Long-term consequences of flooding: a case study of the 2011 Queensland floods

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ABSTRACT

Devastating floods in southeast Queensland in 2011 were the combination of flash flooding in the Lockyer Valley with riverine flooding in the Brisbane metropolitan area. While there is considerable information about the immediate impact on those affected, there is less understanding of the long-term health effects that follow such events. This study explored the perceptions of health effects and support received by people affected by the 2011 southeast Queensland flood six years after the event. A cross-sectional survey of 327 people was conducted in areas affected by the floods. The questionnaire sought information about the ongoing social, economic, demographic and self-declared physical and mental health effects. The data were analysed through comparison of those unaffected with those directly affected by the floods. Residents whose households were flooded were more likely to score their health negatively than non-affected residents and had higher reported rates of trauma, injury and mental illness. Twenty-six per cent of this group reported that they still experience some adverse health effects from the floods. Managing the long-term health implications of a flood-affected population is an important public policy task. Dissatisfaction with recovery operations and perceived injustices associated with insurance and compensation arrangements may aggravate health consequences. Early recognition and intervention may assist with reducing secondary effects.

Introduction

Flooding is the most common type of natural disaster and has caused nearly US$153 billion in damages globally in the last decade. Floods affected over 400 billion people and accounted for almost half of all victims of natural disasters (EM-DAT 2018). A recent IPCC report stated the frequency and intensity of flooding is likely to increase in the wake of continuing climate change (IPCC 2012) and growing urbanisation may expose more people to such events (Du *et al.* 2010).

In 2010–2011, the strongest La Niña pattern observed since 1974 brought above-average rainfall to Queensland and major flooding occurred across the state in the aftermath of Tropical Cyclone Yasi. With the Brisbane River peaking at 4.46 metres, Brisbane city and surrounding areas including Ipswich, Toowoomba, the Lockyer Valley and Moreton Bay experienced significant flooding. Seventy-eight per cent of the state was severely affected (Department of Infrastructure and Planning 2017), 35 people tragically lost their lives and more than 29,000 homes and businesses were damaged. The estimated total economic losses were more than $5 billion (Queensland Floods Commission of Inquiry 2012).

There is considerable awareness of the immediate effects of flooding, such as morbidity, mortality, the social, economic and environmental disruption and the pressure placed on health services. In the year preceding the Brisbane floods, a study documented the health impacts on those affected (Alderman, Turner & Tong 2011), which sits within the broader body of literature examining the social, psychological and physical health issues experienced soon after flooding (Ahern *et al.* 2005, Du *et al.* 2010, Reacher *et al.* 2004, Zhong *et al.* 2018, Leon 2004, Paranjothy *et al.* 2011).

What is less known are the long-term health effects of such events and the factors that influence them. To provide insight into this, a survey was conducted to explore the perceptions of health status and support received by people six years after the flood. The aim was to identify the nature of those long-term effects including perceived determinants as reported by the participants.

Method

The study involved surveying residents in areas of southeast Queensland affected by the 2011 floods. The method was similar to that used by Turner and colleagues (2013) who surveyed a sample of residents approximately seven months following the 2011 floods. Flood-affected areas were identified by examining local flood maps and included areas of Brisbane, Ipswich, Morton Bay, Lockyer Valley and Toowoomba. Twelve electorates were selected from these areas and a random representative sample of 3000 adult residents was obtained from the Australian Electoral Commission electoral role database for these places.

A paper-based questionnaire was mailed out to each sampled individual in January 2017 along with a reply-paid envelope. Further promotions of the study were undertaken through the public media including interviews on ABC Radio and with local newspapers. The questionnaire contained a letter asking participants for their voluntary participation and stressed the anonymity and confidentiality of the survey. The questions garnered social, economic, demographic and self-declared physical and mental health information.

The original questionnaire developed for the 2011 flood survey (Alderman, Turner & Tong 2013) was used and modified to reflect any long-term effects. Initial screening questions were included to ascertain the movement of the respondents within the flooded or non-flooded areas. Direct questions about whether people considered any ongoing effects of the 2011 flood on their physical or mental health were added. The General Health Questionnaire (GHQ-12) was used to assess the perceived health status of the participants. Differences in GHQ-12 between affected and non-affected respondents were tested using mean scores and F-test at $p<.05$.

Ethics approval was granted by the Queensland University of Technology Human Research Ethics Committee (Approval: 1500001159). Descriptive analysis was undertaken for each variable in comparing health status and perceptions of people directly affected by the floods to those who did not feel they were directly affected. Comments and responses to the final open-ended question were analysed using thematic analysis.

Results

Response rate and characteristics

Of the 3000 mailed out questionnaires, 62 were undelivered and 327 were completed and returned, yielding a response rate of 11 per cent. Overall, 51 per cent of the respondents were female with the majority being married or de facto (77 per cent), in some form of employment (49 per cent) or retired (34 per cent), owned their home (86 per cent) and were born in Australia (78 per cent). The mean age of respondents was 57, with those aged 45 years and over being over represented (78 per cent). These and other demographic indicators are outlined in Table 1.

Flood effects

Of the 327 respondents, 13 per cent (n=43) identified as being affected by the 2011 floods and reported a range of impacts on their property including:

- 81 per cent had damage to the outside of their property (e.g. fencing, yards)
- 26 per cent had damage to whole or part of their living areas
- 5 per cent had demolition of the whole house
- 12 per cent had damage to vehicles
- 5 per cent lost animals.

Of the 43 flood-affected respondents, 44 per cent (n=19) stated they did not receive any reimbursements from the government or insurance companies to cover their losses and 63 per cent (n=12) of this group stated they did not receive any community support (i.e. social, financial, language, physical or mental health support).

The spread of gender, marital status, education level, country of origin and ethnicity were similar between those affected and those unaffected (see Table 1), although there were some small differences observed in age, income, employment status and home ownership between the groups. Notably, among those affected, more people identified as renters (21 per cent and 12 per cent, respectively) and housekeepers or family carers (14 per cent and 3 per cent, respectively).

Participants were asked to score their general health using the 12 questions in the GHQ-12. Scores were combined for all items. The results are detailed in Table 2. They show that flood-affected respondents were more likely to score their health negatively (mean score: 27.0, SD: 6.8) than non-affected residents (mean score: 23.3, SD: 5.4; $p<.00$). Compared to those unaffected, there was a notable higher reporting of trauma or injury (12 per cent, OR=5.5, 95 per cent CI=1.7–17.2) and mental illness (21 per cent, OR=29.6, 95 per cent CI=6.6–132.5) among those affected by the floods, with 26 per cent (n=11) reporting they still experience some health effects from the floods including depression (n=4), insomnia (n=3), asthma (n=2), arthritis (n=2) and other health issues (n=4).

Respondent commentary

The final question asked respondents to comment generally on their experience of the flood and its impact on them. Seventy-two respondents provided comments, allowing for a qualitative exploration of the responses. Several respondents commented on the stress and anxiety experienced from not being able to return to their homes or being unable to leave their homes for safety reasons. Three of the respondents stated their inhibited mobility, due to old age or a disability, had a compounding effect on their stress and anxiety and that this had continued after the flood. A common theme for five respondents was the problems, stress and anxiety experienced through the loss of communications. Specifically mentioned was being cut off from communication with loved ones they were caring for or from whom they received support because

Table 1: Demographic characteristics of the study participants.

Variable Affected Status	Total % 100% (327)	Affected % 13% (43)	Unaffected % 87% (283)
Gender			
Male	49	40	50
Female	51	60	50
Age			
18–24 years old	4	5	4
25–44 years old	18	14	18
45–64 years old	44	63	42
65 years and older	34	19	26
Education Level			
Less than high school	4	5	4
High school	28	21	29
Some university/college/vocational	49	47	38
Graduate degree	23	2	23
Other	5	2	5
Employment Status			
Employed (full or part-time)	49	51	48
Housekeeper/family – carer	4	14	3
Retired	34	21	36
Permanently sick/living with disability	3	7	3
Student	3	0	4
Other	6	7	7
Country of Origin			
Australia	78	74	78
Other	22	26	22
Home ownership			
Renter	13	21	12
Homeowner	86	79	87
Other	1	0	1
Income per year			
$156,000 or greater	13	12	13
$78,000–$155,999	27	27	27
$52,000–$77,999	14	7	15
$39,000–$51,999	8	7	8
$26,000–$38,999	10	5	11
$13,000–$25,999	12	22	10
$12,999 or less	2	0	2
Prefer not to answer	15	20	14
Ethnicity identified			
Aboriginal or Torres Strait Islander	1	0	1
Caucasian	93	93	94
Asian	4	2	43
Other	2	5	2

of obstructed travel and interrupted access to official information and instruction due to power outages.

More than ten respondents commented on how the floods adversely impacted on their income, business operation and capacity and general financial situation; for some this resulted in long-term social and economic deprivation. A number of respondents included information on post-disaster support with several stating their dissatisfaction with recovery operations and the perceived injustice associated with insurance and compensation arrangements coordinated by local council and the Queensland Government.

Several respondents commented on adverse health reactions experienced after the floods; some were also identified in the comparative analysis. The majority demonstrated an understanding of the causal relationship to the stress of the flooding experience and its short-term and long-term consequences. An issue was highlighted by five respondents around feeling anxious and re-traumatised during periods of heavy rain regardless of flood risk. This triggered concern of being affected again. Six described that they feel more prepared for future flooding.

Several respondents commented on the positive experiences associated with the 2011 floods. These mainly centred around the provision of physical support and donations creating a sense of community value and strengthening community connectedness and resilience. For some, this created a sense of reassurance of support in the future.

Discussion

A flooding event is a traumatic experience, with health effects being likely larger and longer lasting than the immediate and short-term periods commonly examined. Flooding can interrupt health service availability, transport, equipment, clean water, food and the means to send and receive communication. These disruptions can influence short-term health effects and prolong and accentuate other diseases especially psychological illness and chronic disease (Zhong *et al*. 2018). There is also likely to be a latency period or delayed onset of symptoms. While these effects and symptoms may diminish over time as part of the normal recovery process, the emotional drain of the event can be particularly severe for those whose experience was frightening and traumatic. The results of this study explored the nature of these health issues.

Effect of the Queensland floods

In the context of the 2011 southeast Queensland floods, the results compliment and build on the research of Alderman and colleagues (2013) and Turner and colleagues (2013) by offering a longer-term perspective on a population experiencing a similar exposure and noting possible ongoing effects. The 2011 survey reported that direct flood exposure had significant effects on the perceived physical and psychosocial health outcomes of residents in flood-affected areas. Those affected were more likely to report poor overall and respiratory health, psychological distress, poor sleep quality and probable PTSD. Expanding on this, Turner and colleagues (2013) reported possible increases in tobacco, alcohol and medication usage by those affected by the floods.

General health

The results are echoed in several studies examining longer-term health effects following floods. These studies suggest that flood victims may experience poorer health outcomes and are more vulnerable than the general population. For instance, studies suggest that floods may decrease a population's general health status and raise the frequency of visits to medical providers (Zhong *et al*. 2018, Assanangkornchai, Tangboonngam & Edwards 2004, Turnstall *et al*. 2006). Chronic diseases have been identified as long-term health issues related to floods (Reacher *et al*. 2004, Gautam *et al*. 2009, Jiao *et al*. 2012) with evidence showing some patients with chronic medical conditions reduced their treatment after floods and this contributed to poorer health outcomes (Kessler 2007, Tomio, Sato & Mizumura 2010). In a Korea-based study, flooding was identified as a significant factor in the reduction of quality of life with the largest reductions found in physical and social functioning (Heo *et al*. 2008).

Psychosocial health

Trauma exposure from floods has been reported in several studies as a risk factor for developing adverse psychosocial outcomes in both high and low-resourced countries (Zhong *et al*. 2018, Assanangkornchai, Tangboonngam & Edwards 2004, Heo *et al*. 2008, Neria, Nandi & Galea 2008, Norris *et al*. 2004, Reacher *et al*. 2004). Similarly, studies evaluating flooding in the UK in 2007 found a two- to five-fold increase in mental health symptoms of people affected by the floods. This was influenced by the severity of flooding, the level of disruption to essential services and how the community recovered. Increased incidence of anxiety, depression and PTSD was observed and, in keeping with much of the research, females were more likely to experience psychological distress (Carroll *et al*. 2010, Paranjothy *et al*. 2011).

Psychological consequences have also been documented for other types of disasters. Parts of Australia are prone to bushfires and studies show a heightened level of psychological distress long after these events. For example, the Black Saturday bushfires in Victoria in February 2009 resulted in 173 fatalities and widespread damage and destruction to buildings and infrastructure. Five years on, higher rates of psychological problems have been recorded for those living in severely affected regions than for those living in less-affected areas and the general population (Bryant *et al*. 2018). Similarly, a study in South Australia on the mental health of adults who experienced a major bushfire in their childhood, found evidence of significantly higher rates of some mental disorders among the survivors than in the control group (McFarlane & Van Hooff 2009).

The dominant factors associated with persistent and severe mental health issues included death of someone close, not receiving mental health assistance (Bryant *et al*. 2018), lack of or weakened social supports (Bryant *et al*. 2017) and exposure to subsequent life stressors or traumatic events (Bryant *et al*. 2018, McFarlane & Van Hooff 2009).

Response and recovery

Immediately following the floods, the Queensland Government established the Queensland Reconstruction Authority Board that was tasked with managing the rebuild and repair of infrastructure in flood-affected areas (Britton 2011). A commission of inquiry was launched to investigate the disaster and recovery efforts (e.g. reinstating essential services), provision of urgent and emergency services (e.g. evacuations, search and rescue) as well as community preparedness and possible preventative measures (Queensland Floods Commission of Inquiry 2012). While the Commission's report praised the government's efforts, it did note inadequacies and made recommendations to improve responses to similar events including improvements to flood planning and information dissemination and clarifying terms of insurance, building codes and communications.

Studies of the long-term effects of disasters confirm that people and communities, particularly in developed countries, are resilient and that despite facing traumatic events and distress, their psychological health improves over time. However, for some people the psychological consequences may linger, especially if the person is not well supported or connected (Bryant *et al*. 2017) or if they experience other life stressors. Therefore, while the Queensland Floods Commission recommendations may maximise the community's preparedness and minimise the damage for future events, this study showed a need to improve the identification and provision of long-term services for people affected by disasters that will alleviate additional suffering and adverse health conditions.

Challenges

This study considered some of the longer-term physical and psychosocial health impacts but there are some challenges that limit a comprehensive assessment of these and their links to other factors and determinants. The cross-sectional design of the study limits the utility of the findings compared to a longitudinal study design (e.g. Bryant *et al*. 2018, McFarlane & Van Hooff 2009). However, this study was conducted anonymously and was not designed as a cohort study. In addition, the response rate of 11 per cent represented a sample of those affected by the floods of 43, which was insufficient for generating strong statistical conclusions. A rigorous survey follow-up process could have increased the overall responses received. Challenges arose from the survey being conducted six years after flood exposure. This left room for re-call bias and perhaps important consequential effects were missed, which, although initially observable, could have resolved in the interim time period.

The degree of flood exposure and a person's role during a flood event are important risk factors for long-term health outcomes (Assanangkornchai, Tangboonngam & Edwards 2004, Heo *et al*. 2008, Norris *et al*. 2004, Reacher *et al*. 2004). When it comes to psychosocial aspects, research highlights that vulnerability to developing a mental health disorder during and preceding a flood is exacerbated by other factors including a person's ethnicity, age, previous exposure to trauma, homelessness, access to social supports, socioeconomic status, pre-existing mental health condition and experience of loss and trauma (Alderman, Turner & Tong 2012). The scope of this study did not account for assessments of the type and degree of exposure nor other possible confounding factors such as the effect of home ownership, exposure to other major weather events and the stress of dealing with insurance companies.

Sampling bias was encountered in this study as a proportion of the affected population had moved away from the area. The sample derived from the electoral role may have excluded residents who reside in the sampled areas but who do not have a fixed address. The inclusion of these groups is important for future studies especially as these residents could be considered as vulnerable.

Implications and recommendations

Flood events are felt most strongly by the people who live in affected areas. As observed in the study and others, these people are at higher risk of experiencing psychological distress and ongoing mental health issues. It is important that this is recognised, including possible delayed onset, by health care providers and that programs are put in place to appropriately respond.

Managing the long-term health of a flood-affected population is an important public policy task. The dissatisfaction with recovery operations and the perceived injustices associated with insurance and compensation and government arrangements indicate that building trust is vital to this process. Emergency and disaster management policy must be responsive to community needs and address the gaps in government and insurance company obligations. To achieve this, a monitoring system is recommended that captures and records data on flood-affected people after flood events that includes health status. This would assist in a greater understanding of how communities in flood-prone areas are coping and would provide data for longitudinal study.

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