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A Longitudinal Examination of Interpersonal Violence Exposure, Concern for Loved Ones During a Disaster, and Web-Based Intervention Effects on Posttraumatic Stress Disorder Among Adolescent Victims of the Spring 2011 Tornadoes

Amanda K. Gilmore¹, Matthew Price², Kaitlin E. Bountress³, Kelly L. Zuromski⁴, Kenneth Ruggiero¹, Heidi Resnick¹

¹Medical University of South Carolina, Charleston, SC

²University of Vermont, Burlington, VT

³Virginia Commonwealth University, Richmond, VA

⁴Harvard University, Cambridge, MA

Abstract

Natural disasters are common and devastating, and can affect the mental health of adolescents. It is also common for adolescents to have histories of interpersonal violence (IPV). The current study was a secondary data analysis of a larger randomized clinical trial and examined the moderating effect of IPV history and concern for loved ones during a disaster on treatment condition effects on posttraumatic stress disorder (PTSD) symptoms over time among disaster-exposed adolescents. Participants ($n = 979$) were recruited postdisaster to participate in a randomized clinical trial examining the efficacy of a web-based intervention, Bounce Back Now (BBN), on mental health symptoms at 4 and 12 months postintervention. It was found that adolescents with an IPV history and who had caregivers that were concerned for loved ones during a disaster had more PTSD symptoms at baseline than those without such histories. Furthermore, caregiver concern for loved ones during a disaster moderated the effect of BBN on PTSD symptoms over time. Specifically, the BBN condition was most effective for adolescents who had caregivers who were concerned for loved ones during the disaster in reductions of PTSD symptoms over time. The current study provides further evidence for the use of technology-based interventions for individuals as a means to address mental health symptoms after a traumatic event, especially among those with more severe traumatic experiences.

Keywords

violence exposure; PTSD; interpersonal violence; web-based interventions; natural disasters

Natural disasters are common and can be devastating, with 458 fatalities and 1,276 injuries caused by natural disasters alone in the United States in 2016 from severe weather (National

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Weather Service, 2017). Trauma exposure in childhood and adolescence, including exposure to natural disasters, is associated with a range of mental health symptoms with posttraumatic stress disorder (PTSD) symptoms being among the most common (e.g., Kilpatrick et al., 2000; Kilpatrick et al., 2003; Waldrop et al., 2007), and risk of these symptoms increases further for adolescents who have experienced polyvictimization, or multiple forms of victimization (Finkelhor, Ormrod, & Turner, 2007; Ford, Elhai, Connor, & Frueh, 2010). A web-based intervention, Bounce Back Now (BBN), can reduce mental health symptoms among disaster-exposed adolescents (Ruggiero et al., 2015). However, the role of other victimization history in treatment outcomes has not yet been examined. Interpersonal violence (IPV) is widespread among adolescents, with 8.5 million women and 1.5 million men experiencing rape before the age of 18 years (Smith et al., 2017), 3.5 million women and nearly 1 million men experiencing stalking before the age of 18 years (Smith et al., 2017), and 21% of female and 10% of male high school students who date experiencing dating violence (Centers for Disease Control and Prevention [CDC], 2016). Adolescents who have experienced IPV prior to disaster exposure may benefit uniquely from interventions targeting PTSD symptoms. Furthermore, a recent study found that both an IPV history and experiences during a disaster, including concern about the safety of loved ones increased the likelihood of adolescent PTSD (Resnick et al., 2017). However, it is unclear how IPV history and concern for loved ones during a disaster are associated with treatment response for a web-based intervention targeting postdisaster PTSD among adolescents. Therefore, the current study examined adolescents' history of IPV and concern for loved ones during the disaster as moderators of treatment outcomes 4- and 12-months after receiving the BBN intervention.

BBN: A Web-Based Intervention

Web-based and *mHealth* interventions have several advantages including the ability to immediately disseminate to disaster-exposed populations, low cost, and ability to be personalized to adolescent symptoms. BBN is a web-based intervention that is efficacious at reducing mental health symptoms among disaster-exposed adolescents (Ruggiero et al., 2015). BBN addresses posttraumatic stress symptoms, cigarette use, alcohol use, and depressive symptoms through separate modules for adolescents and parents after experiencing a disaster. A randomized controlled trial compared BBN, BBN + adult self-help (ASH) for parents, and assessment-only control condition on PTSD and depression (Ruggiero et al., 2015). It was found that the intervention conditions were more effective than the assessment-only control condition on reducing PTSD and depression. Previous literature suggests that polyvictimization is associated with more negative mental health outcomes than single victimization alone (Finkelhor et al., 2007; Ford et al., 2010); therefore, it may be possible that individuals with multiple victimization experiences may respond to interventions differently than those who only experienced a disaster.

IPV and Concern for Loved Ones During a Disaster

IPV confers higher risk of symptomatology, including PTSD, more so than history of other event types (Breslau et al., 1998; Briere & Elliott, 2000; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Kilpatrick et al., 2013; Resnick, Kilpatrick, Dansky, Saunders, & Best,

1993). Considering PTSD specifically, one meta-analysis found that adolescent girls who experienced interpersonal trauma were at highest risk of developing PTSD compared with boys and other types of traumatic experiences (Alisic et al., 2014). The importance of IPV history has also been noted as a risk factor for the sample utilized in the current study. Resnick and colleagues (2017) investigated how a prior history of IPV, compared with prior history of accident or disaster, related to PTSD symptoms among tornado-exposed adolescents. Results from this study indicated that prior, pretornado IPV was robustly associated with PTSD symptoms assessed 8 months posttornado, finding that adolescents endorsing IPV history experienced 3 times the number of current symptoms as those without an IPV history. Certain features of IPV may uniquely contribute to higher risk of psychopathology, beyond other traumatic event history, experiences during the disaster, and demographic variables (Resnick et al., 2017). Moreover, Zuromski et al. (2018) found that this same pattern emerged when investigating suicidal ideation posttornado, in that, IPV history was more robustly related to ideation, above and beyond current PTSD symptoms, whereas history of other types of traumatic events was not related to suicidality. Collectively, these findings highlight the relative importance of IPV history, suggesting that prior experience of IPV may confer heightened risk of mental health problems following exposure to additional traumatic events.

Experiences during a disaster can affect mental health symptoms postdisaster, with concern for loved ones during the disaster being one of those experiences. Previous research has found that in technology-based interventions for trauma-exposed individuals, the intervention is most effective for individuals with more severe symptoms. Specifically, a video-based intervention conducted during a post-sexual assault medical forensic exam found that the intervention was most effective for women with prior sexual assault histories (Resnick et al., 2007). A similar finding emerged for a college sexual assault risk reduction program for women who engaged in heavy episodic drinking, such that a web-based intervention was more effective at reducing alcohol use and sexual assault risk among individuals with more severe sexual assault histories (Gilmore, Lewis, & George, 2015). It is possible that individuals who have been through the experience before, or who had more severe trauma histories, were more interested in the intervention content because it may be more salient compared with those with less severe trauma histories. In the context of BBN, it would be expected that individuals with more severe trauma histories, indicated by both IPV or concern for loved ones during the disaster, would have more reductions in mental health symptoms over time compared with those with no IPV history or no concern for loved ones during the disaster. Also, reductions in symptoms may be more apparent due to a greater range of symptoms among those with prior IPV and more severe disaster exposure indicators.

Current Study

The current study examined the moderating effect of predisaster IPV history and concern for loved ones during a disaster on the efficaciousness of a postdisaster web-based mental health intervention (BBN) on PTSD symptoms over time. It was hypothesized that individuals with a history of IPV and concern for loved ones during disaster would benefit from BBN more in terms of reductions in PTSD over time, compared with those without an IPV history or

concern for loved ones during the disaster. Specifically, it was hypothesized that IPV history would moderate the effect of BBN (compared with control condition) on PTSD symptoms over time, and that concern for loved ones during the disaster would moderate the effect of BBN (compared with control condition) on PTSD symptoms over time.

Method

Participants

A total of 2,000 adolescents were recruited using an address-based sampling technique to recruit families living in communities that were affected by the 2011 tornadoes in Joplin, Missouri, and several areas of Alabama (see Ruggiero et al., 2015, for more detailed information regarding sampling strategies). The tornados resulted in 150 deaths, 1,000 injuries, and 7,000 homes destroyed (National Oceanic and Atmospheric Administration [NOAA], 2011).

For this analysis, a subset of participants who enrolled in the treatment study were used. Although the treatment was offered to all 2,000 families, only $n = 979$ began treatment. A total of 254 families were randomized to the control condition and 725 were randomized to a BBN condition (BBN only = 361, BBN + ASH = 364). Data from these individuals were used for the current analysis. Participants were majority female (52.9%), aged $M_{\text{age}} = 14.3$ years, $SD_{\text{age}} = 1.7$ years. The majority of adolescents identified as White (73.9%) and the remaining identified as Black (24.5%), Other (1.6%), and Hispanic (3.9%). A total of 21.8% of families had a household income below US\$20,000, 21.2% reported income between US \$20,000 and US\$40,000, 18.1% reported income between US\$40,000 and US\$60,000, 12.0% reported income between US\$60,000 and US\$80,000, 9.4% reported income between US\$80,000 and US\$100,000, and 17.5% reported a household income above US\$100,000.

Procedure

Participants were recruited from households living within 5 miles of the Category 4 or 5 tornado and within 2 miles of a Category 2 or 3 tornado. Eligible households, those having a 12- to 17-year-old residing in the home at the time of the tornado, were identified through a landline match or mail screen. Assent and consent were obtained on the phone from adolescents and parents, respectively. All participants were paid US\$5 for completing a screening to determine eligibility.

Participants, including adolescents and their parents, completed a baseline interview ($M = 25$ min) between September 2011 and June 2012 ($M = 8.8$ months after tornado, $SD = 2.6$ months after tornado). On completion of the interview, participants were provided with a unique user identifier (ID) to access the website followed by a letter with instructions. Participants were randomly assigned to a control condition, BBN, or BBN + ASH, and were compensated US\$15 for completing the interview and US\$25 for accessing the website. Participants completed follow-up interviews that were conducted at both 4 and 12 months after the baseline interview. Adolescents completed the history of IPV and posttraumatic stress symptoms questionnaires and parents completed the question regarding concern for loved ones.

Conditions

BBN included four-session modules for adolescents that participants were able to self-select. These modules included content on PTSD symptoms (“stress”), depressive symptoms (“moods”), cigarette use (“smoking”), and alcohol use (“alcohol”). The modules focused on PTSD, depression, and cigarette use included a screener, and adolescents with positive screens were encouraged to complete the module, whereas those with negative screens were invited to exit the module but were able to complete it if they wished. The alcohol use module was a prevention module and, therefore, no screeners were in place. Modules included education, evidence-based symptom, or use reduction skills, and included a variety of media types (e.g., text, graphics, videos). More details are available in the main outcome paper (Ruggiero et al., 2015). Some participants received BBN + ASH, which included all the components described above for adolescents plus content for parents. Parental content was one module and parents self-selected what they would like to learn about, which included addressing parent–adolescent communication, psychoeducation relating to common disaster mental health problems, adolescent internalizing problems, and adolescent problematic behavior. Parents also had access to *Disaster Recovery Web*, an adult disaster mental health intervention (Ruggiero et al., 2006). More details are available in the main outcome paper (Ruggiero et al., 2015). There were no differences between BBN and BBN + ASH on PTSD symptoms; therefore, these two conditions were merged for the purposes of the current study.

The control condition included quizzes and myths and facts questions. No education or recommendations were provided in this condition.

Measures

IPV exposure.—History of IPV among adolescent participants was assessed using three questions (i.e., “Have you ever been beaten up, hit, punched, shot at, or threatened to be hurt badly?” “Have you ever seen a family member being hit, punched, or kicked very hard at home, not including ordinary fights between brothers and sisters?” and “Have you ever seen someone in your town being beaten up, shot at, or killed?”). Responses were dichotomized (1 = yes, 0 = no) such that participants who experienced any history of IPV (i.e., responded yes to history of physical/aggravated assault, witnessed family, or witnessed community IPV described above) were coded as 1. Those who responded no to all IPV items were coded 0.

Concern for loved ones during the disaster was assessed using a single-item question asking whether participant parent or caregiver was concerned about the safety or whereabouts of loved ones (1 = yes, 0 = no).

Adolescent PTSD symptoms were based on the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994) symptom criteria due to the time of the study and were assessed using the National Survey of Adolescents PTSD module, which yields strong reliability and concurrent validity (Kilpatrick et al., 2003). Symptom counts were created to indicate how many PTSD symptoms were endorsed by the adolescent that have lasted 2 weeks or longer during the past month. Symptoms were assessed at baseline, 4-month follow-up, and at 12-month follow-up.

Data Analytic Plan

The hypotheses for the current study were examined with two negative binomial regression models conducted in SPSS Version 24: a main effects model and a moderation model. A negative binomial distribution best represented the distribution of the outcome variables, which were counts of PTSD symptoms. The distributions did not fully meet the assumptions of other distributions including a Poisson regression (there was evidence of overdispersion) and zero-inflated regressions (there was no evidence of overinflated 0s). The main effects model examined the effect of BBN (vs. control condition), IPV history (vs. no IPV history), and concern for loved ones on PTSD symptoms at baseline. The moderation model examined all two-way interactions and the two hypothesized three-way interactions: time (baseline, 4 months, and 12 months) $\times$ IPV history (yes/no) $\times$ treatment condition (BBN vs. control) and time $\times$ concern for loved ones during the disaster (yes/no) $\times$ treatment condition (BBN vs. control) on PTSD symptoms. Age and gender were included as control variables in both the main effects and interaction model. There were no significant differences between treatment condition and control on concern for loved ones during the disaster ($\chi^2 = 0.32, p = .57$) or on IPV history ($\chi^2 = .01, p = .92$).

Results

The main effects model revealed a significant association between IPV exposure and PTSD symptoms and an association between gender and PTSD at baseline (see Tables 1 and 2). This suggests that females and adolescents with an IPV history in addition to their experience with a natural disaster had more PTSD symptoms at baseline. There was a trend for both time and BBN condition on PTSD symptoms suggesting that PTSD symptoms lowered over time, and those in the BBN condition had lower PTSD symptoms than those in the control condition, but these effects did not reach significance. There were no significant associations between age and PTSD symptoms or concern for loved ones and PTSD symptoms.

A significant interaction was found between time, treatment condition (BBN vs. control), and concern for loved ones on PTSD symptoms (see Table 2). Probing of this interaction revealed that among those who were not concerned for loved ones during the disaster, there was no main effect of change over time for adolescents in the BBN condition or the control condition, control: $b = -0.03, p = .338$, odds ratio (OR) = 0.97; BBN: $b = -0.02, p = .120$, OR = 1.02. Among those who were concerned for loved ones, a different pattern of results emerged. Those in the BBN condition experienced a significant decline in PTSD symptoms over time ($b = -0.02, p = .041$, OR = 0.98), whereas those in the control condition did not ($b = 0.02, p = .255$, OR = 1.02; see Table 4). These findings suggest that BBN was most effective for those who had caregivers who were concerned about the safety of loved ones during the disaster. There was no significant interaction between IPV, BBN, and PTSD symptoms over time.

Discussion

This was the first study to examine the effects of IPV exposure and caregiver concern for loved ones during a disaster on postdisaster mental health intervention efficacy. Our

hypotheses were partially supported. As hypothesized, the main effect model revealed that adolescents with a history of IPV had significantly higher baseline PTSD symptoms. However, the BBN condition was not most effective for adolescents with both IPV histories and concern for loved ones during the disaster on PTSD symptoms as hypothesized. Instead, the BBN condition was most effective for adolescents who had caregivers who were concerned for loved ones during the disaster. Taken together, these findings suggest that two interpersonal experiences related to trauma, IPV trauma history and concern for loved ones during a disaster, can affect postdisaster symptomology. Partially consistent with the hypotheses, the BBN condition was most effective for adolescents with more severe trauma exposure, such as caregiver's concern for the safety of loved ones. Although disasters are not typically categorized as interpersonal traumas, the role of interpersonal relationships within the context of disasters may increase the risk of PTSD symptoms. This is consistent with previous findings suggesting that interpersonal traumas are associated with a higher likelihood of PTSD compared with noninterpersonal traumas (Kessler et al., 2017; Kessler et al., 1995). Disasters with and without interpersonal complications provide a unique opportunity to examine the role of interpersonal aspects of a noninterpersonal trauma in relation to treatment outcomes. Another potential explanation for this finding may be that caregiver concern for loved ones may serve as a proxy for a supportive home environment and this may serve as a protective factor within the context of a disaster. For example, caregivers may be more likely to connect an adolescent to needed care for mental health symptoms if the caregiver had concern for their loved ones during the disaster. The caregiver may have also talked more with the adolescent about the disaster and helped the adolescent process the disaster if there was concern for loved ones. Qualitative examinations of caregiver concern for loved ones during a disaster may help further understand protective factors associated with postdisaster adolescent mental health.

The main effects models revealed that an IPV history was significantly associated with more PTSD symptoms among disaster-exposed adolescents. Interaction terms involving IPV history were included in the interaction models; therefore, main effects of IPV cannot be interpreted. Nonetheless, it may be possible to add more specific or in-depth IPV components to the intervention for adolescents who had a history of IPV to increase the efficacy of the BBN intervention for that population. The intervention was more clearly framed as targeting postdisaster responses. Although some psychoeducation was included to communicate awareness of other types of potentially traumatic events, inclusion of more content and examples of how adolescents might have symptoms in response to disaster characteristics such as threats to loved ones and IPV and tailored treatment examples would be useful for those with more complex event histories.

Strengths, Limitations, and Future Directions

Strengths of the current study include the large population, the randomized clinical trial design, and the examination of PTSD among disaster-exposed adolescents. There are several limitations to consider when interpreting the results. First, concern for loved ones during the disaster was a single-item assessment and it was dichotomous. Future research should examine the role of concern for safety of others in postdisaster adolescent PTSD with a more complex assessment of both caregiver and adolescent, including multiple items and response

choices to fully examine the variability. Second, although the intervention was conducted as soon as possible postdisaster, on average, it was approximately 9 months after the disaster. Therefore, different results may have emerged if the baseline assessment and intervention were delivered immediately postdisaster. Finally, the content of the intervention did not target interpersonal traumas in great depth. Future interventions should include components focused on IPV for individuals with IPV histories and should include content regarding interpersonal traumas, given that it is possible that a history of interpersonal traumas or interpersonal experiences within the disaster could affect treatment efficacy.

Conclusion

The current study provides further evidence for the use of technology-based interventions for individuals as a means to address mental health symptoms after a traumatic event. It also provides further evidence that technology-based interventions are most effective for individuals with more severe trauma histories, suggesting that these individuals are more likely to attend to the content due to it being more salient for that population. More work is needed to increase the efficacy of postdisaster interventions for individuals with IPV histories.

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Table 1.

Posttraumatic Stress Disorder Symptom Counts.

	Baseline		4-Month Follow-Up		12-Month Follow-Up	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Total sample	2.47	3.36	1.27	2.60	1.18	2.45
IPV history						
Yes	4.14	3.90	2.15	3.23	1.97	3.10
No	1.50	2.55	0.76	1.93	0.74	1.86
Concern						
Yes	2.69	3.52	1.39	2.77	0.87	1.78
No	1.81	2.75	0.92	2.00	1.27	2.66
Condition						
BBN	2.46	3.35	1.24	2.55	1.10	2.39
Control	2.47	3.38	1.32	2.68	1.33	2.66

Note. IPV = interpersonal violence; BBN = Bounce Back Now; Concern = concern for safety of loved ones during disaster.

Table 2.

Main Effects Negative Binomial Regression Models.

Posttraumatic Stress Symptom Counts			
	<i>B</i>	<i>SE</i>	95% CI
Age	0.03	0.05	[-0.07, 0.12]
Gender	-0.40 [*]	0.19	[-0.78, -0.02]
Time	-0.02 [†]	0.01	[-0.04, <0.01]
BBN (vs. control)	-0.33 [†]	0.19	[-0.71, 0.06]
IPV exposure	0.98 ^{***}	0.19	[0.61, 1.35]
Concern for loved ones	0.24	0.25	[-0.24, 0.72]

Note. CI = confidence interval; BBN = Bounce Back Now; IPV = interpersonal violence; gender was coded as male = 1 and female = 2.

[†]
 $p < .1$.

^{*}
 $p < .05$.

^{**}
 $p < .01$.

^{***}
 $p < .001$.

Table 3.

Moderation Effects Negative Binomial Regression Model on PTSD Symptom Counts.

	<i>B</i>	<i>SE</i>	<i>OR</i>	95% CI
Age	0.02	0.05	0.69	[-0.08, 0.12]
Gender	-0.42 [*]	0.19	0.66	[-0.79, -0.04]
Time	-0.14 ^{***}	0.02	0.87	[-0.19, -0.10]
BBN (vs. control)	-1.12 [*]	0.51	0.32	[-2.11, -0.13]
IPV exposure	0.59	0.46	1.81	[-0.32, 1.50]
Concern	-0.65	0.43	0.52	[-1.49, 0.19]
Time × BBN (vs. control)	0.13 ^{**}	0.05	1.14	[0.03, 0.22]
Time × Concern for loved ones	0.18 ^{***}	0.03	1.19	[0.11, 0.24]
Time × IPV exposure	-0.03	0.02	0.97	[-0.08, 0.02]
BBN × IPV	0.04	0.41	1.04	[-0.76, 0.83]
BBN × Concern for loved ones	1.08 [*]	0.52	2.96	[0.06, 2.10]
IPV × Concern	0.43	0.46	1.54	[-0.47, 1.34]
BBN × Time × Concern for loved ones	-0.21 ^{***}	0.06	0.81	[-0.32, -0.09]
BBN × Time × IPV	0.05	0.04	1.05	[-0.03, 0.13]

Note. PTSD = posttraumatic stress disorder; OR = odds ratio; CI = confidence interval; BBN = Bounce Back Now; IPV = interpersonal violence; gender was coded as male = 1 and female = 2.

[†]
 $p < .1$.

^{*}
 $p < .05$.

^{**}
 $p < .01$.

^{***}
 $p < .001$.

Table 4.

Posttraumatic Stress Disorder Symptom Counts Based on Condition and Concern for Loved Ones During the Disaster.

Concern	Condition	Baseline		4-Month Follow-Up		12-Month Follow-Up	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Yes	BBN	1.35	2.43	1.25	2.59	1.12	2.54
	Control	1.45	2.45	1.18	2.47	1.26	2.15
No	BBN	0.94	1.63	0.80	1.82	1.12	2.37
	Control	1.09	1.92	1.17	2.13	0.59	1.41

Note. BBN = Bounce Back Now; Concern = concern for safety of loved ones during disaster.