10.1016/j.jad.2017.12.096.

Pre-Disaster PTSD as a moderator of the relationship between natural disaster and suicidal ideation over time

Lily A. Brown, Ph.D.¹, Cristina A. Fernandez, Ph.D., MS.Ed.^{2,3}, Robert Kohn, M.D., M.Phil.³, Sandra Saldivia, Ph.D.⁴, and Benjamin Vicente, M.D., Ph.D.⁴

¹Department of Psychiatry, University of Pennsylvania

²Harvard University, T.H. Chan School of Public Health

³Department of Psychiatry and Human Behavior, Warren Alpert Medical School of Brown University,

⁴Departamento de Psiquiatría y Salud Mental, Universidad de Concepción, Concepción, Chile

Abstract

Background: Natural disasters are associated with a variety of negative health consequences, including enhanced suicide risk. Factors that moderate the relationship between disaster exposure and enhanced suicide risk are unknown. The aim of the current study was to determine whether pre-disaster PTSD moderates the association between change over time in thoughts of death, suicidal ideation (SI), suicide plans, and suicide attempts (SA) from pre- to post-disaster.

Methods: Participants ($n = 2,832$) were recruited from Chile as part of the larger PREDICT study and completed a measure of lifetime PTSD and panic disorder at baseline and a lifetime death/suicide measure at baseline in 2003 and again 6, 12, and 24 months later (i.e. “pre-disaster”). One year following a major earthquake and tsunami in 2010 (i.e., “post-disaster”), participants completed another death/suicide measure.

Results: Both those with and without pre-disaster PTSD experienced significant increases in SI from pre- to post-disaster. However, pre-disaster PTSD was associated with significantly accelerated increases in thoughts of death and SI from pre-to post-disaster. At nearly all time-points, pre-disaster PTSD was associated with higher thoughts of death and SI, suicide planning, and SA. In contrast, panic disorder did not moderate the association between time and changes in SI.

Limitations: There was a long time-gap between pre-disaster and post-disaster, with limited data about what occurred during this time.

Conclusion: Pre-disaster PTSD is an important predictor of increased SI following a natural disaster, and groups with pre-disaster PTSD should be prioritized for receipt of mental health resources following a natural disaster.

Keywords

Suicide; Posttraumatic Stress Disorder; Natural Disaster; Chile

Natural disasters are associated with widespread negative psychological and physical health consequences. Earthquakes, tsunamis, volcanic eruptions, hurricanes, monsoons, wildfires and tornados have all been associated with financial stress (Pollack, Weiss, & Trung, 2016), chronic respiratory concerns (Hlodversdottir, Petursdottir, Carlsen, Gislason, & Hauksdottir, 2016), poor dietary intake (Zhang et al., 2017), reduced access to vaccinations (Nidzvetska et al., 2017), insomnia (Psarros et al., 2017) and premature death from non-communicable diseases beyond injuries directly sustained in the natural disaster (Ryan et al., 2015). Relationship quality suffers in the wake of a natural disaster; physical separation and financial strains following a disaster can lead to increased conflict, poor communication, and reduced perceived support (Lowe, Rhodes, & Scoglio, 2012). Additionally, cognitive functioning can also be reduced in individuals who have survived a natural disaster (Ishiki et al., 2016). Psychological consequences of natural disasters are widespread and include depression (Tsuboya et al., 2016), posttraumatic stress disorder (PTSD; Ando et al., 2017), general mental health difficulties (Lieber, 2017), and substance use disorders (Kane et al., 2017), resulting in poorer overall quality of life (Hussain, Nygaard, Siqveland, & Heir, 2016). In some cases, the effect of natural disaster on mental health problems remains over and above the influence of exposure to violence during the natural disaster (Lieber, 2017).

Suicide ideation (SI) and death by suicide also increase following natural disasters (Sinyor, Tse, & Pirkis, 2017). In the year following a major earthquake in Nepal, death by suicide increased by 41% compared to the prior year (Cousins, 2016). Among those at the epicenter of a major earthquake and nuclear power plant crisis in Japan, there was an increased incidence of death by suicide up to three years later (Ohto, Maeda, Yabe, Yasumura, & Bromet, 2015). Greater severity of trauma exposure during a natural disaster increases the risk of SI and suicidal behavior (Chou et al., 2003; Liaw, Wang, Huang, Chang, & Lee, 2008; Lu, 2004; Tanaka et al., 2016; Yang, Xirasagar, Chung, Huang, & Lin, 2005). However, some studies contradict these findings and suggest that suicide rates remain unchanged in response to a natural disaster (Shoaf, Sauter, Bourque, Giangreco, & Weiss, 2004) or even decrease post-disaster, particularly in young adults (Chen et al., 2016). The association between natural disaster and suicide may depend on a variety of moderating factors, though few studies have directly explored potential moderators of this relationship. Further, no research to our knowledge has explored whether pre-disaster PTSD confers greater risk for an increase in SI from pre- to post-disaster.

Elucidating pathways to increased suicide risk is critical. The rate of death by suicide has increased over the past decade in civilians (Center for Disease Control and Prevention; CDC), 2014; Curtin, Warner, & Hedegaard, 2016) and active duty military personnel in the United States (Pruitt et al., 2016). These patterns are not universal; some countries have experienced significant reductions in suicide over time, likely due at least in part to policy change aimed at suicide reduction (Kerkhof, 1999; World Health Organization, 2013). However, the most available longitudinal data suggests that suicide rates in Chile were stable

or increasing from 1997 to 2009 (the most recent year for which data are available; Pan American Health Organization, 2014). In primary care, 14% of Chileans reported SI and 7% reported a history of suicide attempts (SA; Silva, Vicente, Saldivia, & Kohn, 2013). A machine learning model of over 700 mental health patients in Chile resulted in high accuracy, sensitivity, and specificity in detecting patients at high risk for suicide (Barros et al., 2017). Factors associated with higher suicide risk were a sense of unrest, low personal satisfaction, and low beliefs in one's own capacity and coping ability (Barros et al., 2017). More research is necessary to improve prediction and prevention of SI and SA, particularly in understudied Latin American countries; understanding factors associated with increased suicide risk following natural disaster is consistent with this goal.

Several factors serve a moderating or predictive role on the influence between natural disaster and poor psychological and physical health outcomes. For instance, pre-disaster trauma exposure and adversity are linked to greater likelihood of post-disaster PTSD (Bromet et al., 2017), as are pre-existing dysthymia, psychosis, general anxiety and health anxiety after controlling for pre-disaster PTSD (Fernandez et al., 2016). Higher dispositional optimism moderates the associations among disaster-related home damage and PTSD (Carbone & Echols, 2017), and social support moderates the effect of disaster exposure severity on depression (Hall et al., 2016); both optimism and social support were associated with reduced risk for psychopathology following the disaster. A recent review of factors associated with mental health problems following a major Japanese earthquake found that female sex, lack of social support, and preexisting health conditions are all associated with post-disaster PTSD (Ando et al., 2017). However, no research to our knowledge has explored whether pre-disaster PTSD confers greater risk to post-disaster SI.

PTSD is characterized by a constellation of hyperarousal, avoidance, numbing, and negative emotions/cognition symptoms following exposure to a trauma, including natural disaster (American Psychiatric Association, 2013). PTSD at pre-disaster is associated with greater risk of post-disaster PTSD (Fernandez et al., 2016). These findings are consistent with general sensitization effects, or heightened fear responding to novel stimuli (Richardson, 2000) that are observed in PTSD (Rau, DeCola, & Fanselow, 2005). Specifically, individuals with PTSD are more likely to demonstrate heightened physiological and subjective distress to novel cues that are newly paired with an aversive event, even if the aversive event is not as distressing as the original trauma (Grillon & Morgan, 1999). This tendency to exhibit hypersensitivity to newly threatening stimuli or pain may result in negative physical and psychological health outcomes (Deslauriers et al., 2017; Pedler, Kamper, & Sterling, 2016). However, no research to our knowledge has directly explored the link between pre-disaster PTSD and increased post-disaster suicide risk.

Therefore, the purpose of the current study was to examine the prospective relationship between pre-disaster PTSD and post-disaster suicide risk. Using a large sample of Chilean adults, we examined the longitudinal relationship between PTSD at baseline (2003) and suicidal ideation and behavior (SIB) one year following a large earthquake and tsunami in 2010. Consistent with sensitization models, we hypothesized that baseline PTSD would be associated with enhanced risk of thinking about death, thinking about suicide, making suicide plans and SA from pre- to post-disaster. Finally, to determine whether the effect of

PTSD on suicidal thoughts is specific to PTSD or due to the presence of anxiety in general, we repeated these analyses using baseline panic disorder, which has been independently associated with higher suicide risk (Brown, Gaudiano, & Miller, 2010).

Methods

Participants

Participants were recruited as part of the larger PREDICT study, the primary goal of which was to identify depression risk factors in primary care patients across seven countries (Fernandez et al., 2016; King et al., 2008; King et al., 2006). Only participants from the Chilean sample (total $n = 2,918$) were included in the current analyses as they were the only sample for whom a natural disaster occurred during the observation window. The Chilean sample was recruited by researchers from the University of Concepción at 10 primary care centers (with 78 practices) in the national health care service in Concepción and Talcahuano. The national health care service is widely used in these cities, providing care to 75% of residents. Chile had the highest response rate of all seven countries included in the PREDICT study (82 refusals out of 3,000 approached compared to the UK in which 1,681 refused out of 3,319 approached; King et al., 2006). Primary care physicians discussed the study with prospective participants and interested parties were then approached by the research team for recruitment. Of the 2,918 who were interested in the study (97%), 79 were ineligible (due to being over 75 years old, inability to understand Spanish, severe organic mental illness or terminal illness) resulting in 2,839 participants who completed the baseline interview (94.6% of the total sample). See Table I for demographic information for individuals who had usable death/suicide data at baseline.

Measures

Composite International Diagnostic Interview [CIDI], Spanish version 2.1 (World Health Organization, 1997).—The CIDI is a fully-structured lay-administered diagnostic psychiatric interview that assesses lifetime and current disorders per the International Classification of Diseases-10 (ICD-10; World Health Organization, 1992) and Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (DSM-IV; Association & Association, 2000). The CIDI has good psychometric properties, with excellent inter-rater reliability, good test-retest reliability, and good validity. A prior validation study in Chile indicated an overall kappa statistic of 0.94 (with anxiety disorders demonstrating a kappa of 0.85; Andrews & Peters, 1998; Vicente et al., 2006).

PTSD and Panic Disorder.—For the purposes of the current study, lifetime PTSD diagnostic status (as of 2003) and panic disorder status was obtained at baseline from the CIDI.

CIDI Death and Suicide Items.—Death and suicide items were administered under the depression section of the CIDI. Only participants who answered affirmatively to the two depression screener items (low mood and anhedonia) completed the death and suicide items. Items were: 1) thoughts of death (“Durante uno de esos períodos, ¿pensó mucho en la muerte?” which translates to “During that period, did you think much about death?”), 2)

thoughts of suicide (“¿Se sintió tan decaído(a) que pensó mucho en suicidarse?” which translates to “Did you feel so depressed that you thought hard about committing suicide?”) 3) suicide plans (“Planeo cómo podría hacerlo” which translate to “Plans about how you could do it [make a suicide attempt]”), and 4) suicide attempts (“Intentó suicidarse” which translates to “attempt suicide”), which were rated as either present/clinically significant or absent. Death and suicide items were collected for lifetime history at baseline and for time since last assessment at all follow-up observations.

Earthquake Exposure Severity.—Participants completed a questionnaire that assessed exposure to negative consequences of earthquake/tsunami exposure. These included 14 items (rated yes or no) about whether participants: were in a safe place at the time of the earthquake, were trapped and had to be rescued, witnessed injuries, witnessed dead people, experienced the death of a close friend/family member, experienced injury of a close friend/family member, participated in rescuing people who were injured/killed, felt as if their life was at risk, were victims of theft, were victims of looting, were close to the tsunami, had damage to their home, saw buildings being destroyed, or witnessed a fire. Two additional items were not included in this total score because of difficulty with their interpretation, including whether tsunami damage was witnessed from a distance (the interpretation of which could either be positive or negative, depending on the participant) and how much the participant was affected by the disaster (which provided minimal response options). All participants endorsed a minimum of 3 and an average of 12.2 items ($SD = 1.6$), and 280 endorsed all 14 items, reflective of overall high exposure to the disaster in the sample.

Procedure

The baseline assessment occurred in 2003 and included the full CIDI. Participants were assessed again 6 months, 1 year and 2 years after the baseline assessment. However, as the study was targeted toward elucidating risk factors for depression, the assessments at post-baseline time points were primarily focused on depression, including death and suicide items, and did not include a PTSD assessment.

A large-scale natural disaster in the form of an 8.8 on the Richter Scale earthquake struck on the coast of central Chile in 2010, with Concepción as the major urban center receiving the most substantial damage, followed by a 7.7-foot tsunami in Talcahuano. The earthquake and tsunami caused significant death and destruction in both Concepción and Talcahuano, with at least 523 deaths, 24 missing persons, 12,000 injured, 800,000 displaced, and hundreds of thousands of damaged and destroyed buildings.

One year after the earthquake and tsunami (in 2011), study participants completed a final assessment. This assessment included a measure of PTSD (tied only to the natural disaster and therefore not included in the current study), depression, thoughts of death, suicide ideation and behavior on the CIDI.

Data analysis

During the initial interview, 2,832 respondents completed the interview schedule and 1,647 had usable suicide data (as described above, participants did not complete suicide items if

they denied low mood or anhedonia), of which 269 met criteria for lifetime PTSD and 117 met criteria for lifetime panic disorder. All subjects were re-interviewed at 6 months ($n = 2,580$, $n = 753$ with death and suicide data) using the affective disorders section of the CIDI. At 1 year, participants were re-assessed with the CIDI affective disorders section ($n = 2,470$, $n = 682$ with death and suicide item data). Those participants who previously endorsed depression were re-assessed 2 years after baseline with the affective disorders module of the CIDI ($n = 362$, $n = 253$ with death and suicide item data). This 2-year follow-up was the last observation before the natural disaster, which occurred in February 2010. The post-disaster assessment occurred in 2011 (one year after the disaster, $n = 1,727$ who completed this assessment, $n = 748$ with death and suicide item data).

Multilevel mixed-effects logistic regression models were estimated in Stata v. 14 (StataCorp, 2015) using the *melogit* command for the binary death and suicide items (Thoughts of Death, Thoughts of Suicide, Suicide Plans, Suicide Attempts) to account for autocorrelation across observations, with maximum likelihood estimation to account for missing data. Time was coded in 6 month increments and was centered at post-disaster to allow for the interpretation of the main effect of PTSD on death/suicide variables at this time-point. Random intercepts were included in all models. First, linear, quadratic, and piecewise (allowing for different slopes between baseline and pre-disaster and from pre- to post-disaster) effects of Time were tested without any other model predictors using Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC; Akaike, 1973; Hu & Bentler, 1999). Linear and quadratic effects of Time were prioritized over the piecewise models because the piecewise model does not allow for an interpretation of the main effect of baseline PTSD on post-disaster death/suicide items. However, when quadratic effects of Time best fit the model, these analyses were followed with piecewise post-hoc analyses to isolate slope in death/suicide items from baseline to -pre-disaster and from pre- to post-disaster. Second, interactions between Time and Exposure Severity were entered to determine whether natural disaster Exposure Severity should be included as a covariate in subsequent models. Third, interactions between Time and PTSD (present: "PTSD+"; absent: "PTSD-") and the main effect of PTSD were added to the model. If the interaction between Time and PTSD was not significant, then the main effect of PTSD was reported with the interaction term removed from the model. These models were run with and without gender and age as covariates, though results are reported without these covariates as they did not change the pattern of results. Post-hoc tests of the simple slopes were conducted to determine the direction of significant omnibus interactions. In addition, chi-square tests were run for each outcome variable at each time-point to determine whether there were differences based on PTSD.

Finally, to determine whether any significant findings were due to anxiety more generally rather than PTSD specifically, the presence of lifetime panic disorder at baseline was entered as an alternative potential moderator. As with baseline PTSD, this variable was entered as an interaction between Time and Thoughts of Death, Thoughts of Suicide, Suicide Plans, and Suicide Attempts.

Results

Thoughts of Death on the CIDI.

Tests of model fit indicated that a quadratic effect of Time best fit the change in Thoughts of Death (Linear Time AIC: 5342.18, BIC: 5361.12; Quadratic Time AIC: 5336.67, BIC: 5361.92; Piecewise Time AIC: 5338.90, BIC: 5364.16; linear Time from model: $OR=1.57$, $SE: .29$, $z = 2.43$, $p = .015$, 95% CI : 1.09, 2.25; Quadratic Time from Model: $OR = 1.14$, $SE: 0.05$, $z = 2.72$, $p = .007$, 95% CI : 1.04, 1.25). There was a significant effect of quadratic Time on Thoughts of Death, suggesting that Thoughts of Death decreased from baseline to pre-disaster and then increased from pre-disaster to post-disaster, collapsed across all participants. Earthquake exposure severity was a significant moderator of the relationship between quadratic Time and Thoughts of Death ($OR = 1.11$, $SE: 0.04$, $z = 2.89$, $p = .004$, 95% CI : 1.03, 1.19). The pattern of results did not change regardless of whether Exposure Severity or Gender and Age were included as covariates, and results are reported without these variables in the model. Both the linear Time $\times$ baseline PTSD diagnosis interaction and quadratic Time $\times$ baseline PTSD diagnosis interaction on Thoughts of Death were both significant (see Figure 1 and Table II). The main effect of PTSD was significant, suggesting that baseline PTSD+ was associated with 138% higher odds of endorsing Thoughts of Death at post-disaster relative to baseline PTSD-. Post-hoc testing with piecewise effects of Time revealed that the slope in Thoughts of Death from baseline to pre-disaster was significant and negative for PTSD+ ($z = -4.03$, $p < .001$) and non-significant for PTSD- ($z = -1.25$, $p = .211$). Post-hoc testing also revealed that the slope in Thoughts of Death from pre- to post-disaster was significant and positive for baseline PTSD+ ($z = 2.16$, $p = .03$), but not for PTSD- ($z = 0.29$, $p = .78$). This indicates that those with baseline PTSD reported a significant increase in Thoughts of Death from pre- to post-disaster, whereas those without baseline PTSD did not. Chi-square tests revealed that baseline PTSD+ had a significantly greater likelihood of endorsing Thoughts of Death at baseline, 6-month follow-up, and post-disaster (see Table III), but not at 12- or 24- month follow-ups.

Thoughts of Suicide on CIDI.

A quadratic effect of Time best fit the change in Thoughts of Suicide (Linear Time AIC: 4694.45, BIC: 4713.39; Quadratic Time AIC: 4646.33, BIC: 4671.59; Piecewise Time AIC: 4653.94, BIC: 4679.20; Linear Time effect: $OR = 3.91$, $SE: 0.87$, $z = 6.13$, $p < .001$, 95% CI : 2.53, 6.05; Quadratic Time effect: $OR = 1.47$, $SE: 0.08$, $z = 6.75$, $p < .001$, 95% CI : 1.31, 1.64). There was a significant effect of quadratic Time on Thoughts of Suicide that was not moderated by Exposure Severity ($p = .26$), which was not included in subsequent models. There was a significant linear Time $\times$ PTSD diagnosis interaction and quadratic Time $\times$ PTSD diagnosis interaction on Thoughts of Suicide (see Figure 2). A main effect of PTSD suggesting that PTSD+ had 153% higher odds of endorsing Thoughts of Suicide at post-disaster relative to PTSD-. The pattern of results did not change when Gender and Age were included as covariates, and results are reported without these variables in the model. Piecewise post-hoc tests revealed that the slope for Thoughts of Suicide was significant and negative from baseline to pre-disaster for both baseline PTSD+ ($z = -6.46$, $p < .001$) and PTSD- ($z = -5.03$, $p < .001$). Post-hoc tests revealed that the slopes from pre- to post-disaster were positive for both PTSD+ ($z = 2.89$, $p = .004$) and PTSD- ($z = 2.50$, $p = .013$). Chi-

square tests revealed that PTSD+ was significantly more likely to endorse Thoughts of Suicide at baseline, 24-month follow-up, and post-disaster, but not at the 6- and 12-month follow-up (see Table III).

Suicide Plans from the CIDI.

A quadratic effect of Time best fit the change in Suicide Plans (Linear Time AIC: 1583.56, BIC: 1598.93; Quadratic Time AIC: 1574.80, BIC: 1595.30; Piecewise Time AIC: 1575.56, BIC: 1596.06; Linear Time effect: $OR = 2.91$, $SE = 1.09$, $z = 2.85$, $p = .004$, 95% CI : 1.40, 6.08; Quadratic Time effect: $OR = 1.35$, $SE = 0.13$, $z = 3.11$, $p = .002$, 95% CI : 1.12, 1.62). There was a significant effect of quadratic Time on Suicide Plans that was not moderated by Exposure Severity ($p = .74$), which was not included in subsequent models. The linear Time $\times$ PTSD interaction ($p = .879$) and quadratic Time $\times$ PTSD interaction ($p = .982$) on Suicide Plans was not significant (see Figure 3). When these non-significant interactions were dropped from the model, the main effect of PTSD was significant, suggesting that PTSD+ had an 18% increase in the odds of endorsing Suicide Plans at post-disaster relative to PTSD-. As with Thoughts of Death and Suicide, this pattern of results was not changed after covarying for Age and Gender, and results are reported without these covariates. Chi-square tests revealed that PTSD+ was significantly more likely to endorse Suicide Plans only at baseline (see Table IV). The lack of a significant omnibus linear or quadratic Time $\times$ PTSD interaction precludes exploration of simple slopes.

Suicide Attempts from the CIDI.

Tests of model fit indicated that a quadratic effect of Time best fit the change in Suicide Attempts (Linear Time AIC: 1630.04, BIC: 1645.39; Quadratic Time AIC: 1584.68, BIC: 1605.14; Piecewise Time AIC: 1585.08, BIC: 1605.54). There was a significant effect of quadratic Time on Suicide Attempts that was not moderated by Exposure Severity ($p = .73$), which was not included in subsequent models. The linear Time $\times$ PTSD diagnosis interaction ($p = .700$) and quadratic Time $\times$ PTSD diagnosis interaction ($p = .774$) on Suicide Attempts were both non-significant (see Figure 4). When these non-significant interactions were dropped from the model, there was a main effect of PTSD, suggesting that PTSD+ had a 14% increase in the odds of endorsing Suicide Attempts at post-disaster relative to PTSD-. The lack of a significant omnibus linear or quadratic Time $\times$ PTSD interaction precludes exploration of simple slopes. This pattern of results was not changed after covarying for Age and Gender, and results are reported without these covariates. Chi-square tests revealed that PTSD+ was significantly more likely to endorse Suicide Attempts at baseline and 12 months.

Alternative Anxiety Disorder Exploration.

To determine whether the effect of PTSD on suicide variables was specific to PTSD or could better be explained by the presence of anxiety more generally, lifetime history of Panic Disorder was entered as a potential moderator of the relationship between Time and each outcome variable. There was not a significant quadratic Time $\times$ Panic Disorder interaction on Thoughts of Death ($p = .293$), Thoughts of Suicide ($p = .56$), Suicide Plans ($p = .19$), or Suicide Attempts ($p = .73$).

Discussion

Natural disasters have far reaching implications for the psychological and physical health of those exposed, yet few studies have examined which pre-disaster factors moderate the association between disaster exposure and poor health. To our knowledge, this study is the first to demonstrate that pre-disaster PTSD is associated with a significant increase in thoughts of death and suicide from pre- to post-disaster in Chilean disaster survivors. PTSD was also associated with significantly greater likelihood of thoughts of death, thoughts of suicide, suicide plans and suicide attempts at post-disaster. Furthermore, this is the first study of its kind in an understudied sample of Latin Americans. Consistent with prior research (Sinyor et al., 2017), there was an increase in suicidal ideation after the disaster regardless of baseline PTSD status. However, those with pre-disaster PTSD had a steeper increase in suicidal thoughts from pre-to post-disaster.

Consistent with a robust prior literature (Klonsky & May, 2014; Klonsky, May, & Saffer, 2016; Klonsky, Qiu, & Saffer, 2017), the predictive power of PTSD on thoughts of death and thoughts of suicide was much stronger relative to that of suicide plans and suicide attempts. Whereas PTSD was associated with a 138 and 153% increase in thoughts of death and suicide, respectively, PTSD was associated with a 14 and 18% increase in suicide plans and attempts, respectively. In general, prediction of suicidal behavior is more difficult when compared to the prediction of suicidal thoughts. Therefore, it is not surprising that PTSD was a stronger predictor of post-disaster thoughts of suicide relative to suicide plans and suicide attempts. Indeed, while PTSD is independently associated with suicide attempts, the disorder tends to have a slightly stronger association with suicidal thoughts (Klonsky et al., 2016; Sareen, Cox, Afifi, & et al., 2005).

When groups were compared per the presence or absence of pre-disaster PTSD, those with pre-disaster PTSD were significantly more likely to endorse thoughts of death, suicide, suicide plans or suicide attempts on 8 out of 20 observations (four outcomes measured at 5 time-points). Those with pre-disaster PTSD reported a higher (though not statistically-significant) overall percent endorsement of death/suicide variables on an additional 11 observations compared to those without pre-disaster PTSD.

These findings are consistent with a sensitization conceptualization of PTSD (Grillon & Morgan, 1999; Rau et al., 2005), which suggests that PTSD may lead to enhanced fear-based responding to new stimuli. This sensitization to subsequent stressors may ultimately increase the risk for multiple negative health outcomes. In support of this, pre-disaster PTSD is associated with a greater likelihood of developing post-disaster PTSD (Fernandez et al., 2016), even after controlling for other psychiatric disorders. The current study adds to this body of literature and suggests that sensitization may result in other deleterious consequences, including increased suicidal ideation.

Importantly, the current study findings demonstrate some specific suicide risk for individuals with PTSD. Similar models were run using panic disorder as an alternative moderator. Across all outcome variables, panic disorder did not moderate the relationship between time and thoughts of death, suicide, suicide plans, and suicide attempts. This suggests that

increases in thoughts of death and suicide from pre- to post-disaster are not explained by the presence of a general anxiety disorder but are particularly relevant to PTSD. This finding is also consistent with prior literature wherein PTSD is uniquely associated with suicide risk when compared to other anxiety disorders (Victor & Klonsky, 2014).

Thoughts of death and thoughts of suicide items performed comparably despite conceptual differences between these items. Whereas thoughts of death reflect generally morbid thoughts that may or may not be personally relevant, thoughts of suicide reference specific cognitions about killing oneself. Prior literature has demonstrated elevations in both items in other samples. For example, a sample of HIV+ individuals endorsed higher rates of thoughts of death and suicide, but not suicide attempts, compared to HIV- individuals (Robertson, Parsons, van der Horst, & Hall, 2006). However, in bereaved samples, thoughts of death are commonly reported, whereas thoughts of suicide are not necessarily elevated (Bruce, Kim, Leaf, & Jacobs, 1990). In the current study, nearly all (96%) of participants who endorsed thoughts of suicide at baseline also reported thoughts of death, whereas only half (56%) of those who reported thoughts of death also reported thoughts of suicide. Thus, thoughts of death were frequently reported in the absence of thoughts of suicide whereas the converse was not supported in the current sample.

Identification of groups at risk for complications following natural disaster exposure can inform the delivery of targeted treatments for these groups. For instance, computer-delivered cognitive behavior therapy (CBT) is associated with reduced anxiety and depression in children and adolescents who were exposed to a major earthquake in New Zealand (Stasiak, Merry, Frampton, & Moor, 2016). These results suggest that individuals with a history of PTSD may be appropriate for intervention referrals in the wake of a natural disaster, as this group is at high risk for enhanced thoughts of death and suicidal ideation. Intervention development and implementation efforts should be targeted toward this group to reduce suicide risk.

There are several limitations of this study. First, a comprehensive assessment of PTSD was only collected at baseline, so it is not possible to explore the trajectory of change in PTSD as a predictor of enhanced suicide risk from pre- to post-disaster. While PTSD symptoms were measured at post-disaster, they were only assessed in relation to the earthquake/tsunami, and therefore were not included in the current study. Second, the PREDICT study intended to oversample for depressed participants, and therefore, not all participants were interviewed at time 4/pre-disaster. However, mixed effects logistic regression models take advantage of all available data and therefore concern about this missing data is minimized. Third, the gap between pre-disaster in 2005 and post-disaster in 2011 is substantial. It is unclear whether other changes occurred during this time that might better account for the increase in thoughts of death and suicide after the natural disaster. The increase in SI from pre-disaster to post-disaster may be arbitrarily inflated by the extended time between assessments relative to other time-points. For instance, time-points 1 and 2 were separated by 6 months, as were time-points 2 and 3; time-points 3 and 4 (pre-disaster) were separated by one year. In contrast, pre-disaster and post-disaster were separated by 6 years. Therefore, an increase in the likelihood of any negative outcome, including SI, would be expected with growing windows of observation. Nevertheless, the differential trajectory of change over time

between groups based on PTSD status indicates that PTSD confers some additional risk for thoughts of death and suicide. Fourth, the post-disaster interview occurred approximately one year after the disaster. Therefore, it is possible that the pattern of results might be altered if participants were measured more closely to the disaster or for longer follow-up times. Finally, the cause of significant reductions in thoughts of death for those with baseline PTSD and in thoughts of suicide for both groups from baseline to pre-disaster is unclear. These reductions may be explained by regression to the mean or some other unknown explanation. However, similar reductions in suicidal ideation over time have been observed in other samples when participants are followed longitudinally (Mazza & Reynolds, 1998; Prinstein, Nock, Simon, Aikins, Cheah & Spirito, 2008). Therefore, it is quite possible that when followed longitudinally, individuals may report a reduction in suicidal ideation over time. However, consistent with prior research (Cousins, 2016), exposure to a natural disaster may interrupt the reduction result in increased thoughts of suicide. For this reason, a quadratic change in suicidal ideation from pre- to post-disaster may indeed generalize to other samples, though future research should replicate these findings.

This study demonstrates that pre-disaster PTSD confers risk to enhancing thoughts of death and suicide following exposure to a natural disaster. In contrast, pre-disaster panic disorder is not associated with elevated thoughts of death or suicide following a natural disaster, suggesting some specificity of the findings. These findings highlight the need for implementing targeted intervention efforts in the wake of a natural disaster. Individuals with pre-disaster PTSD should be provided with referrals and access to mental health resources following a natural disaster to obviate enhanced suicide risk.

Acknowledgments

Funding for the current study was provided through the following sources: NIMH [F31MH104000 and 5T32MH017119-30]; FONDEF Chile [D021-1140 and 1110687]

References

- Center for Disease Control and Prevention (2014). Data & Statistics Fatal Injury Report for 2014.
- Akaike H (1973). A new look at the statistical model identification. *IEEE Trans. Automat. Contr*, 19, 716–723.
- Ando S, Kuwabara H, Araki T, Kanehara A, Tanaka S, Morishima R, ... Kasai K (2017). Mental Health Problems in a Community After the Great East Japan Earthquake in 2011: A Systematic Review. *Harv Rev Psychiatry*, 25(1), 15–28. doi:10.1097/hrp.000000000000124 [PubMed: 28059933]
- Andrews G, & Peters L (1998). The psychometric properties of the Composite International Diagnostic Interview. *Soc Psychiatry Psychiatr Epidemiol*, 33(2), 80–88. [PubMed: 9503991]
- American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th edition ed.). Washington, DC: American Psychiatric Association.
- American Psychiatric Association (2000). *DSM-IV-TR: Diagnostic and statistical manual of mental disorders, text revision*. Washington, DC: American Psychiatric Association, 75.
- Barros J, Morales S, Echavarri O, Garcia A, Ortega J, Asahi T, ... Nunez C (2017). Suicide detection in Chile: Proposing a predictive model for suicide risk in a clinical sample of patients with mood disorders. *Revista Brasileira de Psiquiatria*, 39, 1–11.
- Bromet EJ, Atwoli L, Kawakami N, Navarro-Mateu F, Piotrowski P, King AJ, ... Kessler RC (2017). Post-traumatic stress disorder associated with natural and human-made disasters in the World

Mental Health Surveys. *Psychol Med*, 47(2), 227–241. doi:10.1017/s0033291716002026 [PubMed: 27573281]

Brown LA, Gaudiano BA, & Miller IW (2010). The Impact of Panic-Agoraphobic Comorbidity on Suicidality in Hospitalized Patients with Major Depression. *Depression and Anxiety*, 27, 310–315. [PubMed: 20099269]

Bruce ML, Kim K, Leaf PJ, & Jacobs S (1990). Depressive episodes and dysphoria resulting from conjugal bereavement in a prospective community sample. *American Journal of Psychiatry*, 147(5), 608–611. doi:10.1176/ajp.147.5.608 [PubMed: 2327488]

Carbone EG, & Echols ET (2017). Effects of optimism on recovery and mental health after a tornado outbreak. *Psychol Health*, 32(5), 530–548. doi:10.1080/08870446.2017.1283039 [PubMed: 28156138]

Chen SL, Lee CS, Yen AM, Chen HH, Chan CC, Chiu SY, ... Chang JC (2016). A 10-year follow-up study on suicidal mortality after 1999 Taiwan earthquake. *J Psychiatr Res*, 79, 42–49. doi:10.1016/j.jpsychires.2016.04.007 [PubMed: 27155808]

Chou YJ, Huang N, Lee CH, Tsai SL, Tsay JH, Chen LS, & Chou P (2003). Suicides after the 1999 Taiwan earthquake. *Int J Epidemiol*, 32(6), 1007–1014. [PubMed: 14681266]

Cousins S (2016). Nepal's silent epidemic of suicide. *Lancet*, 387(10013), 16–17. doi:10.1016/s0140-6736(15)01352-5 [PubMed: 26766336]

Curtin SC, Warner M, & Hedegaard H (2016). Increase in Suicide in the United States, 1999–2014. National Center for Health Statistics. Retrieved from <https://www.cdc.gov/nchs/products/databriefs/db241.htm>

Deslauriers J, Acheson DT, Maihofer AX, Nievergelt CM, Baker DG, Geyer MA, & Risbrough VB (2017). COMT val158met polymorphism links to altered fear conditioning and extinction are modulated by PTSD and childhood trauma. *Depress Anxiety*. doi:10.1002/da.22678

Fernandez CA, Vicente B, Marshall BD, Koenen KC, Arheart KL, Kohn R, ... Buka SL (2016). Longitudinal course of disaster-related PTSD among a prospective sample of adult Chilean natural disaster survivors. *Int J Epidemiol*. doi:10.1093/ije/dyw094

Grillon C, & Morgan CA 3rd. (1999). Fear-potentiated startle conditioning to explicit and contextual cues in Gulf War veterans with posttraumatic stress disorder. *J Abnorm Psychol*, 108(1), 134–142. [PubMed: 10066999]

Hall BJ, Sou K, Chen W, Zhou F, Chang K, & Latkin C (2016). An Evaluation of the Buffering Effects of Types and Sources of Support on Depressive Symptoms Among Natural Disaster-Exposed Chinese Adults. *Psychiatry*, 79(4), 389–402. doi:10.1080/00332747.2016.1158004 [PubMed: 27997324]

Hlodversdottir H, Petursdottir G, Carlsen HK, Gislason T, & Hauksdottir A (2016). Long-term health effects of the Eyjafjallajökull volcanic eruption: a prospective cohort study in 2010 and 2013. *BMJ Open*, 6(9), e011444. doi:10.1136/bmjopen-2016-011444

Hu L, & Bentler PM (1999). Cutoff criteria for fit indexes in covariances structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55.

Hussain A, Nygaard E, Siqueland J, & Heir T (2016). The relationship between psychiatric morbidity and quality of life: interview study of Norwegian tsunami survivors 2 and 6 years post-disaster. *BMC Psychiatry*, 16, 173. doi:10.1186/s12888-016-0868-8 [PubMed: 27245669]

Ishiki A, Okinaga S, Tomita N, Kawahara R, Tsuji I, Nagatomi R, ... Furukawa K (2016). Changes in cognitive functions in the elderly living in temporary housing after the Great East Japan Earthquake. *PLOS One*, 11(1), e0147025-e0147025. Retrieved from 10.1371/journal.pone.0147025

Kane JC, Luitel NP, Jordans MJ, Kohrt BA, Weissbecker I, & Tol WA (2017). Mental health and psychosocial problems in the aftermath of the Nepal earthquakes: findings from a representative cluster sample survey. *Epidemiol Psychiatr Sci*, 1–10. doi:10.1017/s2045796016001104

Kerkhof AJ (1999). The Finnish national suicide prevention program evaluated. *Crisis*, 20(2), 50, 63. doi:10.1027//0227-5910.20.2.50

King M, Walker C, Levy G, Bottomley C, Royston P, Weich S, ... Nazareth I (2008). Development and validation of an international risk prediction algorithm for episodes of major depression in general

practice attendees: the PredictD study. *Arch Gen Psychiatry*, 65(12), 1368–1376. doi:10.1001/archpsyc.65.12.1368 [PubMed: 19047523]

King M, Weich S, Torres-González F, Švab I, Maarros H-I, Neeleman J, ... Nazareth I (2006). Prediction of depression in European general practice attendees: the PREDICT study. *BMC Public Health*, 6(1), 6. doi:10.1186/1471-2458-6-6 [PubMed: 16409633]

Klonsky ED, & May AM (2014). Differentiating Suicide Attempters from Suicide Ideators: A Critical Frontier for Suicidology Research. *Suicide and Life-Threatening Behavior*, 44(1), 1–5. doi: 10.1111/sltb.12068 [PubMed: 24313594]

Klonsky ED, May AM, & Saffer BY (2016). Suicide, Suicide Attempts, and Suicidal Ideation. *Annu Rev Clin Psychol*, 12, 307–330. doi:10.1146/annurev-clinpsy-021815-093204 [PubMed: 26772209]

Klonsky ED, Qiu T, & Saffer BY (2017). Recent advances in differentiating suicide attempters from suicide ideators. *Current Opinion in Psychiatry*, 30(1), 15–20. doi:10.1097/ycp.0000000000000294 [PubMed: 27798483]

Liaw YP, Wang PW, Huang CC, Chang CM, & Lee WC (2008). The suicide mortality rates between 1997–1998 and 2000–2001 in Nantou County of Taiwan following the earthquake of September 21 in 1999. *J Forensic Sci*, 53(1), 199–202. doi:10.1111/j.1556-4029.2008.00592.x [PubMed: 18005008]

Lieber M (2017). Assessing the Mental Health Impact of the 2011 Great Japan Earthquake, Tsunami, and Radiation Disaster on Elementary and Middle School Children in the Fukushima Prefecture of Japan. *PLOS One*, 12(1), e0170402. doi:10.1371/journal.pone.0170402

Lowe SR, Rhodes JE, & Scoglio AAJ (2012). Changes in Marital and Partner Relationships in the Aftermath of Hurricane Katrina. *Psychology of Women Quarterly*, 36(3), 286–300. doi:doi: 10.1177/0361684311434307 [PubMed: 23125478]

Lu TH (2004). Earthquake and suicide: bringing context back into disaster epidemiological studies. *Int J Epidemiol*, 33(6), 1406–1409; author reply 1409–1410. doi:10.1093/ije/dyh234 [PubMed: 15465898]

Mazza JJ, & Reynolds WM (1998). A Longitudinal Investigation of Depression, Hopelessness, Social Support, and Major and Minor Life Events and Their Relation to Suicidal Ideation in Adolescents. *Suicide and Life-Threatening Behavior*, 28(4), 358–374. doi:10.1111/j.1943-278X.1998.tb00972.x [PubMed: 9894304]

Nidzvetska S, Rodriguez-Llanes JM, Aujoulat I, Gil Cuesta J, Tappis H, van Loenhout JA, & Guha-Sapir D (2017). Maternal and Child Health of Internally Displaced Persons in Ukraine: A Qualitative Study. *Int J Environ Res Public Health*, 14(1). doi:10.3390/ijerph14010054

Ohto H, Maeda M, Yabe H, Yasumura S, & Bromet EE (2015). Suicide rates in the aftermath of the 2011 earthquake in Japan. *Lancet*, 385(9979), 1727. doi:10.1016/s0140-6736(15)60890-x [PubMed: 25943937]

Pan American Health Organization (2014). *Suicide Mortality in the Americas: Regional Report*. Retrieved from Washington, DC:

Pedler A, Kamper SJ, & Sterling M (2016). Addition of posttraumatic stress and sensory hypersensitivity more accurately estimates disability and pain than fear avoidance measures alone after whiplash injury. *Pain*, 157(8), 1645–1654. doi:10.1097/j.pain.0000000000000564 [PubMed: 27007066]

Pollack AA, Weiss B, & Trung LT (2016). Mental health, life functioning and risk factors among people exposed to frequent natural disasters and chronic poverty in Vietnam. *BJPsych Open*, 2(3), 221–232. doi:10.1192/bjpo.bp.115.002170 [PubMed: 27458524]

Prinstein MJ, Nock MK, Simon V, Aikins JW, Cheah CSL, & Spirito A (2008). Longitudinal trajectories and predictors of adolescent suicidal ideation and attempts following inpatient hospitalization. *Journal of Consulting and Clinical Psychology*, 76, 92–103. [PubMed: 18229987]

Pruitt LD, Smolenski D, Reger M, Bush N, Skopp N, & Campise RL (2016). Department of defense suicide event report-calendar year 2014 Publication No. 6–9C3997A.

Psarros C, Theleritis C, Economou M, Tzavara C, Kioulos KT, Mantonakis L, ... Bergiannaki JD (2017). Insomnia and PTSD one month after wildfires: evidence for an independent role of the “fear of imminent death”. *Int J Psychiatry Clin Pract*, 1–8. doi:10.1080/13651501.2016.1276192

- Rau V, DeCola JP, & Fanselow MS (2005). Stress-induced enhancement of fear learning: an animal model of posttraumatic stress disorder. *Neurosci Biobehav Rev*, 29(8), 1207–1223. doi:10.1016/j.neubiorev.2005.04.010 [PubMed: 16095698]
- Richardson R (2000). Shock sensitization of startle: learned or unlearned fear? *Behav Brain Res*, 110(1–2), 109–117. [PubMed: 10802308]
- Robertson K, Parsons TD, van der Horst C, & Hall C (2006). Thoughts of Death and Suicidal Ideation in Nonpsychiatric Human Immunodeficiency Virus Seropositive Individuals. *Death Studies*, 30(5), 455–469. doi:10.1080/07481180600614435 [PubMed: 16610158]
- Ryan B, Franklin RC, Burkle FM Jr., Aitken P, Smith E, Watt K, & Leggat P (2015). Identifying and Describing the Impact of Cyclone, Storm and Flood Related Disasters on Treatment Management, Care and Exacerbations of Non-communicable Diseases and the Implications for Public Health. *PLoS Curr*, 7. doi:10.1371/currents.dis.62e9286d152de04799644dcca47d9288
- Sareen J, Cox BJ, Afifi TO, & et al. (2005). Anxiety disorders and risk for suicidal ideation and suicide attempts: A population-based longitudinal study of adults. *Archives of General Psychiatry*, 62(11), 1249–1257. doi:10.1001/archpsyc.62.11.1249 [PubMed: 16275812]
- Shoaf K, Sauter C, Bourque LB, Giangreco C, & Weiss B (2004). Suicides in LOS Angeles County in relation to the Northridge earthquake. *Prehosp Disaster Med*, 19(4), 307–310. [PubMed: 15645626]
- Silva D, Vicente B, Saldivia S, & Kohn R (2013). Suicidal behavior and psychiatric disorders in Chile. A population-based study. *Review of Medicine in Chile*, 141, 1273–1280.
- Sinyor M, Tse R, & Pirkis J (2017). Global trends in suicide epidemiology. *Curr Opin Psychiatry*, 30(1), 1–6. doi:10.1097/ycp.0000000000000296 [PubMed: 27845946]
- Stasiak K, Merry SN, Frampton C, & Moor S (2016). Delivering solid treatments on shaky ground: Feasibility study of an online therapy for child anxiety in the aftermath of a natural disaster. *Psychother Res*, 1–11. doi:10.1080/10503307.2016.1244617 [PubMed: 25751649]
- StataCorp. (2015). *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP.
- Tanaka E, Tsutsumi A, Kawakami N, Kameoka S, Kato H, & You Y (2016). Long-term psychological consequences among adolescent survivors of the Wenchuan earthquake in China: A cross-sectional survey six years after the disaster. *J Affect Disord*, 204, 255–261. doi:10.1016/j.jad.2016.08.001 [PubMed: 27544312]
- Tsuboya T, Aida J, Hikichi H, Subramanian SV, Kondo K, Osaka K, & Kawachi I (2016). Predictors of depressive symptoms following the Great East Japan earthquake: A prospective study. *Soc Sci Med*, 161, 47–54. doi:10.1016/j.socscimed.2016.05.026 [PubMed: 27239707]
- Vicente B, Kohn R, Rioseco P, Saldivia S, Levav I, & Torres S (2006). Lifetime and 12-month prevalence of DSM-III-R disorders in the Chile psychiatric prevalence study. *Am J Psychiatry*, 163(8), 1362–1370. doi:10.1176/ajp.2006.163.8.1362 [PubMed: 16877648]
- Victor SE, Klonsky ED (2014). Correlates of suicide attempts among self-injurers: A meta-analysis. *Clinical Psychology Review*, 34, 282–297. [PubMed: 24742496]
- World Health Organization (1992). *International Statistical Classification of Diseases and Related Health Problems (Vol. 2)*. Geneva, Switzerland.
- World Health Organization (1997). *Composite International Diagnostic Interview (CIDI core) Version 2.1*. In D. o. M. Health (Ed.). Geneva, Switzerland.
- World Health Organization (2013). *WHO Mortality Data and Statistics 2013*. Retrieved from http://www.who.int/healthinfo/statistics/mortality_rawdata/en/index.html.
- Yang CH, Xirasagar S, Chung HC, Huang YT, & Lin HC (2005). Suicide trends following the Taiwan earthquake of 1999: empirical evidence and policy implications. *Acta Psychiatr Scand*, 112(6), 442–448. doi:10.1111/j.1600-0447.2005.00603.x [PubMed: 16279873]
- Zhang W, Ohira T, Abe M, Kamiya K, Yamashita S, Yasumura S, ... Nakano H (2017). Evacuation after the Great East Japan Earthquake was associated with poor dietary intake: The Fukushima Health Management Survey. *J Epidemiol*, 27(1), 14–23. doi:10.1016/j.je.2016.08.002 [PubMed: 28135192]

Figure 1.

Time and PTSD on Thoughts of Death.

The model depicted in Figure 1 includes the main effect of linear Time, quadratic Time, PTSD, and linear Time x PTSD and quadratic Time x PTSD. The blank vertical reference line with long-dashes indicates the last observation prior to post-disaster. The grey vertical reference line with short dashes indicates the approximate time of the disaster.

Figure 2.

Time and PTSD on Thoughts of Suicide

The model depicted in Figure 2 includes the main effect of linear Time, quadratic Time, PTSD, and linear Time x PTSD and quadratic Time x PTSD. The blank vertical reference line with long-dashes indicates the last observation prior to post-disaster. The grey vertical reference line with short dashes indicates the approximate time of the disaster.

Figure 3.

Time and PTSD on Suicide Plans.

The model depicted in Figure 3 includes the main effect of linear Time, quadratic Time, PTSD, and linear Time x PTSD and quadratic Time x PTSD. The blank vertical reference line with long-dashes indicates the last observation prior to post-disaster. The grey vertical reference line with short dashes indicates the approximate time of the disaster.

Figure 4.

Time and PTSD on Suicide Attempts.

The model depicted in Figure 4 includes the main effect of linear Time, quadratic Time, PTSD, and linear Time x PTSD and quadratic Time x PTSD. The blank vertical reference line with long-dashes indicates the last observation prior to post-disaster. The grey vertical reference line with short dashes indicates the approximate time of the disaster.

Table 1.**Baseline Demographic Characteristics and Available Death/Suicide Data**

	PTSD	No PTSD	Statistics
Age mean (<i>SD</i>)	45.6 (14.0)	47.0 (17.1)	$F(1,1645)=1.58, p=.21$
% Female	236 (87.7)	1,067 (77.4)	$\chi^2(1)=14.45, p<.001$
% Married	115 (42.8)	676 (49.1)	$\chi^2(1)=3.56, p=.06$
Years in school mean (<i>SD</i>)	8.2 (3.6)	8.6 (3.9)	$F(1,1645)=2.52, p=.11$
Death/Suicide available data: baseline (<i>n</i>)	269	1,377	
Death/Suicide available data: 6 mo (<i>n</i>)	148	605	
Death/Suicide available data: 1 year (<i>n</i>)	134	549	
Death/Suicide available data: 2 year (<i>n</i>)	66	187	
Death/Suicide available data: post-disaster (<i>n</i>)	126	622	

Table II.
Effect of PTSD on Thoughts of Death, Thoughts of Suicide, Suicide Plans, and Suicide Attempts

<i>Thoughts of Death</i>	<i>OR</i>	<i>95% CI</i>	<i>SE</i>	<i>z</i>	<i>p</i>
Intercept	1.17	0.95, 1.44	0.12	1.45	.146
Linear Time	1.28	0.86, 1.92	0.26	1.23	.22
Quadratic Time	1.08	0.97, 1.19	0.06	1.42	.16
PTSD	2.38	1.39, 4.05	0.65	3.18	.001
Linear Time × PTSD	3.49	1.44, 8.47	1.58	2.77	.006
Quadratic Time × PTSD	1.41	1.12, 1.76	0.16	2.96	.003
<i>Thoughts of Suicide</i>					
Intercept	0.15	0.12, 0.21	0.02	-12.68	<.001
Linear Time	2.94	1.80, 4.80	0.74	4.30	<.001
Quadratic Time	1.35	1.19, 1.53	0.09	4.75	<.001
PTSD	2.53	1.39, 4.62	0.78	3.03	.002
Linear Time × PTSD	4.16	1.53, 11.27	2.12	2.80	.005
Quadratic Time × PTSD	1.49	1.16, 1.92	0.19	3.10	.002
<i>Suicide Plans</i>					
Intercept	1.26	0.81, 1.95	0.28	1.03	.303
Linear Time	2.91	1.40, 6.05	1.09	2.85	.004
Quadratic Time	1.34	1.11, 1.62	0.13	3.10	.002
PTSD	1.18	1.05, 1.31	0.07	2.89	.004
<i>Suicide Attempts</i>					
Intercept	0.38	0.25, 0.58	0.08	-4.41	<.001
Linear Time	9.87	4.60, 21.20	3.85	5.87	<.001
Quadratic Time	1.83	1.50, 2.21	0.18	6.10	<.001
PTSD	1.14	1.04, 1.25	0.06	2.70	.007

Note: Bolded cells indicate significance.

Table III.

Percent Endorsement of Thoughts of Death and Suicide.

	Thoughts of Death (% Endorsement)				Thoughts of Suicide (% Endorsement)					
	Baseline	6 Mo	12 Mo	24 Mo (Pre-Disaster)	Post-Disaster	Baseline	6 Mo	12 Mo	24 Mo (Pre-Disaster)	Post-Disaster
PTSD+	79.9	69.6	59.7	69.7	69.1	61.3	30.4	29.9	42.4	34.9
PTSD-	57.5	54.7	53.3	67.4	54.5	30.9	24.3	24.8	28	24.1
	$\chi^2=47.47, p<.001$	$\chi^2=10.79, p=.001$	$\chi^2=1.79, p=.18$	$\chi^2=0.12, p=.73$	$\chi^2=9.04, p=.003$	$\chi^2=90.88, p<.001$	$\chi^2=2.34, p=.13$	$\chi^2=1.45, p=.23$	$\chi^2=4.71, p=.030$	$\chi^2=6.37, p=.012$

Bolded cells indicate significance.

Table IV.

Percent Endorsement of Suicide Plans and Attempts

	Suicide Plans (% Endorsement)					Suicide Attempts (% Endorsement)				
	Baseline	6 Mo	12 Mo	24 Mo (Pre-Disaster)	Post-Disaster	Baseline	6 Mo	12 Mo	24 Mo (Pre-Disaster)	Post-Disaster
PTSD+	76.6	66.7	71.8	60.7	65.9	55.1	40.9	41	15.7	36.7
PTSD-	65.1	64.8	54.9	63.5	59.3	42.4	31.8	21.4	25	43.2
	$\chi^2=7.48, p=.006$	$\chi^2=.05, p=.82$	$\chi^2=3.56, p=.059$	$\chi^2=.06, p=.81$	$\chi^2=.62, p=.43$	$\chi^2=7.82, p=.005$	$\chi^2=1.154, p=.283$	$\chi^2=6.05, p=.014$	$\chi^2=1.02, p=.313$	$\chi^2=.61, p=.434$

Note: Bolded cells indicate significance.