

The role of flood memory in the impact of repeat flooding on mental health

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Abstract

A highly important but under researched impact of flood events is the long term psychological effect of the distress and trauma caused by damage and losses associated with repeated flooding of communities. As a part of the recovery process responders need to consider flooded households and offer support to mitigate against the stress of flooding. This research aims to consider how the risk of repeat flooding and flood memory can affect the needs of communities with respect to post disaster support. Previous research has identified a variety of influencing factors that affect the prevalence of mental health disorders in the aftermath of flooding. Using a structured literature review and novel conceptual model this research examines the role of flood experience and memory in the impact of flooding on mental health and the needs of flooded communities. It is found that the memory of previous flooding can influence future outcomes in a variety of ways, with some positive incentives towards actions that may result in lower damages in future events. These actions, that affect future trauma, have the potential to mitigate the impact of repeated flooding. Therefore appropriate post disaster needs assessment should not only identify vulnerable individuals but also take account of the risk of future flooding.

Keywords: flood memory, PTSD, Anxiety, frequent flooding, flood impact, mental health, flood recovery.

1 Introduction

The impact of flooding on the physical and mental health and wellbeing of communities can endure long after the loss and damage due to direct contact with floodwater is repaired. Quite apart from the possible loss of life and irreversible injury; studies have demonstrated that a variety of other physical



ailments and mental health issues can arise in the aftermath of a flood [1]. It is clear that, for the UK, Europe and the majority of the developed world, the mental health impacts of flooding are at least as important as the risks from physical illness [1, 2]. However, the detailed level of understanding needed by responders and agencies in order to provide appropriate support throughout the disaster cycle is lacking [3–5]. Furthermore it is not entirely clear how the resources available to offset the longer term effects of flooding on the psychological resilience of individuals and communities should be directed.

Research has explored various factors that can influence the severity of mental health impacts of flooding including flood characteristics [6, 7]; individual characteristics [8]; socio economic factors [6]; preparedness [9]; and duration of reinstatement activities [10]. It also seems intuitive to suggest that flood memory or experience of past flooding will have bearing on the severity of mental health impacts. However research in this area is lacking and it has been identified by the UK Health Protection Agency as an area in need of further research [11].

Therefore this paper seeks to explore various factors, including flood memory on the mental health and wellbeing of flood affected communities and individuals. The eventual aim is to improve the understanding of mental health consequences from repeated flood experience leading to improved provision of support services and targeting of resources to those potentially most vulnerable to future mental health problems as a result of flooding and flood risk [5].

2 Methodology

The research adopted an enquiry based qualitative approach through a structured review of available literature on the basis of research questions designed to answer the main research aim. Literature from the wider field of disaster management was combined with flood specific research in order to address the following research questions:

1. What are the main mental health problems caused by flooding?
2. What factors affect the prevalence and severity of mental health issues in flooded communities?
3. How long does the impact of flooding on mental health endure and does the memory of flooding affect mental health issues following flooding?

A keyword search of academic literature databases provided the majority of the literature, recent publications were prioritised and the presence of several overarching reviews was capitalised upon in order to optimise the coverage of older and diverse literature. Over 80 studies were accessed directly but the pool of background studies was far larger because of many wide ranging reviews.

A novel conceptual framework was then developed based on the available evidence on the research questions. This illustrates the influencing factors, role of memory and mitigating interventions in the context of communities at risk of frequent and repeated flood events. The construct validity of the proposed framework derives from the thorough nature of the qualitative enquiry.

3 Research results

Studies investigating the impact of flooding on mental health span the disciplines of Flood risk management, disaster management, public health, epidemiology, environmental management, climate change and more. Findings from this diverse knowledge base are structured below as they relate to the three research questions. However the emphasis is on identifying lessons for appropriate needs assessment rather than examining appropriate clinical diagnosis or treatment.

3.1 Mental health impacts caused by flooding

Flooding can be regarded as a stressful and sometimes traumatic experience and some psychological reaction is therefore expected and natural [4] and much of this may quickly dissipate. Where this is not the case, Post traumatic stress disorder (PTSD) is the most commonly reported side effect of natural disasters including flooding and symptoms of depression and anxiety are also frequently seen [4]. For example Norris *et al.* [12] reviewed multiple disaster studies, concluding that experiences ranged from inconvenience to severe trauma and that the reaction to those experiences ranged from severe mental health deterioration to some positive developmental aspects. It is apparent that some individuals suffer from more than one mental health issue. For example Norris *et al.* [13] observed both PTSD and Mild depressive disorder (MDD) in populations affected by floods in Mexico and found that co-morbidity was substantial.

Estimated prevalence of mental health disorders varies widely. Alderman *et al.* [14] collated literature estimating the prevalence of mental health disorders ranging from 8.6% to 53% in the first two years following flooding. Some of this variability may be due to sampling and methodological differences in estimation methods. Measurement of the impact of flooding in prompting mental health issues is complicated by the underlying level of psychiatric disorders already present in the population. Notwithstanding, studies imply that the uplift in need after a flood is substantial and variable. For example, in Lewes after the 2000 event, Reacher *et al.* [15] found a four-fold increase in psychological distress in flooded households when compared with non-flooded. Given the wide disparity in observed occurrence of PTSD and other psychological issues, the research clearly demonstrates that some unpicking of influencing factors would be critical in identifying vulnerable communities and individuals and in directing support.

3.2 Factors affecting the development of mental health disorder

Models of health impacts in the literature include Few [16] and Tapsell *et al.* [5]. They suggest a list of factors that make a difference to the prevalence of mental health issues post disaster. These can be grouped into pre-existing conditions, impact of the stressor event and post event conditions and stresses [9]. However the scale and direction of the influencing factors are not consistent across studies.

There are some confirmatory and strong results such as the conclusion that low socio economic status relates to higher level of distress [17]. However, other



factors such as age display much more complex and conflicted relationships with mental health problems. Furthermore the risk of development of severe mental health issues, or PTSD, was found to be related to individuals with extreme pre-existing conditions and the presence of extreme aspects in the stressor event. So for examples survivors who may have a higher than typical risk for PTSD include those with a history of trauma exposure; chronic illness; chronic social problems; or other major life stressors such as single parenting [5]. Table 1 summarises the influencing factors identified in the literature review.

Table 1: Factors influencing the likelihood of experiencing mental health disorder after flooding.

Pre existing conditions	Features of the stressor event	Post event stress and coping strategies
History of psychiatric disorder	Severity of exposure	Presence of other stressors
History of other health related problems	Perception of human control or responsibility for the event	Lack of resources for recovery
Gender	General scale of loss of life or massive injury	Distress of others, particularly spouse
Disaster experience or training	Level of personal property	Living with the threat of constant or growing flood threat
Age		Social support
Ethnicity		Religion
Socio economic status		Family structure
Dependent children		Coping strategies
Urban/rural setting		Need for relocation
Personality factors		

Vulnerability is related to gender. Tapsell *et al.* [5] observed that women and girls exhibited stronger effects than men and boys in 42 out of 45 studies. The effects were most marked in the study of PTSD and within traditional cultures. The presence of strong spousal support in mitigating stress was also less helpful for women than men with women apparently burdened by close social ties [5].

The effect of age as an influencing factor is more complex. While it is clear that age contributes to physical challenges that result in increased physical health impacts, injury and mortality [18], conflicting results are reported in mental health studies in the disaster field [19]. For example, in Korea younger people (under 45) were found to have most symptoms after a flood event [20] and other authors have found similar patterns [21] possibly due to the older generation's coping strategies [22]. However the protective influence of older age was not observed in Vietnam [23]. Some studies have demonstrated that middle aged

adults are the most prone to mental health problems after disasters [12]. Tapsell *et al.* [5] suggest an explanation for this is that flooding adds to the greater responsibilities they already face. Children as a distinct group have also been studied, but no conclusive evidence demonstrates whether children are more or less likely to display mental health impacts [5, 24]. Age as a factor is highly confounded with other life stage, physical abilities and stressor variables to the extent that any true impact of chronological age can rarely be established.

The available research on culture and ethnicity shows ethnic minorities are more vulnerable to disasters in general possibly due to social deprivation and marginalisation [12, 25]. The impact of cultural expectations may also have an influence on the tendency of an individual to seek help [26, 27].

Evidence that implicates the flood severity in mental health disorders strongly suggests this is related to direct, indirect, tangible and intangible losses [13]. These findings also seem to hold true for disasters generally [5, 12, 28]. Indicators include the number of casualties, deaths, losses and disease. For example in Thailand severe flooding quadrupled the incidence of PTSD symptoms whereas in Korea risk of PTSD and depression were influenced by injury, death of a relative and damage [14]. However, the categorisation of severity differs across studies and a full diagnostic would be difficult to establish without considerable further research [9, 29].

On an individual level, pre-existing health conditions and personality factors are good predictors of post-disaster mental health problems for a given disaster severity [12]. This has also been demonstrated specifically for flood events [5]. After a flood the stress associated with lack of basic services, evacuation and poor living conditions, can also damage mental health [4, 13, 30]. Events seen to be accidents cause less distress than those seen as preventable [5].

Disaster studies that focus on aspects of the stressor have found that psychological impacts are most likely when at least two severe event factors are present: Extreme and widespread property damage; serious financial hardship; human causes for the disaster; high levels of injury and deaths [12]. However research has also demonstrated differences between different types of mental health issues with PTSD related more to event stressors and depression associated with both event stressors and life stressors [9].

It is clear from the above discussion that it is necessary to consider multiple influencing factors relating to the flood and the population. However research has tended to focus on factors in isolation, rather than investigate interactions between multiple stressors and characteristics rendering the evidence indicative rather than predictive. Recognising these factors may nevertheless help to identify those most at risk of developing PTSD, anxiety and depression, however a deeper understanding of the interactions may allow disaster managers and health professionals to offer specifically targeted support.

3.3 Duration of impact and the influence of flood memory

Duration of impact and flood memory are linked because remembering a flood will have an influence on the length of psychological symptoms. While treatment pathways are outside the scope of the research the existing evidence does allow



for the development of some conceptual framing that may be helpful in designing the timing and focus of intervention strategies.

3.3.1 Duration of impacts on mental health

The duration of symptoms is highly relevant to the influence of repeated flooding. Many trauma symptoms may disappear quite quickly perhaps due to particular coping strategies and support. Other symptoms may arrive after some delay such as PTSD, and different symptoms can emerge in the short and long term [14]. Apart from the burden on mental health services, psychological effects from flooding can influence long term physical health and mortality [18, 31].

Longitudinal studies of mental health impacts after flooding are rare but they suggest that for some individuals the effects are long lasting. For example Norris *et al.* [13] found that symptoms persisted more than 2 years after a flood for some individuals in Mexico and suggested that a minority of those suffering with PTSD would never recover. Tapsell and Tunstall [21] in England, found impacts persisted for the full four years of their longitudinal panel. Furthermore Assanangkomchai *et al.* [32] studying flood affected populations in Thailand found resurgence of symptoms on the anniversary of a flood suggesting a strong link between mental health symptoms and flood memory.

Other cross sectional studies may be carried out long after the traumatic event yet still find significant uplift in mental health symptoms [12]. The possible phases in the health effects of floods have been outlined by Parker *et al.* [33]. These range from threat anxiety in anticipation of an event for those who have knowledge and experience of flood risk; stress and shock effects during the event; worry and depression during early recovery; stress and stress related illness during long-term recovery; and post-event anxiety over future threat and impaired mental health which brings the phases full circle if a subsequent event occurs but may eventually dissipate if the threat is removed or forgotten.

3.3.2 Impact of previous flood experience and flood memory

As noted above, previous research has suggested that experience of disaster has some influence on the mental health outcomes following a second or subsequent event. Flood memory as a concept has been studied but not generally within the context of impact on mental health and it can be thought of as an individual, collective or institutional property of populations at risk [34, 35]. The analysis in 3.3.1 demonstrates a possible logical causal route for the influence of both experience and memory on the future severity of symptoms. However according to Mason *et al.* [4] the direction of this influence is unclear from observed health outcomes in post flood evaluations. In their recent study in the UK prior experience was found to have a negative effect on mental health outcomes [4]. Galea *et al.* [36] and Heo *et al.* [20] also observe that past trauma increases the likelihood of developing PTSD, whereas other authors propose an inoculation theory that prior experience with a stressor increases capacity to deal with it [37, 38]. The positive aspect of this controversy is that the differences in observed outcomes may be as a result of coping strategies and interventions applied between one disaster and another. For example people could be encouraged to engage in detached coping in the short-term at least as this allows for more

effective assessment of the options to prevent recurrence of flooding [4]. Therefore it may be helpful to consider in detail the mechanisms through which flood experience could influence mental health outcomes in order to identify potential interventions that could result in more positive outcomes.

4 Conceptual model of the impact of flood memory on mental health

In conceptualising how flood memory could affect the prevalence of symptoms in the population each of the identified influencing factors has been considered in turn. Those factors that remain unchanged due to flood experience (such as gender) or marginally impacted (such as socio-economic status) were removed. The remaining factors were considered as to whether they would potentially increase or decrease the prevalence of mental health issues (table 2).

For many of the influencing factors it was seen that their influence on future mental health could be in either direction and therefore the mitigating or contributing actions also need to be considered. This analysis leads to a conceptual framework of the impact of flood memory on psychological distress that recognises the role of health and disaster management professionals in partnership to reduce the future mental health footprint (as seen in Figure 1).

This framework, derived from the existing evidence as categorised under the research themes above is directional in nature as it is not calibrated with evidence of the strength or duration of the individual influences on overall mental health. However, the structured approach would be suitable for operationalisation if suitable data were available. Furthermore in explicitly expressing the temporal aspects of the many influencing factors it can be used to encourage appropriate long term investment in necessary support services.

4.1 Research implications

Mental health consequences of flood events have not been fully addressed in the past either in disaster or health fields. But the purpose of this present review is not to predict the required mitigating actions in advance of flooding. Few [16] and Tapsell *et al.* [5] have pointed out the difficulty and futility in making this attempt. It is important to avoid pathologising a natural reaction to trauma and offer appropriate post disaster support that can detect those individuals that may be more vulnerable and likely to develop more severe and longer term symptoms [17]. In this respect the memory and frequency of flooding could be instrumental in setting up conditions that could trigger higher levels of emotional distress. Therefore it is relevant to consider what actions can be taken in recently flooded locations to mitigate against the impact of a second flood.

We can deduce that mitigation of mental health impacts for a given individual with fixed personality and socio economic conditions for the next flood might be achieved through one of the following approaches:

The first approach is to assess what steps could be useful in preventing the development of psychological problems after an event. The model suggests

Table 2: Mental health influencing factors affected by flood memory.

Pre existing conditions	Features of the stressor event	Post event stress and coping strategies
History of psychiatric disorder (could be made worse because of lasting impact of previous event)	Level of personal property damage and loss (could be improved by preparedness but otherwise could be cumulative)	Need for relocation (could be improved through better resilient reinstatement)
History of other health related problems (could be made worse because of lasting impact of previous event)	Perception of human control or responsibility (Frequent flooding could feel like victimisation but improved preparedness could give feeling of control)	Lack of resources for recovery (May be more prepared but previously held resources could be exhausted)
Disaster experience or training (Could be improved because of previous experience)		Distress of others, particularly spouse (could be worse through memory of flooding)
		Social support (may be improved due to past experience or subject to compassion fatigue)
		Coping strategies (May be enhanced through past experience but may have to be abandoned)
		Living with the threat of constant or growing flood threat (likely to be made worse by flood memory)

helpful interventions might be: support for faster reinstatement particularly for those without insurance; sympathetic insurance and reinstatement professionals; good advice on coping strategies that help individuals forget or assimilate the trauma of their experiences; strengthening of community networks and other social support; and provision of counselling and direct mental health support.

The second approach reduces future vulnerability to flooding through taking steps to increase the capacity and resilience of people and the built environment [39]. Helpful interventions might include: resilient reinstatement of buildings [40], disaster preparedness training; and warning systems. Indeed a whole range of flood risk management measures can be used to lower the risk of physical

Influencing Factor	Impact of flood	Possible mitigation	Potential combined impact
Pre-existing mental health	-	Treatment/counselling	=
Pre-existing physical health	-	Treatment	=
Flood Experience	+	Training and preparedness	+
Level of personal loss	=	Preparedness	+
Perception of control	~	Information/preparedness	~
Relocation	=	Resilient reinstatement/preparedness	+
Resources	~	Insurance/preparedness	+
Distress of others	-	Treatment/counselling	=
Social support system	~	Reinforce community organisations	+
Coping strategy	~	Choose appropriate coping strategy	+
Living with threat	-	Counselling/preparedness	=

Figure 1: Impact of flood memory on mental health impacts in frequently flooded communities.

damage and loss [41]. The resilience of the population at risk can also be enhanced through many means including: the provision of peace of mind via insurance; good advice on coping styles that enable rational actions while reducing trauma; preparedness training; improving general wellbeing; and boosting community cohesion [39].

5 Discussion and conclusions

Impact on the mental health of affected households, usually PTSD, depression or anxiety, is often the largest health effect observed in the context of flood events. The effects can last for many years within a population although the majority of individuals will recover quite quickly. There are several indicators that may allow responders to identify those most at need of support in the aftermath of disasters but large scale predictive mapping of likely need is problematic.

Flood memory is one of the indicators found to have an influence on the prevalence of mental health disturbance but there are some contradictory findings and theories surrounding this issue. Underlying causes of the differential observed outcomes could be related to the balance between worsening pre-existing health conditions and improvements in preparedness that may lessen the stress of the subsequent flood and recovery period.

Interventions, physical and psychological, in the immediate aftermath of a flood event, designed to restore or improve the pre-flood conditions will therefore be expected to mitigate against the worsening pre-existing conditions

for successive floods. Furthermore, action to limit the severity of flooding in the successive flood will contribute to lower levels of trauma and therefore may lead to improved mental health outcomes.

Coping strategies need to be explored. Those strategies appropriate to short term recovery following a single flood may be different from those appropriate for those at risk from frequent and repeated flooding. However an initially detached coping style may enable a more rational consideration of the options available to act.

Finally the results show that future research in this field may benefit from a multi-dimensional approach to measurement of impacts and further consideration of the complex relationship between concepts of flood memory and mental health. The formulation of a conceptual model of the impacts of flood memory on mental distress following repeated flooding will be helpful in deriving appropriate multi-dimensional research designs that include the effect of previous flooding.

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