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England

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The English National Study of Flooding and Health

Summary of the evidence generated
to date

About Public Health England

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Executive summary

Background

Floods are common and the most frequent global natural hazard.

The incidence and impact of flooding events has been increasing world-wide and this trend is set to continue.

The need to understand better the longer-term impact of flooding on health was identified during the recovery phase of the response to flooding in the winter of 2013-2014.

PHE established the National Study of Flooding and Health working with 3 academic partners to determine the impact of flooding on mental health and wellbeing.

Methods

People living in neighbourhoods affected by flooding in the South of England between 1 December 2013 and 31 March 2014 and in Cumbria in December 2015 were invited to participate.

Participants were categorised according to exposure as flooded, disrupted by flooding or unaffected and followed annually for 3 years.

Validated instruments were used to assess the prevalence of common mental health problems and health-related quality of life.

Key findings

There is a very significant impact of flooding on mental health.

There is an adverse impact on the mental health among those whose lives are disrupted by flooding as well as those whose homes are flooded.

The increase in mental health problems persists for 3 years.

There are factors associated with worse outcomes including flood-related factors such as depth of flood water in the home.

Many people experience persistent flood-related damage to their homes and this is associated with worse mental health outcomes.

Evacuation and displacement, particularly without warning, increases the risk of anxiety and post-traumatic stress disorder.

Loss of domestic utilities is associated with worse mental health outcomes, such as:

- losing access to health and social care services which increases the risk of depression and anxiety among people who require those services
- insurance issues which are important secondary stressors
- an increased demand on services in populations affected by flooding for a prolonged period of time with people seeking help from formal sources such as their GP and from informal sources such as friends and family

Conclusion

The evidence generated by this study highlights the large burden of mental health problems associated with flooding and the need for preventive interventions before flooding occurs, during flooding incidents and for a sustained period after flooding. The study provides important information to inform those interventions.

Introduction

Floods are one of the most common environmental emergencies and have significant health impacts. The 2017 UK Climate Change Risk Assessment highlights that both climate change and urban development will result in more frequent flooding in the UK. (1) Furthermore, the population at risk of flooding is expected to increase by 40% assuming no population growth and adaptation to climate change continues at the current rate (1). Mental Health problems are also common. The national Adult Psychiatric Morbidity Survey identified that in 2014 one in 6 (17.0%) people aged 16 and over in England had a common mental disorder with a prevalence of generalised anxiety of 5.9% and depression 3.3% (2).

In the immediate aftermath of flooding, people can suffer from injuries, infections, exposure to chemical hazards and disruption to health services. These risks are generally well described and our surveillance systems indicate that, in the UK, their impacts are relatively small, it is likely this is as a result of our robust infrastructure. The longer-term impacts of flooding on health are less well understood and may arise from the damage to homes, loss of domestic utilities, having to move out until the home is habitable, and delayed return to normal activities of daily living

Prior to the National Study of Flooding and Health, some studies had described the health impacts of flooding in the first few months after the event using qualitative methods or cross-sectional surveys. However, there was little evidence available to help us understand the scale, intensity or duration of these impacts. Better information was needed to support those affected and to inform decisions about services and interventions before, during, and after a flood.

The storms of winter 2013-14 brought the wettest winter to England in 250 years. Following them, Public Health England (PHE) established the English National Cohort Study of Flooding and Health, working with academic partners at the NIHR Health Protection Research Units in Evaluation of Interventions at the University of Bristol, Emergency Preparedness and Response at King's College London, and Environmental Change at the London School of Hygiene and Tropical Medicine.

The study followed up participants annually for 3 years to identify the duration of impacts of flooding on health and wellbeing, to help inform preventive and follow up actions and to reduce harm from future floods (See Appendix 1 for more information on methods)

This document provides a summary of the findings to date and their implications. Public Health England is using this evidence to inform the development of resources for policy makers and practitioners.

The burden of mental ill health associated with flooding

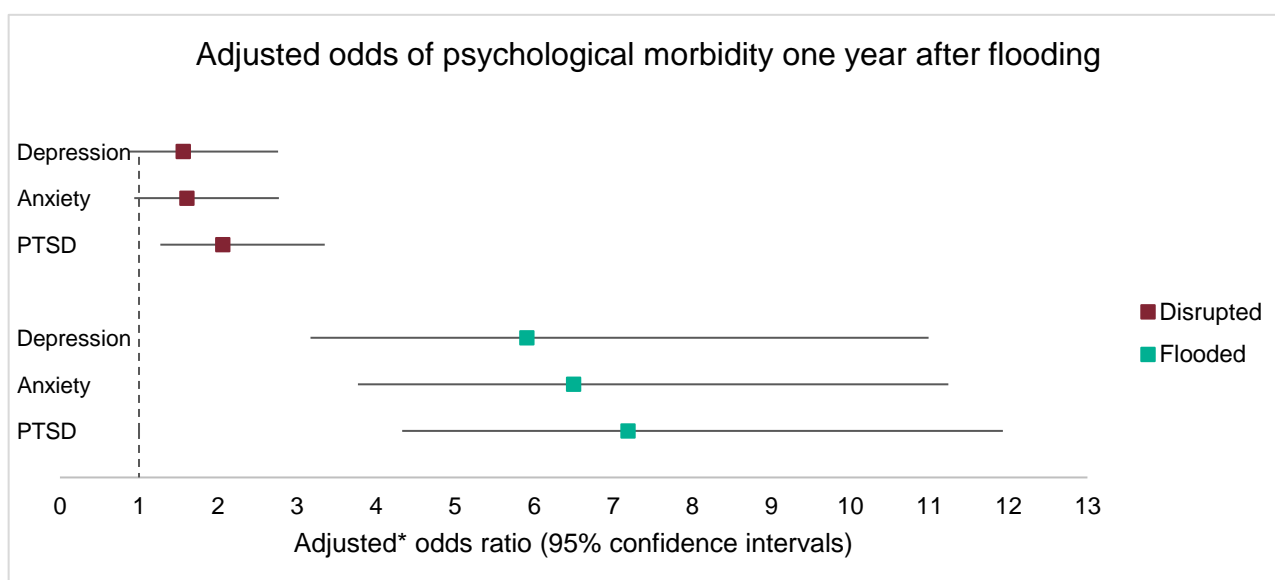
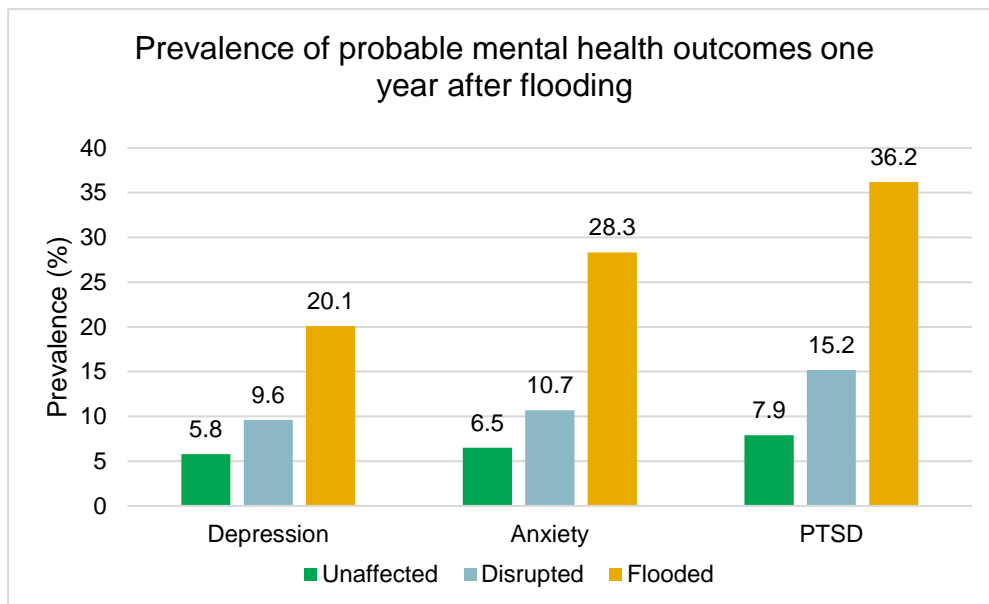
This study has shown that communities, commissioners, and providers of services should prepare for a substantial mental health burden in communities affected by flooding, and that responders can help to reduce this burden through several pragmatic steps in the immediate aftermath of a flood.

Key findings

1.1 The number of people who experience mental health effects one year after flooding is substantial

Poor mental health is already an important health problem in many communities and flooding is likely to exacerbate this. We identified that:

- the percentage of people with probable depression, anxiety or post-traumatic stress disorder (PTSD) was highest amongst people whose homes were flooded - the prevalence of probable depression amongst those whose homes were flooded was 20.1%, anxiety 28.3% and PTSD 36.2%
- the percentage of people with probable depression, anxiety or PTSD was also elevated amongst those whose lives were disrupted by the flood but who did not have floodwater in the liveable part of their homes, although not to the same extent - amongst those whose homes were not flooded but their lives were disrupted, the prevalence of probable depression was 9.6%, anxiety, 10.7% and PTSD 15.2%
- the odds of having these mental health issues was approximately 6 times higher in this group than in those who were unaffected by flooding (2)



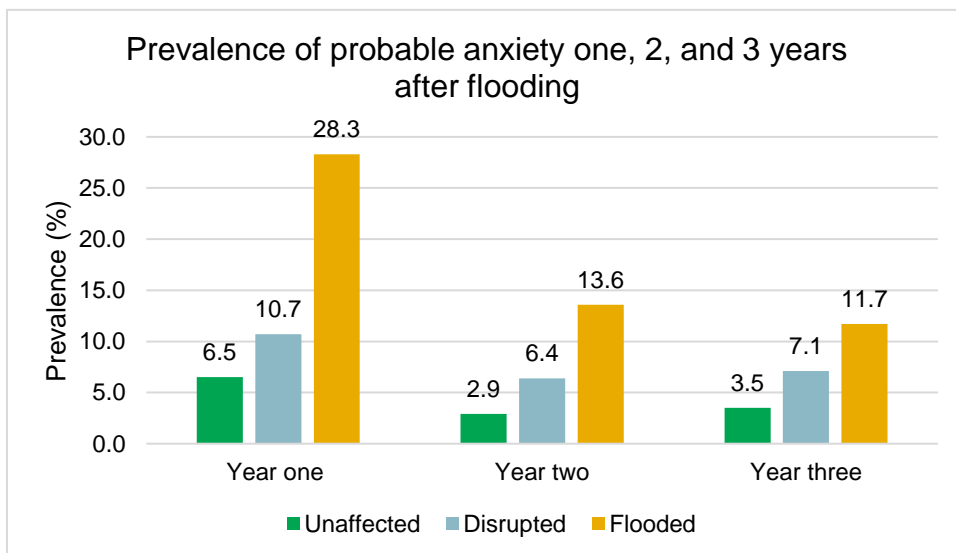
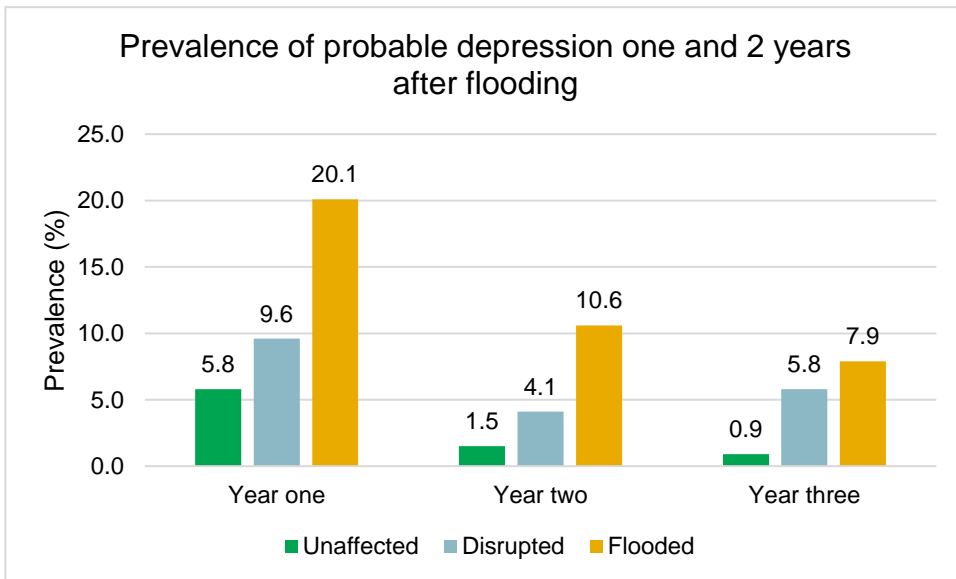
*Adjusted odds ratios are adjusted for age, sex, pre-existing illness, deprivation, local authority, ethnicity, marital, education and employment statuses. The reference group is participants unaffected by flooding.

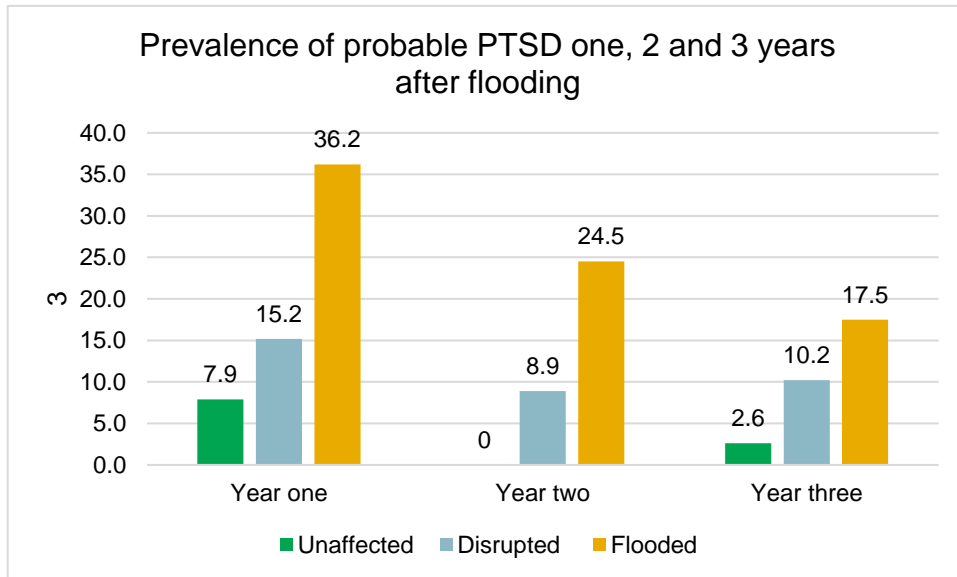
1.2 Flooding can have severe, long-lasting consequences on mental health in affected populations

These consequences can be prevented and mitigated but if action is not taken they may persist for at least 3 years. We observed that:

- the prevalence of probable psychological morbidity remained high among people whose homes were flooded 2 years after the event (depression 10.6%, anxiety 13.6%, PTSD 24.5%). (3)

- the overall prevalence of probable psychological morbidity reduced in the 12 months from one year to 2 years after flooding. A greater reduction in anxiety was seen compared to depression or PTSD
- exposure to disruption caused by flooding was no longer significantly associated with probable psychological morbidity 2 and 3 years after flooding
- 3 years after flooding psychological problems remained higher in the flooded group compared to the unaffected group, although a significant reduction in prevalence for all probable mental health outcomes was observed in the flooded group - overall, 5.7% had symptoms of probable depression, 8.1% of probable anxiety and 11.8% of probable PTSD





Factors associated with adverse health outcomes

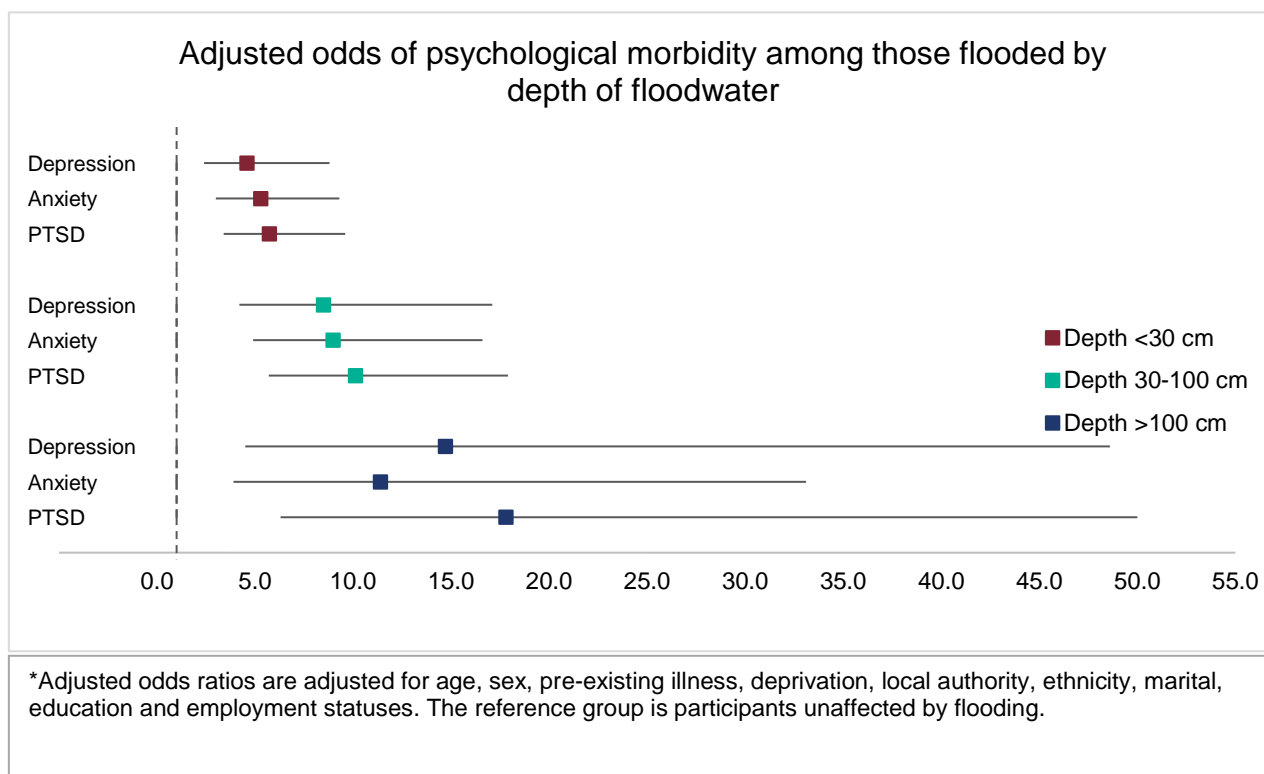
1.3 Greater depth and duration of flooding increases the risk of mental illness

One year after flooding, the odds of probable psychological morbidity amongst people whose homes were flooded was greater among those living in homes which had deeper floodwater. For instance, those who reported floodwater depth of >100cm had odds of probable depression which were approximately 15 times greater than people whose homes were unaffected. (2)

The risk of probable psychological morbidity was greater amongst those whose homes were flooded for over 24 hours compared to those whose homes were not. The risk did not increase further for those whose homes were flooded for periods beyond 7 days but remained around the same.

Fourteen per cent of people reported persistent flood related damage in their homes 2 years after flooding and these people had higher odds of mental health problems (3).

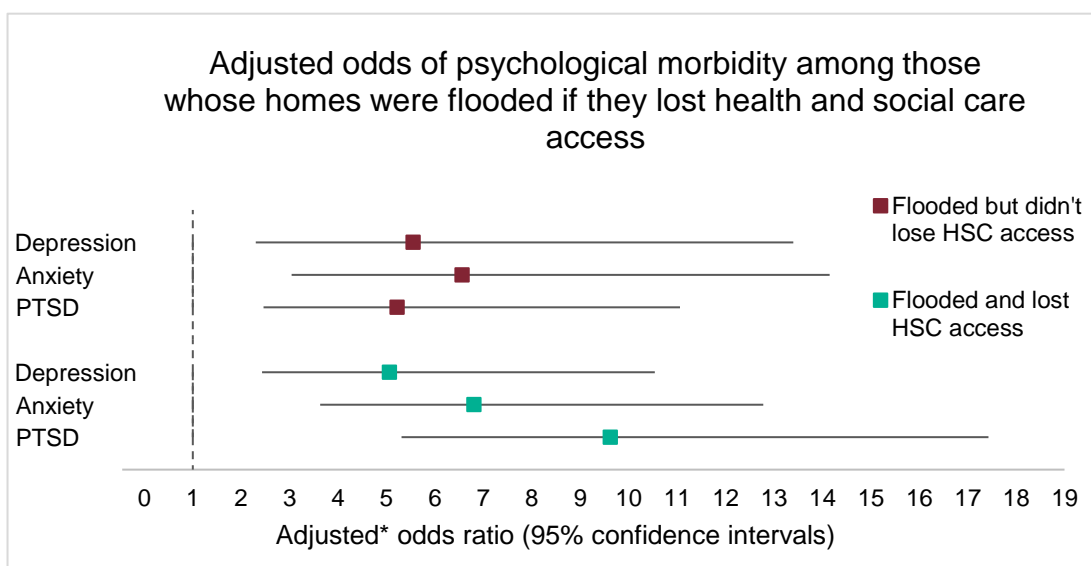
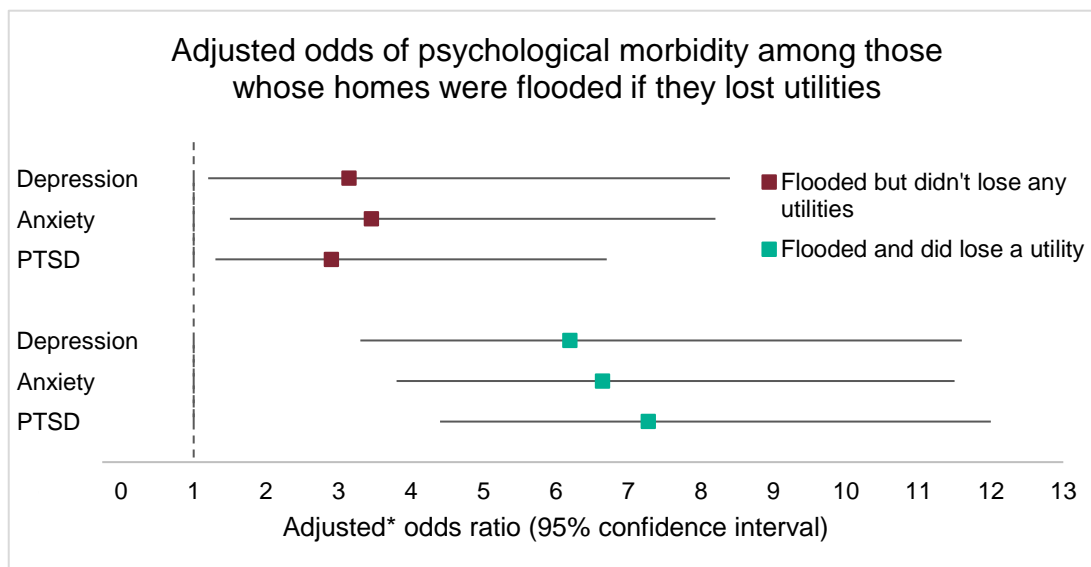
Three years after flooding, nearly 1 in 10 of participants reported experiencing persistent damage in the living areas of their home, most commonly damp and visible mould.



1.4 Loss of domestic utilities and difficulties accessing services increase the risk of mental illness

Amongst those whose homes were flooded, experiencing disruption to key domestic services further increased the risk of probable psychological morbidity in those who needed and usually accessed them. This was particularly true for losing a domestic utility (such as gas, electricity or water), access to health or social care services, or other activities (2).

Amongst those whose homes were not flooded, but whose lives were disrupted by the flood, losing access to health and social care services further increased the risk of probable depression and anxiety if such services were required. A similar, but smaller effect was seen for loss of access to work/education and other activities.



*Adjusted odds ratios are adjusted for age, sex, pre-existing illness, deprivation, local authority, ethnicity, marital, education and employment statuses. The reference group is participants unaffected by flooding.

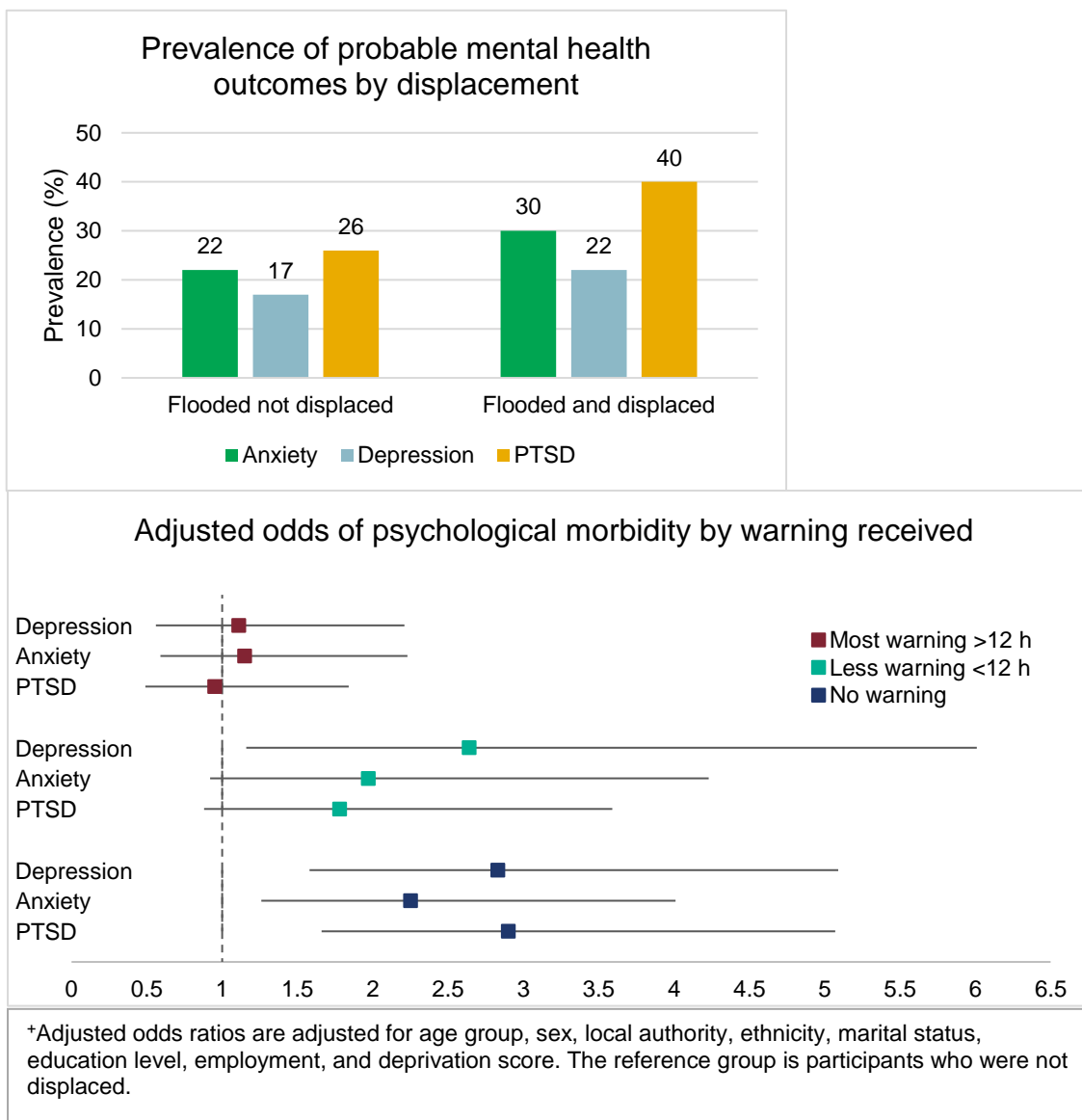
1.5 Evacuation and displacement, particularly without warning, increases the risk of probable anxiety and PTSD

Amongst those whose homes were flooded, evacuation (i.e. leaving home in advance of, or at the onset of flooding) further increased the risk of probable anxiety and PTSD (4). Amongst those whose homes were not flooded, evacuation did not increase the risk.

Among the displaced, those who reported receiving no warning before flooding and subsequent displacement from their home were significantly more likely to report symptoms of probable depression and PTSD but not anxiety.

Receiving a timely warning, at least 12 hours in advance of the flood, was the only factor associated with reducing the increase in probable psychological morbidity among people who were subsequently displaced from their home.

The mental health needs of displaced people may place an additional burden on primary care and mental health services outside of the directly affected area(s).

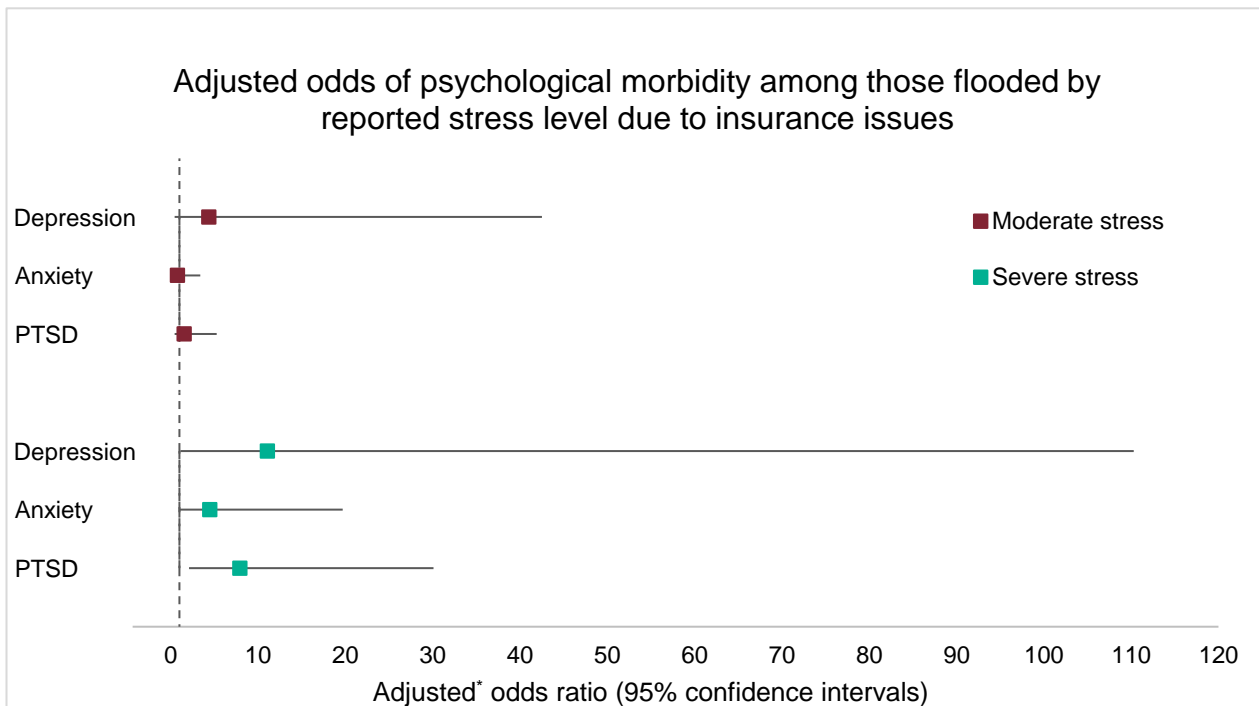
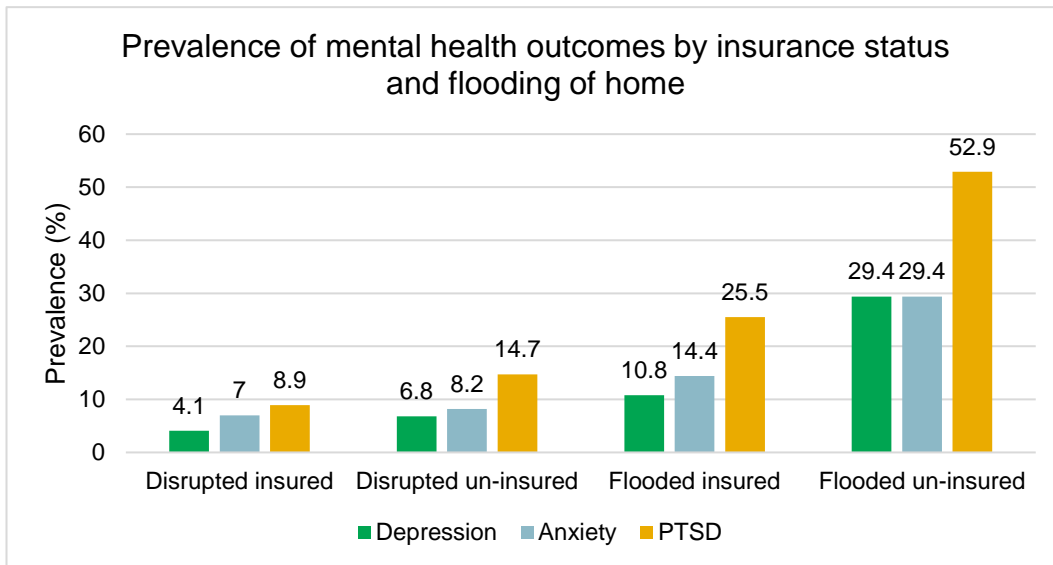


1.6 Insurance-related issues

Two years after floods, people whose homes were flooded and did not have household insurance at the time were significantly more likely to experience symptoms of probable depression, anxiety and PTSD than those who did have such insurance (5).

Those who were flooded and reported feeling stressed due to insurance-related issues arising from flooding had significantly higher odds of developing symptoms of probable

depression, anxiety and PTSD. This suggests that insurance-related factors could contribute to the psychological morbidity associated with flooding.



*Adjusted odds ratios are adjusted for age group, sex, ethnic group, pre-existing illness, deprivation score, and education. The reference group is participants who were flooded and experienced no or mild stress.

1.7 Other secondary stressors:

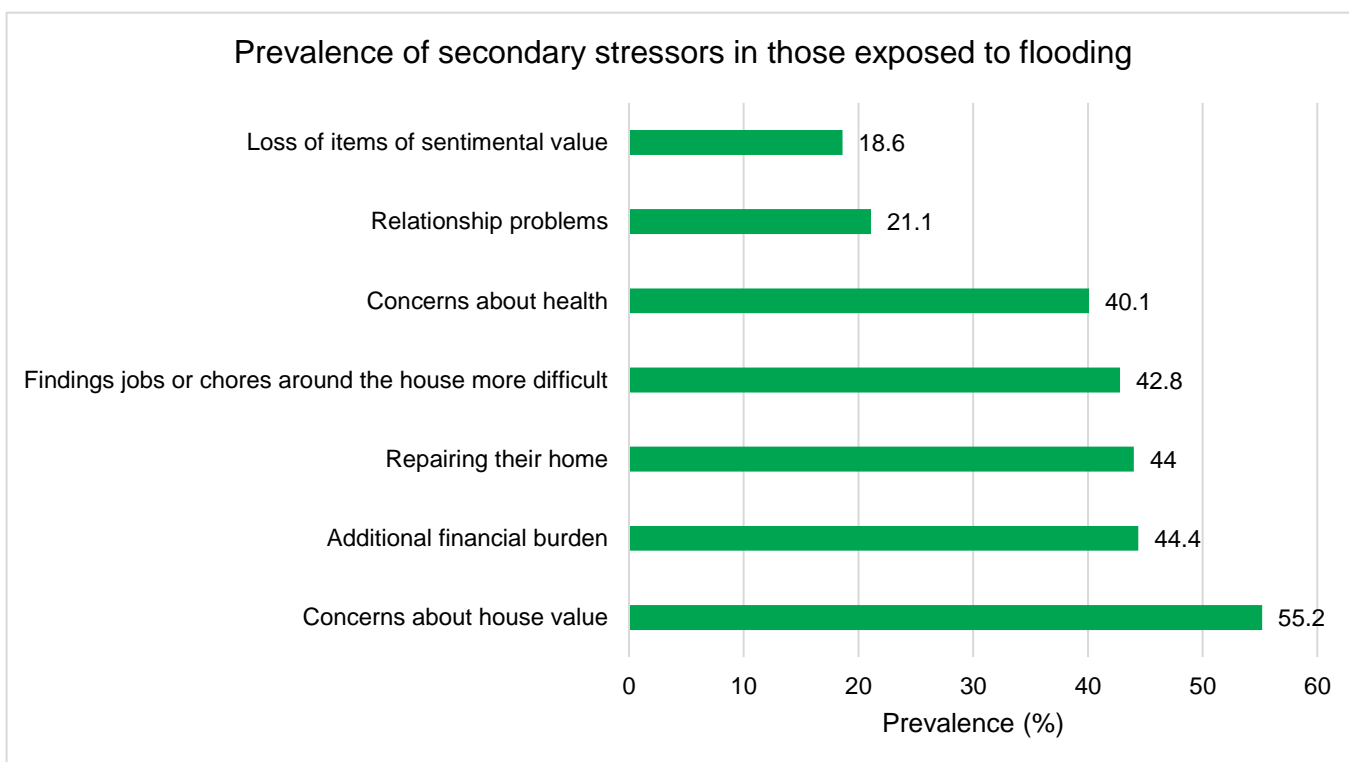
Secondary stressors are factors indirectly associated with flooding which may be amenable to action in order to reduce their public health impact. These include loss of personal items or financial losses, and difficulties with insurance and compensation (6).

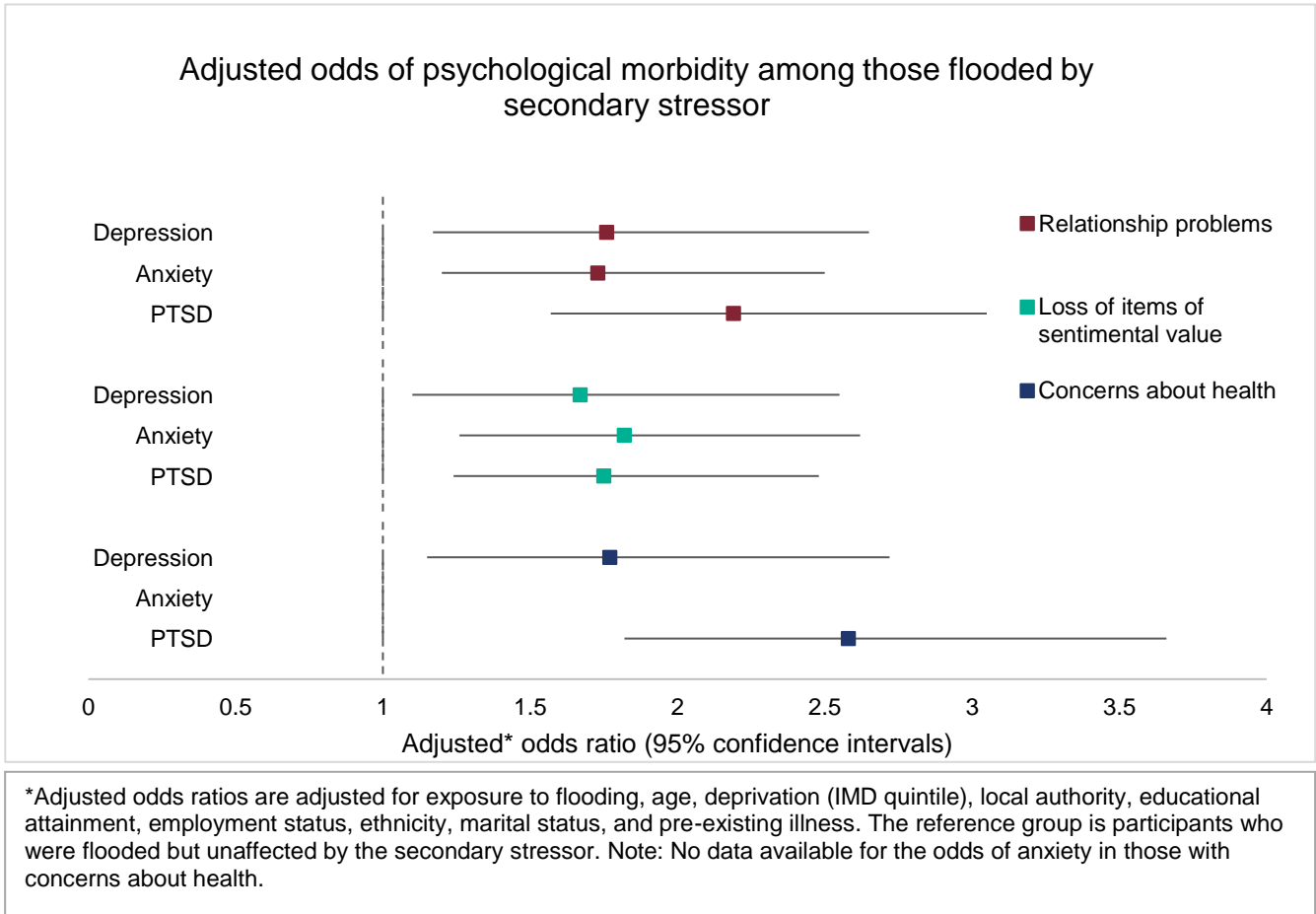
These 'secondary stressors' were associated with symptoms of probable depression, anxiety and PTSD in the aftermath of flooding.

The most frequently experienced secondary stressors were concerns about house value, additional financial burden resulting from exposure to flooding, home repairs and finding jobs or chores around the house more difficult.

The study identified 2 secondary stressors that should be the focus of preventative action in order to mitigate their effects in future flooding events. These were concerns about health and the loss of items of sentimental value.

Participants reporting concerns about their personal health and that of their family had greater odds of probable depression and PTSD.





1.8 Impact of repeated exposure to flooding events:

In some parts of the country, repeated exposure to flooding is common. In Cumbria, 54% of participants whose homes flooded during the 2015/16 floods had been flooded before. (7)

The prevalence of probable depression was increased among those who experienced repeat flooding (29.8%) compared with a single flooding event (16.3%), but this difference was not significant.

There was little evidence of a difference in the prevalence of probable anxiety and PTSD, or in health-related quality of life, between people who reported repeat flooding compared to those who had only been affected once (prevalence of anxiety: 22% for single and 22.8% for repeat flooded participants; prevalence of PTSD: 41.2% for single and 45.9% for repeat flooded participants).

This information needs to be interpreted with caution as the sample size in the Cumbria component of the study was small.

Health-related quality of life

It is important to consider the effect that flooding may have more broadly on people's lives and how they perceive their wellbeing is affected. For this purpose, this study also assessed health-related quality of life (HRQoL) using a tool that includes domains related to physical, mental, emotional and social functioning to understand the impact of health on people's ability to live a fulfilling life. We have also quantified HRQoL to help inform future economic evaluations of the impact of flooding which is an important consideration for commissioning decisions in flood prevention. The study showed that exposure to flooding and disruption from flooding significantly reduce HRQoL.

1.9 Health-related quality of life (HRQoL) changes year on year by exposure group

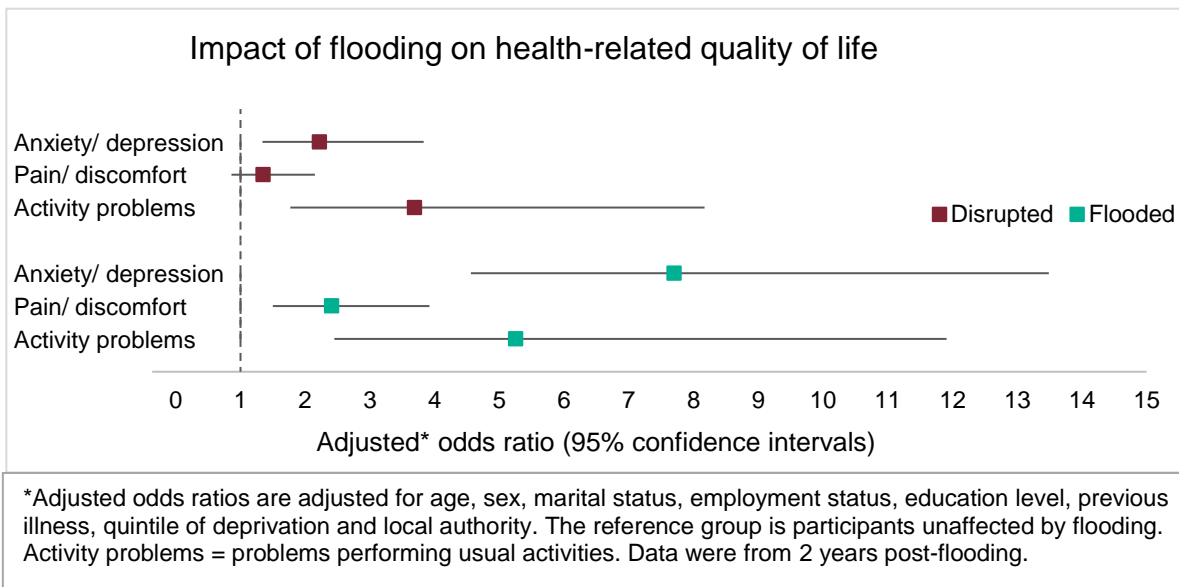
HRQoL was significantly reduced in people who were exposed to or disrupted by flooding; this effect was more pronounced in those whose homes were flooded compared with those who experienced other disruption. (8)

Flooding resulted in a significant reduction in overall HRQoL score 2 and 3 years post-flooding.

Independent associations were identified between exposure to flooding and experiencing increased anxiety/depression and pain/discomfort, which persisted for up to 3 years post-flooding.

Respondents reported problems performing usual activities following flooding. Exposure to flooding increased the odds of experiencing progressively severe problems with being able to engage in usual activities.

The prevalence of reported anxiety/depression in this study component is unsurprising, given the evidence already generated of the effect of flooding on probable psychological morbidity. The association between exposure to flooding and experiencing pain/discomfort may be more complex.



Implications of these findings

This study has identified that there is a large burden of psychological morbidity associated with flooding and that the impact of mental health in flooded populations persists for at least 3 years. The prolonged impact indicates a need for interventions and access to services beyond the immediate aftermath of flooding.

Another important finding of the study is that the adverse impact of flooding on mental health and wellbeing is not just restricted to those whose homes are flooded but also to those whose lives are significantly disrupted by flooding, therefore, it is important that commissioners and providers of services consider the wider needs of the population in areas affected by flooding.

Flooding is an important risk factor for poor mental health and, therefore, there is a need to design and evaluate interventions to prevent and minimise its impact on health.

Some relevant guidance is already available. For example, the levels of depression and PTSD amongst people whose homes were flooded were high and comparable to those among members of the public involved in major incidents. National Institute for Health and Care Excellence (NICE) guidance (reference) for the management of PTSD recommends that practitioners take opportunities for identification and management of PTSD in routine health care contacts.

The study has identified a number of factors associated with worse outcomes which can be used to inform the development of interventions. These include:

1. **Flood-related factors** such as depth and duration of flooding or persistent flood-related damage in the home such as mould. This suggests there are likely to be significant health gains from limiting ingress of water when a home is flooded and repairing homes as soon as possible. Those who had experienced loss of utilities as well as flooding had worse outcomes. Some of these factors may be useful indicators to identify those at greatest risk of mental health problems and provide information to target services to those with greatest need, but the study also showed that disruption to day to day life such as reduced access to health and social care services for those who normally access those services was associated with worse outcomes. Among those disrupted by flooding but without floodwater in the home, disruption to work and education was a more important predictor of psychological morbidity. There are likely to be benefits from identifying individuals who regularly use health and social care services and reinstating these vital services as soon as possible.
2. **Response-related factors**, particularly, displacement after flooding was associated with higher psychological morbidity. The amount of warning received showed evidence of being protective against mental health symptoms. Longer warning, for example through increased

use and awareness of early warning systems, may help reduce impact on mental health.

3. **Secondary stressors** such as financial difficulties, concerns about the health of members of the family or loss of personal items of sentimental value are indirect consequences of the event which in combination with direct factors such as flooding of the home were shown to have an impact on health. Preventative interventions to mitigate the impact of these secondary stressors, such as flood plans that include information from animal charities and rescue shelters about local arrangements for pets in the event of a flood, community initiatives to promote social cohesion and support after flooding, and advice about keeping sentimental items safe from floodwater, should be evaluated to determine if they reduce the burden of mental ill health associated with flooding.
4. **Insurance-related factors** including both not having household insurance or experiencing severe stress due to insurance issues result in increased incidence of mental health problems. Interventions to support communities through insurance processes are needed to help reduce probable mental health morbidity following a flood event. Services, including insurance providers, should ensure that they have appropriate measures in place to help navigate insurance processes.

Some of these factors are amenable to interventions in the aftermath of flooding but others have a more prolonged effect. The evidence generated by this study highlights the need for preventive interventions before flooding occurs, intervention during flooding incidents and for a sustained period after flooding. A combination of interventions is needed to minimise the impact of flooding on health. This combination should include interventions aimed at identifying those at highest risk and targeting them but also community-wide services or interventions.

The study has identified that there is an increased demand on services in populations affected by flooding for a prolonged period of time, at least up to 3 years after the event. People flooded or disrupted by flooding were more likely to seek help from formal sources such as their GP and also from voluntary and community services and from informal sources such as friends and family. This increase in help seeking was prolonged in line with the duration of psychological morbidity. Although we have observed an increase burden on services, it is also known that often people with mental health problems do not seek help or seek help from informal sources. It is likely, therefore, that there is a significant potential unrecognized burden of mental health after flooding within communities.

The study has also demonstrated that flooding and the mental health impacts that follow are not confined to particular social groups but that anyone can be affected. Further work is needed to understand whether the impacts are different depending on the population and type of flooding, and to understand the economic impact of the burden of ill health associated with flooding. Most importantly, there is a need to design and evaluate interventions to prevent and reduce the mental health impact associated with flooding.

Appendix

Data collection methods

The study was established to follow, over time, the impact of the winter 2013/14 floods on mental health outcomes of a sample of adults in the south of England. A further round of recruitment to the study was undertaken in Cumbria after floods in 2015. Data was collected approximately one, 2, and 3 years after the floods via questionnaire. Invitations to participate in the study were initially sent to a total of 8,761 addresses in postcodes in 6 local authority areas (Gloucestershire, Wiltshire and Surrey, Sedgemoor, South Somerset, and Tonbridge and Malling) where at least one house was known to have been flooded between 1 December 2013 and 31 March 2014.

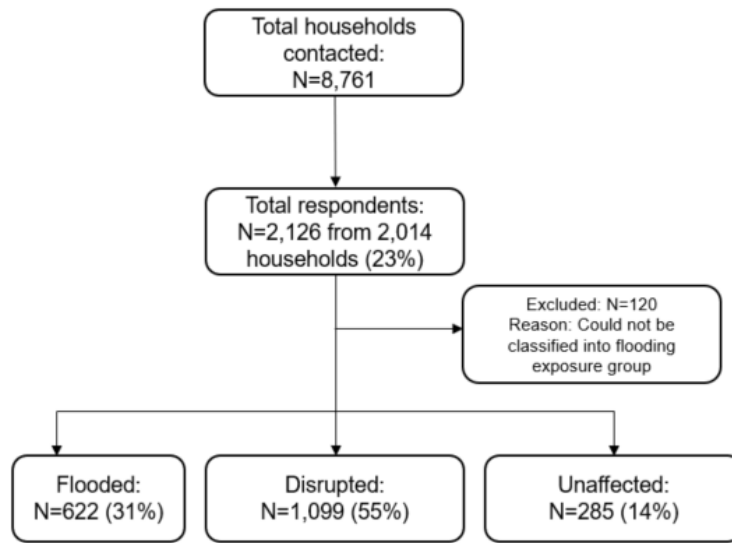
The questionnaire included questions on whether flood water entered the respondent's home, various types of disruption as a result of flooding, validated sets of questions to assess mental health outcomes (probable depression, anxiety and post-traumatic stress disorder (PTSD) symptoms), and some questions on sociodemographic information. Based on their responses, participants were allocated to one of 3 categories which were:

- flooded – reported floodwater in at least one of the liveable rooms of their home
- disrupted – reported no floodwater in liveable rooms of their home but reported at least one disruption including loss of utilities, loss of access to services, evacuation, or flooding of non-liveable parts of their home
- unaffected – reported no flooding or disruption to their lives from flooding in their area

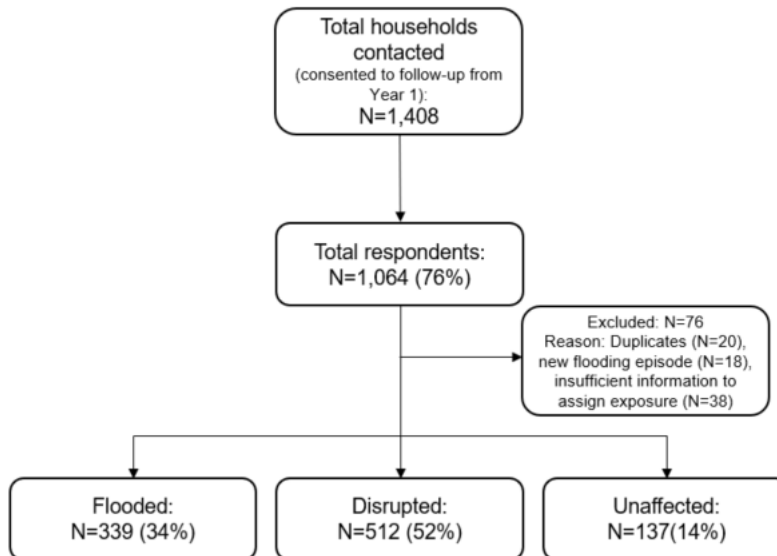
Descriptions of specific methodologies for each analysis have been described elsewhere (2-7).

Response to the study: South of England

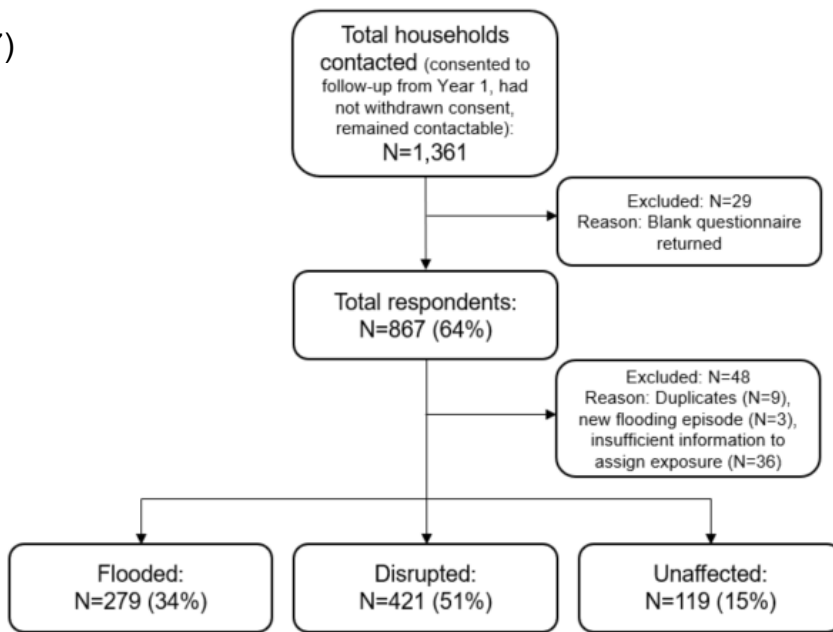
Year 1 (2015)



Year 2 (2016)

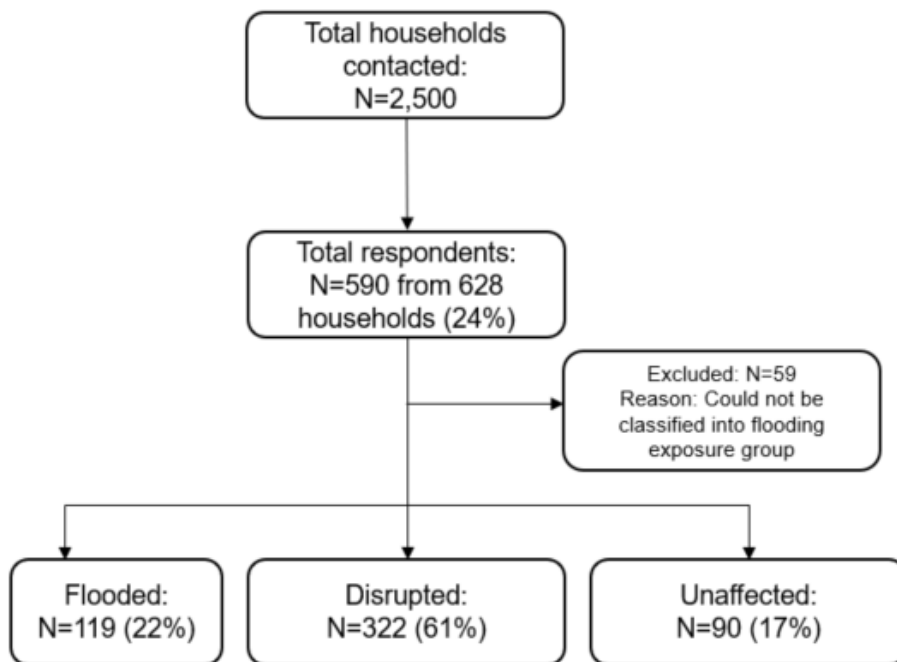


Year 3 (2017)



Response to the study: Cumbria

May 2015



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Accepted for publication

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