Risk and Protective Factors for Mental Health and Community Cohesion After the 2013 Calgary Flood

Erin Hetherington, MSc; Sheila McDonald, PhD; Muci Wu, BSc; Suzanne Tough, PhD

ABSTRACT

Objective: To examine mental health and community cohesion in women living in Calgary after a natural disaster considering previously collected mental health data.

Methods: Data from an ongoing longitudinal cohort, the All Our Families study, were used to examine mental health and community cohesion 5 months after a major flood in Calgary, Canada. Participants who had completed a baseline questionnaire before the flood were eligible for inclusion in this study (N = 923). Four multivariable logistic regression models were built to examine predictors of post-traumatic stress, depression, anxiety, and community cohesion.

Results: Elevated anxiety before the flood was associated with 2.49 (95% CI: 1.17, 5.26) increased odds of experiencing high levels of post-traumatic stress, regardless of whether respondents lived in a flood-risk community or not. Women who experienced damage to property, or who provided help to others, were more likely to perceive an increased sense of community cohesion (adjusted ods ratio (AOR): 1.67; 95% CI: 1.09, 2.54 and AOR: 1.68; 95% CI: 1.13, 2.52, respectively).

Conclusions: Women with underlying mental health conditions may be more vulnerable to the psychological impacts of a natural disaster regardless of their level of exposure. Natural disasters may bring communities together, especially those who were more tangibly impacted. (*Disaster Med Public Health Preparedness*. 2017;page 1 of 8)

Key Words: floods, natural disasters, mental health, community cohesion, cohort

A natural disaster is an unpredictable, unexpected, and uncontrollable event occurring in nature and typically results in a sense of collective stress and social disruption, with the extent of its impact spanning social, health, and economic realms.[1] Floods are the most common type of natural disaster and tend to have the highest cost burden.[2] Beyond their physical impacts, natural disasters can also lead to a wide range of mental health issues, including post-traumatic stress disorder, depression, and anxiety.[3,4] However, natural disasters can also have strengthening outcomes, such as an increased sense of community, because people share an experience and work together on recovery efforts after a major event.[5,6]

The risk factors for negative mental health outcomes following natural disasters have been previously reviewed.[2,3,7,8] Common demographic pre-disaster risk factors for poor mental health outcomes include being of a younger age, female gender, lower socio-economic status, and of a minority ethnic status.[3,7,8] Psychosocial risk factors include previous mental health problems and lower social support.[3,9] Disaster-related risk factors include level of exposure (level of damage to personal property or injury), previous

exposure to natural disasters, and loss of services or employment.[2,4,10-12]

Reports of the impact of flooding events vary in terms of who was sampled and the outcomes assessed. A study on the effect of the 2011 Brisbane floods in Australia found that, overall, 22% of flood-impacted respondents had elevated levels of psychological distress, and that those who were directly impacted by the flood (damage to property or possessions) had higher odds of elevated distress (OR 1.9; 95% CI: 1.1, 3.5).[12] A study of communities affected by flooding in the United Kingdom in 2007 found elevated levels of anxiety (48%) and depressive symptoms (43%) among those with damage to their homes.[10] A study on the impact of Hurricane Ike, which caused major flooding in Texas in 2008, found only 5% of those who sustained damages to their homes to have probable depression.[11]

Previous reviews have identified broad limitations in the literature regarding disasters and mental health, specifically regarding the cross-sectional nature of the majority of data.[3,13] Cross-sectional data limit assessment of a mental health sequela because it is difficult to determine whether the natural disaster triggered the mental health problem, increased the severity of a pre-existing

condition, or was unrelated.[13] Studies that exclusively measure poor mental health prevalence after a disaster cannot conclude that the disaster caused the conditions, as they may simply reflect a pre-disaster burden.[3] Adequate control groups are difficult to identify, and they may be systematically different from exposed groups in other ways, which will result in inappropriate comparisons. Studies that attempt to retrospectively assess mental health before the disaster are subject to recall bias, primarily due to underreporting of previous conditions.[3,14]

The evidence on what contributes to the strengthening effects of natural disasters, such as community cohesion, is mixed. Community cohesion refers to a sense of trust, honesty, and sincerity toward others in their community or neighborhood.[9] Kaniasty's research after flooding in Poland suggested that those who received support after flooding felt a greater sense of community.[9] Research in the United Kingdom suggested that greater exposure to a disaster (more physical or material harm) was associated with more community cohesion, but that this relationship is inversed at very high levels of exposure.[15] Initial community cohesion after a natural disaster may also deteriorate over time, as people become dissatisfied with the help received.[5,9,16]

Over 3 days in June 2013, torrential rains and flooding in southern Alberta led to the evacuation of over 100,000 residents in the region. Major flooding in Calgary (pop. 1.2 million), a center for energy and finance in Western Canada and the largest city affected by the disaster, caused the closure of the central business district for over a week and severe disruptions to schools and utility services. In Calgary, overland flooding affected the downtown core communities as well as several higher- and lower-income residential communities along the river.[17] The damage from the flood in the entire region was estimated at over 6 billion Canadian dollars, making it the second most expensive natural disaster in Canadian history.[18]

To date, there is little in the peer-reviewed literature examining the public health impacts of this disaster, with the exception of one study that documented increased rates of prescriptions for anti-anxiety medication and sleep aids after the flood.[19] The current study examines both negative and strengthening outcomes of this natural disaster among mothers of young children living in Calgary. Using data from an ongoing longitudinal cohort study that began in 2008, the current analysis uses prospectively collected data on mental health to assess mental health and community cohesion after the 2013 flood. Specifically, we address the risk and protective factors associated with 4 outcomes: post-traumatic stress, depression, anxiety, and community cohesion.

METHODS
Study Design
The All Our Families (AOF) study (previously All Our Babies) is a longitudinal prospective cohort study initiated in

2008 in Calgary, Alberta. Women completed questionnaires twice during pregnancy and at 4, 12, 24, 36, and 60 months postpartum with data collection for the 8-year point underway. The study has a 77% longitudinal retention rate and the questionnaires address lifestyle, behavior, resource utilization, child development, parenting, maternal physical and mental health, and early childhood experiences. Further information on the AOF study is described elsewhere.[20]

At 5 months after the flood in 2013, AOF participants who had previously agreed to participate in further research were sent a questionnaire to better understand their flood experience as well as damages sustained, help or aid provided and received, post-traumatic stress, maternal psychological distress, and social cohesion. The questionnaire was constructed based on the disaster impact literature, consultations with experts in the field, and on information from the 2011 Alberta Slave Lake Fires and the 1998 Quebec Ice Storm. To ease participant burden, shorter validated versions of mental health scales were used in the post-flood questionnaire. The overall response rate to the flood impact questionnaire was 67% (1913/2861). The current sample includes the 923 participants who completed both the flood impact questionnaire and the 36-month questionnaire before the flood.

Measures
All outcome measures as well as flood-specific questions are from the flood questionnaire. All other pre-flood variables are from previous questionnaires with baseline mental health data specifically from the All Our Families 36-month questionnaire, which some participants completed up to 18 months preceding the flood.

Post-flood outcome constructs included post-traumatic stress, depression, anxiety, and community cohesion. Post-traumatic stress was measured using the Impact of Events Scale-Revised.[21,22] For this study, a cut-off point was set at the 90th percentile to indicate high levels of post-traumatic stress. Depressive symptoms after the flood were assessed using the 12-item short version of the Center for Epidemiologic Studies - Depression Scale (CES-D). A score of 12 or higher indicates somewhat-elevated to very-elevated depressive symptoms.[23,24] Anxiety symptoms after the flood were measured using the 6-item short version of the Spielberger State Anxiety Scale (SSA), with a cut-off point at 1 SD above the mean to indicate clinically relevant symptoms.[25] Four items from the Perceived Post-Disaster Community Cohesion Scale (PDCC) were used to measure beliefs and perceptions on community cohesion following a disaster.[9] Respondents were asked about the sense of solidarity and unity after the flood compared with that before the flood (*people are nicer toward each other than before the disaster; people are more sincere, honest and open toward each other; people in this community are more integrated and united; people have a stronger sense that we are all part of a community*). Reliability for the 4 items in this sample

was high (Cronbach's *α*: 0.86). Higher scores indicate a greater sense of post-disaster community cohesion in the longer term, and a score of 1 SD above the mean was used as a cut-off point to indicate high community cohesion.

As part of the flood questionnaire, participants were also asked to indicate any damages sustained to personal property (dwelling, vehicle, infrastructure, and possessions) and community services (library, school, neighborhood, etc.). Participants also provided information on the provision of aid to family, friends, and the wider community.

Pre-flood variables included socio-demographic factors such as age, education, income, ethnicity, and immigrant status. Baseline psychosocial variables included mental health (depression, anxiety), social support, and partner relationship. Depressive symptoms before the flood were assessed using the twenty item CES-D with a score of 16 or more indicating clinically significant levels of distress.[26] Anxiety symptoms before the flood were assessed using the Spielberger State Anxiety Inventory (SSAI), with a cut-off score of 40 for clinically relevant symptoms.[27,28] Social support before the flood was assessed using the National Longitudinal Study of Children and Youth social support scale.[29] This scale measures perceived social support with a series of questions about whom the respondent can rely upon for guidance, about the assurance that others will provide help, and about attachment. A cut-off point at 1 SD below the mean was used to indicate low social support.[30]

Using postal-code data, participants living in a community that had been identified as being at a high risk for flooding by the city of Calgary in 2012 were classified as living in an at-risk community.[31]

Analysis

Participants who lived in Calgary, had agreed to additional research, and had completed the 36-month questionnaire before completing the flood-impact questionnaire were eligible for inclusion in this study (N = 923). Descriptive statistical analyses were carried out for all outcomes and covariates of interest. For each of the 4 outcomes, a multi-variable logistic regression model was built using a manual backward elimination procedure to determine the relevant predictors of each outcome and potential confounders.[32] Variables considered for inclusion in all 4 models were all demographic factors, flood-related factors, and factors related to the provision of help. For the first 3 models (predictors of post-flood stress, depressive symptoms, and anxiety), we considered psychosocial factors before the flood. This allows for temporal ordering of mental health variables measured before the flood, and for assessing their association with mental health after the flood. For the fourth model (predictors of community cohesion), we considered psychological symptoms after the flood because a person's current level of

mental health might impact their sense of community. Modeling began by including all candidate variables and eliminating them one-by-one, beginning with those with the highest *P*-value based on the Wald test. Covariates were retained in the model if they had a significant association with the outcome of interest ($P \leq 0.05$), or if they changed the point estimate of other covariates by over 10% (indicating confounding). The final parsimonious model was compared with the initial fully adjusted model to ensure the robustness of the estimates and confirm that all confounders had been included. Possible effect modification by baseline mental health and geographical location (living in a flood-risk community) was examined in stratified analysis. All analyses were conducted in STATA v.13.[33] Using postal-code data from participants, AOF families were plotted on the map of Calgary using ARC GIS software.[34]

RESULTS

Descriptive statistics for the sample are available in Table 1. The mean age of the women in our sample was 34 years (SD 4.4), and ~80% had at least post-secondary education, had a higher income (>$80K), were Caucasian, and were born in Canada. Of the participants, 27% had previously been exposed to a natural disaster, but only 8% lived in a community listed as being at a high risk for flooding. Baseline depressive and anxiety symptoms were 13% and 15%, respectively. A total of 11% of respondents indicated elevated levels of post-traumatic stress. Only 5% of respondents indicated depressive symptoms after the flood, and 12% had high levels of anxiety symptoms after the flood. In all, 17% of participants indicated that they had a high sense of community cohesion after the flood.

Of the participants, 17% (n = 157) indicated suffering any loss or damage to personal property, to community services, or to the neighborhood. The losses and damages reported were primarily to community property (library, school, etc.) (n = 141) with only 21% (n = 33) of those who reported any loss indicating that this was personal property loss (dwelling, vehicle, or possessions).

Almost two-thirds (65%, n = 603) of respondents provided flood relief or support and participated in dispensing aid, with some providing multiple types of support to multiple groups. Among those who provided support, the majority provided support to community organizations and nongovernmental organizations (NGOs) (71%, n = 425), followed by support to friends and neighbors (51%, n = 311), family (28%, n = 166), or their employer (14%, n = 82). Of those who provided aid to families, the majority did so in the form of emotional and practical aid (66%, n = 110 and 59%, n = 97, respectively). Of those who provided aid to community organizations and NGOs, the majority did so in the form of supplying goods (72%, n = 304), followed by financial contributions (38%, n = 161).

TABLE 1

Descriptive Statistics		
	Total Sample (N = 923)	
	n	%[a]
Demographic Factors		
Maternal age (mean, SD)	34.5	4.4
Graduated post-secondary or more	760	82.3
Total household income of $80K or more	727	79.5
Ethnicity (Caucasian)	765	83.1
Born in Canada	760	17.5
Flood-related factors		
Had previous exposure to a natural disaster	245	26.6
Lived in a flood-risk community	64	8.0
Was evacuated	52	5.6
Experienced any damage to personal property or community services	157	17.1
Flood relief		
Provided help to others	603	65.4
Psychosocial factors before the flood		
Depressive symptoms before the flood (CES-D $\geq$ 16)	116	12.6
Anxiety symptoms before the flood (SSAI score $\geq$ 40)	139	15.2
Lower social support (NLSCY score $\leq$ 17)	163	17.7
Partner tension (some)	380	42.7
Partner tension (a lot)	11	1.3
Psychological symptoms after the flood		
Elevated post-traumatic stress (90th percentile)	105	11.5
Depressive symptoms after flood (CES-D - 12-NLSCY $\geq$ 2)	48	5.2
Anxiety symptoms after the flood (SSA—6 $\geq$14)	112	12.3
High sense of community cohesion (PDCC $\geq$ 15)	157	17.1

Abbreviations: CES-D, Center for Epidemiologic Studies - Depression Scale; NLSCY, National Longitudinal Study of Children and Youth PDCC, Perceived Post-Disaster Community Cohesion Scale; SSA, Spielberger State Anxiety Scale; SSAI, Spielberger State Anxiety Inventory.
[a]Some variation in denominator due to missing data.

Risk and protective factors for post-flood outcomes:

Multivariable logistic regression for the risk and protective factors associated with negative mental health outcomes (post-traumatic stress, depression, and anxiety) are presented in Table 2. All covariates that were significant predictors or confounders for each of the outcomes are presented, with statistically significant factors indicated in bold. For the first outcome of post-traumatic stress, having a higher income, being born in Canada, and being Caucasian reduced the risk for high levels of post-traumatic stress. Living in a flood-risk community as well as having previous symptoms of anxiety were risk factors (AOR: 3.90; 95% CI: 1.69, 9.01 and 2.49; 95% CI: 1.17, 5.26, respectively) for post-traumatic stress.

For the second outcome of increased risk for depressive symptoms, living in a flood-risk community, having anxiety symptoms before the flood, and having low levels of social support were all associated with an increased risk for depressive symptoms after the flood (Table 2), even when controlling for baseline depressive symptoms. For the third outcome of anxiety symptoms, having anxiety symptoms at baseline was associated with increased odds of experiencing anxiety symptoms after the flood (AOR 7.07; 95% CI: 4.36, 11.45). Previous exposure to a natural disaster was also

associated with increased odds of anxiety after the flood (AOR 1.63; 95% CI: 1.01, 2.67).

Table 3 shows the results of the fourth logistic regression, risk and protective factors associated with high community cohesion. Elevated post-traumatic stress, experiencing damage to personal property, or participating in community services and providing help to others were associated with increased odds of reporting a high levels of community cohesion after the flood.

DISCUSSION

This study assessed the mental health and community cohesion outcomes of participants in a longitudinal pregnancy cohort 5 months after major flooding in Calgary, leading to 3 broad findings.

First, most respondents in our sample did not experience major psychological distress 5 months after the flood. This may be reflective of the different type of sample used in our study compared with traditional post-disaster samples.[3] Traditional post-disaster samples tend to be concentrated in highly affected zones, who experience the most visible impact. Our sample was comprised of a much more diverse population, living across Calgary, with only 8% living in

TABLE 2

Factors Associated with Negative Mental Health Outcomes						
	Elevated Post-Traumatic Stress		Depressive Symptoms		Anxiety Symptoms	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Total household income of $80K or more	**0.28**	**(0.17**, **0.48)**				
Ethnicity (white)	**0.27**	**(0.14**, **0.52)**				
Born in Canada	**0.45**	**(0.23**, **0.87)**				
Lived in a flood-risk community	**3.90**	**(1.69**, **9.01)**	2.04	(0.65, 6.42)	1.95	(0.93, 4.08)
Experienced any damage to personal property or community services	1.49	(0.75, 2.96)	**2.51**	**(1.05**, **5.99)**		
Had previous exposure to a natural disaster					**1.63**	**(1.01**, **2.67)**
Anxiety symptoms before the flood (SSAI score ≥ 40)	**2.49**	**(1.17**, **5.26)**	**9.85**	**(4.06**, **23.96)**	**7.07**	**(4.36**, **11.45)**
Depressive symptoms before the flood (CES-D ≥ 16)	1.37	(0.62, 3.07)	1.15	(0.47, 2.82)		
Lower social support (NLSCY SSS ≤ 17)			**2.41**	**(1.13**, **5.13)**		

Abbreviations: CES-D, Center for Epidemiologic Studies - Depression Scale; NLSCY SSS, National Longitudinal Study of Children and Youth social support scale; SSAI, Spielberger State Anxiety Inventory.

TABLE 3

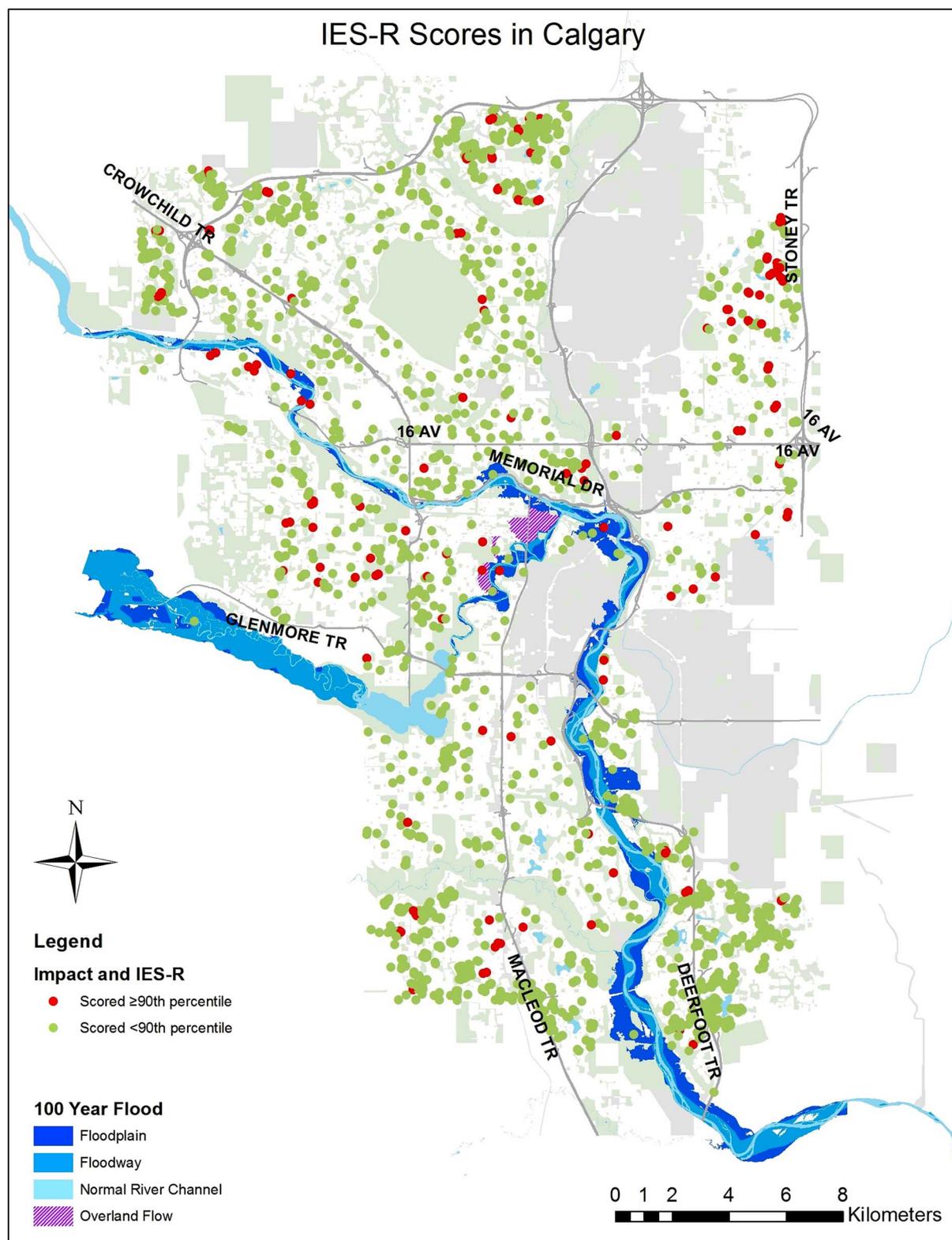| Factors Associated with High Levels of Community Cohesion		
	AOR	95% CI
Elevated post-traumatic stress (90th percentile)	**2.54**	**(1.60, 4.04)**
Experienced any damage to personal property or community services	**1.67**	**(1.09, 2.54)**
Provided help to others	**1.68**	**(1.13, 2.52)**

flood-risk communities and 17% experiencing loss to property or services. Very few studies of this type measure the impact of a disaster within an existing cohort, but one study in New Zealand on the impact of an earthquake in an existing cohort found similar low levels of major psychological distress.[35]

Second, a higher level of exposure to the flood (living in a community at a risk for flooding, or experiencing loss or damage to property or services) was not the only factor that was associated with high levels of post-traumatic stress or other mental health outcomes after the flood. The map of families (Figure 1) shows that many families with high levels of post-traumatic stress did not reside near a high-risk flood area. This is consistent with the results of the multivariable analysis, which indicate that demographic factors as well as pre-existing high levels of anxiety are associated with increased odds of experiencing post-traumatic stress, regardless of whether families lived in a flood-risk community. The vulnerability of people with pre-existing mental health problems to natural disasters is well documented in the literature using retrospective assessments of mental health.[3,4] This study adds to this evidence with prospectively collected data. The results also suggest that vulnerability to the impact of a natural disaster may not always be obvious, and that families with no tangible damage from a disaster may also suffer psychological effects, which is consistent with literature suggesting that disasters affect a broader community beyond those directly impacted.[9,36]

Finally, our results suggest that in addition to the negative impacts of natural disasters, there may be supportive impacts as well. In our study, those with high levels of post-traumatic stress were also more than twice as likely to report high levels of community cohesion. Increased community cohesion after natural disasters has also been reported in Poland, the United States, the United Kingdom, and in New Zealand.[9,15,16,37] In an examination of community cohesion in Carlisle, after major flooding, Chang[15] found that the level of community cohesion varied by severity of exposure to the flood. Our analysis lends support to this finding, as those who had suffered a loss to personal or community property also felt a higher degree of community cohesion. Previous literature has focused on how receiving aid after a disaster increases people's sense of community cohesion.[9,15] Our study adds to this finding by showing that the provision of aid—that is, the act of helping others—also increased people's sense of community. This is not unexpected, and it helps build on the theory that communities can be resilient to natural disasters through the provision of aid and services to disaster victims via existing social networks.[38] Norris et al[38] suggest that community resilience is important not only in the recovery from a disaster, but also in terms of preparing for future events. Community and civic leaders can use the language of community resilience to mobilize support in the aftermath of a disaster. For example, encouraging people to help others not only because it benefits the recipients of aid but also because it benefits those giving help by strengthening community cohesion for current and future events.

FIGURE 1

Shows the All Our Families Who Scored High Levels of Post-Traumatic Stress in Red, and Families Scoring Low Levels in Green.

IES-R Scores in Calgary

Legend

Impact and IES-R
- ● Scored ≥90th percentile
- ● Scored <90th percentile

100 Year Flood
- ■ Floodplain
- ■ Floodway
- ■ Normal River Channel
- ▨ Overland Flow

Abbreviation: IES-R, Impact of Events Scale-Revised.

Strengths and Limitations

The response rate to the flood survey was 67% and respondents were more likely to be married, have a higher income, have a higher level of education, be born in Canada, and be Caucasian compared with non-respondents. This is not uncommon in longitudinal cohorts; however, it may affect the generalizability of our study, and the findings may not be applicable to more vulnerable women. All participants in this study were women, and mothers of young children, and, consequently, findings may not apply to all populations.

Results regarding risk factors for depression should be interpreted with caution as only 5% of participants screened positive for depressive symptoms. Estimates of the prevalence of depression and its association with natural disasters are variable and generally do not control for baseline depressive symptoms.[2,3] A study of major depression after Hurricane Ike reported a similar prevalence (4.9%), whereas a study in England after the 2007 flooding measured over 13% prevalence of depression, with both samples including directly and indirectly affected individuals.[10,11] In our sample, 15% of respondents had depressive symptoms before the flood and only 5% did afterwards. This decrease in prevalence is unexpected and may indicate a measurement error associated with the shorter scale used in the post-flood questionnaire. It is also likely an underestimate of the prevalence of depressive symptoms. Finally, all measures were self-reported, which can bias the results.[26]

The major strength of this study is the availability of prospectively collected mental health data allowing us to consider baseline mental health in assessing post-disaster psychological distress and its ability to examine factors associated with strengthening outcomes such as community cohesion that have implications for post-disaster recovery.

This study captures a broader sample than the traditional post-disaster research that focuses on those that are in visibly or tangibly affected zones. Our study shows that being in the immediate proximity of a natural disaster, in this case the river, was not the only factor, and sometimes not the most influential factor, for mental health outcomes. These findings suggest that disasters affect the broader community in both negative and supportive ways.

CONCLUSIONS

Our study revealed generally low levels of post-traumatic stress after the 2013 Southern Alberta flood among mothers with young children in Calgary. Our sample included women who were well-educated, had higher incomes, were Caucasian, were born in Canada, and had access to a publically funded health-care system. In this study, vulnerability to mental health challenges after a natural disaster was associated with both the level of exposure to the disaster and pre-existing mental health conditions. Finally, greater exposure to the disaster and participating in the provision of aid were both associated with an increased sense of community cohesion after the flood. First responders, civic leaders, and mental health professionals should recognize that numerous factors influence vulnerability to catastrophic events, with pre-existing mental health challenges playing a significant role. Yet, considerable benefits can be achieved by engaging in help or aid activities following a natural disaster.

About the Authors

Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada (Hetherington, McDonald, Wu, and Tough).

Correspondence and reprint requests to Suzanne Tough, Owerko Centre, c/o 2500 University Dr. NW, Calgary, AB, T2N 1N4, Canada (e-mail: stough@ucalgary.ca).

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