Received support in the aftermath of Hurricane Florence: Reciprocal relations among perceived support, community solidarity, and PTSD

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Abstract

Background and Objectives: The social support deterioration model (SSDM) posits that individuals who do not receive adequate support following a disaster are vulnerable to losses in community solidarity and perceived support, as well as the development of persistent distress. However, limited longitudinal research has evaluated the relations among support and these outcomes among disaster-affected individuals. **Design:** The current study utilized random intercept cross-lagged panel modeling (RI-CLPM) to examine reciprocal relations among received support, community solidarity, perceived support, and posttraumatic stress disorder (PTSD) symptoms among rural Hurricane Florence survivors (n = 261) assessed 5-8 months post-hurricane (T1), and then at two more timepoints at three-month intervals (T2 and T3). **Results:** Results of the RI-CLPM supported that lower received support at T2 was associated with decreases in community solidarity at T3, and higher perceived support at T1 was associated with increases in received support at T2. In supplemental analyses, higher received support at T2 was associated with lower PTSD symptoms at T3. **Conclusions:** Consistent with the SSDM, individuals who receive less support post-disaster are vulnerable to losses in community solidarity and potentially persistent PTSD symptoms. Conversely, those with stronger support networks may be better able to access needed support in the longer-term.

Keywords: Social support, natural disasters, recovery, PTSD symptoms, solidarity

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Natural disasters including floods, hurricanes, tornadoes, and earthquakes, can result in extensive and devasting losses for those affected. In addition, the physical, emotional, social, and economic toll of disasters on affected communities can often extend for many months or years afterward (Kessler et al., 2008; Wadsworth et al., 2009). Despite experiencing extensive and ongoing losses, many individuals in disaster-affected communities are able to display resilience or to recover successfully (Lowe & Rhodes, 2013; Pietrzak et al., 2012). As such, it is critical to identify both individual-level and community-level factors that promote resilience and recovery following adversity in order to develop interventions to promote resilient outcomes among those affected by such devastating losses. The overarching goal of the current study was to evaluate the importance of social resources, or the lack thereof, in the aftermath of a disaster.

Social Support Deterioration Deterrence Model

One of the most influential theoretical frameworks developed to explain the importance of social resources in the post-disaster context in influencing resilience/recovery is the social support deterioration deterrence model (SSDM; Kaniasty & Norris, 1995; Kaniasty & Norris, 2004). This model posits that there is a predictable social response within affected communities following disasters. Specifically, there is an initial outpouring of mutual helping and support, with members of the affected community rapidly mobilizing to help those most in need (Kaniasty & Norris, 1995; Kaniasty & Norris, 2004). At the same time, within the affected community there is a strong sense of community solidarity, altruism, and belongingness (Kaniasty & Norris, 1995).

Unfortunately, in many communities, this initial outpouring of mutual support and solidarity is short lived, as it soon becomes apparent that the need for support in the community far outstrips that which is available (Kaniasty & Norris, 2004). As a result, many members of the affected community, particularly those who experienced more substantial losses and those who had fewer resources prior to the disaster, do not receive the level of support that they need to recover, and that they anticipated receiving. This inadequate receipt of needed support is theorized to interfere with recovery leading to the development of significant and persistent distress over time.

Several social mechanisms are posited to in part account for these negative outcomes. For one, individuals who do not receive adequate support from others experience a decline in their community solidarity. At the same time, disruptions to individuals' social networks, reduced opportunities for social interactions, and the overwhelming of community support networks due to the physical impact of the disaster itself exacerbate these declines in community solidarity (Kaniasty & Norris 2004). Compounding this impact, individuals who do not receive adequate tangible and emotional support post-disaster experience a decline in their perceived support. Perceived support can be defined as an individual's appraisal that members of their support network are available to provide various forms of support, that the support that they provide is adequate to meet their needs, and that their social support network is helpful overall (Barrera, 1986). Collectively, this lack of adequate received support, deterioration of perceived support, and loss of community solidarity contribute to significant and persistent distress (Kaniasty & Norris, 2004). While not specifically delineated in the social support deterioration deterrence model, a lack of adequate received support and losses in perceived support and solidarity may also interfere with recovery from disaster-related PTSD symptoms. Specifically, survivors who

do not receive needed tangible and emotional support in managing hurricane-related stressors may not have adequate opportunity to engage in the emotional and cognitive processing of the trauma to recover from disaster-related PTSD symptomology.

Some limited existing empirical evidence suggests that not receiving adequate support post-disaster can negatively affect individuals' community solidarity. In a sample of Polish flood survivors, Kaniasty (2012) examined a number of potential predictors of community solidarity. Results confirmed that after accounting for the effect of both demographic variables (age, gender, education) and disaster exposure, both lower received support and greater perceptions of receiving inadequate aid 12 months post-flood was associated with lower community solidarity 20 months after the disaster. However, to our knowledge, this is the only study assessing the impact of received support post-disaster on community solidarity.

A number of studies conducted post-disaster have documented that received support post-disaster is positively associated with perceived support. For example, Tyler (2006) found in a sample of Iowa flood survivors that post-flood received emotional support predicted post-flood perceived support after controlling for levels of pre-flood perceived support. In their sample of Polish flood survivors, Kaniasty (2012) found that after accounting for the effect of both demographic variables (age, gender, education) and disaster exposure., received support assessed at 12 months post-flood was associated with perceived support at 20 months post-flood. In addition to research with flood survivors, in two samples of individuals exposed to hurricanes (Hurricane Hugo and Hurricane Andrew), lower received support prospectively predicted lower perceived support, which in turn was associated with greater psychological distress (Norris & Kaniasty, 1996). In this longitudinal post-hurricane model, the two latent social support variables (received and perceived support) were moderately positively correlated, r_s = .31 and .49, and the

latent perceived support variable was moderately negatively correlated with the latent distress variable, r_s = -.38 and -.45.

Further, research suggests that received support has an important impact on psychological outcomes, including general psychological distress and posttraumatic stress disorder (PTSD) symptoms following disaster, although with some mixed findings. For one, several cross-sectional studies conducted following natural disasters found an association between lower received support, particularly lower received emotional support, and greater post-disaster distress and PTSD symptoms, with findings generally reflecting moderate correlations (r_s = -.21 to -.30; McGuire et al., 2018; Suar et al., 2017). Some longitudinal studies have also suggested that emotional received support in particular is associated with post-disaster adjustment. For example, Platt and colleagues (2012) examined reciprocal relations between hurricane-related PTSD and received support among a sample of individuals exposed to Hurricane Ike. Results showed that lower received emotional support assessed 2 to 6 months post-hurricane was associated with greater PTSD symptoms assessed 5 to 9 months post-hurricane. However, emotional support assessed at 5 to 9 months post-hurricane was not associated with PTSD symptoms at 14-19 months post-hurricane. Additionally, Shang and colleagues (2019) found that receipt of higher quality overall social support (support that was adequate, easy to obtain, and matched to participants' needs) assessed at 7 months following the Lushan earthquake in China was associated with fewer earthquake-related PTSD symptoms assessed at 2 years post-earthquake. However, quantity of received support did not prospectively predict PTSD symptoms in this model.

Limitations of Extant Research

The extant post-disaster research has provided some support for the SSDM including the potential importance of received support post-disaster in affecting longer-term outcomes including community solidarity, perceived support, and psychological distress/PTSD symptomology. However, this research has several limitations that should be noted. For one, the research base overall is quite limited with few longitudinal studies. Additionally, the relations proposed in the SSDM have not been consistently found post-disaster, particularly findings examining the association between received support and post-disaster adjustment. For example, some of the previously reviewed studies found that receipt of greater tangible aid and informational support was instead associated with *greater* distress, or that receipt of these forms of support was not associated with distress (Platt et al., 2012; Shang et al., 2019; Saur et al., 2017). In addition, extant studies have been frequently conducted in the longer-term post-disaster, with cross-sectional studies often conducted at around the one year point post-disaster, and longitudinal studies frequently conducting follow-up assessments 1.5- to 2-years post-disaster. Finally, few studies have conducted multiple assessments spaced at regular intervals post-disaster (e.g., assessments conducted every 3 or 6 months) to evaluate how the relations among the constructs of interest potentially change over time.

Another limitation is a lack of evaluation of the possibility of reciprocal relations among support, solidarity, and distress. For example, it seems plausible to posit that individuals who do not feel embedded in their local communities, as well as those with low perceived support would be less able to access needed support. It also seems possible that individuals experiencing high levels of symptomology would have more difficulty accessing needed support. However, only Platt and colleagues' (2012) study of Hurricane Ike survivors examined possible reciprocal relations between PTSD symptoms and received support, with results supporting reciprocal

relations among these constructs from T1(2 to 6 months post-hurricane) to T2 (5-9 months post-hurricane), such that T1 PTSD symptoms was associated with T2 emotional support and T1 emotional support was associated with T2 PTSD symptoms. However, neither cross-lagged path from T2 to T3 (14-19 months post-hurricane) was significant. Thus, the limited existing evidence supports that there may be reciprocal relations between distress and received support post-disaster and that the nature of these relations may change over time.

Study Goals and Context

The current study sought to address some of the limitations of extant research by evaluating the role of received support following natural disasters utilizing a longitudinal study of survivors of Hurricane Florence. This hurricane made landfall in the Wilmington, North Carolina area of the United States in September of 2018 and caused an estimated 17 billion U.S. dollars in damage to the state of North Carolina. The rural Sandhills region of North Carolina was one of the hardest hit regions, primarily due to catastrophic flooding that occurred in the area. Of note, this same region was still recovering from similar flood damage from Hurricane Matthew two years earlier. For the current study, residents of four rural counties in the Sandhills region of North Carolina who experienced high levels of hurricane-related stress completed three assessments of their social support, community solidarity, and hurricane-related PTSD symptoms, with the assessments occurring three months apart.

The primary goal of the current study was to evaluate potential reciprocal relations among received support, perceived support, community solidarity, and PTSD symptoms in order to both evaluate the SSDM's proposed centrality of received support in leading to negative outcomes, as well as to examine the extent to which outcomes proposed to be affected by received support in the post-disaster context influence received support and PTSD symptoms

over time. To accomplish this goal, random intercept cross-lagged panel modeling (RI-CLPM) was utilized. By utilizing RI-CLPM, both the extent to which within person standing on each construct was associated with changes in the other model constructs over time could be evaluated. RI-CLPM is considered superior to other modeling strategies as it accounts for the extent to which stability in constructs over time is reflective of the trait-like, time invariant nature of said constructs. Because traditional cross-lagged panel analysis does not account for this stability of constructs, stable, between person differences can lead to inflated results regarding the causal nature of the relations between constructs in the model (Hamaker et al., 2015). In contrast, autoregressive and cross-lagged paths in the RI-CLPM represent within person relationships over time. For example, the autoregressive paths in the RI-CLPM represent "within-person carry-over effects" or the degree to which a participant's score at a previous timepoint is related to their score at the next timepoint *relative to their average level of that construct* (Mulder & Hamaker, 2020). Similarly, cross-lagged paths represent how a variable at one timepoint influences a different variable at a subsequent timepoint relative to each participant's average level of both constructs. Specifically, we tested two models:

Model 1: The relations among received support, perceived support, and PTSD symptoms over time.

Model 2: The relations among received support, community solidarity, and PTSD symptoms over time.

Based on the SSDM, we predicted that received support would be associated with changes in perceived support and community solidarity over time. Further, based on both the SSDM and existing research, we predicted that received support would be associated with changes in PTSD symptoms over time, particularly in the earlier term post-disaster (T1 to T2).

We also predicted that PTSD symptoms would be associated with changes in received and perceived support, particularly in the longer-term (T2 to T3). Finally, based on both the SSDM and previous research, we predicted that perceived support would be associated with changes in PTSD symptoms, particularly in the longer-term (T2 to T3).

Method

Participants

Participants were 261 adults residing in four rural North Carolina counties recruited to participate in a study of individuals who experienced high levels of hurricane-related stress. Participants ranged in age from 19 to 81 (M = 44.0 years, SD = 12.8). The majority (88.5%, n = 231) were women. A total of 52.5% (n = 137) identified as White, 25.3% (n = 66) as African American, and 17.2% (n = 45) as Native American. Fewer identified as Asian American (0.4%, n = 1), multiracial (1.1%, n = 3), or other (3.4%, n = 9). A total of 2.3% (n = 6) were Hispanic/Latinx. As far as education, 6.9% (n = 18) did not complete high school, 21.5% (n = 56) completed high school/earned their GED, 32.2% (n = 84) had some post-secondary education, and 39.5% (n = 103) graduated from college. A total of 61.3% (n = 160) had dependent children at home, and 53.3% (n = 139) had a household income of $30,000 U.S. dollars or less.

Procedures

Residents of four rural North Carolina (NC) counties were recruited to participate in a study of individuals who "experienced high levels of hurricane-related stress," 5 to 8.5 months following the U.S. landfall of Hurricane Florence. Multiple strategies were utilized to recruit participants, including social media ads, online newspaper ads, local media stories, door-to-door recruitment, tables/fliers at community events, and word of mouth. To be eligible, individuals

had to be over the age of 18, to be residing in one of the four study recruitment counties when Hurricane Florence made landfall, to have been exposed to high levels of hurricane-related stress (e.g., flood damage to one's home, loss of employment), to still be experiencing the negative effects of Hurricane Florence in their daily life, and to own a smartphone with a data plan.

A total of 426 individuals consented to participate electronically via their smartphone or other device and initiated the T1 survey, hosted on the secure survey platform Qualtrics. Of these individuals, 11.5% (n = 49) did not report that they were experiencing daily impacts from the hurricane, 4.0% (n = 17) did not experience high levels of hurricane-related stress, less than 1% (n =2) were under 18, 1.2% (n = 5) were not residing in one of the four recruitment counties when the hurricane made landfall, and 1.2% (n = 5) did not own a smartphone with a data plan. An additional 19.5% (n = 83) did not complete the T1 survey, and less than 1% (n = 4) asked to be removed from the study after completing the T1 survey. In total, 261 (61.3%) individuals who initiated the T1 survey were eligible and enrolled in the study.

The baseline (T1 survey) consisted of five eligibility questions followed by measures of hurricane stressor exposure, social support, community solidarity, and hurricane-related PTSD symptoms. Three months and six months after completing the baseline survey, all participants were contacted via text message to complete the T2 and T3 surveys in Qualtrics. They received up to four weekly reminders via text message to complete the surveys. The T2 and T3 surveys contained similar measures as the T1 survey. Participants received a $10 gift card for completing the baseline (T1) survey, and a $25 gift card for completing each of the T2 and T3 surveys. The study was approved by the East Carolina University IRB. In addition, all participants received a list of local hurricane-related resources at the end of each survey.

A total of 69.7% (n = 182) of T1 participants completed the T2 survey. There were no significant differences in age, gender, race, ethnicity, relationship status (married/cohabitating versus single/widowed/divorced), postsecondary education, or low-income status (household income less than $30,100 per year) between individuals who completed the T2 survey and those who did not. Individuals who completed T2 (11.0%, n = 20) were significantly less likely to report they lost their job as a result of Hurricane Florence compared to those who did not (21.5%, n = 17), χ^2 (1, N = 261) = 5.02, p = .025. There were no other significant differences in hurricane stressor exposure between those who completed T2 and those who did not. A total of 60.5% (n = 158) of participants completed the T3 survey. There were no significant differences in age, gender, race, ethnicity, relationship status, postsecondary education, or low-income status between individuals who completed the T3 survey and those who did not. Individuals who completed T3 (5.7%, n = 9) were significantly less likely to report their spouse or partner lost their job as a result of Hurricane Florence compared to those who did not (13.6%, n = 14), χ^2 (1, N = 261) = 4.84, p = .028. There were no other significant differences in hurricane stressor exposure between those who completed T3 and those who did not.

Measures

Hurricane stressor exposure

Participants were administered 24 yes-no items regarding exposure to hurricane stressors as part of the T1 survey. These items assessed flood-related losses (e.g., home damage, loss of possessions), exposure to contaminants (e.g., mold in the home, contaminated water), loss of employment, displacement, financial losses, development/worsening of physical and mental health conditions, and loss of family pet(s). Items assessed personal exposure to stressors,

stressors experienced by the participant's spouse/partner, and stressors experienced by the participant's children.

Received social support

The 19-item Inventory of Socially Supportive Behaviors- Short Form (ISSB-SF) was administered to assess received social support (Barrera et al., 1981; Barrera & Baca, 1990). For each item, individuals indicated how often they had received each form of support from others in the *past four weeks* on a 5-point rating scale bounded by 1 (*not at all*) and 5 (*about every day*). The measure assesses three types of support: guidance (Suggested some action you should take), emotional support (Expressed interest and concern in your well-being), and tangible support (Provided you with a place to stay). In the current study, a total received support score was calculated by summing all items. In a study of adults recruited from community mental health centers, the ISSB-SF was found to have good total score internal consistency ($\alpha = .84$; Barrera & Baca, 1990). In the current study, total score internal consistency across assessments was excellent: T1 $\alpha = .94$, T2: $\alpha = .94$, and T3: $\alpha = .93$.

Perceived social support

The 12-item Multidimensional Scale of Perceived Social Support (MSPSS) was administered to assess perceived social support (Zimet et al., 1988). The measure assesses perceived support from family (My family really tries to help me), friends (I can talk about my problems with my friends), and a significant other (There is a special person who is around when I am in need). For each item, individuals indicated their level of agreement on a 7-point Likert scale from 1 (*very strongly disagree*) to 7 (*very strongly agree*). In the current study, an average perceived support score was calculated by summing all items and dividing the obtained score by twelve. Prior research in college and community samples has supported the internal consistency

and test-retest reliability of the subscale and total scores, with alphas ranging from .81 to 98, and test-retest reliabilities ranging from .72 to .85. Supporting construct validity, scores were negatively correlated with scores on self-report measures of anxiety and depression (Zimet et al., 1988; Zimet et al., 1990). In the current study, internal consistency values for total scores across assessments were excellent: T1 $\alpha = .95$, T2: $\alpha = .96$, and T3: $\alpha = .96$.

Community solidarity

Community solidarity was assessed with a 6-item measure developed to assess community solidarity after mass shootings (Hawdon et al., 2012). A sample item is "I feel I am part of the community." Individuals indicated the extent to which they agreed with each statement with regards to the community in which they were living when Hurricane Florence hit on a 5-point Likert scale bounded by 1 (*strongly disagree*) and 5 (*strongly agree*). An average solidarity score was calculated by summing all items and dividing the obtained score by six. The measure has demonstrated good internal consistency in three samples of individuals exposed to mass shootings in the U.S. and Finland ($\alpha_s = .78$ - .89; Hawdon et al, 2012). Internal consistency across assessments in the current study was excellent, TI: $\alpha = .90$, T2: $\alpha = .91$, and T3: $\alpha = .92$.

Hurricane-related PTSD symptoms

The PTSD-Checklist for DSM-5 (PCL-5) was administered to assess hurricane-related PTSD symptoms (Weathers et al., 2013). The PCL-5 contains 20 items designed to correspond with DSM-5 criteria for PTSD. At each assessment, participants indicated how much they have been bothered by each symptom *over the past month* in connection to the hurricane on a 5-point rating scale bounded by 0 (*not at all*) and 4 (*extremely*). A sample item is: "Blaming yourself or someone else for the hurricane or what happened after it?" Scores are summed and can range from 0 to 80 with a cutoff score of 33 for likely current PTSD (Bovin et al., 2016). The PCL-5

has demonstrated good internal consistency in a sample of hurricane survivors (α = .93; Lowe et al., 2015). In the current study, internal consistency of the PCL-5 across assessments was excellent, T1: α = .95, T2: α = .95, and T3: α = .96.

Analysis plan

Two random intercept cross-lagged panel models (RI-CLPM) utilizing *MPlus* (version 8.0; Muthen & Muthen,1998-2017) were conducted to examine the relations among received support, perceived support, community solidarity, and PTSD symptoms across the three assessments (T1-T3). Analyses were conducted utilizing the *MPlus* syntax developed by Hamaker (2018). All variables were modeled as observed variables utilizing total scores at each assessment- T1-T3. RI-CLPM represents an extension of traditional cross-lagged panel models and partials out between- and within-person variance in observed indicators over time (Burns et al., 2020; Hamaker et al., 2015). Cross-lagged parameters within this model thus reflect whether changes from an individual's expected score on one variable in the model are predicted by deviations on the second variable in the model at an earlier observation point (Burns et al., 2020). RI-CLPM is preferred over traditional cross-lagged panel modeling because it accounts for the extent to which stability in constructs over time is reflective of the trait-like, time invariant nature of said constructs (Hamaker et al., 2015).

Missing data on study variables was infrequent, ranging from 0% (PTSD symptoms T2) to 2.5% (received support T3). Missing data, including attrition at T2 and T3, were handled using full information maximum likelihood (FIML) estimation. FIML provides unbiased estimates of model parameters and standard errors when missing data are missing completely at random or missing at random. Variables related to attrition at T2 and T3- job loss and

spouse/partner job loss, were used as auxiliary variables using the saturated correlates approach (Graham, 2003).

Results

Hurricane exposure, social support, community solidarity, and hurricane-related PTSD

Given study inclusion criteria, the sample obtained was heavily exposed to hurricane stressors. Participants endorsed exposure to an average of 9.14 (*SD* = 4.30) of the 24 possible stressors. Some of the most frequently endorsed stressors included experiencing mold damage to one's home (72.8%, *n* = 190), flooding of one's home (52.1%, *n* = 136), damage/loss of one's possessions (62.5%, *n* = 163), and being displaced from one's home (44.1%, *n* = 115). Other frequently endorsed stressors included exposure to contamination (66.3%, *n* = 173), having unsafe drinking water (57.5%, *n* = 150), loss of employment (45.6%, *n* = 119) and development of a new or worsened mental health condition (66.7%, *n* = 174).

Descriptive statistics of study variables are summarized in Table 1. Correlations among study variables are summarized in Table 2. Participants frequently reported hurricane-related PTSD symptoms with 35.7% scoring above the accepted clinical cutoff at T1, as did 33.5% at T2 and 29.3% at T3. On average, participants reported low to moderate receipt of social support that declined from T1 to T2 and remained stable at T3. On average, participants initially reported moderately high perceived social support that declined slightly at T2 and remained stable at T3. Finally, participants reported moderately high levels of community solidarity that remained stable at T2 and T3. Scores on all variables covered their entire possible range or nearly their entire possible range.

Random-intercept cross-lagged panel models

Results of the RI-CLPM examining the relations among received support, perceived support, and PTSD symptoms are summarized in Table 3. Greater perceived support at T1 was associated with increased received support at T2. Additionally, greater perceived support at T2 was associated with increased perceived support at T3. Results of the RI-CLPM examining the relations among received support, community solidarity, and PTSD symptoms are summarized in Table 4. Greater received support at T2 was associated with increased community solidarity at T3. In a supplemental RI-CLPM including received support and PTSD only, received support at T2 was associated with lower PTSD symptoms at T3 (https://tinyurl.com/t3fe23w9). In contrast, in a supplemental RI-CLPM including perceived support and PTSD only, perceived support did not predict PTSD symptoms and PTSD symptoms did not predict perceived support (https://tinyurl.com/5e732jcp).

Discussion

The overarching goal of the current study was to evaluate one of the central tenets of the social support deterioration deterrence model (SSDM), which states that not receiving adequate social support in the aftermath of a disaster has cascading effects on post-disaster recovery. Specifically, the model posits that individuals who do not receive adequate social support experience a loss in their community solidarity, experience a deterioration in their perceived social support, and ultimately develop persistent psychological distress (Kaniasty & Norris, 2004). To examine these relations in the current study, RI-CLPM was conducted to examine the relations among received social support, perceived social support, and hurricane-related PTSD over time among a sample of rural Hurricane Florence survivors exposed to high levels of hurricane stress who completed three assessments post-hurricane, with each assessment occurring three months apart.

Interestingly, and inconsistent with the predictions of SSDM, received social support was not associated with changes in perceived social support over time. However, it should be noted that prior studies that documented a longitudinal relation between lower received support and reductions in perceived support did so later in the post-disaster recovery period (20 to 24 months post disaster; Kaniasty, 2012; Norris & Kaniasty, 1996) and did not utilize RI-CLPM. It is possible that this relation between received and perceived support may have emerged in the current study if participants had been followed for a longer period. Of note, lower perceived social support at T1 was associated with decreases in received support at T2. This is consistent with the notion that individuals experiencing continued stress post-disaster need to rely more on their extant support networks (e.g., friends and family) for assistance as the mutual helping provided in the community at large (e.g., assistance from community organizations, religious institutions, volunteer groups) that occurs in the near-term post-disaster dissipates. Further, it suggests that those with stronger social support networks may be better able to access needed tangible and emotional support in coping with the disaster. Additionally, greater perceived support at T2 (8-11 months post hurricane) was associated with greater perceived support at T3 (11-14 months post hurricane), suggesting that those with stronger social support networks may be protected from a deterioration in perceived support in the longer-term post disaster.

Finally, it is of note that greater PTSD symptoms were not associated with decreases in perceived or received support over time, suggesting that losses of perceived support and difficulty accessing received support were not being driven by disaster-related distress. This is in contrast with some prior research which suggests that disaster-related PTSD symptoms are associated with deterioration in social support over time (e.g., Platt et al., 2012). However, it is possible that this relation may have emerged if participants had been followed for a longer period

post-hurricane. It is also possible that prior findings may reflect inflated cross-lagged paths as Platt and colleagues (2012) did not utilize RI-CLPM to account for the trait-like time invariant nature of the constructs assessed.

With regards to community solidarity, receiving less support at T2 (8-11 months post-hurricane) was associated with a decline in community solidarity at T3 (11-14 months post-hurricane). This supports the notion that individuals who are exposed to high levels of hurricane stress are vulnerable to a loss in community solidarity over time when they find that they are not able to obtain needed support. It is also consistent with Kaniasty's (2012) finding that low received support was associated with low community solidarity in a sample of Polish flood survivors. Participants in the current study reported multiple hurricane-related stressors that could result in significant social disruptions, such as being displaced from their home and loss of employment. As such, participants were likely vulnerable to experiencing losses in community solidarity over time, particularly if they also did not receive adequate support in managing the disaster. The fact that the path from received support to changes in community solidarity was only significant from T2 to T3 suggests that, at least for those experiencing high levels of disaster-related stressors, continuing unmet needs for social support in the longer-term are likely to lead to a loss of community solidarity. Notably, although low levels of received support was associated with a loss in community solidarity over time, this loss of community solidarity was not associated with reductions in received support or increased PTSD symptomology. Likewise, PTSD symptomology was not associated with losses in community solidarity.

Surprisingly, we found few significant cross-lagged paths for PTSD symptoms. None of the paths from perceived support to PTSD symptoms were significant. This is in contrast to a number of prior findings (e.g., Kaniasty, 2020; Kaniasty & Norris, 2008; Lowe & Rhodes, 2013;

Suar et al., 2017). However, it should be noted that none of these prior studies utilized RI-CLPM. In addition, the current sample involved a highly hurricane exposed and highly distressed group of hurricane survivors. It is possible that perceived support may be more likely to lead to either a resilient or early recovery trajectory with regards to PTSD symptomology (groups underrepresented in the current sample). Supporting this possibility, Lowe and Rhodes (2013) utilized latent class growth curve analysis to evaluate trajectories of distress among low-income women in New Orleans exposed to Hurricane Katrina who were assessed in the year prior to the hurricane and at 1- and 3-years post hurricane. They found that pre-disaster perceived social support was a predictor of belonging to a resilient adjustment trajectory. Additionally, individuals with greater pre-disaster perceived support were exposed to fewer hurricane stressors, suggesting that perceived support may be protective against the development of distress via its association with lower exposure to disaster-related stressors.

In contrast, in a supplemental RI-CLPM only including received support and PTSD there was some preliminary evidence that lower received support at T2 (8-11 months post-hurricane) was associated with increases in hurricane-related PTSD symptoms at T3 (11-14 months post-hurricane). It is likely that this inconsistent finding is due in part to the relatively small sample size and small number of observations in the RI-CLPM models (Hamaker et al., 2015). This preliminary finding suggests that individuals who do not receive adequate levels of support in managing ongoing hurricane stressors over time may be less able to recover from hurricane-related PTSD symptomology, and instead are at risk for experiencing increased symptoms over time. This could be because they do not receive adequate support to effectively engage in the emotional and cognitive processing of the trauma to facilitate recovery. This finding is also consistent with prior research in samples exposed to hurricanes and earthquakes (Platt et al.,

2012; Shang et al., 2019). Of note, the path from T1 received support to T2 PTSD symptoms was not significant in any models. This suggests that perhaps other factors, such as level of exposure to disaster-related stressors are more important in predicting PTSD symptoms in the earlier phases of recovery, but that over time a lack of adequate received support may begin to interfere with recovery from symptomology. Interestingly this finding differed somewhat from Platt and colleagues (2012) who found that received support predicted PTSD symptoms from T1 to T2 (5 to 9 months post-hurricane) but not from T2 to T3 (14 to 19 months post-hurricane). It is also important to note that participants in Platt and colleagues' (2012) study were exposed to fewer hurricane-related stressors than participants in the current study and as a result reported much lower hurricane-related PTSD symptomology, with only 2.6% of participants at T2 and 2.8% of participants at T3 screening positive for PTSD, limiting their ability to identify predictors of high levels of PTSD symptomology.

Limitations

Limitations of the current study should be acknowledged. First, although participants were fairly representative of the overall population from which they were recruited as far as age, race, and ethnicity, the majority of participants were women. As a result, findings are likely not representative of the experiences of male hurricane survivors. In addition, assessments were conducted at 5-8 months, 8-11 months, and 11-14 months post-hurricane, limiting our understanding of the relations among constructs in both the near-term and longer-term post-disaster. Further, given the goal of the overall study was to evaluate the experiences of individuals who were continuing to experience hurricane-related stress 5-8 months after the storm, participants likely were not representative of the broader regional population, which

included many individuals who only were exposed to a small number of hurricane stressors. As such, we had limited ability to identify predictors of resilient responses post-hurricane.

Implications for Future Research

Bearing these limitations in mind, results have implications for future research focused on the influence of social resources and post-disaster adjustment. First, results overall support the potential utility of aspects SSDM for explaining post-disaster adjustment among those severely affected, such that post-disaster perceived support was associated with greater received support from T1 to T2 and some preliminary results suggesting that lower received support at T2 was associated with greater PTSD symptoms at T3. Findings overall suggest that the relations among perceived support, received support, and distress over time post-disaster are more complex than some earlier research suggest. Future work should continue to evaluate the utility of the SSDM in explaining adjustment from the near-term to the longer-term post-disaster (i.e., 2 years or longer), particularly utilizing more advanced modeling techniques including RI-CLPM, as well as utilizing pre-disaster assessments when available. The timing of assessments is a key factor in any longitudinal design, and future work should aim to determine the optimal times to observe changes in the constructs in the SSDM, and thus optimal times for intervention. Future research should develop and evaluate the effectiveness of interventions focused on increasing social resources among disaster survivors beyond the initial response post-event. Future work should also examine the strength of relations among social support, solidarity, and distress in multiple populations of survivors, including among diverse racial/ethnic groups and among different socioeconomic groups, as well as survivors of different types of disasters. Finally, future work should focus on the identification of additional factors that promote resilience and recovery in the face of disasters. Work in these areas will lead to a fuller understanding of the multiple

individual-, social-, and community-level factors that affect longer-term adjustment following disasters.

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Table 1

Descriptive statistics of study variables

	T1 *M* (*SD*) Range Skew Kurtosis	T2 *M* (*SD*) Range Skew Kurtosis	T3 *M* (*SD*) Range Skew Kurtosis
Received support	42.89 (16.30) 25-109 0.56 -0.41 *n* = 258	41.09 (14.13) 19-93 0.70 0.61 *n* = 179	41.54 (13.5) 19-83 0.61 0.19 *n* = 154
Perceived support	4.80 (1.46) 1.0-7.0 -0.63 -0.10 *n* = 258	4.60 (1.56) 1.0-7.0 -0.66 -0.18 *n* = 181	4.58 (1.52) 1.0-7.0 -0.48 -0.27 *n* = 156
PTSD symptoms	26.52 (17.78) 0-74 0.44 0.15 *n* =258	23.58 (17.13) 0-75 0.58 -0.29 *n* = 182	23.16 (17.50) 0-73 0.59 -0.16 *n* = 157
Community solidarity	3.49 (0.90) 1.0-5.0 -0.28 -0.10 *n* = 259	3.43 (0.93) 1.0-5.0 -0.37 0.09 *n* = 181	3.46 (0.95) 1.0-5.0 -0.35 -0.09 *n* = 157

Table 2

Correlations among primary study variables

	2	3	4	5	6	7	8	9	10	11	12
1. T1 Received support	.54*	.55*	.36*	.28*	.19*	.24*	.23*	.14	.06	-.10	-.01
2. T2 Received support	___	.68*	.31*	.40*	.34*	.23*	.33*	.31*	-.12	-.14	-.15
3. T3 Received support	___	___	.24*	.34*	.43*	.07	.17*	.25*	-.12	-.13	-.20*
4. T1 Perceived support	___	___	___	.62*	.57*	.50*	.43*	.51*	-.38*	-.43*	-.44*
5. T2 Perceived support	___	___	___	___	.76*	.38*	.48*	.50*	-.41*	-.52*	-.45*
6. T3 Perceived support	___	___	___	___	___	.40*	.45*	.60*	-.39*	-.51*	-.50*
7. T1 Solidarity	___	___	___	___	___	___	.50*	.59*	-.32*	-.36*	-.35*
8. T2 Solidarity	___	___	___	___	___	___	___	.62*	-.33*	-.36*	-.36*
9. T3 Solidarity	___	___	___	___	___	___	___	___	-.33*	-.34	-.40*
10. T1 PTSD symptoms	___	___	___	___	___	___	___	___	___	.72*	.72*
11. T2 PTSD symptoms	___	___	___	___	___	___	___	___	___	___	.76*
12. T3 PTSD symptoms											

Note: * $p < .05$.

Table 3

Results of RI-CLPM examining relations among received support, perceived support, and PTSD symptoms

Model path	*B*	SE	*p*	*β*
T1 to T2 model paths				
RI Received support ↔ RI Perceived support	2.72	2.24	.225	.26
RI Received support ↔RI PTSD	1.47	18.49	.937	.01
R1 PTSD ↔ R1 Perceived support	**-7.58**	**2.59**	**.003**	**-.56**
T1 Received support ↔ T1 Perceived support	**5.96**	**2.23**	**.008**	**.45**
T1 Received support ↔ T1 PTSD	13.87	17.53	.429	.11
T1 PTSD ↔ T1 Perceived support	-2.16	2.36	.360	-.19
T2 Received support ↔ T2 Perceived support	**4.14**	**1.71**	**.015**	**.47**
T2 Received support ↔ T2 PTSD	-19.15	15.48	.217	-.28
T2 PTSD ↔ T2 Perceived support	**-4.44**	**1.72**	**.010**	**-.46**
T1 Perceived support →T2 Perceived support	0.29	0.21	.162	.26
T1 Received support →T2 Received support	-0.14	0.12	.256	-.19
T1 PTSD → T2 PTSD	0.05	0.18	.783	.06
T1 Received support →T2 Perceived support	0.01	0.02	.464	.11
T1 Perceived support → T2 Received support	**3.01**	**1.28**	**.019**	**.39**
T1 Received support →T2 PTSD	-0.03	0.14	.825	-.04
T1 PTSD → T2 Received support	-0.08	0.15	.597	-.09
T1 Perceived support →T2 PTSD	-2.07	1.58	.190	-.25
T1 PTSD → T2 Perceived support	-0.03	0.02	.126	-.24
T2 to T3 model paths				
T2 Received support ↔ T2 Perceived support	**4.14**	**1.71**	**.015**	**.45**
T2 Received support ↔ T2 PTSD	-19.15	15.48	.216	-.28
T2 PTSD ↔ T2 Perceived support	**-4.43**	**1.72**	**.010**	**-.46**
T3 Received support ↔ T3 Perceived support	**2.96**	**0.94**	**.002**	**.43**
T3 Received support ↔ T3 PTSD	**-33.63**	**12.15**	**.006**	**-.51**
T3 PTSD ↔ T3 Perceived support	**-2.61**	**1.02**	**.011**	**-.34**

Model path	*B*	SE	*p*	β
T2 Perceived support →T3 Perceived support	**0.40**	**0.12**	**.001**	**.42**
T2 Received support →T3 Received support	-0.09	0.23	.681	-.10
T2 PTSD → T3 PTSD	-0.01	0.27	.970	-.01
T2 Received support →T3 Perceived support	0.02	0.02	.328	.12
T2 Perceived support → T3 Received support	2.23	1.55	.150	.33
T2 Received support →T3 PTSD	-0.50	0.26	.057	-.44
T2 PTSD → T3 Received support	-0.16	0.21	.454	-.17
T2 Perceived support →T3 PTSD	-0.46	1.91	.810	-.06
T2 PTSD → T3 Perceived support	-0.03	0.02	.078	-.22

Note: Significant model paths are indicated by bold text.

Table 4

Results of RI-CLPM examining relations among received support, community solidarity, and PTSD symptoms

Model path	*B*	SE	*p*	*β*
T1 to T2 model paths				
RI Received support ↔ RI Solidarity	1.66	0.92	.070	.23
RI Received support ↔RI PTSD	-1.55	17.27	.928	-.01
R1 PTSD ↔ R1 Solidarity	**-4.24**	**1.09**	**.000**	**-.47**
T1 Received support ↔ T1 Solidarity	1.74	0.96	.069	.24
T1 Received support ↔ T1 PTSD	17.14	16.32	.294	.14
T1 PTSD ↔ T1 Solidarity	-0.80	0.98	.416	-.13
T2 Received support ↔ T2 Solidarity	**2.79**	1.01	.006	**.55**
T2 Received support ↔ T2 PTSD	-20.51	15.97	.199	-.28
T2 PTSD ↔ T2 Solidarity	-0.93	1.16	.424	-.17
T1 Solidarity →T2 Solidarity	-0.16	0.19	.391	-.16
T1 Received support →T2 Received support	-0.05	0.12	.644	-.08
T1 PTSD → T2 PTSD	0.10	0.20	.607	.11
T1 Received support →T2 Solidarity	0.01	0.01	.180	.21
T1 Solidarity → T2 Received support	3.77	2.08	.070	.27
T1 Received support →T2 PTSD	-0.11	0.13	.377	-.14
T1 PTSD → T2 Received support	-0.07	0.15	.634	-.09
T1 Solidarity →T2 PTSD	-0.53	2.39	.826	-.04
T1 PTSD → T2 Solidarity	-0.01	0.01	.651	-.09
T2 to T3 model paths				
T2 Received support ↔ T2 Solidarity	**2.79**	**1.01**	**.006**	**.55**
T2 Received support ↔ T2 PTSD	-20.51	15.97	.199	-.28
T2 PTSD ↔ T2 Solidarity	-0.93	1.16	.424	-.17
T3 Received support ↔ T3 Solidarity	0.96	0.65	.140	.21
T3 Received support ↔ T3 PTSD	**-32.46**	**12.02**	**.007**	**-.50**
T3 PTSD ↔ T3 Solidarity	-0.87	0.75	.245	-.17

Model path	*B*	SE	*p*	β
T2 Solidarity →T3 Solidarity	0.01	0.15	.941	.01
T2 Received support →T3 Received support	-0.03	0.23	.907	-.03
T2 PTSD → T3 PTSD	0.03	0.25	.909	.03
T2 Received support →T3 Solidarity	**0.03**	**0.01**	**.019**	**.38**
T2 Solidarity → T3 Received support	1.04	2.35	.660	.08
T2 Received support →T3 PTSD	-0.47	0.26	.067	-.43
T2 PTSD → T3 Received support	-0.24	0.19	.218	-.27
T2 Solidarity →T3 PTSD	0.24	2.83	.933	-.02
T2 PTSD → T3 Solidarity	-0.01	0.01	.655	-.07

Note: Significant model paths are indicated by bold text.