Developing a conceptual model of flood impacts upon human health

Date
February 2009

Report Number
T10-09-02

Revision Number
1_1_Pn10

Task Leader
Sue Tapsell
Partner FHRC/MU

FLOODsite is co-funded by the European Community
Sixth Framework Programme for European Research and Technological Development (2002-2006)
FLOODsite is an Integrated Project in the Global Change and Eco-systems Sub-Priority
Start date March 2004, duration 5 Years

Document Dissemination Level
PU Public
PP Restricted to other programme participants (including the Commission Services)
RE Restricted to a group specified by the consortium (including the Commission Services)
CO Confidential, only for members of the consortium (including the Commission Services)

Co-ordinator: HR Wallingford, UK
Project Contract No: GOCE-CT-2004-505420
Project website: www.floodsite.net
ACKNOWLEDGEMENT

The work described in this publication was supported by the European Community’s Sixth Framework Programme through the grant to the budget of the Integrated Project FLOODsite, Contract GOCE-CT-2004-505420.

DISCLAIMER

This document reflects only the authors’ views and not those of the European Community. This work may rely on data from sources external to the members of the FLOODsite project Consortium. Members of the Consortium do not accept liability for loss or damage suffered by any third party as a result of errors or inaccuracies in such data. The information in this document is provided “as is” and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and neither the European Community nor any member of the FLOODsite Consortium is liable for any use that may be made of the information.

RELATED DOCUMENTS


© Members of the FLOODsite Consortium
SUMMARY

During the twentieth century the frequency of major floods has increased substantially. The different types of floods may lead to a wide range of health outcomes that are context and event specific. Floods can have both direct and indirect impacts upon those affected by them, and in recent years there has been an increased recognition of the human health impacts related to flood events.

The risk to people’s health from being flooded depends upon a complex range of factors including e.g. prior health status, age, gender, socio-economic grouping, cultural background, levels of social capital, extent of flood damage, institutional response and factors affecting the recovery process. This research set out to examine the health impacts related to flooding across Europe and to develop a conceptual model that will provide insights into the factors influencing the impacts of floods on people’s health and well-being. The original objectives of Task 10 relating to the human health impacts of flooding were to:

- develop a model that will provide insight into the factors influencing the impacts of floods on people’s health and well-being, based on existing research and data, and
- where data is available, to quantify the health impacts of flooding and factors contributing to adverse health effects.

Following a review of the literature on the various impacts of floods upon human physical and psychological health and a discussion on the availability of data on floods and health, the report goes on to discuss some of the key factors that may influence, intervene in, or mitigate, human health impacts. Various impact assessment methodologies are outlined with a view to assessing the possibility of using such methods to determine potential health impacts in specific populations. A short case study is given of one research project which attempted to quantify the health impacts of flooding in the UK. This is then followed by a brief outline of several conceptual models which have been developed to explain the impacts of floods upon human health.

Finally, the research puts forward a further Health Impacts of Floods Model which builds upon existing models to conceptualise the various impacts, along with the factors which may contribute to, intervene or mitigate these impacts. The focus is not to derive quantitative or aggregate measures of risk (as the literature shows this to be extremely difficult and problematic) but to understand how and why the health impacts of hazards vary between locations, groups and individuals in society, and what shapes the ability of people and institutions to respond and cope. The model is meant to be used as an organisational framework for analysis and further research.

The model can be used by those with a responsibility to provide health services in flood risk areas, by emergency planners and responders, flood risk managers and other responsible authorities in order to reduce exposure to floods, to reduce vulnerability to their impacts and to increase future resilience and capacity building. The Model, particularly if refined, may be a simple and practical tool for health impacts appraisal as well as to aid in future planning. The report ends with some conclusions and recommendations for refining the Model and for future research.
# CONTENTS

Document Information ........................................................................................................... ii
Document History .................................................................................................................. ii
Acknowledgement ................................................................................................................ ii
Disclaimer .............................................................................................................................. ii
Summary ................................................................................................................................ iii
Contents .................................................................................................................................. v

1. Introduction to human health and floods ......................................................................... 8
   1.1 Aims and approach ........................................................................................................... 9
   1.2 Structure of the report ..................................................................................................... 9

2. The health effects of flooding: a review of the literature .................................................. 10
   2.1 Types of flood events .................................................................................................... 10
   2.2 Availability of data on floods and human health ......................................................... 12
   2.3 Physical health impacts ................................................................................................. 13
       2.3.1 Overview .................................................................................................................. 13
       2.3.2 Risk to life ............................................................................................................... 14
       2.3.3 Injuries .................................................................................................................... 14
       2.3.4 Risk to public health .............................................................................................. 15
       2.3.5 Nutrition ................................................................................................................ 18
       2.3.6 Displacement .......................................................................................................... 19
       2.3.7 Neighbourhood or community-level impacts ......................................................... 20
   2.4 Psychological health and disasters ................................................................................ 21
       2.4.1 Evidence from the UK ............................................................................................ 23
       2.4.2 Post Traumatic Stress and Common Mental Disorders ......................................... 24
       2.4.3 Identity and the sense of ‘self’ and ‘place’ ............................................................... 26
   2.5 The time-scale of health impacts following disasters .................................................. 26

3. Factors that influence or modify the impact of floods on health ....................................... 29
   3.1 Social vulnerability and flooding ................................................................................... 29
       3.1.1 Social vulnerability indicators ................................................................................. 31
       3.1.2 Problems with the use of social indicators ............................................................. 32
   3.2 Gender .......................................................................................................................... 34
   3.3 Family factors ............................................................................................................... 35
   3.4 Age .................................................................................................................................. 36
   3.5 Children ......................................................................................................................... 36
   3.6 Culture and ethnicity .................................................................................................... 37
   3.7 Social support ............................................................................................................... 37
   3.8 Psychological debriefing ............................................................................................... 40
   3.9 Psychological resources and ways of coping following disasters ................................ 41
   3.10 Preparedness and awareness ...................................................................................... 43
   3.11 Disaster management and mitigation .......................................................................... 45

4. Impact assessment methodologies ..................................................................................... 48
   4.1 Social Flood Vulnerability Index ................................................................................... 48
   4.2 Social and Environmental Impact Assessments ............................................................ 48
   4.3 Environmental Health Impact Assessment .................................................................... 49
   4.4 Health Impact Assessment ............................................................................................ 49
       4.4.1 Further research on HIA ........................................................................................ 51
       4.4.2 Validity, reliability and standardisation in HIA ....................................................... 52
5. A case study in quantifying the health impacts of floods ........................................53
   5.1 Results from the health check lists ..............................................................53
   5.2 GHQ-12 results .........................................................................................55
   5.3 PTSS results ..............................................................................................56
   5.4 Subjective severity of flood impacts .........................................................57

6. Existing conceptual models to explain the health impacts of flooding .............60
7. A new Health Impacts of Floods Model ..........................................................67
8. Conclusions and recommendations ................................................................69
9. References ......................................................................................................71

Tables
Table 2.1: Causes of flood events ........................................................................11
Table 2.2: Reported public health effects from flooding (largely from epidemiological lit­erature reported in Few et al., 2004) .................................................................17
Table 2.3: Normal and longer-lasting stress reactions to experiencing disasters ....22
Table 3.1: Indicators for assessing social vulnerability to floods .........................32
Table 5.1: Self-reported health effects of flooding: flooded sample .....................54
Table 5.2: Psychological health effects reported in the weeks or months after flood, by gender ....................................................................................................55
Table 5.3: Results from GHQ-12 for current health in the last few weeks ..........56
Table 5.4: Significance of key factors identified in multivariate regression analysis as influencing health measures used in the study (in order of decreasing statistical significance) ..........................................................57

Figures
Figure 2.1: Global flood events 1985 to 2004 ((Source: NASA-supported Dartmouth Flood Observatory, cf Few et al., 2004: 9)) ........................................10
Figure 2.2: Categorisation of flood damages .......................................................11
Figure 2.3: Mean scores on stress of the flood event and overall severity of the flood by Evacuation .....................................................................................20
Figure 3.1: Mean scores for overall severity of flood event by gender and age ....34
Figure 4.1: EHIA ten step approach (Fehr, 1999: 619) ........................................50
Figure 5.1: Conceptual model of factors affecting vulnerability and resilience to flooding. Source: Tunstall et al., 2007 ......................................................59
Figure 6.1: Causal model of relationships between impacts and judged overall severity of flooding. Source: Green 1988 .........................................................61
Figure 6.2: Conceptual model of relationships between impacts of flooding and effects on health. Source Tapsell et al., 1999 ........................................63
Figure 6.3: Few and Matties Flood Hazards & Health model .........................64
Figure 6.4: The Health Impact Pathways Model (Few, 2007: 289) ......................65
Figure 6.5: Framework for analysing social-psychological dimensions of flood risk management (Source: Tapsell, 2009 forthcoming) .....................66
1. Introduction to human health and floods

Flood events, like other natural disasters, can have varying and significant impacts upon those who are exposed to them, as well as those who have to respond to such events. Recent predictions suggest that the extent of flooding is expected to increase over the next 50 to 100 years owing to the effects of climate change and global warming (IPCC, 2007). Moreover, research has suggested that these effects may be even more extreme than previously estimated, in particular with regard to potential increases in rainfall volume and intensity and risk of extreme sea level rise (Evans et al., 2008). Added to this is the increased risk from intense pluvial flooding in urban areas where the capacity of drainage systems may be insufficient to deal with the volumes involved. In 2007 alone there were 200 major floods worldwide, resulting in more than 8,000 deaths and affecting 180 million people (Pitt, 2008: 15).

Floodplains are among the most densely populated areas in the world, being particularly well suited for development (Kron, 2002). Moreover, environmental changes are taking place against a backdrop of wider societal changes that may alter the likelihood of human exposure to hazards as well as people’s susceptibility to their impacts (Few, 2007).

In relation to flood hazard, until recently, flood defence policy was dominated by a technical world view. Much flood defence has been aimed at stopping or alleviating damage occurring through structural means (i.e. defence schemes). In addition, the response to hazards has been a “command and control” mentality that focused on clean-up and the rescue of survivors. As the risks of flooding increase no protection work can provide one hundred percent security. This has resulted in the recent shift in policy terms from flood defence to flood risk management (e.g. Defra, 2005). The more intangible aspects of flooding were largely ignored in policy terms, as impact analysis tended to focus on economic and financial damages and losses, as these losses are better understood and more easily measured and valued. However, the social aspects of flood risk management have gained in importance in recent years (Mileti, 1999). There is now growing concern regarding the longer-term impacts of climate change, including flooding, on human health (IPCC, 2007; WHO, 2002). In the last few years there has been a growing awareness of the significance of the social impacts that flooding may have on those affected; that floods are also about people. Along with the risk to life, floods have the potential to impact upon human physical and psychological health and well-being.

Recent years have seen an increased recognition of the health impacts of flooding. Dramatic media images of flood events from across the globe, such as the Mozambique floods (2000), the Central European floods (2002), the Asian Tsunami (2004), Hurricane Katrina (2005), the summer floods in England and Wales (2007), and the Indian floods (2008), have highlighted the human impacts of such events. Coastal flooding in particular has the potential to pose even greater risk to life than river flooding (Baxter et al., 2001). Until recently, little research has been conducted on the health impacts of flooding. Recent studies in Europe have concluded that flooding can have significant effects upon people’s physical and, more significantly, mental health but that more quantitative data is necessary to understand these impacts in order for appropriate mechanisms to be put in place to minimise the impacts and provide adequate response (Hajat et al. 2005; RPA/FHRC 2004; Hajat et al. 2003; Reacher et al. 2004; Tapsell et al. 2002; Ohl and Tapsell, 2001; Tapsell and Tunstall, 2000). These health impacts can be short-term or long-lasting depending upon flood characteristics, individuals’ personal characteristics and circumstances, and institutional response. In particular, certain groups within populations may be more vulnerable to these impacts and may need greater support to prepare for and recover from flooding. A better understanding of the effects of floods on human health is therefore needed to aid flood risk managers, health service providers and other responsible agencies in seeking more effective intervention strategies and other measures to prevent or mitigate these impacts, to promote speedier recovery and to develop strategies to increase resilience and capacity to cope with future flooding.
1.1 Aims and approach
The overall objective of Task 10 of the FLOODsite project is to focus research efforts on innovative methods to understand, model and evaluate flood damage. Activity 1, of which this research forms a part, aimed to develop a methodology for assessing risk to life in European flood events (see Project Document T10-07-10, Priest et al., 2007). Flood risk to people is highly dependent on flood hazard characteristics such as depth, duration and velocity or load (including pollutants). These characteristics vary according to several ‘place’ or ‘area’ characteristics or factors such as geomorphology, hydrogeology, warning time, the type of flooding etc. Furthermore, the risk to people’s health from being flooded depends upon prior health conditions, extent of flood damage, institutional response and factors affecting the recovery process. The risk to health and well-being will also vary according to factors such as people’s age, gender, socio-economic grouping, cultural background and levels of social capital. This research therefore sets out to examine the health impacts related to flooding across Europe and to develop a conceptual model that will provide insight into the factors influencing the impacts of floods on people’s health and well-being.

The original objectives of Task 10 (Activity 1) relating to the human health impacts of flooding were to:

- develop a model that will provide insight into the factors influencing the impacts of floods on people’s health and well-being, based on existing research and data, and
- where data is available, to quantify the health impacts of flooding and factors contributing to adverse health effects.

The World Health Organization defines good health as ‘a state of complete physical, mental and social well-being, not merely the absence of disease and infirmity’ (WHO, 1948). However, obtaining sufficient data to quantify a health effects model would be complex and would require extensive, lengthy and expensive fieldwork, which should include longitudinal data. Due to resource limitations it has only therefore been possible to develop a conceptual model which is based upon an extensive review of relevant literature and existing data. The Health Impacts of Floods Model can be used by flood risk managers and other responsible authorities to improve flood risk management and response in order to avoid or mitigate the negative impacts upon human health,

1.2 Structure of the report
The report begins with a review of the literature on the various impacts of floods upon human physical and psychological health. It briefly discusses the availability of data on floods and health and then goes on to discuss some of the key factors that may influence, intervene in, or mitigate, these health impacts. Various impact assessment methodologies are outlined with a view to assessing the possibility of using such methods to determine potential health impacts in specific populations. A short case study is given of one research project which attempted to quantify the health impacts of flooding in the UK. This is then followed by brief outlines of several conceptual models which have been developed to explain the impacts of floods upon human health, including the new Health Impacts of Floods Model developed for this research. The report ends with some conclusions and recommendations for future research.
2. The health effects of flooding: a review of the literature

2.1 Types of flood events

During the twentieth century the frequency of major floods has increased substantially (Milly et al., 2002). Figure 2.1 illustrates the extent of different types of flood events at a global scale. The health impacts discussed in this report can largely be related to three broad categories of flood events: ‘slow onset’ river flooding usually resulting from persistent or heavy rainfall; ‘flash floods’ more frequently experienced during or after brief torrential rain; and ‘coastal’ flooding often resulting from sea surges or tropical storms. In addition these events often include flooding from overwhelmed sewerage systems (Table 2.1). The different types of events may lead to a wide range of health outcomes that are context and event specific.

Figure 2.1: Global flood events 1985 to 2004 ((Source: NASA-supported Dartmouth Flood Observatory, cf Few et al., 2004: 9)
Table 2.1: Causes of flood events

<table>
<thead>
<tr>
<th>Cause</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Rainfall</td>
<td>Slow-onset riverine or fluvial flood</td>
</tr>
<tr>
<td></td>
<td>Flash flood (rapid onset) – pluvial flood</td>
</tr>
<tr>
<td></td>
<td>Sewer/urban drains – pluvial and/or fluvial flood</td>
</tr>
<tr>
<td>Thawing of Ice</td>
<td>Glacial melt</td>
</tr>
<tr>
<td></td>
<td>Snow melt</td>
</tr>
<tr>
<td>Dam failure</td>
<td>Dam-break flood</td>
</tr>
<tr>
<td></td>
<td>Dam-overtopping</td>
</tr>
<tr>
<td>Coastal/Tidal wave extremes</td>
<td>Storm surge</td>
</tr>
<tr>
<td></td>
<td>Tsunami</td>
</tr>
</tbody>
</table>

Source: Adapted from Parker (2000)

Floods can have both direct and indirect impacts upon communities affected by them. Figure 2.2 illustrates the different direct and indirect categorizations of flood damages, including the more intangible human health impacts.

Figure 2.2: Categorisation of flood damages
2.2 Availability of data on floods and human health

There is now a growing body of international literature on the subject of health and natural disasters (e.g. Ticehurst et al. (1996) on earthquakes; Turner et al. (1995) on fires; Juratowitch et al. (2002) on floods). Yet to date there has been relatively little scientific research tracing the health outcomes of flood hazards, and little social science research on how vulnerable populations and health care systems respond and adapt to the health risks (Few, 2003). Hajat et al. (2003), in reviewing the literature on the human health consequences of flooding in Europe, state that despite floods being the most common natural disaster in the region, the associated health risks are poorly characterised. The effects of weather disasters such as floods on health are difficult to quantify because secondary and delayed consequences are poorly reported (WHO, 2003a). This obviously poses a problem when trying to develop a model to assess health impacts.

There is thus presently a weak evidence-base to assess the health impacts of flooding, particularly that of urban flooding. Relatively few rigorous epidemiological studies have been undertaken and it is extremely difficult to assess the duration of symptoms and disease, as well as the attribution of cause, without longitudinal data. Recent publications focusing on health outcomes, and specifically with regard to adaptation to climate change, include Kirch et al., 2005; Few and Matties (2006), Menne and Ebi (2006) and the European-funded project Climate Change and Adaptation Strategies for Human Health (cCASHh) (EVK2-2000-00070). Probably the most comprehensive global assessment to date of the health risks from flooding was that reported in Few and Matties (2006). The research presented findings from a wide-ranging review of global literature on health impacts, adaptation processes and policies relating to flood risk. The study included a substantial review of the epidemiological evidence base for health outcomes of flooding and a review of literature analysing mechanisms of response to health risks from floods. Interested readers should consult this publication for a more in-depth discussion than is provided here.

The health impacts from flooding do not easily lend themselves to controlled epidemiological studies and much health information is derived from retrospective reports (Fewtrell and Kay, 2008). It is generally not possible to obtain accurate information on disease incidence or prevalence before a flood and it is likely that detection may increase after the flood because of enhanced surveillance activities which may bias the estimates. Moreover, there are limited data on the duration of most flood-related health impacts. Routine surveillance data can be useful in determining episodes of infectious disease before and after flood events, although this is at best a crude tool that under-records actual incidence of more minor illness. But surveillance only captures a small proportion of actual illness, as not everyone will seek medical advice and where people do the connection with a flooding event may not be made. Moreover, these studies can be very resource and time intensive.

Mortality statistics only are generally available for flood disasters, and again datasets may be subject to bias. Many studies also suffer from methodological shortcomings (see Few and Matties, 2006 for a discussion). In developing countries accurate information on the mortality impact of flood events is particularly limited. Data that is available shows that by far the greatest global burden on mortality from floods is in Asia. The speed of onset of floodwaters is a key factor determining the number of immediate flood-related deaths; few deaths from drowning occur during slow rising floods. Generally, there is very weak data available on non-drowning (non-immediate) deaths that can be attributed to a flood event (Few and Matties, 2006).

The knowledge gap on health outcomes relates in part to a need to improve monitoring and surveillance. This includes strengthening general surveillance systems for infectious diseases, and developing and enhancing specific surveillance following flood events. There is a need for control groups for comparison with non-flooded populations, use of longitudinal data or routine data in order to gain information on pre-flood levels of disease, and use of objective measures of disease outcome (Few and Matties, 2006).

Health outcomes of floods can thus be seen as the culmination of a series of events whereby a flood hazard leads to mortality and morbidity effects in humans exposed to the hazard. Interventions can be
made at various points along this process, including structural and non-structural mechanisms of flood risk management. Efforts to tackle the health risks from flooding include both measures that reduce vulnerability to health impacts and measures to strengthen coping capacity and resilience in the face of threats to health. The different physical and psychological health impacts will now be discussed below in more detail.

2.3 Physical health impacts

2.3.1 Overview

Floods can have different kinds of impacts upon human health and wellbeing. For example effects might include: direct health impacts (death from drowning and major injuries, minor injuries, and diseases); indirect health impacts (population displacement, damaged property and infrastructure, contaminated water supplies, loss of crops/food), and mental health impacts (psychological and behavioural disorders, alcoholism) (Ramsbottom et al., 2005; Few et al., 2004; RPA, FHRC et al., 2004; IPCC, 2001). Although evidence suggests that the health impacts are similar irrespective of the type of flooding, the levels of health impact may well vary. For example, gastrointestinal effects are likely to be greater as a result of flooding of an urban river with a waste-water treatment works input above the flooding point, compared with flooding caused by run-off from a more microbiologically pristine area.

The greatest burden of mortality from flooding is from drowning, heart attacks, hypothermia, trauma and vehicle-related accidents (Few et al., 2004; Jonkman and Kelman, 2005). For some people, the shock of seeing their home flooded can also be significant (Tunstall et al., 2006). Although providing clear cause-effect pathways from hazard to health outcomes raises major methodological difficulties, as highlighted in the above Section), a number of studies suggest that there is a strong epidemiological link. Bennet’s study of the 1968 Bristol, UK, floods (Bennet, 1970), which demonstrated significant effects on morbidity and mortality, was the first population-based epidemiological study on the impacts of flooding. Research carried out by UK social scientists in the 1980s and 1990s further highlighted the seriousness of the so-called ‘intangible’ impacts of flooding such as on people’s health and well-being (Parker et al., 1983; Green et al., 1985; Green, 1988; Tunstall and Bossman-Aggrey, 1988; Green et al., 1994) and concluded that these impacts can often assume more significance to those affected than financial losses.

Schnurr (2001) summarises recent literature on the relationship between exposure to traumatic stressors, such as floods, and a variety of physical health outcomes. Studies have shown that individuals who have been exposed to a traumatic stressor may have serious and long-term physical health outcomes, including poor self-reported health status, more self-reported medical problems, and greater service utilisation, morbidity and mortality relative to individuals who have not been exposed. Empirical evidence reviewed by Hovanitz (1993) supports that stress is a cause of the link between disaster and impaired physical health, and that victims of natural disasters report longer illnesses and poorer health. Health outcomes include heart and lung disease, diabetes, gastrointestinal disorders, chronic pain, and poor health-related quality of life. Some findings show greater all-cause mortality attributable to an excess of accidental deaths among trauma survivors (Watanabe and Kang, 1995) while other findings show an increase during the period immediately after a disaster (Leor et al., 1996). Pre-existing health conditions also appear to lead to increased susceptibility to health problems among some people who have experienced flooding, particularly the very elderly. Along with a number of anecdotal accounts of elderly people dying following flooding (e.g. Tapsell et al., 1999; Tapsell and Tunstall, 2001), there is some quantitative evidence that death can be hastened by the experience of flooding, rather than somehow being caused by it (Bennet, 1970).

A study of flood hazards in Manila, the Philippines, suggests that floods expose people to respiratory infections, skin allergies and gastro-intestinal illnesses, with children the most at risk (Zoleta-Nantes, 2000). Similar physical health effects have been reported in a study following the autumn 2000
flooding in Lewes, England, the main effects being: skin rashes, earache, gastroenteritis and injuries (WHO, 2002; Reacher et al., 2004). Inui et al. (1998) examined diabetic patients in Kobe, Japan, before and after an earthquake. Compared with control patients in Osaka who had not experienced the earthquake, the Kobe patients showed increases in haemoglobin A1c, indicating worsened metabolic control (Few et al., 2004). These and other health problems were also reported in two qualitative studies in England following flooding in 1998 and 2000 (Tapsell et al., 1999; Tapsell and Tunstall, 2001).

Further health impacts can result from disruption of normal health care provision and social programmes (Ohl and Tapsell, 2001; Meusel and Kitch, 2005). Following Hurricane Katrina reported health needs included dentistry and hearing care (Mosca et al., 2007; Hogan, 2006), and it has been estimated that some diabetics went as long as six months without insulin (Berggren and Curiel, 2006). Clear and consistent advice is necessary on both physical and mental health risks and needs to be widely available in flood risk areas (Health Protection Agency pers. comm., 2008).

2.3.2 Risk to life

In Europe and other parts of the developed world, few people die as a result of flooding thanks to increasingly sophisticated methods of flood forecasting and warning systems and improved preparedness planning. Although not discussed in detail in this report, recent floods in Europe have resulted in a number of fatalities. For example, in August 2005 at least 50 people died, 33 of them in Romania, due to flooding caused by heavy rains in Austria, Bulgaria, Germany, Romania, and Switzerland (www.em-dat.net1). Although not as widespread in nature, flooding also affected parts of Europe in 2006 with a reported 47 fatalities in Romania between April and July (www.em-dat.net1). Europe suffered eight major floods from January to July 2002 that killed 93 people and affected 336,000. The August 2002 floods in Central Europe caused more than 100 fatalities in Austria, the Czech Republic, Germany, Hungary and the Russian Federation (WHO-Europe, 2002a). The 1997 Oder floods were the largest floods on record in Poland (Kundzewicz et al., 1999) and caused 50 deaths (Kundzewicz and Kundzewicz, 2005). Examinations of media reports suggest the summer 2007 flooding in England and Wales caused 13 deaths (both directly and indirectly), as two separate periods of flooding in June and July affected large areas (see FLOODsite Project Document T10-07-10, Priest et al. (2007) for an in-depth discussion on risk to life from flood events).

2.3.3 Injuries

Common health effects from floods can also result from minor injuries (Schmidt et al., 1993; Manuel, 2006). However, surprisingly little information is available on injuries due to floods. In many cases such injuries are not routinely reported in most countries, and where they are reported they often cannot be identified as flood related. Such injuries can include: cuts, abrasions, contusions, sprains, skin irritations and burns. Injuries may occur during all phases of flooding i.e. before (pre-onset), during (onset) and after (post-onset) the event. In the pre-onset and onset phase injuries may be incurred by people attempting to remove themselves, their family, pets or valued possessions from the approaching floodwaters. More serious injuries can include fractures and punctures, and are a particular risk when there are large heavy objects such as cars or trees moving within fast-flowing floodwaters. There is also potential for injuries in the post-onset phase when people return to their homes and businesses. During the clean-up phase particular care needs to be taken with unstable buildings (a cause of death in many floods in parts of Europe – see Priest et al., 2007), electrical power cables, chemical spills, and carbon monoxide poisoning e.g. from faulty generators used to pump out or dry buildings.

In their review of weather-related disasters in the USA, French et al (1983) reviewed 34 reports of flash floods covering the period 1969-81 and only three of these provided information on injuries. At a

1 In order for an event to be recorded into the database, at least one of the following criteria must be fulfilled: 10 or more people killed, 100 or more people affected/injured/homeless, significant disaster, e.g. ‘worst disaster in the decade’, significant damage, e.g. ‘most costly disaster’. Source: www.em-dat.net Data Accessed 22/01/07
global scale the majority (93%) of flood-injuries occur in Asia. The injury to death ratio is much smaller than that seen for wind storms. In general, floods with a slow onset are less likely to produce injuries (Siddique et al., 1991). In a community survey of 108-181 households following the 1988 floods in Nimes, France, 6% of households surveyed reported mild injuries (contusions, cuts, and sprains) related to the flood (Duclos et al., 1991). After the Midwest floods of 1993 in Missouri, 524 flood-related conditions were reported, and of these 250 (48%) were injuries, the most common being sprains/strains (34%), lacerations (24%), “other injuries” (11%), and abrasions/contusions (11%) (Schmidt et al., 1993). In the largest UK study to date of 983 households who had experienced flooding, a number of injuries were reported by respondents during or immediately following flooding, the main ones being: sprains/strains (7%), skin irritations/rashes (7%), cuts and contusions (5%), electric shocks (5%), hypothermia (2%) (RPA/FHRC et al., 2004). In addition to the flooded community, rescue workers and other emergency teams are also at risk of injury.

2.3.4 Risk to public health

The effect of floods increasing the risk to public health from communicable diseases appears relatively infrequent in industrialised countries due to good sanitation and water supplies and lack of overcrowding (Cervenka, 1976; Aavitsland et al., 1996; Malilay, 1997; Schmidt et al., 1993; Meusel and Kitch, 2005; Ahern and Kovats, 2006), although it is not unknown. The loss of normal living conditions, for example for cooking and washing, can exacerbate risk to human health. Instances where outbreaks of disease have been reported tend to be small isolated occurrences but the risk could increase in the future with global warming. Diarrhoeal episodes following flooding have been reported by Wade et al. (2004) and Reacher et al. (2004). Some cases of West Nile fever and leptospirosis have also been reported in Europe (Environment Agency pers. comm., 2005).

Flooding can also increase exposure to environmental pathogens. Moving back into properties before they are adequately dried and aired can exacerbate health problems. In Germany following the 2002 Elbe and Mulde floods high bacterial cell counts were observed in cellars of flooded houses, streets and playgrounds. Some bacteria (thought to have come from flooded sewerage plants or farms) showed a high degree of multi-resistances against antibiotics (Abraham and Wenderoth, 2005). Mould can also pose a threat to health following water damage to properties. For the majority of people undisturbed mould is not a substantial health hazard but excessive exposure to mould-contaminated materials can cause adverse health effects in susceptible persons and protective equipment needs to be used when cleaning properties (Brandt et al., 2006). People in Carlisle, UK, were still reporting dampness and problems in their homes three years after the 2005 floods (Fernandez-Bilbao, Twigger-Ross et al., 2008). Following Hurricane Katrina in the US in 2005, chemical spillages posed risk to health from concentrations of aldrin, arsenic, lead and semivolatile organic compounds in sediments and soils. These concentrations exceeded the thresholds for human health soil screening levels (Presley et al., 2006). Toxicants in sediment and air may also pose a problem, as again evidenced following Hurricane Katrina (Manuel, 2006).

The public health risks from flooding are potentially more serious in less industrialised more developing countries. Infectious disease is particularly a flood-related health concern in countries where infectious disease transmission is an endemic public health problem; in areas with an existing history of diseases such as cholera, the risk to public health increases. Where this is the case the rate of diseases that were present before a flood may increase due to decreased sanitation and water supplies or overcrowding among displaced persons (CDC, 2004). In urban areas, with their high densities of populations, this risk to health may be particularly significant. Enteric infections may result from increased faeco-oral cycling from disruption of sewage disposal and safe drinking water infrastructure. Infectious disease outbreaks have been reported following major flood events, and these outbreaks vary in magnitude and rates of mortality. There is some evidence from Mozambique, India and Bangladesh that diarrhoeal disease increases after flooding (Fun et al., 1991; Kunii et al, 2002; Kondo et al., 2002). Routine surveillance data and hospital admissions records are often used to quantify these impacts. Some of the main reported public health impacts following flooding are outlined in
Table 2.2, based on literature reviewed by Few et al. (2004), along with relevant studies for illustration.

Not all studies provide epidemiological evidence to substantiate claims that flooding causes the reported health impacts. Moreover, it is possible that some impacts may be indirect rather than direct consequences of flooding (Few et al., 2004). For example, there is very little rigorous epidemiological evidence to support the argument that the transmission of vector-borne diseases increases with flooding. None of the malaria studies reviewed by Few et al. provide epidemiological data of sufficient quality, and only two studies on arboviruses (Hopkins et al., 1975; Han et al., 1999) provide reasonably rigorous data to support the case that flooding may have influenced increased transmission rates. But, even these two studies do not demonstrate a casual linkage between the outbreaks and flooding.

In developing countries diarrhoeal disease is a major cause of childhood mortality and morbidity and studies have shown strong seasonal variations in numerous populations. Diarrhoeal disease can be caused by both viral and bacterial pathogens. Due to improvements in the treatment of diarrhoea (such as Oral Rehydration Therapy), mortality has decreased in many countries, but morbidity remains high (Few et al., 2004). Research from China on the severe 1994 floods in Beijian reported no outbreaks of communicable diseases in the survey area as local health and sanitary departments had reacted promptly and made epidemic control a top priority in disaster relief work (Wong and Zhao, 2001).

Further health risks include vector-borne diseases such as malaria, dengue and West Nile fever, as well as snake or other animal bites. For example, 85% of people hospitalised during the 2000 flood in Mozambique had contracted vector-borne diseases such as malaria (a 4-5 fold increase). Climate suitability is a primary determinant of whether the conditions in a particular location are suitable for stable malaria transmission. A change in temperature (such as a change in season) may lengthen or shorten the season in which mosquitoes or parasites can survive. Changes in precipitation or temperature may result in conditions during the season of transmission that are conducive to increased or decreased parasite and vector populations (Few et al., 2004).

There is also good evidence of outbreaks of rodent-borne disease such as leptospirosis, but relatively weak evidence that flooding leads to outbreaks of other infectious diseases (e.g. cholera, hepatitis) (Few and Matties, 2006). Ensuring uninterrupted provision of safe drinking water is therefore the most important preventive measure to be implemented following flooding in order to reduce the risk of outbreaks of water-borne diseases.

In Sri Lanka, several hospitals and health centres were severely damaged in the 2004 Tsunami, water supplies were disrupted resulting in contamination and an acute shortage of clean drinking water. Sanitation facilities and sewage treatment works were also damaged, increasing the risk of outbreaks of diarrhoeal diseases (Abeykoon and Karalliedde, 2006). This risk was exacerbated in the temporary camps set up to house survivors as adequate sanitation was lacking. Outbreak warning and surveillance systems areas were set up and strengthened in the affected areas. Despite the health risks, no major disease outbreaks were reported. The WHO credits this to the resilience of the public health systems and response capabilities of the health sector in Sri Lanka, supported by the dedicated and committed work of local and international communities (Abeykoon and Karalliedde, 2006). However, it was recognised that during the rehabilitation and recovery efforts, there was a need to meet the psychosocial and mental health needs of survivors.
### Table 2.2: Reported public health effects from flooding (largely from epidemiological literature reported in Few et al., 2004)

<table>
<thead>
<tr>
<th>Disease or health effect</th>
<th>Comment</th>
<th>Country where cases reported</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhoeal diseases such as cholera</td>
<td>Caused by both viral and bacterial pathogens (e.g. rotavirus and cryptosporidium). Can be strong seasonal variations. ‘Faecal-oral’ transmission e.g. from drinking contaminated water and via contaminated food’. Children often more susceptible.</td>
<td>India, Bangladesh, Mozambique, Sudan</td>
<td>Cairncross and Feachem (1993); Mondal et al. (2001); Siddique et al. (1991); Fun et al. (1991); Kunii et al. (2002); Kondo et al. (2002); CDC (1989)</td>
</tr>
<tr>
<td>Hepatitis A and E</td>
<td>Also transmitted primarily through the faecal-oral route</td>
<td>Sudan, USA, Vietnam</td>
<td>McCarthy et al. (1994), Mackowiak et al. (1976), Corwin et al. (1999); Hau et al., 1999.</td>
</tr>
<tr>
<td>Poliomyelitis (polio)</td>
<td>A viral infection – all types can cause paralysis. Transmitted primarily through the faecal-oral route.</td>
<td>South Africa</td>
<td>Van Middelkoop et al. (1992)</td>
</tr>
<tr>
<td>Infection from helminths (parasitic worms)</td>
<td>Worms can be either water or soil-based. Water-based worms depend on an aquatic intermediate host to complete their life cycle. Soil-based are not immediately infective and first require a period of development in favourable conditions, usually in moist soil. Both infections associated with conditions of poor sanitation and hygiene.</td>
<td>Haiti, Poland</td>
<td>Cairncross and Feachem (1993); Lilley et al. (1997); Plonka and Dzbenski (1999)</td>
</tr>
<tr>
<td>Vector-borne diseases: malaria, dengue fever (arbovirus)</td>
<td>Many infections transmitted by mosquitoes which breed in or close to stagnant or slow moving water (puddles, ponds).</td>
<td>Various countries in Africa, Asia and Latin America</td>
<td>Russac (1986); Hederra (1987); McCarthy et al. (1996); El-Sayed et al. (2000); Nandi and Sharma (2000)</td>
</tr>
<tr>
<td>Encephalitis (arbovirus)</td>
<td>E.g. Murray Valley encephalitis and St. Louis encephalitis</td>
<td>Australia, New Guinea, North America, parts of the Caribbean, and Latin America</td>
<td>Chin (2000); Cordova et al. (2000); Anders et al. (1994); Hopkins et al. (1975)</td>
</tr>
<tr>
<td>West Nile virus</td>
<td>Associations of infection found with mosquito bites and flooded basements</td>
<td>Egypt, Israel, India, Romania</td>
<td>Chin (2000); Hubalek (2000); Hubalek and Halouzka (1999); Han et al. (1999)</td>
</tr>
<tr>
<td>Bancroftian filariasis</td>
<td>Transmitted through the bite of a mosquito</td>
<td>Malawi</td>
<td>Nielsen et al. (2002)</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>Water-borne disease associated</td>
<td>China</td>
<td>Chen Minggang</td>
</tr>
</tbody>
</table>
with stagnant water. The transmission cycle requires an intermediate snail host in which the schistosome parasite gestates. Humans become infected when the parasite penetrates skin.

(1999); Zhang YuQi et al. (2002)

Rodent and animal-transmitted disease: hantavirus pulmonary syndrome an acute zoonotic viral disease

Hantavirus pulmonary syndrome first recognized in 1993 in New Mexico and Arizona, USA. The natural reservoir for the disease includes various species of rodent and infection in humans occurs after inhalation of aerosolized virus or direct contact with infected rodents or their excreta.

South-west USA, Panama

Chin (2000); Bayard et al. (2000)

Leptospirosis - zoonotic disease

Caused by bacterial pathogen and transmitted in urine from animals to humans, either directly, when urine from an infected animal (including dogs, cats, cattle, rodents and wild animals) enters the body through a break in the skin, or indirectly, in contaminated water and soil. Not solely associated with flooding. Often affects sewer workers and agricultural labourers.

Argentina, Bangladesh, Brazil, Costa Rica, Cuba, India, Korea, Mexico, Nicaragua, Philippines, Portugal, Puerto Rico, Russia, USA.

Fuortes and Nettleman (1994); Ingraham and Ingraham (1995); Vanasco et al. (2000); Bharti et al. (2003); Karande et al. (2003)

2.3.5 Nutrition

With normal routines disrupted other aspects of life may also suffer following flooding. Diet and exercise is one such area. Nutrition health status can be affected due to lack of access to foodstuffs e.g. if food distribution networks are affected, and reliance on different and poorer quality foodstuffs. In industrialised countries, people may often have to rely on takeaway foods following flooding as they have no kitchens in which to cook, as well as often a lack of motivation to cook (GfK NOP, 2007: 13).

We had a takeaway every night for three months and I don’t mind admitting that ... what me and my wife did we had one meal a day because you couldn’t go for a takeaway in the morning, in the dinner time and so what we did was and it’s daft because we’ve got used to it, we eat one meal a day, the baby gets fed at crèche. Resident, Barnsley (GfK NOP, 2007: 13).

In developing countries increased morbidity, malnutrition and mortality are likely to result if there is no access to food for more than several days, especially among young children (Few and Matties, 2006). The impacts of flood inundation of agricultural land are also likely to affect food production, not just for the local community, but also for those who live further away and are reliant upon the agricultural land for their food supply.

Disruption to critical infrastructure and services following flooding, and poor provision of logistical support, can result in additional distress for those affected, and even for those not flooded.
Contingency planning for the loss of such services is crucial and better planning is also needed to source essential supplies in major emergencies (Water UK, 2008).

2.3.6 Displacement

Floods, and particularly catastrophic floods, are liable to result in significant displacement of affected populations. Displacement may occur within national borders or can be cross-border. These displacements can lead to a range of health outcomes, both physical and psychological. In developing countries in particular, individuals may literally lose their whole home, as well as their possessions and even livelihoods and may not have an alternative source of food, water and shelter. Access to essential medicines and health care may also be acutely affected. Moreover, large-scale population movements will place a particular burden on the local and national health care infrastructure.

In developed countries displacement may also have a significant impact. Evacuation before floods can reduce risk to life in the case of severe flooding and is often necessary post-flooding as properties will often be uninhabitable for many months. However, poorly organised and managed evacuation can add to the distress to those who are flooded, as evidenced during Hurricane Katrina in the US (Nossiter and Schwartz, 2008). The 2007 UK floods also highlighted the need to re-evaluate the location of evacuation shelters, as many were themselves flooded (Pitt, 2008).

Recovery following flooding is dependent upon a number of factors, key to which are the extent of damages and losses and individual and community resources available to deal with these. The extent of damages will usually determine the length of displacement and disruption to life. Where damage is extensive many people have to live in temporary housing such as hotels, mobile homes and rented accommodation for many months, lengths of up to one year are not uncommon. Such displacement can have significant socio-psychological impacts. The 2000 flooding in Lewes, UK, was shown to be highly associated with Common Mental Disorder 10 months after the flood event, and there was a strong indication that displacement was an important factor in this psychological distress, in addition to loss and damage to property and possessions and financial concerns (WHO, 2002).

Displacement and post-flood disruption to life has been reported in the UK as the most significant stressor from flooding affecting people’s well-being (Parker et al., 1983; Green et al., 1985; Tapsell and Tunstall, 2001; Carroll et al., 2006; Tunstall et al., 2006). The aftermath of flooding, the disruption and long recovery process, appear to generate the most severe stress, with people’s lives being ‘put on hold’ until the home or business is back in order. Following the 2005 Carlisle flood in the UK, families were split as temporary accommodation in local hotels was not adequate enough to accommodate everyone (Fernandez-Bilbao, Twigger-Ross et al., 2008). In some cases adults and children had to share living in a hotel room for a whole year. Different members of families had to stay with different relatives, often causing tensions. Little support was forthcoming from employers, adding to the stress experienced by those who were flooded but who still had to continue working.

The world was on its head, wasn’t it? Everything you knew to be normal didn’t exist any more. Nothing was right was it? Resident, Chesterfield (GfK NOP, 2007: 33).

Figure 2.3 highlights the significance of evacuation on stress levels experienced and reported by flooded respondents in a large-scale survey in the UK when correlated by the overall perceived severity of flooding upon households.
2.3.7 Neighbourhood or community-level impacts

Impacts of disasters at the community level have been little assessed. Moreover, the vulnerability of human beings in the community has emerged as the least known element in the disaster literature as hazard-proof building structures and prediction of hazard impact and warning systems have been improved (King and MacGregor, 2000). One problem relates to how the term ‘community’ is defined. For this research it is defined as those people living within flooded or at risk areas or those affected by flooding. Research suggests that community impacts appear to have modest outcomes (Norris et al., 2001b; Phifer and Norris, 1989). However, following floods there may be a community-wide tendency for people to feel less positive about their surroundings, less enthusiastic, energetic and less able to enjoy life after being exposed to trauma. Such findings are a reminder that disasters impact whole communities, not just selected individuals. Evidence from the north of England suggests that flooding may impair the quality of community life for quite some time due to the disruption of community activities and a sense of community breakdown (Tapsell and Tunstall, 2001).

However, floods can result in a positive sense of communities pulling together and helping each other, enabling mutual practical and emotional support (Tapsell and Tunstall, 2000; Tapsell and Tunstall, 2001; Fernandez-Bilbao, Twigger-Ross et al., 2008; Pitt, 2008). Community networks are often effective tools in aiding recovery and reducing psychosocial impacts. In Alberta, Canada, residents reported that their communities were more helpful in dealing with post-flood health problems than public and service delivery sectors (Acharya et al., 2007). Pelling (1997) identifies households and communities as active agents in the management of vulnerability to hazards and examines the potential of such groups in reducing this vulnerability. Evidence from the Kobe earthquake in Japan shows that close, developed communities recovered much quicker than communities viewed as being transient, isolated and insular (Hill and O’Brien, 1999).

Therefore, there is a need to look at increasing community involvement in building disaster resilience and creating disaster-resistant communities (Pitt, 2008). Post-disaster response may thus be better aimed at mobilising, maintaining and enhancing natural community and social support systems. Involving communities in planning and implementing responses will not only give people a sense of partnership and ownership in managing emergencies and recovery but also reduce the uncertainties and anxieties associated with flooding (Tapsell, forthcoming). Whether directed toward the community, family, or individual, the emphasis for should be on empowerment, meaning that communities should draw upon and build their strengths, capabilities, and self-sufficiency. Moreover,
a flood can be used as an opportunity to help regenerate deprived communities, rather than restoring them to pre-flood norms, as is the case in Carlisle (Fernandez-Bilbao, Twigger-Ross et al., 2008).

Values can be deeply relevant to understanding community level response to flood hazard (Morris-Oswald and Sinclair (2005). Shared values indicate common motivations and can serve as the common ground for conflict resolution and to achieve common goals, e.g. increased resilience. Values (norms and beliefs) orientations of floodplain residents were highlighted in the study of two communities in Canada which assessed the influence of these values on flood management planning and mitigation decisions (Morris-Oswald and Sinclair (2005). For example, a core value expressed in both communities was security; however this was expressed through specific and somewhat different dynamics in each town. In one, the importance of social capital was reflected in ensuring a sense of security, the community having a history of kinship ties and extensive social networks. Values related to growth and economic development were particularly evident in this town, while in the other town residents seemed more content with the status quo with regard to community growth. Consequences of value orientations were most profound with regard to public involvement, expectations of government institutions, and structural protection measures.

2.4 Psychological health and disasters

In recent years the psychological or mental health impacts of flooding have become increasingly recognised as significant in affecting people’s well-being. Mental health studies relating to flood events come mainly from developed or industrialised countries. Evidence from research suggests that it is particularly these mental health impacts that are the most significant. There is strong evidence that flooding can have an adverse effect on common disorders such as anxiety and depressive illness, especially in the elderly. Adjustment Disorder, and Acute Stress Disorder are other possible diagnoses of Common Mental Disorders which may be experienced by disaster victims. These can be differentiated by looking at the type of stressor, and the range and duration of symptoms (Rick et al., 1998). Stressors from experiencing flooding can also place survivors at risk for behavioural and emotional readjustment problems (NCPTSD, 2001). For example respondents in a study of the June 2000 floods in the North East of England (Tapsell and Tunstall, 2001) were shown to display symptoms of Common Mental Disorders such as those related to Adjustment Disorder including avoidance of talking or thinking about the flooding, flash-backs, sleep disorders, and depression. Developing obsessive behaviour was reported by some respondents following the Carlisle floods, such as frequent cleaning of the house once it had been restored (Fernandez-Bilbao, Twigger-Ross et al., 2008). Increased stress levels and other psychological health effects of the flooding can also influence long-term mortality (Jonkman, 2003, Bennet, 1970).

There is now a growing literature on disasters and mental health. Norris et al. (2001a) reviewed 177 articles comprising samples composed of over 50,000 individuals who experienced 80 different types of disasters: 62% were natural disasters (mostly in the USA and involving adults). Individuals’ experiences ranged from little more than inconvenience to severe trauma and loss. Most disaster survivors will only experience mild (normal) stress reactions, and disaster experiences may even promote personal growth and strengthen relationships (NCPTSD, 2001). Reacher et al. (2004) found adults to have a four-fold higher risk of psychological distress in flooded households compared with non-flooded. Pre-disaster symptoms were almost always among the best predictors of post-disaster symptoms in research reviewed by Norris et al. (2001b). Having a “neurotic” personality increases the likelihood that an individual will experience post-disaster distress. Pre-disaster symptoms have also been found to interact with severity of exposure. Participants with higher pre-flood symptoms were more significantly affected by a flood than were participants with lower pre-flood symptoms.

The general rule in the vast majority of studies reviewed by Norris et al. (2001a) was that people improved over time, although this was not always linear. Chronic problems identified relating to natural hazards including floods were: troubled family and interpersonal relationships, social disruption, occupational and financial stress, concerns about general living conditions and the wider
community, and obligations to provide support to others. Table 2.3 shows the likely normal and longer lasting stress reactions experienced by survivors of disasters.

Table 2.3: Normal and longer-lasting stress reactions to experiencing disasters

<table>
<thead>
<tr>
<th>Emotional reactions: temporary (i.e. for several days or a couple of weeks), feeling of shock, fear, grief, anger, resentment, guilt, shame, helplessness, hopelessness, or emotional numbness.</th>
<th>Dissociation (feeling completely unreal or outside yourself, having blank periods).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive reactions: confusion, disorientation, indecisiveness, worry, shortened attention span, difficulty concentrating, memory loss, unwanted memories, self-blame.</td>
<td>Intrusive re-experiencing (flashbacks, nightmares etc.).</td>
</tr>
<tr>
<td>Physical reactions: tension, fatigue, edginess, difficulty sleeping, bodily aches or pain, startling easily, racing heartbeat, nausea, change in appetite and sex drive.</td>
<td>Extreme attempts to avoid disturbing memories (e.g. through substance use)</td>
</tr>
<tr>
<td>Interpersonal reactions in relationships at school, work, in friendships, in marriage, or as a parent: distrust, irritability, conflict, withdrawal, isolation, feeling rejected or abandoned, being distant, judgmental, or over controlling.</td>
<td>Extreme emotional numbing (unable to feel emotion, emptiness)</td>
</tr>
</tbody>
</table>

(NCPTSD, 2001)

The World Health Organization (2001) has acknowledged that the mental health consequences of floods have not been fully addressed by those in the field of disaster preparedness or health service delivery. With the increased likelihood of future flooding, and the potential for increased risks to mental health, these impacts need to be addressed. Moreover, it is generally agreed that mental health is broader than a lack of mental disorders and includes people’s general well-being (WHO, 2001) and quality of life. These so-called ‘intangible’ impacts of flooding can often assume more significance to people than financial losses (Parker et al., 1983; Green et al., 1994; Tapsell et al., 1999, 2003; Carroll et al., 2006; Werritty et al., 2007).

Disaster studies that focus on aspects of the stressor have found that certain kinds of experiences put disaster victims at particularly high risk for psychological problems. In the studies reviewed by Norris et al. (2001a), effects on people were greatest when at least two of the following event-level factors were present:

- Extreme and widespread damage to property.
- Serious and ongoing financial problems for the community.
- Human carelessness or, especially, human intent caused the disaster.
- High prevalence of trauma in the form of injuries, threat to life, and loss of life.

Disasters that caused massive destruction or threat to life and/or prolonged social and financial disruption and resource loss (e.g. the dam collapse in Buffalo Creek West Virginia in 1972; Hurricane
Andrew in 1992) were most likely to be associated with severe or very severe impairment to people’s health. Global indices of resource loss (both psychological and social) show that the greater the amount of resources lost, the greater the psychological distress. Lutgendorf et al. (1995) reports that survivors of Hurricane Andrew reported symptoms of Chronic Fatigue Syndrome; the greater the extent of disruption to lives caused by the hurricane, the greater were the symptoms. The effects of highly destructive events such as hurricanes may be reduced by strong interpersonal and community supports, whereas the effects of less destructive events may be heightened by a low resource context. Therefore the development of stress in disaster populations can be complex.

Family, community, social, structural, cultural and environmental factors can all have an effect. Disasters should, however, have minimal long-term consequences for mental-health at the population level when:

- Injuries and deaths are rare,
- The destruction or loss of property is confined relative to the size and resources of the surrounding community.
- Social support systems remain intact and function well.
- The event does not take on more symbolic meanings of human neglect or maliciousness.

2.4.1 Evidence from the UK

In the UK, there is no doubt that flooding is associated with increased rates of the most common mental disorders: anxiety and depression (Bennet, 1970; Reacher et al., 2004; Tapsell and Tunstall, 2006). Parker et al. (1983) approached 102 households believed to have been flooded in 1978 in Swalecliffe, Kent. Over 50 per cent of respondents reported that they had not yet recovered from the flood and that the tangible effects were less important than the intangible effects. The most significant flood impacts reported were (in order of importance):

- disruption to life of the household
- loss of memorabilia and personal belongings
- being evacuated from home
- the stress of the flood event itself

A further study by Green et al. (1985) focused on assessing the intangible effects of the tidal flooding of December 1981 at Uphill, Weston-Super-Mare. Three population samples were drawn: 101 flooded households; a control sample of 100 near flooded households; a further control sample with no experience of flooding. Apart from demographic questionnaires, three main survey instruments were employed: an interview schedule (flooded households) and two self-completion questionnaires (flooded and non-flooded households). The main instrument of the self-completion questionnaires was the Nottingham Health Profile (Hune and McEwen, 1980), along with a short version of the Life Events score (Holmes and Rahe, 1967).

There were found to be consistent patterns of increased psychological problems amongst those who had been flooded than among those not-flooded. For example, 75% of flooded households reported mental health impacts, particularly depression and sleeping problems. Age was significantly correlated with more severe health impacts – the older the respondent the more likely they were to attribute some health effect to the flood. In the latter two studies above, key correlations showed that those reporting the greatest overall flood impacts also reported the most severe impacts from health effects and stress from the risk of future flooding, and that those suffering little damage in their homes also reported little effect on their health.

Green et al. (1994), in analysing data for the EUROflood project of 1,700 cases from different flood events in England and Wales (also see Section 6), also found that the stress of flooding can result in both short and long-term health damage, as well as increasing worry and anxiety about future flooding.
The analysis used 500 different variables and focused on short duration floods that were relatively shallow (generally less than 1.5 metres in depth). The key findings were:

- The stress of the flood event was reported as being the most critical variable identified as important in determining whether health effects were reported.
- The stress experienced by the household was associated with the depth of the flood.
- Stress was significantly reduced if flooding occurred during daylight hours.
- Elderly people tended to report a higher degree of severity of health damage than did younger people.
- Evacuation was found to be particularly distressing.
- Financial losses were often less important than the loss of personal belongings.

Analyses also showed that individuals responded to a perceived threat by mobilising personal and social resources and that the availability of such support may serve to buffer or ameliorate the impacts of the threat, although the results were inconclusive.

The largest study to date in the UK was carried out as part of a major project funded by the Department for the Environment, Food and Rural Affairs (Defra) in England which had the wider aim of developing a robust, yet simple to use, methodology to account for the intangible impacts on human health and well-being of flooding in assessing the benefits of flood alleviation measures. A full report on the research is given in RPA/FHRC et al., 2004. The study involved a series of focus groups and retrospective face-to-face questionnaire interviews with 983 ‘flooded’ and 527 ‘at risk’ respondents in 30 locations experiencing fluvial or surface water flooding of varying degrees since January 1998. The study was not based on epidemiological evidence such as that provided by Bennet (1970), but research conducted by social scientists based on retrospective data collection and respondents’ self reporting of symptoms; no control groups were used in the study. The research demonstrated that flooding causes short and longer-term physical and psychological health effects. It also demonstrates significantly higher rates of psychological impairment among those who have been flooded compared with those not flooded but at risk. Further issues during recovery related to problems experienced in dealing with insurance claims and building contractors repairing and restoring properties; dealing with insurance claims was statistically the most significant factor affecting people’s psychological health (RPA et al., 2004; Tunstall et al., 2006 – also see Section 5 below for more detail). Evidence from 2007 indicates that UK insurance companies have since improved their service compared with earlier floods (Pitt, 2008: 158). However, lack of insurance take-up among low-income households is still an issue that needs to be addressed.

The health problems reported in RPA/FHRC et al. (2004) were also similar to those of a smaller but case-controlled epidemiological study by Reacher et al. (2004) following the Lewes flooding of autumn 2000, whereby flooding was associated with earache, a significant increase in risk of gastroenteritis with depth of flooding, worsening asthma and other respiratory illnesses and skin rashes, and significant psychological impacts. Findings from qualitative research with 15 communities in England and Wales affected by inland flooding confirmed the extent of flood impacts upon people’s health, lives and well-being and provided deep insights into the factors that may affect these health impacts (Tapsell et al., 1999; Tapsell and Tunstall, 2000; Tapsell and Tunstall, 2001; Tapsell et al., 2003; RPA, FHRC et al., 2004).

### 2.4.2 Post Traumatic Stress and Common Mental Disorders

There is a growing body of literature that indicates a link between Post Traumatic Stress Disorder (PTSD) and physical health in the context of disasters. After the formalisation of PTSD as a diagnosis since 1980, studies began to emerge on veterans of World War II and Vietnam (e.g. Van Dyke et al, 1985). Beck and Franke (1996) report that 15-20% of people studied following natural disasters went on to experience symptoms of Post Traumatic Stress Disorder (PTSD). One of the hallmark symptoms of PTSD is physiological reactivity to traumatic reminders (in the case of flooding this might be...
subsequent heavy rainfall). Some survivors who may have a higher than typical risk for PTSD include those with a history of:

- Exposure to other traumas
- Chronic medical illness or psychological disorders
- Chronic poverty, homelessness, unemployment, or discrimination
- Recent or subsequent major life stressors or emotional strain (such as single parenting)

There are a growing number of international studies focusing on PTSD following flooding (e.g. Canino et al., 1990; Auger et al., 2000; Norris et al., 2002; McMillen et al., 2002; Verger et al., 2003). Thirty-eight percent of those interviewed following the 1993 Midwest floods in the US met criteria for post-flood psychiatric disorder (McMillen et al., 2002). Manuel (2006) cites PTSD being common among survivors of Hurricane Katrina; 44% of children in New Orleans were reported as experiencing symptoms of new mental health problems such as depression, anxiety and sleep disorders following the hurricane (Mack et al., 2007). People with psychiatric histories are disproportionately likely to develop disaster-specific PTSD and people with a history of psychiatric illness are more likely to develop post-trauma psychopathology.

Those who are diagnosed with PTSD or psychiatric problems are also more likely to have a greater number of physical health problems than those who are not diagnosed (Stoudemire, 1995; Boscarino, 1997). However, the relationship between PTSD and poor health is likely to be mediated in part by behavioural factors that are known risk factors for disease such as smoking, diet and lack of exercise. However, it is important to note that at the present time existing research is not able to determine conclusively that PTSD causes poor health. Moreover, most people directly exposed to disasters will not experience PTSD and most will recover naturally (Eyre, 2002). Psychiatric disorders other than PTSD are also associated with increased physical morbidity. Depressed people often report more physical symptoms and use more medical treatment than do non-depressed people (Schulberg et al., 1987). Furthermore, depression is related to decreased immune function.

Few studies address mental health impacts of flooding in developing countries, although the number is now growing. The lack of research may reflect low levels of mental health service provision as well as a shortage of research expertise on mental health epidemiology (see Few and Matties, 2006). There is some existing evidence that flooding in Bangladesh has been associated with increased behavioural problems in children and can have significant impacts upon women and the urban poor (Durkin et al., 1993; Rashid, 2000; Rashid and Michaud, 2000). Choudhury et al. (2006) also report psychosocial consequences in tornado-affected areas, with women being more affected than men and 66% being traumatised.

In China, one study focused on PTSD in Hunan following the 1998/99 floods. Of 33,340 subjects studied 8% (2,875) showed symptoms of PTSD and the authors called for improved mental health services for flooded populations (Liu et al., 2006). Another Chinese study looked at quality of life (QOL) among flooded and non-flooded populations in the Dongting lake area. Quality of life was significantly poorer in the flooded group. Impacts of the floods on QOL was greater among farmers, older people, people with introvert personalities and those with adverse life-events, whereas social support and extrovert personalities offset the negative impacts (Tan et al., 2004). In South Korea research has shown that flooded residents experienced higher levels of stress, anxiety, depression and PTSD compared with those not flooded (Chae et al., 2005). Following the 2004 Asian Tsunami in Myanmar, Htay (2006) called for mental health and psychological aspects to be included in disaster preparedness and management plans and reported evidence that psychological support to the affected community not only reduced psychological distress but also facilitated physical rehabilitation. Llewellyn (2006) also called for the mental health of victims in Banda Aceh, Indonesia, to be addressed following the 2004 Tsunami.
### 2.4.3 Identity and the sense of 'self' and 'place'

Damage to people’s homes from disasters can also have a significant impact upon their mental health. People’s homes are their private ‘places’, the centre of both individual and family life; they are often conceived as an unchanging static place (Massey and Jess, 1995); however, flooding changes homes and has the power to transgress the boundaries of home that are usually closely guarded. Thus a special dwelling place, filled with a lifetime of memories, can be transformed into one filled with the sludge, mud and sewage, as illustrated by qualitative research in the UK.

*Seeing all my home just covered in rubbish ...everything just completely rubbedhished, it’s like you feel as if your life as been turned into rubbish, it was really horrible.* (2000, female 5 months after flood, Tapsell and Tunstall, 2001).

*... but if you haven’t got your home, you haven’t got that sense of security and the fundamental sense of well being and being alright ...* (2000, female 5 months after flood, Tapsell and Tunstall, 2001).

Flooding of homes is also said to undermine people’s individual sense of self identify and place identity (Sime, 1997; Fullilove, 1996; Cox and Holmes 2000; Tapsell and Tunstall, 2001; Tapsell and Tunstall, 2008) and may even result in people redefining their concept of home (McCarthy, 2004).

*... We lost interest in the house when it flooded; we lost interest in it as a home. It wasn’t a home anymore.* (1998, male 7 months after flood, Tapsell et al., 1999).

People have a strong emotional attachment to their homes and can experience severe distress if their homes are damaged or destroyed. Eighty-nine per cent of respondents in the largest UK study (n.983) reported losing some irreplaceable items or items of sentimental value (RPA, FHRC et al., 2004). Possessions within the home can assume considerable significance to people as attachment objects, helping to mark important events and experiences in people’s lives, define who they are, and who they care most about (Csikszentmihalyi and Rochberg-Halton, 1981; Keene, 1998). Green (1993) and Tapsell and Tunstall (2001) reported that anxiety about future risk of flooding leads to changes in the way individuals and households use their home, and in their lifestyle. Moreover, Rose (1993), Massey (1994) and Fordham (1998) have also argued that the unequal social construction of gender roles in the home may result in floods having greater impacts upon women than men; women may thus bear a disproportionate share of the risks (see Section 3.2 below for further discussion on gender).

### 2.5 The time-scale of health impacts following disasters

The long-term effects of floods on health are of particular significance. There is growing evidence that disaster victims may continue to experience psychological health symptoms long after the event (Green et al., 1985, Steinglass and Gerrity, 1990; McDonnell et al., 1995; Bland et al., 1996; Shaw et al., 1996; and Caldera et al., 2001; Tunstall et al., 2006). Psychological effects can last for months and even years after an event and are therefore an important consequence (Jonkman, 2003). In a discussion of research examining longer-term effects of disaster exposure, some findings suggest that for natural disasters psychological consequences may persist for as long as three years, though most symptoms seem to abate by about 16 months (Bravo et al., 1990; Steinglass and Gerrity, 1990). A four year qualitative study with 41 respondents in two flooded communities in England found evidence of persisting psychological effects in a minority of participants four years after flooding (Tapsell et al., 2003). In research by Krause (1987) following Hurricane Alicia, findings from a random community survey of 351 older adults suggested that the major effects of the storm diminished in about 16 months. Significant gender differences were found in this adjustment process. Increased psychological symptoms have been found to be more common in female than male flood victims and also significantly more common than increased physical health effects in both sexes (Abrahams et al., 1976). Increased stress levels and other psychological health effects of the flooding can also influence long-term mortality (Jonkman, 2003, Bennet, 1970). The particular characteristics and context of individual flood events and those affected will obviously influence the length of the particular health outcomes experienced.
In the studies reviewed by Norris et al. (2001a) the severity of symptoms in the early phases of disaster recovery was an accurate predictor of symptoms in later phases and delayed onsets of psychological disorders were rare. Third, symptoms usually peaked in the first year and were less prevalent thereafter, leaving only a minority of communities and only a minority of individuals within those communities substantially impaired. A study by researchers in the US (Waelde et al., 1998; 2001) noted that victims of the 1997 floods in California evidenced symptoms of two stress disorders: acute stress and PTSD; that is both short and long-term stress reactions. In a similar vein, Smith (1996), McFarlane et al., (1997) and Bland et al., (1996) report long-lasting psychological health impacts following floods, bushfires and earthquakes. Following the 2002 floods in Prague, Czech Republic, findings indicate long-term persisting psychological impacts (Preiss et al., 2004).

Phifer and Norris (1989) found the psychological consequences associated with personal property loss following flooding to be relatively short-term (less than one year), whereas exposure to widespread community destruction had a longer-term impact (up to two years), regardless of individual loss. Following flooding there may be a community-wide tendency for people to feel less positive about their surroundings, less enthusiastic, energetic and less able to enjoy life. Evidence from the north of England suggests that flooding may impair the quality of community life for quite some time due to the disruption of community activities and a sense of community breakdown (Tapsell and Tunsall, 2001). To date, there has been little research on this aspect of flood impacts, particularly in relation to flooding in urban areas with their more diverse and mobile populations.

Krause (1987) suggests that the failure of researchers to consider the temporal dimensions of the stress process may be at least partially responsible for the disappointing empirical findings from research on stress and health. The delay of the manifestation of the health effects may be dependent upon the latency of the inundation period typical of that health effect. Careful consideration should be given to the time lag between the occurrence of a stressor and initial symptoms development, as well as the length of time that is required for symptoms to abate.

The health effects of disasters such as flooding can be seen as a time-dependent wave phenomena, whereby different types of health effect are manifested at different periods of time. The possible phases in the health effects of floods have been outlined by Parker et al. (1987). These range from effects in anticipation of the event (anxiety and fear) if people are aware of the risk; effects during the event (threat to life, injuries, contact with floodwaters); early recovery (worry over damages and losses, financial concerns); long-term recovery and aftermath (stress and stress-related illnesses); and post-event anxiety and impaired mental health (e.g. over future threat).

One of the problems in the estimation of the longer-term prevalence of a disorder is that although people may be currently free of a symptom, a proportion may have experienced past episodes that would have placed them at the level of 'caseness' (Power, 1988). According to Power, although there are clinical interviews that attempt to assess past episodes of illness, it is essential to develop past versions of self-report scales that can be used when there are insufficient resources for semi-structured interviews. There have previously been several attempts to devise both ‘worst ever’ and ‘lifetime ever’ modifications of self-report questionnaires (Power, 1988; Schwarz and Zuroff, 1979; Bromet et al., 1986). Power used an amended version of the General Health Questionnaire 28 (GHQ-28) (Goldberg and Hillier, 1979) to construct a “worst episode” or a “Time I Felt Worst” version.

Results from Power’s research suggest that the “worst episode” version of the GHQ-28 is reliable. In the retrospective use of the GHQ-28, 96% of his sample were classified as “past cases”. Even using a more arbitrary cut-off point 45% would have been classified as “past cases”. Power was able to use a six month follow-up test to determine the reliability of the scale to take account of the problems associated with recall. At both times respondents also completed the standard GHQ-28 to determine current health, as in any assessment of past psychiatric illness, current psychiatric status also needs to be measured to investigate the effects of current symptoms on the recall of previous symptoms. Findings also showed that when respondents’ current symptoms increased between initial assessment
and follow-up, they were more likely to endorse a greater number of symptoms for a past “worst ever” episode, and, conversely, when the respondent improved between assessments, the fewer the number of symptoms that were endorsed for the past episode. This result was also found by Bromet et al. (1986). According to Power (1988), there is good evidence that depressives may be more accurate than normal controls in their recall of negative events. Correlations also showed that there was a tendency for younger people to score slightly higher than old people on the “worst ever” GHQ.

Although some cautions were noted, Power concluded that the GHQ-28 showed good overall test-retest reliability and that the subscales generally showed comparable inter-correlations with those for the GHQ-28. The cautions were that comparisons would have to be made with a clinical interview before any conclusions could be reached about cut-off values for caseness. A ‘Worst Ever’ version of the GHQ-12 was used in the UK survey of 983 flooded participants and showed significant differences compared to current GHQ-12 results (RPA/FHRC et al., 2004 – see Section 5 below).
3. Factors that influence or modify the impact of floods on health

A number of factors have been suggested as possibly modifying or mitigating the health effects from flooding or intervening to avoid these effects. These factors can include socio-demographic aspects of flooded populations which make them more vulnerable or resilient to hazards, environmental factors such as climate, aspects of the stressor event itself (e.g. flood characteristics), institutional factors, individual psychological resources, characteristics and perceptions. A number of key factors are discussed below, starting with social vulnerability.

3.1 Social vulnerability and flooding

There has been much discussion in recent years on whether certain individuals or groups within societies (e.g. households with young children, older residents, long term ill or disabled, unemployed, and those on lower incomes or with lower social status) are likely to be more vulnerable or resilient to the effects of hazards and disasters than the population in general (Blaikie et al. 1994; Enarson and Morrow, 1999; Morrow, 1999; Fordham, 1998; Buckle et al., 2000; Tapsell et al., 2005; De Marchi et al., 2007; Steinführer and Kuhlicke, 2007; Tunstall et al., 2007). Vulnerability reduction can reduce the risk of negative health impacts caused by floods and other disasters, for example by decreasing susceptibility (by emergency prevention and mitigation) and increasing resilience (by emergency preparedness).

However, vulnerability to flooding is now broadly recognised as being a function of both the physical environment and of the socio-economic and political context (Parker, 2000). ‘Vulnerability’ is here defined as being determined by the characteristics of a person or group in terms of their limited capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (Blaikie et al., 1994). Social vulnerability is determined by a complex range of social factors and is a multi-faceted concept incorporating issues of livelihood, housing, security and gender among many others. Social norms and customs, international, national and private and public law may regulate these constituents of vulnerability, and these constituents may differ from country to country. Those who are most vulnerable socially, politically and economically are likely to be the least resilient in recovering from floods, and may experience the most pronounced impacts. Social resilience can be defined as “the capacity of a community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organising itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures” (FLOODsite, 2005).

Much of the early work on social vulnerability was formulated in developing countries where the most vulnerable groups tend to be those who do not have their fundamental needs, such as adequate, food, shelter and health care met. Researchers have since seen the value of transferring this knowledge base to developed world contexts (Blaikie et al., 1994). The social vulnerability approach to hazard and disaster management argues that society also creates conditions in which people face disasters differently (Blaikie et al., 1994). Social vulnerability is partially the product of social inequalities (those social factors that influence or shape the susceptibility of various groups to harm and that also govern their ability to respond), however, it also includes place inequalities – those characteristics of communities and the built environment, such as level of urbanization, growth rates and economic vitality, that contribute to the social vulnerability of places.

With the growing awareness of, and emphasis on, the social aspects of flooding in the last decade, particularly in Europe, more and more research is now focusing on assessing the social vulnerability of individuals, households and communities to flood risk and impacts. Many quantitative surveys have been undertaken focusing on household impacts (including health impacts) and responses to floods (e.g. Sketchly and Sketchly, 2000; RPA, FHRC et al., 2004; Carroll et al., 2006; Steinführer et al.,
2007; De Marchi et al., 2007; Tunstall et al., 2007; Werrity et al., 2007). Analytical approaches for assessing vulnerability tend to closely follow research paradigms from historical narratives, contextual analyses, case studies, to statistical analyses, GIS and mapping techniques. Much social research involves qualitative approaches and methods such as in-depth interviews, focus groups (e.g. Tapsell et al., 1999, 2002, 2003; Tapsell and Tunstall, 2001) and oral histories (e.g. Thrush, 2002), although quantitative techniques such as structured surveys and collection of statistical data are also frequently employed.

Social impact and response are often measured by threats to lifelines or infrastructure to support basic needs, special needs of populations, poverty or wealth indicators, gender, age etc. The nature of social vulnerability will depend on the nature of the hazard to which the human system in question is exposed. The geographical scale also poses difficulties in measurement as applications range from local to global scales. For flood risk the most detailed vulnerability assessments are conducted at the local level, often of individuals or households. Methodological decisions often mean sacrificing localised detailed case study approaches for more broadly based patterns and distributions (Cutter, 1996). Sophisticated tools for health risk assessment exist (see Section 4 below) but these are largely aimed at providing aggregate measures or focus on description of impacts and response capacities. Survey techniques such as the General Health Questionnaire (Goldberg and Hillier, 1979) and the Post Traumatic Stress Scale (Scott and Dua, 1999) have been used in England and Wales to assess health impacts following flooding (RPA/FHRC et al., 2004; Tunstall et al., 2006).

Morrow (1999) refers to the social construction of disaster vulnerability and to the social exclusion of some groups in disaster response. Green et al. (2007) report that pre and post-disaster inequalities slowed recovery in New Orleans following Hurricane Katrina and suggest that structural damage was not the only, or even the primary, impediment to recovery for many residents; instead it was the outcome of pre-existing social and economic marginalisation. Uneven recovery citywide was also said to be shifting city demographics, with the white affluent residents disproportionately returning to the city (Green et al., 2007). The study provides lessons on the potential effects of recovery planning on returning residents and neighbourhoods.

Masozer et al. (2007) used GIS technology to analyse household income, housing values, and elevation and flood levels to examine if neighbourhoods in New Orleans were impacted differently by Hurricane Katrina based on pre-existing social, physical and economic vulnerabilities. Although severe flood damages occurred in the majority of the city’s neighbourhoods, findings suggest that pre-existing socio-economic conditions play a significant role in the ability for particular economic classes to respond immediately to the disaster and to cope with the aftermath. Luck of transportation increased vulnerability to evacuate among low-income groups and caused problems during recovery, as did lack of insurance cover and inability to negotiate bureaucratic systems during recovery. Pre-existing socio-economic conditions were not therefore predictors of flood damage but played an important role in recovery and response. Vulnerability is thus intimately related to social processes in disaster-prone areas and is usually related to the fragility, susceptibility or lack of resilience of the population when faced with different hazards.

Socio-economic status is thus suggested as a key factor in determining resilience following a disaster. In 91% of disaster samples studied by Norris et al. (2001b), lower socio-economic status was consistently associated with greater post-disaster distress. The effect of socio-economic status has been found to grow stronger as the severity of exposure increases. Green (1993) suggested that the financial resources which individuals can mobilise form an important buffering element to impacts from a flood. Household income levels are likely to be important determinants in influencing the impacts of financial expenditure. Evidence from the 1990 Towyn and 1993 Aberconwy coastal floods in North Wales (which directly affected some 9,000 people) indicates that personal and family finance was one of the greatest concerns to the people affected (Hill and O’Brien, 1999).

Studies by Bolin and Stanford (1998) and Kaniasty and Norris (1995) on support systems following natural disasters both report lower-income victims and those of ethnic minorities being unable to
obtain adequate support and relief. In the UK, one example of how socio-economic status may affect flood impacts is that of insurance. Flood insurance in the UK is an unusual arrangement compared with many European countries and North America, where flood insurance is not available as a standard feature in household policies. Those people with lower socio-economic status may have few resources to pay for flood insurance and are, therefore, at greater risk of losses, and the potential health implications resulting from losses, than those who have insurance cover.

Vulnerability assessment has been accepted as a requirement for the effective development of emergency management capability. However, there is also a need to consider location, community facilities, time, and social and economic trends. People or communities are resilient or vulnerable in the context of particular situations, especially their risk environments (Tunstall et al., 2007). There is still a limited understanding of what the terms vulnerability and resilience include. This lack of understanding often constrains the effective practice of emergency management (Buckle et al., 2000).

In a study of the East Gippsland floods of June 1998 in Australia, vulnerability was as much a result of exposure to two years of drought, many years of environmental alteration, and the effects of isolation, as it was to the effects of the flood itself. According to Buckle et al. (2001) it is not possible to divorce vulnerability and resilience from each other – they are linked in a double helix and are not necessarily opposite ends of a continuum.

In recent years a perspective has emerged that views hazards as basic elements of environments and as constructed features of human systems, rather than as the extreme and unpredictable events they are traditionally perceived as (Wong and Zhao, 2001). A further conceptualisation of vulnerability which has gained in significance in the scientific community in recent years is that of Cutter et al. (2000; 2003). The authors use a conceptual model of vulnerability that incorporates both biophysical and social indicators to provide an ‘all-hazards’ assessment of vulnerability at the local level. These may be particularly relevant for comparing results from diverse locations and contexts as they incorporate the notion of ‘place’ which may also correlate with territory.

### 3.1.1 Social vulnerability indicators

There have been groups of vulnerability studies with a long history which seek to identify those population groups which are most likely to experience the adverse impacts of natural hazards including flood hazards (Mbithi and Wisner, 1973; Reardon and Matlon, 1989; Cutter 1996; FEWSNET, 2000). Most of this research has focused upon developing countries at the local to regional spatial scales and has tried to determine social indicators which may determine vulnerability. However, social indicators research is currently experiencing a renaissance, especially in the area of sustainability science. There are now many examples of the use of indicators to assess human vulnerability to various hazards and threats in developed countries (e.g. Cutter et al., 2003; Granger et al., 1999 and Dwyer et al., 2004). Many sets of indicators have been developed to examine highly context-specific processes. For example, the United Nations Development Program’s Human Development Index (UNDP, 2000) provides a composite indicator of human wellbeing, as well as indicators of gender disparity and poverty among nations. The World Bank similarly provides annual data and indicators in its World Development Indicators Reports (e.g. World Bank, 2003).

According to Norris et al. (2001b), an adult’s risk for psychological distress following disaster will increase as the number of the following factors increases:

- Female gender
- 40-60 years old
- little previous experience or training relevant to coping with disaster
- ethnic minority
- low socio-economic status
- children present in the home
- for women, the presence of a spouse, especially if he is significantly distressed
- psychiatric history
• severe exposure to disaster, especially injury, life threat, and extreme loss
• Living in a highly disrupted or traumatised community
• Secondary stress and resource loss

Yet there is still no consistent set of metrics used to assess vulnerability to environmental hazards, although there have been calls for just such an index, and Cutter et al. (2003) talk of the need for redirecting social indicators research. As part of Task 11 of the FLOODsite project an analysis was undertaken of such social indicators used in vulnerability research and whether they may increase or decrease social vulnerability, the key indicators reported in a review of the literature on vulnerability are given in Table 3.1.

Table 3.1: Indicators for assessing social vulnerability to floods

<table>
<thead>
<tr>
<th>Indicators for assessing social vulnerability to floods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age - very young and elderly (+)</td>
</tr>
<tr>
<td>Women - impacts (+)</td>
</tr>
<tr>
<td>Men (particularly young) - risk taking behaviour (+)</td>
</tr>
<tr>
<td>Long-term-illness or disability (+)</td>
</tr>
<tr>
<td>Employed (-), unemployed (+)</td>
</tr>
<tr>
<td>Occupation (+/- skilled or unskilled, also linked to income and financial status)</td>
</tr>
<tr>
<td>Education level (higher level -, low level +)</td>
</tr>
<tr>
<td>Family/household composition (large families +, single parents +, single person households +, home owner -, renter +)</td>
</tr>
<tr>
<td>Length of residence (linked to prior experience, short residence +)</td>
</tr>
<tr>
<td>Proportion of ethnic minorities and new migrants/visitors (large no. +)</td>
</tr>
<tr>
<td>Type of housing (single storey and mobile housing +)</td>
</tr>
<tr>
<td>Levels of risk awareness and preparedness (high awareness -, low awareness +)</td>
</tr>
<tr>
<td>Serviced by flood warning system (yes -, no +)</td>
</tr>
<tr>
<td>Previous flood experience (no experience +)</td>
</tr>
<tr>
<td>Access to decision-making (increased access -)</td>
</tr>
<tr>
<td>Trust in authorities (no +, yes -)</td>
</tr>
<tr>
<td>Social capital/networks (yes -, no +)</td>
</tr>
</tbody>
</table>

(+ = increases vulnerability while - = decreases vulnerability) (Tapsell et al., 2005)

3.1.2 Problems with the use of social indicators

The use of taxonomies of “vulnerable groups” such as those outlined above e.g. women, children, the elderly, is not without problems (Wisner, 2005). Vulnerability and resilience may be examined at a variety of levels e.g. the individual, the family, group, street, community, demographic groups etc. People or communities are resilient or vulnerable in the context of particular situations, especially their risk environments. It is important to remember that any person may belong to a number of the above cohorts and that families will contain members with different needs and strengths. Individuals and communities may each possess degrees of resilience that will vary over time and within each of these categories. Moreover, people may be vulnerable and resilient in different ways. A person may be vulnerable to a particular loss e.g. flooding of their home, but they may have resilience in terms of
being insured, having skills to repair damage or personal networks to provide them with emotional support. In this case their resilience is independent of the potential for loss or vulnerability.

Quality of housing will be an important determinant to a community’s vulnerability to a flood but is less likely to influence its vulnerability to drought. People with very different backgrounds and occupations may be equally resilient in totally different situations e.g. a person may be vulnerable to a particular loss such as flooding of their home, but they may have resilience in terms of being insured, having skills to repair damage or personal networks to provide them with emotional support. In this case their resilience is independent of the potential for loss or vulnerability. Some groups, e.g. farmers or small businesses may have special needs that are different from others in their communities.

Although there is truth that these groups may often have “special needs” and that there is empirical support for the use of such “check lists”, the taxonomic approach fails in that it produces too many “false positives” e.g. not ALL women are equally vulnerable. According to some writers (e.g. Buckle et al., 2000; Brown and Damery, 2002), this is a very limited view of vulnerability in that these categories have not been adequately explored and may give rise to a stereotyped and unenlightened view of risk and capacity for hazard response.

Moreover, vulnerability is not static; because someone is deemed ‘vulnerable’ at the present time does not mean that they will remain so (Tapsell et al., 2005). The same applies to the non-vulnerable; people may become vulnerable due to forces or processes such as aging, illness or redundancy, which are independent of adverse events such as floods. In addition, people may become vulnerable as a direct consequence of an adverse event. An example of this would be increased insurance premiums following a flood, which may result in insurance becoming prohibitively expensive, or it may be affordable but only at the expense of some other resource, thus compromising the individual’s or family’s quality of life.

Another problem is that although researchers are beginning to recognize the differential vulnerabilities of social groups, these analyses are often uni-dimensional, i.e. they focus on gender or race/ethnicity or age etc. but not on the interactions within and between several social groups. Although indicators may not in isolation make a person vulnerable, a combination of these indicators, or the relationship between indicators, may render an individual highly vulnerable (Dwyer et al., 2004). Therefore, we need to know how vulnerabilities are compounded to create the most vulnerable (Wisner 1993). Many of the indices apply additive models to produce their vulnerability scores. However, relationships of indicators can take many interactive forms, not all of which are additive, and which need to be considered. Cutter et al. (2003) also conclude that not all indicators are necessarily equal, and the need to develop a defensible weighting scheme is important.

There have been few studies comparing social vulnerability in differing cultural contexts. One example is that conducted as part of Task 11 in FLOODsite, which analysed social vulnerability of flooded and at risk populations in Germany, Italy, England and Wales, see Steinfuhrer et al. (2007). Many similarities were found across the four countries regarding social vulnerability, however, local culture and context was a key influencing factor. Institutional arrangements, previous flood-experience, frequency of floods, location, community size etc. all matter and can be summarised under the umbrella-term “risk culture”, which differs between and among regions.

The findings from Task 11 also suggest that there is evidence for certain groups being more vulnerable at certain phases of a flood event than others (De Marchi et al. 2007, 188-90; Steinfuhrer and Kuhlilke 2007, 113-5; Tunstall et al. 2007, 125-7); however, the situation is much more complex and ambiguous. Two findings were highlighted: firstly, no single social variable or set of social variables could be identified to explain all aspects of community vulnerability, coping and resilience in flooding. Several factors come into play in the different phases of a flood event and affect specific behavioural responses and coping activities. Secondly, context is key: both local conditions and event specifics need to be taken into account for explaining vulnerability. There is thus no universal catalogue of vulnerable groups; social vulnerability to flooding is always rooted in specific spatial, socio-economic, demographic and cultural contexts (Handmer, 2003).
3.2 Gender

As mentioned in various Sections above, natural disasters such as floods have been shown to have more adverse impacts on women than men in both more developed and in developing countries (Rose, 1993; Massey, 1994; Fordham, 1998; Ketteridge and Fordham, 1997; Morrow, 1999; Rashid, 2000; Rashid and Michaud, 2000; Tapsell and Tunstall, 2001; RPA/FHRC et al., 2004; Tunstall et al., 2007). Increased psychological symptoms have been found to be more common in female than male flood victims and also significantly more common than increased physical health effects in both sexes (Abrahams et al., 1976). Fordham (1998) suggests that women are often invisible in disasters as they are often confined to the ‘feminine space’ and private domain of the home and may suffer more inconvenience when their routine in the home is disrupted, being the chief homemakers and carers. Women, even when in full or part-time employment, are traditionally responsible for the management of the household. Moreover, a woman’s paid and unpaid care-giving responsibilities may position them to emotionally and materially sustain their families throughout the flood and recovery process.

Men and women may also express their distress in different ways, although socio-economic or ethnic differences may be just as important, or even more important, than gender differences. In the majority of the households represented in both quantitative and qualitative studies in the UK, it was the women’s health at all ages that was reported to have been most affected by the flooding, see Figure 3.1.

![Overall severity of the flood event by gender and age](source.png)

Figure 3.1: Mean scores for overall severity of flood event by gender and age

Some studies suggest that women or girls may be at greater risk than men or boys for PTSD and other mental health problems following exposure to disaster (Gleser et al., 1981; Steinglass and Gerrity, 1990). In 42 out of 45 studies (93%) of women or girls were affected more adversely by disasters than were men or boys, and the psychological effects were stronger and longer lasting. Effects occurred across a broad range of outcomes but the strongest effects were for PTSD, for which women’s rates often exceeded men’s by a ratio of 2:1. The effects of gender were greatest within samples from traditional cultures and in the context of severe exposure. For men, disasters may lead to changes in self-perception away from the traditional identity as protector of their families to one of helplessness. Men have admitted feeling distressed at not being able to do more during the flood event itself, as well as afterwards when working full-time and leaving their wives to cope with much of the recovery process (Tapsell et al., 1999; Tapsell and Tunstall, 2001).
3.3 Family factors

In many disaster studies reviewed by Norris et al. (2001a) other factors identified as modifying the impact of disaster exposure included: family strains, troubled interpersonal relationships, social disruption, occupational and financial stress. There are discussed in more detail below.

Familial factors have also been identified as modifying the impact of disaster exposure. Marital stress has been found to increase after disasters, and research suggests that strong marital ties can exacerbate the negative psychological consequence of disasters for female victims (Gleser et al., 1981; Solomon, et al., 1987). Solomon et al. (1987) found that although excellent spouse support attenuated male symptomology, its presence was associated with an exacerbation of symptoms in exposed females. They suggest the importance of considering both the positive and negative consequences of social involvement following disasters because, for women in particular, very strong social ties may be more burdensome than supportive in times of extreme stress. Strains in relationships were reported by 152 out of 982 respondents (16%) following flooding in the UK (RPA, FHRC et al. 2004). However, the experience of flooding has also been seen to strengthen some relationships, with partners providing strong emotional support for each other (Tapsell et al., 2003).

Mechanic et al. (2001) in a study of the 1993 Mid-western flood looked at 205 married/co-habiting women. Their findings showed incidents of physical aggression (a minority), emotional abuse, verbal abuse and anger from their partners. Whether this was greater than normal is not known. Other studies have reported domestic violence increases of 46% following Mt Saint Helens eruption (Adams and Adams, 1984), and marital stress being more prevalent among survivors of Hurricane Hugo who were severely exposed to the disaster (Norris and Uhl, 1993). Norris (2001a) states that there is little conclusive evidence that domestic violence increases after major disasters, however, evidence suggests that post-disaster prevalence may be substantial. It has also been questioned whether domestic violence influences women’s post disaster recovery. Mechanic (2001) found that it strongly influenced women’s post disaster mental health, while Norris and Uhl (1993) found that as marital stress increased so too did psychological symptoms such as depression and anxiety.

Being a parent can also add to the stress of disaster recovery. In a study by Allen and Rose (1998), children were highly sensitive to post-disaster distress and conflict in the family. Parents who were healthier, less irritable, and more supportive had healthier children. There is, therefore, evidence of a high correlation between child and parent stress in disaster situations. Providing care and support for overly stressed parents might be one of the most effective ways to care for and support a child (also see Section 3.5 below).

Financial stress and obligations to provide financial and social support to the family are other factors cited as impacting upon people’s psychological health and well-being following flooding. Evidence from the 1990 Towyn and 1993 Aberconwy floods in North Wales (which directly affected some 9,000 people) indicates that personal and family finance was one of the greatest concerns to those affected (Hill and O’Brien, 1999). Occupational stress and the problems of coping with flood recovery while in full or part-time employment were also commonly reported in UK research. For some the stress is doubled by their work premises also being flooded, which may also result in unemployment (Tapsell et al., 1999; Tapsell and Tunstall, 2001).

A lot of people couldn’t work initially. Many people [reported] sick and not for the physical illness. They couldn’t cope with what was happening and they couldn’t face going to work, and a lot of employers weren’t sensitive to that. (2000, female, 5 months after flood, Tapsell and Tunstall, 2001).

Lack of understanding by employers, work colleagues, family members and those living nearby who had not been flooded, can also lead to many people feeling socially isolated and abandoned (Tapsell et al., 1999; Tapsell and Tunstall, 2008).
3.4 Age

Findings on age as a factor affecting the impacts of disasters is still inconclusive. During severe floods the very young, frail and elderly may be at particular risk from loss of life (Jonkman, 2003). Ticehurst et al. (1996) report that older subjects in their study of earthquake victims in Australia, reported higher overall levels of PTSD symptoms than younger subjects, with women often being more affected than men. However, there is some evidence that elderly victims are less vulnerable to mental health problems and PTSD following disasters than are younger victims (Gleser et al., 1981; Tapsell et al., 2003). Huerta and Horton (1978) found that elderly persons cope quite well with disaster situations and tend to report fewer adverse emotional effects and feelings of relative deprivation than younger victims. Kilijanek and Drabek (1979) examined the effect of a tornado on the elderly by comparing pre and post disaster data from victims over 60 years old with data from younger victims. Older victims differed from younger victims in a number of ways, including their experience of the loss and strategies for recovery, but were not more adversely affected. Older victims were also no more likely than age-matched controls to report significant physical or mental health problems. In re-analysing data for FLOODsite Task 11, Tunstall et al. (2007) found no significant differences across age groups with regard to the overall severity of a flood event, see Figure 3.1 above).

However, middle-aged adults were most adversely affected in every American sample where they are differentiated from older and younger adults (Norris et al., 2001b). Some research suggests that this age group are more at risk because they have greater stress and burdens before the disaster strikes and they assume greater obligations afterwards. The elderly may have greater life experiences to draw from, experience in local issues or strategies, a wide network of friends and family, and personal strength drawn from many years of life. This was also evidenced in qualitative research in the UK (Tapsell et al., 1999; 2003). Therefore, rather than viewing older adults as an at-risk group, they could be viewed as a resource for disaster stricken communities. Communities might therefore want to encourage groups at very low risk, such as older adults, to assume a greater share of the burden for a community’s recovery by volunteering and participating in recovery activities following disasters. Cross-cultural research suggests that the effects of age may differ across countries according to the social, political, economic and historical context of the disaster setting. However, in Biswas et al.’s (1999b) Indian study there are no details on how different age-groups were affected.

3.5 Children

Is has been suggested that children are often among those who are the most affected by a disaster (Durkin et al., 1993; Allen and Rosse, 1998; Becht et al., 1998; Flynn and Nelson, 1998; Bokszczanin, 2002), yet there has been little research to date in this area. Findings from research following flooding in Towyn (North Wales) and the North East of England found some significant impacts on children, which some parents thought had been gnored (Hill and O'Brien, 1999; Tapsell and Tunstall, 2001). Balaban (2006) suggests that children are among the most vulnerable members of affected communities. For example, infants and children are not little adults and can be uniquely vulnerable to environmental toxicants. Children and adolescents with chronic conditions are at increased risk of adverse outcomes following disasters. At the time of Hurricane Katrina in the US, 27% of New Orleans residents were aged under 18 years old. Those with existing chronic conditions such as asthma saw this worsen and others missed hospital visits and ran out of medications (Rath et al., 2007). Those with chronic conditions were more likely to exhibit significant negative psychological consequences of the hurricane, overall sadness and withdrawal and behavioural changes. However, the sample was not selected by means of random sampling so it cannot be said to be representative of the general population. Following the 2007 floods in the UK, in a survey of 647 flooded households (GfK NOP, 2007: 361), 15% of respondents reported an impact upon their children’s physical health and 35% on their emotional health.

Research into children’s psychological responses to disasters and emergencies is thus still at an early stage and has often resulted in contradictory findings, although this may be due to use of a range of survey instruments of varying reliabilities (Evans and Oehler-Stinnett, 2006). Children have been known to suffer from PTSD, depression, anxiety and behavioural disorders following exposure to
traumatic events. An important impact on children is the disruption to their familiar routines. Many parents report that their children are anxious of a repeat flood event and become agitated during heavy rainfall. The loss of treasured possessions and even pets can deeply affect children and mothers have reported behavioural problems with their children following flooding. These problems have included sleeping problems, nightmares, and tantrums (Tapsell and Tunstall, 2001). These behavioural changes were also noted in children following the 1990 North Wales floods in Towyn (Hill and O’Brien, 1999). Durkin et al. (1993) also found that pre-flood none of the 162 children in their sample in Bangladesh were ‘very aggressive towards others’, but after the flood 16 children (9.9%) were aggressive and this was statistically significant.

A number of other issues were raised by parents following flooding in 2000 in the UK, these included: the lack of advice for parents on how to deal with children after a disaster such as flooding, and the sort of impacts they might face; the lack of support and childcare facilities where parents (especially single parents) could leave their children while they dealt with the clean up and recovery process; the lack of psychological or emotional support for children (Tapsell and Tunstall, 2001). Crèches and playgroups were set up in Towyn, following the 1990 flooding, which many parents found extremely helpful.

Evans and Oehler-Stinnett (2006) suggest that school psychologists should gain crisis preparation and intervention and trauma mental health training and need to understand the effects of natural disasters, such as economic loss, relocation and health concerns, including mental health stress on children. They suggest that a significant minority of children develop severe symptoms and PTSD.

3.6 Culture and ethnicity

There is little explanatory research available on the effects of culture and ethnicity in relation to the impacts of disasters. However, US research shows that the disproportionate risk of psychological distress for adult ethnic minorities appears to be both from (1) differential exposure to more severe aspects of a disaster and (2) culturally specific attitudes and beliefs that may prevent individuals from seeking help. In the US majority groups fared better than ethnic minority groups (100%), however, the effects were greater in developing countries than in the US (Norris et al., 2001b). Qualitative research in the UK found that respondents from ethnic minorities reported more health impacts than other respondents, particularly for women. They also reported feeling particularly isolated due to language problems, a lack of understanding of institutional responses, and cultural expectations which required women to remain in flooded properties (Tapsell et al., 1999; 2003).

3.7 Social support

Key among those factors fostering coping capacity at various phases of the hazard cycle is social capital (Pelling, 1998; Cannon, 2000). Adger (2000) defines social capital as the potential and actual personal relationships of an individual or a group of individuals and the resources which can be mobilized via such networks. Individuals respond to a perceived threat by mobilising personal and social resources; the availability of such support may serve to buffer or ameliorate the impacts of the threat. Social capital is made up of the networks and relationships between individuals and social groups that facilitate economic well-being and security. There are different types of social capital. For example, bonding social capital involves social connections that reinforce exclusive identities and homogeneous groups such as people from the same ethnic group or socio-economic status. In contrast, bridging social capital, which forms in the presence of weak ties, involves inclusive connections with people from different social groups. Bonding social capital is said to allow for only a limited expansion of access to information and social resources (Beaudoin, 2007).

Social capital and social support thus may mediate response to disaster exposure and there is evidence that disaster victims find support important. For instance, the incidence of psychiatric symptoms following the 1974 Brisbane floods in Australia was said to be directly related to dissatisfaction with help received after the flood (Abrahams et al., 1976). The Lewes (UK) Flood Aftercare Group was
formed by various statutory and voluntary sector organisations following the October 2000 flooding in the town. There was particular concern about the social recovery of people affected by the flood, and the group was seen as a success in providing emotional, informational, practical and social support to over 250 people (LFAG, 2001). In Alberta, Canada, residents of feedlot farms reported that their communities (family, friends, neighbours, church and employees) were more helpful in dealing with flood-related health problems than public and service delivery sectors. Few utilised healthcare services despite many reporting mental health problems (Acharya et al., 2007). Following Hurricane Katrina one study suggests that spirituality (church membership, attendance and prayer) among older Black women promoted emotional resilience in the aftermath of the traumatic event (Lawson and Thomas, 2007) and was a way of positive coping.

Another study following Hurricane Katrina measured social capital in terms of social interactions before and after the hurricane to identify predictors of health outcomes; findings support the evidence that social capital in positive forms can result in positive health outcomes (Beaudoin, 2007). Depression was more common among those with low levels of pre and post hurricane positive social interactions but high levels of negative social interactions (e.g. experience of violence and negative interactions). In China a mutual help system based upon extended family and kinship relationships was seen to be a significant source of support during flood hazards. Aid included moral support, provision of food and shelters and even cash loans to buy seeds and other equipment to restore production. The idea of loss sharing is emerging in rural China as an important flood-hazard adjustment, whereby local authorities in flood areas have begun to levy a sort of ‘flood tax’ on each household in recent years with the aim of building up a pool of emergency funds to assist needy flood victims (Wong and Zhao, 2001).

Brouwer (2006) studied the role of local resources (knowledge and social capital) following the Mozambique 2000 floods. Affected communities had to develop their own responses in areas which received little post-flood aid. Many people lost animals and tools in the flood. Responses focused on mutual aid drawing upon traditional livelihood practices of sharing (e.g. ploughs and animals) and reciprocity (lending draught animals to a person without such animals in exchange for work), particularly through the use of social capital. Traditionally, men and women tend to engage in different practices and this was evident in the post-flood coping strategies. The partners in most relations tend to be either socially unequal or live in different places. In this situation access to cattle was a major indicator of wealth as well as vulnerability. Gender is important and female-headed households often do not have cattle. The more activities people engaged in the larger was their safety net. However, the activities were not strong enough to deal with a disaster on the scale of the 2000 floods.

Not all studies have shown social support to be a positive factor and in some cases findings have been contradictory. Lutgendorf et al., (1995) in a study with Hurricane Andrew victims in Florida demonstrated that social support and optimism were significantly associated with lower illness burdens after the event. However, in another study of survivors from Hurricane Andrew, McDonnell et al. (1994) found that households that received some form of assistance were no more likely to report improved long-term recovery relative to those that received no assistance. In this case it appeared that disaster relief efforts had less impact on subjective long-term recovery than did job or income loss or housing repair. Green (1995) also found that the extent and type of social support received by victims of flooding seemed to have no effect on their reported stress or extent of disruption caused during a flood event.

Little is known about how coping and social support relate to health in PTSD. Green at al. (1985) suggest that inadequate social support relates to severity of PTSD and related symptoms, however the cause and effects of this relationship is unclear. A longitudinal study found that exposure to floods was associated with a subsequent decline in both perceptions of social support and social participation (Kaniasty et al., 1990). Another study found that initial levels of PTSD and low social support (but not poor coping) predicted subsequent physical symptoms (Solomon et al., 1990). No evidence of mediating or moderating roles for coping and social support were found, although it is suggested that
ultimately such roles may be important in understanding the relationship between PTSD and physical health.

Research for FLOODsite Task 11 in Germany (Steinführer and Kuhlicke, 2007) and Italy (De Marchi et al., 2007) focused specifically on assessing the role of social capital and social networks (formal and informal) on social vulnerability to floods. In Germany findings revealed that informal social networks (family to a higher degree than friends) were the most important source of support. Formal and informal networks before the flood event were relied upon in order to receive, refine and validate uncertain or unexpected information. In this respect, formal networks (e.g. official organisations) proved to be more trustworthy during the flood event than both weak and strong informal ties. During recovery people once again successfully activated their strong informal ties and social networks and received a variety of material, physical and mental support which often preceded the material compensations provided by public authorities. In relation to the spatial dimension of informal networks (close friends and family), findings showed that there are good reasons to argue both against and in favour of local strong ties in respect to coping with a disaster. In the situation of the 2002 Mulde flood, locally based networks were on the one hand partially dysfunctional because literally everybody was affected. Thus, for example, they tended to provide no valuable (surplus) information in before the flood since all members usually relied on the same sources of information. Hence, exclusively local networks could not fulfil their main function when the general situation was very uncertain. On the other hand, being faced with the same situation also contributed to feelings of collective solidarity. In this phase of the event – but, not surprisingly also in the post-flood period – people with social networks exclusively located outside the region were relatively disadvantaged in comparison with people who could mobilise local or regional contacts (Steinführer and Kuhlicke, 2007).

In Italy both formal and informal social networks were shown to play a support role. Before and during the flood events most support was provided by family and relatives, followed by voluntary organisations, mainly the local fire brigade, which played a more important role than the municipality and civil protection service. Not surprisingly, local firemen were also considered the main ‘safety catalysts’. Local fire brigades have a very long tradition in the Italian research areas: their effectiveness is well known and is mostly based on local attachment, deep knowledge of the territory, training in facing emergencies, capacity of coordinating and managing crises and intervening in the short term (De Marchi et al., 2007). The role played by other kinds of networks were also analysed but no relevant findings were found. Indeed social network types (family, friend, mixed, no network), location (local, external, mixed, no networks), advice and support networks (in both cases formal, informal, mixed, not necessary) were not shown to play any significant role in influencing respondents’ behaviours, attitudes, or expectations in almost all the different phases of the flood events. However, ‘community embedding’ was seen to have played a role, especially during the events. Respondents with a low community embedding proved to be more vulnerable: they received less help during the events, showed a lower level of knowledge about floods, considered their communities less prepared to face future events, and gave more negative judgements about changes in community life after the events (e.g. changes regarding solidarity between town residents, trust in local authorities, risk awareness).

Moreover some findings revealed a close link between the relevance attributed to informal networks/social capital and the level of trust in local authorities. In those communities where the level of trust in local authorities was weaker, social capital and informal networks weighed more in the residents’ evaluations about community preparedness. Also informal networks were considered more positively as safety catalysts. This lead to the conclusion that where trust in local authorities and expert systems is weaker, residents tend to rely more on their own resources (i.e. personal networks). This is

---

2 The original “strength of weak ties”-hypothesis was developed by Granovetter (1973, revisited in 1983). It holds that heterogeneous social networks resting in various social and local contexts have more and in particular more diverse information about a certain topic (in its original application referring to labour markets and getting a job) than a dense network consisting of persons who are similar in various socio-economic and socio-demographic dimensions.
probably not by chance as confidence in these networks has “replaced” the lack of trust in local authorities and expert systems.

Although the case studies in England and Wales re-analysed for Task 11 did not focus specifically on communities and community vulnerability, some observations were made from the individual and household data regarding some of the issues raised above (Tunstall et al., 2007). Social capital as such was not examined in the studies but the issues of social support following flooding, length of residence, the receipt of flood warnings, and area house prices may be related factors in explaining community vulnerability. The findings confirm what previous qualitative research has shown, that flood events do to some degree engender a community spirit and mutual help among those affected (Tapsell et al., 1999; Tunstall and Tapsell 2001). Levels of social support within the community can be demonstrated by the help received from neighbours and friends. Neighbourliness and community cohesion played a part in generating actions to prepare for flooding and to protect property, although there was no evidence that such help actually mitigated the effects of flooding. There were some significant differences in preparedness actions taken of those who did and did not receive outside help. In one survey, the amount of help available within the household was not significant, but being given help from outside the home in protecting property and preparing for flooding was a significant factor. There were also marked differences in the level of help received from outside the household during the floods, although somewhat different questions were asked in the different studies and may partially explain these variations. Neighbours and friends were revealed as the leading helpers but forms of help varied significantly in the different locations targeted. Both the social composition and social cohesiveness of the areas and the characteristics of the flood events may contribute to this variation.

Receiving help also varied according to certain social characteristics, such as social grade. Those in the lowest social grade groups were significantly less likely to be helped by neighbours than higher social groups. This was also true for those living in vulnerable housing, the elderly, those with poor prior health, households with ill or disabled persons, and single person households. Tenure was also significant, with renters less likely to be helped in this way. It appears therefore that there was no more, and in some cases less, help forthcoming for those who could be regarded as socially disadvantaged. It may be that many within these groups are less embedded into local support networks and therefore may get overlooked when it comes to neighbourly help. Households with children aged ten or under were more likely to be helped by neighbours and friends than other households. It is possible that these families received help because of their greater local network connections. People who have been living at the same address for a number of years should also, in theory, be more integrated within their local community. However, length of residence was only a significant factor for receiving help from neighbours and friends in one survey. In that survey, flood experience (often linked with length of residence) was also significantly associated with getting help of all kinds, with those who had experienced previous flooding more likely to be helped in some way. Other factors such as the depth and extent of flooding were also significant in the help received, but those helped tended to have higher vulnerability scores, probably because those who attracted help from outside the home were more seriously affected by the flooding. Thus such help did not emerge as a mitigating factor in vulnerability (Tunstall et al., 2007).

Therefore it is still unclear which forms of social support are most effective, and whether support may even have little effect upon health outcomes. Access to social support needs to be further explored. It is crucial to understand the processes that influence the receipt or mobilisation of post-disaster social support. The rule of relative advantage acknowledges that the distribution of post-disaster help is often dependent upon network size, help-seeking, comfort and economic well-being; therefore, it is not necessarily allocated by need.

### 3.8 Psychological debriefing

The intense debate as to the most effective ways to intervene immediately following a traumatic or disaster-related event remains unresolved. For example, there is some confusion about whether psychological support services are helpful following disasters or whether they do more harm than
good. Although there is a need to provide some form of early intervention and crisis support (Eyre, 2002), conclusions drawn from studies on Psychological Debriefing (PD) are mixed. The efficacy of a long-standing psychological debriefing procedure, Critical Incident Stress Debriefing, has been questioned as it has been said to yield disappointing results and may even have adverse impacts on participants (Kenardy and Carr, 2000; Combs, 2007). Findings do not confirm the efficacy of a one-session intervention shortly after trauma. PD does not necessarily decrease psychological disturbances after a trauma, and some studies found that a single session may hinder natural recovery.

It is recommended that intervention does not take place in the initial aftermath period; if people present themselves to clinics or counsellors requesting help, single session contact should be avoided. It is suggested that people should be scheduled for 2-3 visits over a 2-6 week period. People who continue to experience severe distress that interferes with normal functioning up to three months after the event are at higher risk of continued problems and should be referred for appropriate treatment (NCPTSD, 2001). This does not mean that appropriate trauma interventions are not helpful, but as the principal form of psychological intervention in the aftermath of a disaster, this approach is likely to lack relevance to the needs of the vast majority of disaster survivors. There is no convincing evidence that debriefing reduces the incidence of PTSD and some controlled studies suggest that its use may impede natural recovery from trauma.

An alternative crisis intervention method recommended is that of Psychological First Aid (Combs, 2007). This focuses on meeting each individual’s crisis-related psycho-bio-social needs in a practical manner, through the development of an action plan for recovery. Although this approach still requires continued empirical analysis it is now widely cited in the literature (Combs, 2007). One early intervention method for disaster-related mental health services little tested to date is that of telephone hot-lines for disaster survivors and first responders. This approach was widely used following Hurricane Katrina to offer psychological assistance on an as-needed basis to callers experiencing mental, emotional and/or behavioural distress, and was reported to have been successful. It aims to help listen to people’s concerns and then to formulate an action plan designed to structure the forthcoming hours and days. Both listening and formulating a plan are widely accepted components of the Psychological First Aid approach (Combs, 2007).

A psychosocial support programme was launched in Sri Lanka following the 2004 Tsunami by the Ministry of Health, the WHO and others aimed at reaching survivors through the use of community level workers and providing them with appropriate services. The duties of the community workers were to provide social support, meeting the needs of day-to-day life, obtaining aid etc., and providing psychological first aid and identifying those who needed specialised mental health services (Abeykoon and Karalliedde, 2006).

Health-related responses and policies to promote population resilience to flooding must include practical support for individuals who are flooded and provision of adequate psychological support (Reacher et al., 2004). Yet, few national disaster plans explicitly address measures to deal with psycho-social aspects of flooding (PAHO, 1999). NSW Health (2000) in Australia stress that mental health ‘first aid’ (in terms of psychological first aid, triage, assessment, referral and interventions) needs to be part of an emergency health care response. Outreach activities may include psycho education, revisiting pre-existing ways of coping, ensuring medication of psychiatric cases, and creating self-help groups.

3.9 Psychological resources and ways of coping following disasters

Norris et al. (2001c) reviewed the empirical literature on psychosocial resources in the aftermath of natural and human-caused disasters. Protection afforded by psychological resources included: ways of coping (which can be positive but not always helpful e.g. avoidance coping, blame assignment); beliefs about coping (often more important than actual coping, perceptions about capabilities to cope); self-efficacy, mastery, perceived control, self-esteem, hope and optimism. Protection afforded by social resources included level of social embeddedness, and received and perceived social support (see
above Section). In the latter case those who believe that they are cared for by others, and that help will be available if needed, fare better psychologically than those who believe they are unloved and alone. Smith (1996) reports active coping as being associated with less psychological distress among flood victims when tested at six weeks and five months after the 1993 Midwest flooding in the US, while avoiding coping was associated with greater psychological distress.

Otto et al. (2006) found that in a study of the 2002 floods in Dresden, Germany, a positive outlook on life and people’s belief in a just world was able to buffer psychological symptoms following a natural disaster. Conversely, unjust-world belief significantly correlated with depression, anxiety and psychological distress; the more victims believe in an unjust world, the more their general psychological symptoms were increased. Women were found to be at a higher risk of such symptom load. However, belief in a just world did not buffer against PTSD-like symptoms.

One form of coping reported in some of the literature is the increased use of alcohol and prescription drugs. There are some indications that substance abuse may increase following exposure to disasters (IPCC, 2001; Tapsell and Tunstall, 2001). However, alcohol abuse does not appear to be a common reaction. Rates of onset of alcohol dependence after a disaster range from 0% to 2% (NCPTSD, 2001b). People who had significant problems with alcohol before a disaster are likely to have problems after. Using alcohol occasionally as a way of coping is more common, in about 15% of disaster victims on average (from 6% to 40%); the higher rates tend to be for those people with other psychological diagnoses. Virtually no cases of new onset drug abuse emerged in any of the studies reviewed (NCPTSD, 2001b).

In Carlisle, loss of motivation to pursue personal interests and hobbies following flooding was reported, when in fact taking part in such activities would probably have aided people’s recovery (Fernandez-Bilbao, Twigger-Ross et al., 2008). The importance of keeping up routine social activities is important, as these organised activities help to maintain social networks and support camaraderie.

Post-flood anxiety has been reported by flood victims in a number of qualitative studies (Tapsell et al., 1999; 2003; Tapsell and Tunstall, 2001). According to Beck (1976), the factors involved in the occurrence of more severe and persistent anxiety can be divided into two categories:

1. factors that lead people to experience relatively greater levels of anxiety (e.g. the experience of being flooded);
2. factors involved in the maintenance of high levels of anxiety (e.g. subsequent heavy rainfall and anxiety about future flooding, and lack of confidence in the responsible authorities to provide protection from flooding or a flood warning).

In psychology, cognitive theory proposes that people experiencing anxiety believe that they are threatened with either physical or social harm. Whether or not the harm they fear is objectively present is immaterial to the experience of anxiety (Salkovskis, 1966). One of the hallmark symptoms of PTSD is physiological reactivity to traumatic reminders, which in the event of flooding has been shown to be heavy rainfall (Tapsell et al., 1999; Tapsell and Tunstall 2001; RPA/FHRC, et al., 2004). Beck, Emery and Greenberg (1985) describe a useful conceptualization of the cognitive component of anxiety which appears relevant to flooding:

\[
\text{Anxiety} = \frac{\text{Perceived probability of threat} \times \text{Perceived cost/awfulness of danger}}{\text{Perceived ability to cope with danger + Perceived “rescue factors”}}
\]

Tapsell and Tunstall (2006) applied this conceptualization to studies of people affected by flooding and found evidence from the literature that the perceived probability of the threat of future flooding multiplied by the perceived costs and impacts did appear to increase levels of anxiety. There also appears to be evidence that aiding people’s capacity to cope and providing appropriate, adequate and timely support (rescue) may serve to moderate mental health effects and thus reduce levels of anxiety.
An individual’s capacity to come to terms with a traumatic experience is greatly influenced by his or her social context. Secure, supportive relationships are essential for the victim’s communication and processing of the traumatic experience and eventual recovery. This suggests that psychosocial resources could be targeted after a disaster at those who are identified as socially isolated. Yet few mental health services are prepared for the psychiatric casualties of trauma (Hobbs, 1995). To be effective, the psychosocial response needs to be comprehensive and integrated. Health service providers need to work closely with social services, primary care and community health services, voluntary organisations and other relevant agencies (Hobbs, 1995). Moreover, disasters can have an impact on people at progressively greater geographical and temporal distances from the trauma incident e.g. on friends or relatives of victims or survivors, on front-line hospital staff, and on media personnel; this aspect of flooding has been poorly researched to date. The impacts on front-line workers and responders, both short and long-term, have often gone unrecognised.

3.10 Preparedness and awareness

It is now acknowledged that preparation and planning for natural hazards such as floods can help avoid or reduce damage and losses and thus many negative impacts including those on human health. There are many ways in which people can prepare and plan for floods; with the increasing risk these measures will become even more important. Pre-disaster strategies, such as flood warning systems and preparedness plans, along with flood mitigation measures, are very important in reducing vulnerability. Key factors in preparedness and planning for floods are awareness and acceptance of the risk and a desire and ability to take mitigating actions. Awareness is often related to past experience of flooding and it is difficult to raise awareness where no history of flooding exists. This has particular implications for areas with a low probability of flooding, but where the potential consequences could be high (Shaw et al., 2005). Being aware of flood risk and/or experience of flooding has been highlighted as a key factor in whether people adopt flood warning technologies (e.g. Tapsell et al., 2004; Fielding et al., 2006).

Individual, group and societal factors are known to affect perceptions of risk (Petts et al., 2002). Fielding et al. (2002) found the following factors to decrease the level of flooding awareness, and therefore preparedness, in ‘at risk’ areas and to increase vulnerability (in order of impact):

- No previous flood experience
- Social class C, D, E (i.e. lower socio-economic groups)
- Living in rented accommodation
- Newly resident within area e.g. up to one year
- Not serviced by a flood warning system
- Unemployed
- Aged under 45 or over 55

Research by Tunstall et al. (2007) and Burningham et al., (2008) also found the following factors to have an important effect on flood risk awareness:

- flood experience
- length of time at present address
- tenure
- age
- social class (with this being the most significant in predicting awareness).

The literature on vulnerability stresses the primacy of public risk perception and understanding in mediating the success of attempts to increase hazard resistance and resilience (Brown and Damery, 2002). The way the public understands such information is critically important in informing risk perceptions, determining behavioural responses during a flood event and, therefore, influencing hazard vulnerability at both an individual and a community level. Flood risk information is often framed
using technical concepts and notions of statistical probability such as ‘return periods’. These issues feed into public expectations about the role of flood management institutions, and therefore the behaviour adopted when receiving communications regarding flood probability from ‘official’ sources. According to Brown and Damery (2002), the lay public have a fundamentally different intellectual standpoint from that of the experts, which should be taken into account when technical information about flood risk is disseminated. The ‘information-deficit’ model widely applied in the past (i.e. that if people have information they will take the necessary actions) is said to neglect the socially embedded and contextualised manner in which people make sense of the world, and onto which individual vulnerability is overlaid.

Attempting to communicate information such as that on climate change with reference to increased flooding is thus likely to be ineffective (Whitmarsh, 2008). This is particularly true where audiences differ from communicators in their view on the cause of flooding and do not trust the institutions communicating or managing the risks (Tapsell et al., 1999). Thus a ‘culture of blame’ may develop with flood risks being open to social definition and different interpretations and constructions (Cutter, 1993). Lack of trust in responsible authorities can be a significant factor affecting socio-psychological responses to floods and can impact upon how people engage with risk information they receive from these sources.

Issues of societal risk understanding and perception are now recognised as crucial to the success of environmental management policies. Brown and Damery (2002) suggest that despite the important link between assessments of exposure to flooding (hazard assessments) and issues of social vulnerability, the link has rarely been explored in detail and has often been reflected in policy terms by a highly technocratic approach to flood risk management. A rigid and deterministic definition of vulnerability is often favoured that is in keeping with the wider technocratic paradigm that pervades management institutions. The authors call for a movement away from the technocratic ideals of hazard management and advocate the need for greater integration and balance between technical dimensions of hazard management and the corresponding issues of social vulnerability. Twigee-Ross et al., (2008) have also called for a more socially accountable, engaged and collaborative form of flood risk management and thus for a shift from a technical to a socio-technical approach.

Responses to risk are intimately bound up with wider values. Risk is multidimensional with perceptions directly influenced by belief systems, experience, and individual characteristics. In those locations where flooding is frequent or recent, perception is normally higher and people are more likely to be prepared. Messner and Meyer (2005) state that if (average) flood risk perception is low in a region, then many people (including experts and politicians) do not perceive themselves to be at risk. As a consequence, people will not take any actions to decrease the flood risk or to prepare for a flood event, often contributing to negative health outcomes.

In disasters of smaller magnitude, there is evidence that prior experience with the specific type of event may reduce anxiety. People who have previous experience show higher levels of hazard preparedness and are more likely to evacuate when authorities suggest they do. Norris and Murrell (1988) in a study of flood victims in Kentucky found that, while controlling for pre-flood symptoms, there were modest flood effects on both trait anxiety and weather-specific distress in older adults without prior flood experience, but no flood effects in older adults who had been in floods before. The study provides support for the “innoculation hypothesis” and other conceptualisations that emphasise the advantage of being familiar or experienced with a stressor that is at hand. Other evidence indicates that where people are aware of the risk, even if subsequently flooded, the health effects are likely to be less pronounced (RPA/FHRC et al., 2004). An implication from this is that “experienced” victims could be a valuable resource in prevention efforts. However, Tunstall and Bossman-Aggrey (1988) reported that previous experience of flooding did not leave residents with knowledge about how to cope with a future flood, but with a feeling that there is little they can do. This ‘loss of control’ may be a stressor in its own right and can explain the high levels of continuing anxiety and worry expressed by residents. Other research suggests that the more a person is exposed to a disaster the more they are
likely to feel an impact. A “dose-response” relationship was found in studies with survivors of the Mount St Helens volcanic eruption.

Evidence from England (Pitt, 2008; GiK NOP, 2007; Tunstall, et al., 2007), Italy (De Marchi et al. (2007) and Germany (Steinführer and Kuhlícke, 2007) shows that even though people may be aware of flood risk this does not mean that they take actions to prepare themselves and that relatively few people take effective individual damage avoidance measures on receipt of a flood warning. There is often a tendency for people to deny personal flood risk even if people perceive their local area to be generally at risk; that risk does not necessarily translate to their own property (Burningham et al., 2008; Steinführer and Kuhlícke, 2007). Harries (2008) argues that one reason why people do not prepare for flooding is because such measures are perceived as endangering other needs that are more immediate and pressing, such as protecting their emotional security and existing representations of security (e.g. the home being a safe place) which may result in denial of being at risk. For others, flood mitigation measures such as flood gates were rejected as they lessen the visual conformity of their homes to an idealised norm, and even reduce the value of properties. The maintenance of high levels of anxiety following flooding may or may not lead to people taking actions to mitigate the risk of future flooding. The importance of emotions to risk perception is beginning to emerge (e.g. Slovic et al., 2002) but its impact on risk response has as yet received little attention. Harries (2008) suggests that most householders will only take action to protect themselves if they feel confident that such action will not increase their anxiety.

All of these perceptions and behaviours are related to people’s social constructions and evaluation of the risk (Steinführer et al., 2007). There is thus a need to understand the role of risk attitudes and risk perceptions in individual decision-making behaviour, and how such a risk behaviour framework may be used as a tool to formulate effective response strategies.

3.11 Disaster management and mitigation

Any possible increase in the occurrence of future floods caused by climate change is likely to have implications for human health. To reduce these human health impacts it is important to prevent human populations from exposure to floods as much as possible by the use of pre-disaster strategies. Much of the current planning policy and practice fosters an environment susceptible to flooding (White and Howe, 2002). There is now a realisation that true flood prevention and mitigation will need to address not only the hydrological factors, but also the economic, social and political factors influencing wider society and underpinning the impact of damaging floods. Response to flooding has also changed to an emphasis on the reduction in loss of life and property through mitigation, preparedness, response and recovery (Cutter et al., 2000).

Hard engineering structures alone are no longer able to provide the most cost-effective flood protection for people, and benefit cost analysis in option appraisals for flood protection is moving towards considering the more ‘intangible’ social aspects of flood impacts, such as that on people’s health and well-being, as well as the more traditional economic impacts (RPA/FHRC et al., 2004). Disaster prevention, mitigation and preparedness are related to disaster management and require active and effective participation of disaster management institutions and experts. The way in which any major disaster is managed is a key factor in influencing recovery. For flooding, the emphasis on flood risk management has now moved away from reliance on physical control and structural measures towards reducing human vulnerability through non-structural approaches such as those of flood forecasting and warning systems, land use planning, flood-proofing, insurance, and self-help strategies. A key area relating to institutional vulnerability that has been identified in England and Wales is the issue of flood warnings (Tunstall et al., 2007). Evidence indicates that receipt of a flood warning may help to reduce negative health impacts from floods.

The notion of sustainable floodplain development focuses on the use of an integrated approach to flood-hazard mitigation and prevention (Mileti et al., 1995). A policy of sustainable floodplain development would promote ‘living with floods’ by establishing the social connections needed to
accomplish emergency relief tasks and to strengthen people’s preparedness to anomalous floods. Living with floods may become a reality for many people in the future. Villagers in China who have adapted to living with low level floods but have requested better emergency relief and rehabilitation programmes following particularly disastrous floods (Wong and Zhao, 2001). Functional adaptation strategies are likely to play an increasingly important role in mitigating the impacts of future flooding. The success of these strategies will depend largely upon the cohesiveness of the social networks in the affected communities and the preparedness of their members. Hazard-resistant building design standards could reduce the chance of housing damage and the losses and stress experienced by people living in flood-prone locations.

Results from the literature indicate that many of the health impacts of flood events could be prevented or reduced. Floods are much more geographically specific than many other hazards and it is possible to predict with good accuracy the extent and magnitude of many flood events (Penning-Rossell et al., 2005). What is also interesting from the UK research is that many of the key factors that appear to influence the mental health effects of flooding are those which are susceptible to human intervention and management (Tunstall et al., 2005). Notably, measures such as having adequate insurance cover, and more particularly, the way in which insurance companies process flood claims, can have a highly significant impact on health outcomes. Much therefore depends on the efficiency and professionalism of insurance company personnel and building contractors, as well as help made available within communities by local authorities and emergency services. This suggests that the management of post-flood response by community and professional agencies can have a significant impact on mental health outcomes and needs to be more seriously addressed by all those involved.

Health services providers must also be prepared and develop appropriate strategies based on levels of flood risk in their areas. Surveys of health ministries carried out by the World Health Organization (WHO) found a wide variation in preparedness and response activities among the 52 European Region member states (Menne, 2005). Despite a 2004 WHO and European Environment Agency working group agreeing that the prevention of health effects due to weather and climate events should be included among national health priorities, there is inadequate evidence of the effectiveness of public health interventions following flooding (Hajat et al., 2003). Maintenance of existing public health responses to flooding is important to sustain the low risk in industrialised countries. Surveillance of flood-related morbidity and mortality, vector populations and environmental health should continue throughout the response and recovery periods (Malilay, 1997). More and better quality data and centralised and systematic national reporting for deaths, injuries and psychological impacts from floods are needed using standardised methodology. Very little is known on flood morbidity and mortality using routine data sources or pre-existing cohorts, impacts of floods on health care systems and the effectiveness of flood early warning systems (Menne, 2005). Moreover, only focusing on extreme events may miss significant health impacts, therefore frequent and extreme events may need different intervention and preparedness strategies.

Public health authorities must assume a co-ordinating role as well as acting as primary advocates for health. Each should review the specific needs in their own areas in order for each locale to provide a tailored response. There is thus a need to provide better post-event care and advice for those who have been affected. The possible locations of particularly vulnerable groups within communities need to be identified and provision made for providing support to these people (Penning-Rossell et al., 2005; Menne, 2005). There is also a need for the identification and provision of health services for individuals with post-flood mental health problems. This may include Psychological First Aid and therapies such as cognitive restructuring to help people to reassess their perceptions about flooding and their ability to cope with potential future flood events (Tapsell and Tunstall, 2006).

As well as emergency response during a flood event, medium to long term interventions may be needed to support populations who have been flooded. These should include initiatives such as public health authorities being alerted to the possibility of post-flood diseases and injuries, and for health care providers to be prepared for increased demand on their services. Public guidance should be issued that
includes advice on health measures before, during and after floods (Tapsell and Tunstall, 2006; Pitt, 2008). Moreover, health services need to assess their own vulnerability to flooding and take necessary precautions to reduce their own risk and potential damages.

Mediating factors between stress and health may include flood warning, coping strategies and social support; however, where flooding is unexpected, sudden and without warning, these may be weakly developed or non-existent. Self-help measures to reduce the damage to property and the stress caused by flooding can be encouraged, thereby alleviating some of the negative consequences on people's health. These measures include development of a household, business or community Flood Plan along the lines of those widely used in the USA, and other community preparedness developments. Where feasible and cost-effective, flood alleviation schemes may also be considered, along with development control legislation to restrict new building in the floodplain. Practical property-level resistance and resilience measures can also be used to mitigate flood damages and reduce recovery time. These measures include permanent and temporary flood proofing measures and adaptation of properties. The function of these measures is to reduce the amount of ingress of floodwaters into properties, or at least to hold back floodwaters long enough to enable homeowners to move people and belongings to a safe place, thereby reducing the levels of damage.

Finally, measures to improve income levels and to address inequalities within societies are key to improving resilience to future natural hazards such as floods. These measures need to be addressed by national and local governments.
4. Impact assessment methodologies

One objective of this study was, where data is available, to quantify the health impacts of floods and the factors contributing to adverse health effects. Many of the studies cited in the literature discussed above have attempted to carry out such quantification, in most cases for specific isolated flood events. However, as highlighted in Section 2.2, there is generally still a paucity of data on floods and human health, as well as methodological issues with sampling and general research approaches, and still a lack of systematic collection of health data in relation to floods. The following section outlines some current methods and impact assessment tools and approaches which are used to assess potential impacts of various future developments and proposals, rather than collecting data following a specific event. It is suggested that the suitability of some of these approaches (or adapted approaches) could be assessed in relation to their potential use for determining the health impacts of flooding, although this was beyond the scope of the current research.

4.1 Social Flood Vulnerability Index

The first methodology is not an impact assessment tool but rather one that assesses social vulnerability within populations at risk of flooding. This social vulnerability may also be an indicator of potential health impacts. The Social Flood Vulnerability Index (SFVI) was originally developed for Catchment Flood Management Plans in England and Wales for the development of a modelling and decision support framework and in order to map possible levels of vulnerability within locations that might influence flood impacts (see Tapsell et al., 2002). The choice of data used within the index is constrained by the need to (a) use data that is available for the whole of England and Wales and (b) use data that is available for small geographical areas; this data was available from the national Census.

The SFVI is a composite additive index based on three social groups (the elderly aged 75 and over, single parents, and the long-term sick) and four financial deprivation indicators (unemployment, overcrowding in households, non-car ownership, and non-home ownership). The rationale for the selection of these variables was based upon existing research. To identify the financially deprived, a deprivation index (the Townsend Index) was used because, unlike other deprivation indices, it focuses on deprivation outcomes (such as unemployment, overcrowding, non car ownership and non home ownership), rather than targeting predefined social groups. This enabled identification of a social classification and is important because financial deprivation is only one of several factors that are said to contribute towards vulnerability to flood-effects. It was the intention to target only those social groups which previous research has shown to be particularly vulnerable. The SFVI has proven useful in highlighting areas particularly vulnerable to the impacts of flooding, including health impacts, and results can be displayed in GIS format.

4.2 Social and Environmental Impact Assessments

Social Impact Assessment (SIA) is not a single method but a collection of tools and approaches, and as such it usually requires a team approach. (IAIA, 2003) Assessment methods used are diverse and range from large-scale formal studies to participatory research, and may often use rapid rural appraisal techniques. The selection of relevant tools and methods depends on the context and resources, but normally involves collection of both quantitative and qualitative data. Most of the evidence is primary data from the affected area such as survey research, informant interviews, oral histories, participatory group exercises. Secondary sources that can be used include census data, geographical data (including maps), national and local government statistics, governmental and non-governmental documentation, newspaper reports and previous research. Inclusion of local stakeholders is crucial to the success of SIAs. It has proven difficult, if not impossible, to develop international guidelines for SIA as regulatory, cultural/religious and socio-economic priorities vary greatly. In general SIA can be understood as a framework for evaluation of all future impacts on humans of specific developments or policies and on all the ways in which people and communities interact with their socio-cultural,
economic and environmental surroundings. The technique is said to be best suited to country or programme level initiatives where relevant data sets are more likely to be available.

Environmental Impact Assessments (EIA) are often conducted on many new developments as part of the planning process, often in association with SIAs. There is currently wide interest in developing tools for assessing the impact on the health of the local population of proposed developments that will cause environmental changes. A computer model called ARMADA (Age Related Morbidity And Death Analysis) has been developed which provides a framework for investigating such health impacts (Utley et al., 2003). ARMADA generates estimates of age-related patterns of morbidity and mortality within the local population. The estimates incorporate the demographic features of the population in question and base-line information about the incidence of the disease classes being considered. It is currently unclear what the potential might be for using ARMADA to assess health impacts of flooding, but the possibility could be explored when considering plans for new developments within floodplains.

4.3 Environmental Health Impact Assessment

A component of EIA dealing specifically with impacts on human health is often called an Environmental Health Impact Assessment or EHIA. Fehr (1999) sets out a ten step approach to EHIA, shown in Figure 4.1, which has been successfully applied in studies in Germany (e.g. for assessing the impact of environmental pollution on human health). Many similar studies have been conducted using similar methods in other countries such as the UK, Canada, the US, and New Zealand (Fehr, 1999).

EHIA demands special efforts to communicate the underlying assumptions, the resulting predictions and the assessments correctly and efficiently to all parties. Risk comparisons and visualization methods may be helpful in this respect. Moreover, the assessment of predicted impacts necessarily implies subjective decisions. Fehr (1999) concludes that the coverage of human health aspects in EIA still tends to be incomplete. Possible reasons include:

- The complexity of the task of prospective impact assessment
- Insufficient provision of specific methods, tools and instruments
- Inadequate access to data that are both current and reliable
- Lack of systematic evaluation of EHIA applications
- Public health departments are often left out of participation.

4.4 Health Impact Assessment

Health Impact Assessment (HIA) is a relatively new multidisciplinary process and its potential as a tool for assessing disaster risk or vulnerability has not yet been fully explored. HIA views a range of evidence within a structured framework through a variety of procedures and methods, often integrated with EIA and SIA early in the planning cycle. It uses checklists of determinants as indicators of changes in health risks. Health inequality is a central issue and identification of the most vulnerable groups is very important (ProVention Consortium, 2007).

HIA is a multidisciplinary process which comprehensively examines potential health effects of a particular proposal or development considered within a structured framework based on a broad model of health which proposes that economic, political, social, psychological and environmental factors determine population health. HIA is a combination of different procedures, methods and tools by which a policy, programme or project can be judged regarding its potential health effects on a population, as well as the distribution of those effects within the population (Veermann et al., 2003). There is no such thing as HIA methodology per se. Rather HIA borrows from a wide variety of fields including epidemiology, risk analysis, economics etc., adapting and applying methodologies as dictated by available data and the information needs of policy-makers and stakeholders. The methods used to estimate effects on determinants of health are thus diverse, which is not surprising considering
the diversity in factors that influence health. For physical and chemical factors methods are well developed, models are also available for traffic flows and accident rates. As a consequence of a narrow evidence base no such models are available for many other determinants. In the cases reviewed by Veermann et al. (2003), estimates were commonly made on the basis of (unpublished) data or information provided by project developers. The latter source may introduce systematic bias. According to Veermann et al. (2003), in the absence of standardised, validated methods and readily applicable data, some authors display substantial creativity in quantifying socioeconomic determinants. These efforts should be critically evaluated so that they may contribute to the development of a more uniform and robust approach.

Figure 4.1: EHIA ten step approach (Fehr, 1999: 619)

In practice, the emphasis in HIA is often placed upon community consultation and on formulation of recommendations for a health-maximising implementation of the policy or project at stake, with less attention for the actual health consequences that might result (Veermann et al., 2003). Quantification of health effects in HIA has a number of advantages. Firstly, knowing the size of an effect helps decision makers to distinguish between the details and the main issues that need to be addressed and facilitates decision making by clarifying the trade offs that may be entailed. Moreover, adding up all positive and negative health effects into a net effect permits the use of economic instruments such as cost effectiveness analysis, which further aids decision making. However, there are two difficulties in quantification: the availability of valid data, and the availability of methods to analyse the data and translate them into information on the health effect of the proposal under scrutiny. Veermann et al. (2003), concentrated on the latter problem and analysed reports of HIAs using a framework in which policy decisions influence health via its determinants. This divides the HIA process into two steps, which are referred to as “exposure impact assessment” and “outcome assessment” respectively.
Veer mann et al. (2003) discuss what methods are used in quantitative exposure impact assessment, and secondly, what methods are used for quantitative outcome assessment.

Few socioeconomic and behavioural determinants are quantified up to the level of health outcomes. One of the problems may be that a stable evidence base is lacking. Unlike physical and chemical substances, socioeconomic and behavioural determinants are context dependent. This means that the evidence is only generalisable to a limited extent across time and space, and that the degree of standardisation achieved in EHIA will be hard to match in HIA that focuses on other policy areas. The measures of health outcome used in different studies are quite diverse, ranging from numbers of deaths in a specified population, to hospitalisations for asthma and injury only accidents. This diversity is justified by differences in the research questions that need to be answered, but it hinders comparison of effects. It would be useful to additionally express health outcomes in a summary measure of public health such as the Disability-adjusted life year (DALY). DALYs combine life years lost (or gained) and time spent with disease, adjusted for the severity of that disease.

Fewtrell and Kay (2008) used DALYs to quantify the health effects resulting from floods at two case study sites in England. DALYs are summary measures of health that allow comparison of effects across a wide range of health outcomes. The measure combines years of life lost by premature mortality with years lived with a disability (YLD), standardized using severity and disability weights. The measure uses a standard life expectancy at birth of 80 for men and 82.5 for women, and DALYs are discounted at 3% and age weighted. However, as few properties in the case study area were flooded and people affected the health impacts and DALYs were small. No deaths or serious injuries were recorded

4.4.1 Further research on HIA

Reports of HIA studies are difficult to obtain as they seldom appear in peer reviewed literature and are not always made public. Veermann et al., (2003) provide an overview of what has been quantified in prospective HIA in terms of exposure and health outcomes, and what methods were used. They assess what can currently be expected from quantitative HIA, and what further research may contribute. A number of areas have been identified in which research and development could benefit quantitative HIA:

- methods to quantify the health effects of socioeconomic and behavioural determinants;
- the development of user friendly simulation models for outcome assessment in HIA;
- the use of summary measures of public health in HIA (in addition to disease specific outcomes);
- the use of expert opinion and scenario building in HIA;
- empirical research into the validity and reliability of methods for HIA, and of complete HIA studies.

Whatever shape it takes, quantification in HIA will be limited by the availability of relevant and reliable data. The more detailed the techniques, the higher the information requirements. For example, demographic computer simulation models can cope with differences by age and sex, but the model has to be filled with data that specify these differences. Taking into account health inequalities also increases information needs. The evidence base is especially narrow when it comes to linking policy options to health determinants.

Data problems commonly hamper attempts at quantification. If that is the case, robust qualitative work may be the best option. However, before concluding that quantification is not possible it may be worthwhile bearing in mind that the perspective of a decision maker differs from that of an epidemiologist. Not taking any decision is not an option for a decision maker, while the cautious epidemiologist may conclude that further study is needed. An expert’s guess may still be better than no guess at all. The use of a structured process to obtain expert opinion can improve its validity and credibility (Veermann et al., 2003).
4.4.2 Validity, reliability and standardisation in HIA

Another issue about which little is known relates to the validity and reliability in HIA. For some of the methods used in HIA, validity and reliability have been assessed but for many methods no such research has been done. Likewise, methods to assess the validity and reliability of complete HIA studies are yet to be developed; even agreed upon definitions suitable for HIA are lacking. Veermann et al. (2003) tentatively define the validity of HIA studies as the degree to which the predicted health effects are confirmed by empirical research. This implies a need for outcome evaluation, notwithstanding the difficulties that this entails.

Once methods for quantitative HIA have been developed and their validity is becoming clearer, there will be a need for standardisation. Similar to developments in the field of health economics, guidelines will be needed to determine what effects to include, what time horizons are appropriate, how to deal with uncertainty, and what are suitable indicators of health outcomes. Standardisation will increase comparability among studies and promote HIA as a reliable and credible instrument for intersectoral health policy making (Veermann et al., 2003).

The above tools and approaches, particularly HIA, may hold potential for use in prospective studies to determine the health impacts from flood events in particular locations with specific return periods. Indeed, some retrospective health impact assessment studies have been conducted e.g. by the WHO (2005). However, these studies have taken place immediately following flooding and have largely focused on determining immediate risks to public health generally within populations. It is very likely that other health impact assessment studies for floods exist but further research would be needed to identify these and their possible usefulness for European floods. A scoping exercise to determine the use of such approaches would be useful. However, this would need to be conducted with the involvement of flood modellers, epidemiologists, toxicologists, and mental health professionals.
5. A case study in quantifying the health impacts of floods

One study mentioned earlier in this report is *An Appraisal of the Human Intangible Impacts of Flooding* funded by the Government Department for the Environment, Food and Rural Affairs (Defra) in England. This study will be used here to illustrate one case study which attempted to quantify health impacts in relation to floods. Specific requirements of the study were to obtain greater understanding of the social issues that underlie the long-term health risks of flooding, and to develop an easy to use methodology that could be applied in economic appraisals to generate robust and defensible valuations for human-related intangible impacts of flooding, based on the improved understanding of the relevant social issues (RPA/FHRC *et al.*, 2004). The focus of the analysis and reporting of the data was on the long and short term health impacts of flooding, and the economic values that may be attached to avoiding health and stress effects (RPA/FHRC *et al.*, 2004; Tunstall *et al.*, 2006).

Data was collected throughout England and Wales covering a range of up to 30 locations and many different flood events between 1998 and 2003. Two separate population samples were targeted, both flooded (n 983) and ‘at risk’ (n 527). The survey was preceded by a qualitative research stage involving focus group discussions to inform development of the survey instrument. The research was conducted by social scientists and was not a full epidemiological study e.g. in the sense of having prospective data, control groups for comparison and being able to re-test the data; however the ‘at risk’ population sample can be treated as a control group. According to Jankowski (2000), the most common way that physical health has been measured in existing research studies is by the self-reporting of health conditions or symptoms, or by respondents providing perceptions of their overall physical health. Three self-reporting survey instruments were used in the ‘Intangibles’ study: a checklist of health effects developed from the earlier qualitative research, the General Health Questionnaire (GHQ-12) (Goldberg and Williams, 1988), and the Post Traumatic Stress Scale (PTSS) (Scott and Dua, 1999).

### 5.1 Results from the health check lists

The health checklist was used to measure the short and medium term physical effects of the flood event as well as the longer-term psychological effects associated with being flooded. Table 5.1 shows findings from the self report health checklists for the flooded population sample. Findings support those from examples in the literature cited earlier in the report on the type of symptoms and health problems experienced. The results also serve to illustrate the timing of the various health effects. For example some health effects are associated with over-exertion during and immediately following the flood; others with coming into contact with flood waters during the flood and clean up phase. Conditions associated with damp and dusty environments, also after the flood and during recovery, were reported along with prior health problems which were exacerbated by the experience of flooding; and ongoing stress and anxiety after the flood. By far the most significant health effects reported were those on respondents’ psychological health and well-being. Moreover, as Table 5.2 illustrates, female respondents reported significantly more of these effects than males.

Overall, findings showed an association between reported physical and psychological health effects, although this needs to be explored in more detail. The psychological effects may partly explain some of the reported physical illnesses, such as increased blood pressure. In addition the physical health problems experienced by respondents may themselves be stressors adding to the psychological effects.
### Table 5.1: Self-reported health effects of flooding: flooded sample

<table>
<thead>
<tr>
<th>Physical health effects experienced during or immediately after the flooding</th>
<th>No</th>
<th>%</th>
<th>Physical health effects experienced in the weeks and months following flooding</th>
<th>No</th>
<th>%</th>
<th>Psychological health effects experienced in the weeks, months and years following flooding</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock</td>
<td>327</td>
<td>33</td>
<td>Gastro-intestinal illness/upset stomachs</td>
<td>96</td>
<td>10</td>
<td>Anxiety when it rains</td>
<td>543</td>
<td>55</td>
</tr>
<tr>
<td>Cold, coughs, flu, sore throats or throat infections</td>
<td>194</td>
<td>20</td>
<td>Stiffness in joints</td>
<td>91</td>
<td>9</td>
<td>Increased stress levels</td>
<td>353</td>
<td>36</td>
</tr>
<tr>
<td>Headaches</td>
<td>116</td>
<td>12</td>
<td>Respiratory/cHEST illness e.g. asthma, pleurisy</td>
<td>79</td>
<td>8</td>
<td>Sleeping problems</td>
<td>245</td>
<td>25</td>
</tr>
<tr>
<td>Exposure to chemicals and contaminants in flood waters</td>
<td>81</td>
<td>8</td>
<td>High blood pressure</td>
<td>76</td>
<td>7</td>
<td>Flashbacks to the flood</td>
<td>170</td>
<td>17</td>
</tr>
<tr>
<td>Injuries due to over exertion during the flood e.g. sprains, strains, heart problems</td>
<td>65</td>
<td>7</td>
<td>Skin irritations e.g. rashes, dermatitis etc</td>
<td>55</td>
<td>6</td>
<td>Increased tension in relationships e.g. more arguing</td>
<td>152</td>
<td>16</td>
</tr>
<tr>
<td>Skin irritations e.g. rashes</td>
<td>71</td>
<td>7</td>
<td>Heart problems</td>
<td>27</td>
<td>3</td>
<td>Mild depression</td>
<td>140</td>
<td>14</td>
</tr>
<tr>
<td>Injuries e.g. cuts and bruises due to being knocked over by flood water</td>
<td>44</td>
<td>5</td>
<td>Muscle cramps</td>
<td>22</td>
<td>2</td>
<td>Difficulty in concentrating on tasks</td>
<td>127</td>
<td>13</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>21</td>
<td>2</td>
<td>Sprains and strains</td>
<td>24</td>
<td>2</td>
<td>Mood swings/bad moods</td>
<td>126</td>
<td>13</td>
</tr>
<tr>
<td>Electric shock</td>
<td>5</td>
<td>0.5</td>
<td>Cuts and bruises</td>
<td>24</td>
<td>2</td>
<td>Lethargy/lack of energy</td>
<td>93</td>
<td>10</td>
</tr>
<tr>
<td>Insect or animal bites</td>
<td>19</td>
<td>2</td>
<td>Moderate depression</td>
<td>92</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erratic blood sugar levels (diabetics)</td>
<td>21</td>
<td>2</td>
<td>Anger /tantrums</td>
<td>91</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney or other infections</td>
<td>8</td>
<td>1</td>
<td>Panic attacks</td>
<td>82</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nightmares</td>
<td>64</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Increased use of alcohol/drugs</td>
<td>64</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Severe depression</td>
<td>45</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thoughts of suicide</td>
<td>13</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>38</td>
<td>4</td>
<td>Other</td>
<td>27</td>
<td>2</td>
<td>Other</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>None of the above</td>
<td>452</td>
<td>46</td>
<td>None of the above</td>
<td>658</td>
<td>67</td>
<td>None</td>
<td>279</td>
<td>28</td>
</tr>
<tr>
<td><strong>Total number of respondents</strong></td>
<td>983</td>
<td></td>
<td><strong>Total number of respondents</strong></td>
<td>983</td>
<td></td>
<td><strong>Total number of respondents</strong></td>
<td>982</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Tunstall et al., 2006)
### Table 5.2: Psychological health effects reported in the weeks or months after flood, by gender

<table>
<thead>
<tr>
<th>Psychological effects</th>
<th>Male % (n.381)</th>
<th>Female % (n.602)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety e.g. when rains or river rises</td>
<td>42 (161)</td>
<td>64 (382)</td>
</tr>
<tr>
<td>Increased stress levels</td>
<td>31 (119)</td>
<td>39 (234)</td>
</tr>
<tr>
<td>Sleeping problems</td>
<td>18 (69)</td>
<td>29 (176)</td>
</tr>
<tr>
<td>Flashbacks to flood</td>
<td>11 (41)</td>
<td>21 (129)</td>
</tr>
<tr>
<td>Increased tensions in relationships</td>
<td>16 (61)</td>
<td>15 (91)</td>
</tr>
<tr>
<td>Mild depression</td>
<td>10 (38)</td>
<td>17 (102)</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>9 (34)</td>
<td>15 (93)</td>
</tr>
<tr>
<td>Mood swings</td>
<td>10 (37)</td>
<td>15 (89)</td>
</tr>
<tr>
<td>Lethargy/no energy</td>
<td>6 (22)</td>
<td>12 (71)</td>
</tr>
<tr>
<td>Moderate depression</td>
<td>7 (26)</td>
<td>11 (66)</td>
</tr>
<tr>
<td>Panic attacks</td>
<td>4 (15)</td>
<td>11 (67)</td>
</tr>
<tr>
<td>Increased use of alcohol/drugs</td>
<td>5 (19)</td>
<td>8 (45)</td>
</tr>
<tr>
<td>Nightmares</td>
<td>2 (8)</td>
<td>9 (56)</td>
</tr>
<tr>
<td>Severe depression</td>
<td>3 (12)</td>
<td>6 (33)</td>
</tr>
<tr>
<td>Thoughts of suicide</td>
<td>0.3 (1)</td>
<td>2 (12)</td>
</tr>
<tr>
<td>Anger/tantrums</td>
<td>8 (32)</td>
<td>10 (59)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (1)</td>
<td>9 (2)</td>
</tr>
<tr>
<td>Suffered no psychological effects</td>
<td>42 (158)</td>
<td>20 (121)</td>
</tr>
</tbody>
</table>

(Source: Tunstall et al., 2006)

### 5.2 GHQ-12 results

The GHQ is a commonly used survey instrument to assess impairment of current mental health. The GHQ-12 is a shortened (12 question) version of the longer GHQ and has been widely used to detect psychiatric disorders and disturbance in relation to a variety of natural disasters and is seen as a reliable and valid method of assessment (Goldberg and Williams, 1988). The disadvantage of the GHQ-12 is that it is not event specific and thus psychological problems detected may not be related to the particular event (in this case flood) in question. The GHQ also only considers symptoms experienced over the preceding few weeks, which if administered long after an event may result in the short and medium-term effects not being captured. Therefore a Worst Time version of the GHQ-12, based on the use of a Worst Time GHQ28 by Power (1988 - see Section 2.5 above), was also developed and used to measure the short-to mid term effects.

Table 5.3 shows results from the GHQ-12 and the percentage of flooded respondents displaying symptoms of current mental health impairment compared with respondents who were at risk. Scores among those who were flooded were significantly higher for both men and women. Those at risk were drawn from the same areas as the flooded: some had been present at the time of the flooding but had not themselves been flooded; others had moved to the area after the flooding and had no direct experience of the event. Factors other than the flooding may be contributing to the current high scores amongst flooded respondents. Differences in age and stage in life cycle between the two groups could partly explain the different results. The mean age of respondents was 51, with flooded respondents being slightly older (mean 54.5 compared to 45.4 for those at risk). However, higher GHQ-12 scores were found among flooded respondents for all age groups apart from those aged over 60 compared with those at risk. Moreover, the differences in mental health by age group were not found to be significant within either the flooded or at risk groups. Therefore age is unlikely to account for the extent of the differences when compared with the at risk population.
Table 5.3: Results from GHQ-12 for current health in the last few weeks

<table>
<thead>
<tr>
<th>Population</th>
<th>Current health GHQ-12 % showing impaired mental health (score of 4 or more)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooded – total (n.814)</td>
<td>25</td>
</tr>
<tr>
<td>Flooded – women</td>
<td>26</td>
</tr>
<tr>
<td>Flooded – men</td>
<td>22</td>
</tr>
<tr>
<td>At risk – total (n. 485)</td>
<td>10</td>
</tr>
<tr>
<td>At risk – women</td>
<td>12</td>
</tr>
<tr>
<td>At risk – men</td>
<td>7</td>
</tr>
</tbody>
</table>

Source: RPA, FHRC et al. 2004

Results from the Worst Time GHQ-12 showed significant differences for both women and men compared to current GHQ-12 results, although re-testing to determine the reliability of the instrument was not possible. Two thirds of flooded respondents (64%) were found to have experienced significant mental health problems (worst time GHQ-12 score of four or more) at the time when their health was perceived as most seriously affected after the flood. For some respondents the worst time was reported as being during the first few weeks following flooding, while for others it was several months later. The median worst time was around one month after flooding.

There were significant differences between men and women with the Worst Time GHQ-12, with 68% of women displaying mental health effects compared with 55% of men. These were significantly higher than the current GHQ-12 scores and indicate that women experience more severe effects in the shorter term than men, but that they appear to recover over time. Variations with age were not significant. However, the 65 and over age groups do appear different, and counter-intuitively less affected. This is born out by significant differences in the ‘worst time’ mean scores of the 65+ age group compared with the rest.

The results from the GHQ-12 show that flooding has an impact on the mental health of flood victims, not only in the short term, but also in the long term as reflected in the current scores registered at the time of the interviews (in most cases at least one year after the flooding and in some cases several years). The current scores were higher for the flooded sample than for both the ‘at risk’ sample and the average for England in the Health Survey for England 2003. While there is recovery and resilience, as evidenced by the differences in the worst time and current scores, the flooding appears to have had long lasting impacts on the mental health of flood victims.

5.3 PTSS results

The final survey instrument used in the study was the PTSS. The PTSS is designed to measure the frequency, severity and duration of symptoms and is a tool to categorise whether or not subjects are suffering from PTSD. Unlike the GHQ, it focuses on a traumatic event (in this case the worst flood people had experienced) and seeks information about respondents’ current state of mind and symptoms. The PTSS poses questions on re-experiencing the traumatic event, numbing and avoidance, and hyper arousal. A good method for interpreting symptoms is the PTSD Intensity Score, which is based on the sum of the frequency x distress scores for the symptom questions. The overall possible score can range from 0 to 272. Results showed a small proportion of flooded respondents (15%) to still be suffering from mild to more severe symptoms of post traumatic stress as measured by the PTSD Intensity score, despite the passage of time since the flood events. For the 747 flooded respondents (76%) who completed the PTSS, the mean score was 21 (range from 0 to 121). However, the mean Intensity scores varied considerably in the two pilot studies for the research and in the main survey, indicating that location may be a contributing factor.
5.4 Subjective severity of flood impacts

The way in which people may respond to flooding, and their capacity to recover, may be affected by their subjective severity of the flood impacts. Re-analyses of the study data for the FLOODsite project (Task 11) by Tunstall et al. (2007) sought to measure the subjective impacts of flooding and magnitudes of impacts in detail on the flooded sample by looking at the subjective severity of flooding upon households. The degree of health impact was associated with a wide range of factors: socio-demographic; flood characteristics; and post-flood characteristics/events. Table 5.4 shows the significance of the key factors identified in multivariate analysis as influencing the health measures used in the study.

Table 5.4: Significance of key factors identified in multivariate regression analysis as influencing health measures used in the study (in order of decreasing statistical significance)

<table>
<thead>
<tr>
<th>Significance</th>
<th>PTSD Intensity score as In (P+1)</th>
<th>Current GHQ-12 Likert scale</th>
<th>GHQ-12 worst time (Likert scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly significant P&lt;0.001</td>
<td>Problems with insurers Prior health Gender</td>
<td>GHQ-12 Likert at worst time Prior health</td>
<td>Problems with insurers Gender Prior health</td>
</tr>
<tr>
<td>Significant P&lt;0.05</td>
<td>Evacuation Flood depth Warning time Time to get back to normal Vulnerable housing Contamination of floodwaters Aged 65+</td>
<td>Time to get home back to normal Area house price Problems with insurers Support received</td>
<td>Uninsured losses Evacuation Time to get back to normal Contamination of floodwater Rented accommodation Warning time Aged 65+</td>
</tr>
<tr>
<td>Less Significant P&lt;0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall $R^2$</td>
<td>0.26</td>
<td>0.34</td>
<td>0.26</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.24</td>
<td>0.33</td>
<td>0.24</td>
</tr>
<tr>
<td>N observations</td>
<td>629</td>
<td>733</td>
<td>507</td>
</tr>
</tbody>
</table>

Note: See Tunstall et al. (2006) for a more detailed discussion of these factors

* The adjusted $R^2$ indicates the proportion of the variance in the health measure explained by the listed factors

Getting the house back to normal (the disruption to life and all the problems and discomfort during recovery) was rated as the most serious of the effects, followed by the stress of the flood event itself, having to leave home and worry about future flooding. These first three intangible effects were rated as markedly more serious than the tangible damages to the contents and structure of the property. There were striking and significant differences in the rating of the effects between men and women, with women giving a higher rating than men to almost all the effects and also rating the flood overall as having a more serious effect on their household than did the men.

The stress rating was associated not only with disruption but also with having to leave home, worry about future flooding and with health effects. This rating therefore appeared to capture many of the most severe impacts of flooding on the lives of participants’ households. The overall rating of the seriousness of the effects of flooding was highly correlated with the stress rating. Other effects that were closely associated with the overall rating were disruption, having to leave home, health effects and damage to the house.
Social vulnerability as measured in the re-analyses of the original data remains difficult to explain. Although the levels of explanation offered in the regression analyses are not high, such levels of explanation are common in social science. Community and social variables and psychological measures that were not included in the survey might offer further explanation. The basic flood characteristics of depth and extent of flooding were not as prominent as explanatory factors as might be expected, although they did play a part in explaining some findings. All the respondents in the study had flood waters inside their home and the results of the regression analyses indicated that the actual depth of flooding is not such a salient factor. The contamination of floodwaters was surprisingly important, featuring as a predictor for all the measures and models used in the analyses, not only for the GHQ-12 scores which focuses on mental health, but also for the stress of the event and the overall severity.

Social variables associated with vulnerability, such as old age, ill health and disability in the household, living alone, living alone in old age, having children or young children in the home did not feature as prominently as predictors as might have been expected. Indeed old age and/or living alone were included in some analyses models with an effect in the opposite direction to the expected one. The models were consistent with bi-variate analyses which showed that the middle aged tended to be more vulnerable than older people. Prior health was a predictor of the GHQ-12 scores and featured in six of the eight models that included social variables indicating that health status contributes to many forms of vulnerability, and both in the short term and long term. Gender was also a common factor in the models apart from those for the current GHQ-12. Area house price ratings which reflect the wealth of the areas where people lived were a significant factor in six of the models although the effect was not consistently in one direction. Tenure was also significant for some measures.

When post-flood events and responses were introduced, having to leave home and the time spent in getting the home back to normal were important explanatory variables in explaining social vulnerability. Institutional responses in the aftermath of flooding by insurers and loss adjustors were a very important explanatory factor common to all the vulnerability measures. This shows that how these institutions and the individuals within them deal with insurance claims can have a very significant role in mitigating or exacerbating the impacts of flooding on households. This also emerged very strongly in the earlier qualitative research (Tapsell et al., 1999; Tapsell and Tunstall 2001). Having uninsured losses was a predictor in two models indicating that where insurance cover was adequate, people were less vulnerable. Social and other institutional responses in terms of support from outside the household were factors that did not emerge as significant predictors of vulnerability. Indeed, bi-variate analyses showed that those who received support tended to have higher scores on the vulnerability variables, probably because those who attracted support from outside the home were more seriously affected by the flooding. Thus such help did not emerge as a mitigating factor in vulnerability.

Based upon the above research and re-analyses, Tunstall et al. (2007) put forward a simple model (Figure 5.1) to illustrate the factors affecting people’s vulnerability and resilience to flooding and their relationship to four of the measures used in the analyses: stress of the event, overall severity and results from the GHQ-12 current and Worst Time.

This case study and other literature cited earlier in the report thus highlight the complexity of the possible health impacts which may result from experiencing a flood event. A number of other authors have also tried to model these impacts, as well as the various factors which may modify or mitigate them. These models are now discussed below.
Figure 5.1: Conceptual model of factors affecting vulnerability and resilience to flooding. Source: Tunstall et al., 2007
6. Existing conceptual models to explain the health impacts of flooding

Hazards such as floods are regarded as potentially multi-strike stressors whose components include: that of the event itself, the disruption and problems arising during the recovery process, and from the worry or anxiety regarding the risk of a reoccurrence of the event. As outlined earlier, additional factors affecting the stress and health impacts of flooding may include, among others, socio-economic and cultural factors such as: age, gender, ethnicity, pre-existing health conditions, whether living alone, the number of persons within the household, whether employed, level of income, exposure to vectors, access to health services etc. Five models are outlined below.

1. Green, 1988: Causal model of relationships between impacts and judged overall severity of flooding

In developing a model to predict the severity of a flood, including the effects on health, Green (1988 c/f Green et al., 1994) defined a number of potential impacts based upon studies carried out in the UK and attempted to measure their magnitude (Figure 6.1). Findings were taken from a series of structured surveys on household impacts and responses to floods in the UK, mostly in the 1980s. The full data set included around 1,700 cases and some 500 variables. The floods were predominantly of hours rather than days in duration and relatively shallow, generally less than 1.5m in depth. The degree to which the impacts are independent in magnitude and severity, or are causally related, was a major issue. The subjective severity of one impact may depend in part upon the severity of another. Impacts are not a mutually exclusive set since either some directly determine others or they share a common determining variable. The model is also based upon the assumption that the magnitude of a flood impact is a function of the characteristics of the event (e.g. depth, duration, contaminants present) and of the property (basement flat versus two-storey house).

In terms of the overall model, the most critical variable identified was the stress induced by the event itself. Not only was the stress induced by the event one of the most important consequences in subjective terms of all of those experienced, but it was important in determining, for example, whether or not a household reported suffering health effects. Thus whether or not a household reported experience of some health effect depended upon the degree of stress that they reported experiencing on the event/stress scale used in the survey and on the degree of worry they felt about the possibility of future flooding. In total 38% of respondents reported that their health had been affected and of these 21% had seen a doctor. On average, the impact which was reported as having the greatest severity was the problem of getting the house back to normal (disruption). The direct damages from the flood, as shown in Figure 6.1, did not directly impact on the overall severity of the flood experienced by people. Their importance was in determining the degree of disruption experienced by members of the household. The wealth of a family had a significant buffering effect on the severity of a given magnitude of loss, with wealthier households reporting significantly lower severity of impact for a given value of household contents than did those from poorer families.

It was also found that the degree of stress householders experienced during a flood was less if the flood occurred during daylight hours. This indicates that advance warning of potential flooding is potentially advantageous. However, the limitation in the analysis was that few of those who had actually received a flood warning had also completed the questionnaire which measured the stress of the event. A tentative conclusion drawn was that flood warnings are likely to reduce the stress experienced in a flood which, as mentioned above, is one of the main determinants of the overall severity of the experience. This conclusion was potentially supported by the finding that prior awareness of the flood risk tended to be associated with lower overall severity of impacts, however in this case previous flood experience of flooding did not appear to buffer the over severity.
Figure 6.1: Causal model of relationships between impacts and judged overall severity of flooding.
Source: Green 1988
2. Tapsell et al., 1999: Conceptual model of relationships between impacts of flooding and effects on health

Green’s (1988) model was used as a starting point for the UK study by Tapsell et al., (1999), however there were two important differences between the studies. First, Green was working with quantitative survey data rather than qualitative data, which meant that inter-relations could be measured. Second, the objectives of the two studies differed in that Green was aiming at a causal model of relationships between impacts and judged overall severity of flooding, while Tapsell et al.’s study aimed to investigate the type and extent of health effects resulting from flooding. Tapsell et al. developed their conceptual model based upon existing literature and the results from qualitative focus groups with flood victims conducted around seven months after a major flood. Included in the model were additional impacts which were identified as affecting people’s overall health and wellbeing (Figure 6.2).

Tapsell et al.’s (1999) model indicates that the health effects from flooding may be extremely complex and further suggests that the effects are not a mutually exclusive set, and that some may either directly determine others or may share a common determining variable. The characteristics of the flood event and the type of dwelling, and associated damage and losses, are important in determining the various flood impacts and their subsequent magnitude on people’s health. However, a number of other factors are also important. The levels of stress experienced in coping with the flood event and from the recovery process appear to have a large disrupting effect upon people’s lives, thereby impacting upon physical and mental well-being (as also suggested by Green, 1988). Pre-existing health conditions may also affect physical health and lead to deteriorating mental and social well-being. These prior conditions are not heavily stressed in the earlier model but may be significant in certain cases.

A further influencing factor can be described as a loss in the level of confidence in the authorities and institutions perceived to be associated with providing flood protection and recovery support, and in this case their perceived failure to act. It is likely that some people have little confidence in local flood management authorities even before flooding, and in these cases the flood event probably acts to confirm existing beliefs rather than causing those beliefs. Further, explanations given for the cause of flooding as being ‘natural’ forces may not be believed, exacerbating the loss of confidence in authorities to predict a flood or issue a warning. This may lead to anxiety when storms or rain are forecast, and associated changes in behaviour such as staying up all night, and worry about the possibility of future flooding. The loss of confidence in authorities may also cause a loss of the sense of security people feel in their local area and in their home. This, along with loss of memorabilia, may undermine people’s sense of self identity, which may then result in further loss of confidence in the authorities. This loss of confidence, along with the undermining of self identity and security, can affect both people’s mental and social well-being. The combined impacts of several or all of these factors may therefore have an important overall effect on the physical, mental and social well-being of flood victims. A final group of factors which can be seen to influence all of the above, to a greater or lesser extent, are socio-economic and cultural variables, such as gender, age, education, income and ethnicity.
Figure 6.2: Conceptual model of relationships between impacts of flooding and effects on health. Source Tapsell et al., 1999
3. **Few and Matthies, 2006: How flooding may impact upon health**

In their 2006 edited book on the health impacts of flooding at a global scale, Few and Matthies also put forward a simple model illustrating some of the different pathways through which flood hazards may influence health outcomes. The model was based upon an extensive review of the literature on health impacts and floods, much of which is based upon literature cited earlier in this report (Figure 6.3).

4. **Few, 2007: Health impact pathway model**

More recently, in order to deepen understanding of the processes that shape how vulnerability to health impacts varies, an intermediary research tool was suggested by Few (2007), building upon his earlier model, that narrows analysis to specific hazards (again in this case floods) and health outcomes and disentangles the points at which aspects of vulnerability and response actions come into play. This ‘health impact pathway’ model for flooding depicts the potential progression of impacts of flood hazard events and possible response mechanisms (Figure 6.4). The model encompasses both quantitative and qualitative research methods and it is suggested that it can be used as a tool with which to map out where the different factors that contribute to vulnerability/coping capacity come into effect. The focus of the model is not to derive aggregate measures of risk but to understand how and why the health impacts of hazards vary between individuals and groups in society, and what shapes the ability of people and institutions to cope. The model is useful as an organisational framework for research and analysis and not as a rigid explanatory scheme. Indeed, all of the above models need to be viewed in this way.

![Figure 6.3: Few and Matthies Flood Hazards & Health model](source: Few, R and Matthies, F eds (2006) Flood Hazards & Health. Earthscan, London, pp.3)
Figure 6.4: The Health Impact Pathways Model (Few, 2007: 289)


Tapsell (forthcoming 2009) puts forward a conceptual framework to aid the analysis of the socio-psychological dimensions of flood risk management (Figure 6.5). The socio-psychological dimensions of FRM can be defined as those aspects that have potential to adversely impact on the social, psychological and physical wellbeing of those affected; in other words those aspects affecting a person’s social and psychological functioning. Floods and decisions around FRM policy and practice have the potential to seriously impact upon this functioning, often with long-term consequences for individuals and communities. These impacts affect individuals (through mental processes and impacts) and their interactions with others (social structure and relations) (Cote and Levin, 2002).

The framework is based on the ‘hazard’ or ‘disaster management cycle’ often cited in disaster management literature (e.g. Wisner and Adams, 2002; Few, 2006). Disaster risk management deals with the preconditions, causes and impacts of hazards (Ruhrmann, 2003). Its multiple tasks need to be implemented before, during and after an emergency or disaster. Preparedness, damage control, recovery and mitigation are crucial aims of risk managers. These tasks require administrative, technological, medical and socio-psychological means and resources. The disaster management cycle thus divides disaster events into various stages, normally: preparedness, emergency response, recovery and mitigation. This temporal aspect of the cycle is important; however, flood impacts and responses are dynamic and may often be overlapping or present during more than one phase. Tapsell therefore notes that the various influencing or intervening factors reported are not necessarily discrete to one individual phase. At the centre of the cycle are the individual and societal factors which may increase or reduce the various socio-psychological dimensions of floods at each stage of the disaster cycle.
Figure 6.5: Framework for analysing social-psychological dimensions of flood risk management (Source: Tapsell, 2009 forthcoming)
7. A new Health Impacts of Floods Model

All of the above models help understanding of the factors which may influence the varying human health impacts from flooding and aid in decision-making on how and where to target resources and response. Therefore it was decided that this current research should build upon these other models where possible. As with Few’s (2007) model, the focus is not to derive quantitative or aggregate measures of risk (as the literature shows this to be extremely difficult and problematic) but to understand how and why the health impacts of hazards vary between individuals and groups in society, what are the intervening and mitigating factors and what shapes the ability of people and institutions to cope. The model is meant to be used as an organisational framework for analysis and further research.

Importantly, it was also felt that the new model should differentiate between the different phases of a flood event where possible in order to determine which mitigation and prevention measures might be appropriate before, during and after a flood event. Initially a conceptual model was developed on a similar basis to Few’s (2007) model, with various boxes progressing towards health outcomes, and indicating linkages between the boxes. However, once all the many variables to be included were assembled this model became extremely complex with so many boxes and linkages that it made comprehension difficult. It was therefore decided to simplify the model into a table to include the different stages of a flood event and groups of key factors at each stage (e.g. environmental, institutional, socio-economic etc.) which the literature indicates may have an impact (direct or indirect) upon human health and well-being, see Figure 7.1.

The Health Impacts of Floods Model should be read horizontally from left to right, from before a flood to after. However, the potential health impacts should be considered across all influencing factors (i.e. also vertically), although some are obviously more relevant to certain influencing factors than others, as suggested in the Model. Although based upon a range of literature, most of the vector and rodent borne diseases, e.g. malaria, shistosomiasis, leptospirosis, and some diarrhoeal diseases included in the model are largely absent from floods in industrialised countries but are not completely unknown. In addition, some of the institutional factors, such as registration for a flood warning system, may not apply in less industrialised countries, particularly in rural areas. There are inevitably other factors which could also be included in the model. Further refinement was not possible due to resource and time constraints, however, it is hoped that follow-up research will help to develop the model further. One disadvantage of this model is that it is difficult to indicate the various vertical linkages which may be present between sets of factors, although it does indicate which factors need to be considered at each stage of a flood event. Some factors and impacts have been repeated in more than one section of the model, and others could be further repeated, particularly some of the health impacts. The model could be taken and refined according to particular local conditions and could be applied at various scales from regional to local, for different types of flood events and in different contexts e.g. urban versus rural. According to Smoyer (1998), place is an important component in health and should be included in health risk assessments of extreme weather events. Many epidemiological studies overlook the characteristics of places and instead focus solely on the people who inhabit them.

What the Health Impacts of Floods Model does not do is quantify the various health impacts, which as stated in Section 2.2 above is extremely difficult and can require detailed surveys. More information could be included on location characteristics as well as characteristics of the local populations and institutional arrangements for flood risk management and health care services. Ideally the model should be taken, tested and refined in a series of case studies, both in industrialised and non-industrialised contexts. Furthermore, the model would benefit from the input of epidemiologists, planners, flood risk managers and a range of other stakeholders, particularly for its usability in application. Based upon this model it may be possible to develop a health impact assessment (HIA) tool for floods comprised of groups of questions related to key factors outlined in the model to determine their presence or absence and their level of impact in specific locations.
Figure 7.1: The Health Impacts of Flooding Model

- **Before flood event →**
  - Environmental factors: climate change
  - Physical characteristics: topography, topography etc.
  - Underlying land use and presence of vectors
- **During flood event →**
  - Flood characteristics: speed of onset, depth and velocity
  - Mechanisms to increase income levels in flood risk management decisions
- **After flood event →**
  - Health effects: mental health outcomes, eviction
  - Preparedness and mitigation after flood and before next flood
- **Factors**
  - Intervening or modifying factors
  - Health effects
  - Preparedness and mitigation after flood and before next flood

### Before flood event
- Environment: albedo characteristics, climate change
- Physical: topography, topography, etc.
- Land: urban/land use and presence of vectors

### During flood event
- Physical: flood characteristics, speed, depth, velocity
- Mechanisms: increased income levels

### After flood event
- Health: mental health outcomes, eviction
- Preparedness: mitigation after flood, before next flood

### Factors
- Intervention or modifying factors
- Health effects
- Preparedness and mitigation after flood and before next flood

### Health Impacts:
- Mental health outcomes
- Eviction

### Preparedness and Mitigation:
- After flood event
- Before next flood
8. Conclusions and recommendations

This research set out to examine the health impacts related to flooding and to develop a conceptual model to provide insight into the factors influencing the impacts of floods on people’s health and well-being in Europe. It also attempted, where data is available, to quantify the health impacts of flooding and factors contributing to these adverse health effects. Results from the literature review show that the health outcomes relating to floods are complex and are influenced by a large range of factors. Moreover, findings indicate that these health impacts do not easily lend themselves to controlled epidemiological studies and that much health information is derived from retrospective research.

A number of models have been suggested by researchers to illustrate the various health outcomes from floods. These health impact models are useful in conceptualising the different pathways through which flood hazards may influence health outcomes, and the intervening and mitigating factors which may influence such outcomes. With the increasing risk of more frequent, and more extreme, flooding in the future a better understanding of both the physical and psychological health effects which may result from being flooded is essential in order that measures can be put in place to avoid, reduce or mitigate these negative impacts. Increasingly important in the future may be the impacts on local economies of populations whose health has been affected by flooding and who are unable to work for long periods of time.

The research has put forward a further Health Impacts of Floods Model which builds upon existing models to conceptualise the various impacts along with the factors which may contribute to, intervene or mitigate these impacts. The model can be used by those with a responsibility to provide health services in flood risk areas, by emergency planners and responders, flood risk managers and other responsible authorities in order to reduce exposure to floods, to reduce vulnerability to their impacts and to increase future resilience and capacity building. The Model, particularly if refined, may be a simple and practical tool for health impacts appraisal as well as to aid in future planning. Further testing of the model is necessary with responsible authorities, epidemiologists and flooded communities to refine it where possible or to suggest a suitable alternative approach to modelling the health impacts of floods.

Much more research is needed to try to understand the complex health consequences which may result from flooding. Disease surveillance needs to be increased during and after floods, and information disseminated rapidly to dispel false rumours of public health epidemics. The longer-term psychological impacts on people’s health and social well-being particularly require more investigation, along with the effects of social capital and social support. The social and community dimensions of flooding, which can have significant impacts on households and individuals, are other factors often neglected in post-flood studies. Recommendations for future research include:

- the impacts of flooding on long-term mental health, including that of children
- the effectiveness of Psychological First Aid as an intervention method following flooding
- the impact of flooding and heavy rainfall on diarrhoeal disease, and the main routes of transmission (e.g. flood waters or hygiene)
- the health impacts related to different types of flooding e.g. urban flooding
- indirect mortality attributable to flooding (in addition to immediate deaths from drowning)
- the impacts on health from the disruption of health services and other life supporting systems
- the impacts on the health of front-line workers and those responding to a flood
- the impacts on health of floods in differing cultural contexts.

Finally, Few and Matties (2006) suggest that the following are needed in the design of epidemiological studies that investigate the health impacts of floods:
- Control groups for comparison with non-flooded populations
- Use of longitudinal data, or routine data in order to gain information on pre-flood levels of disease at the individual or population level
- Improved monitoring and surveillance systems during and after flood events
- Improved use of routine surveillance information
- Use of objective measures of disease outcome, where possible.
9. References


145. Lutgendorf, SK; Antoni, MH; Ironson, G; Fletcher, MA; Penedo, F; Baum, A; Schneiderman, N; Klimas, N (1995) ‘Physical symptoms of chronic fatigue syndrome are exacerbated by the stress of Hurricane Andrew’, Psychosomatic Medicine, 57 (4): 310-323


174. National Center for Post-Traumatic Stress Disorder (2001b) Disasters and Substance Abuse or Dependence. Fact Sheet for the National Center for Post-Traumatic Stress Disorder, Department of Veterans Affairs

175. National Center for Post-Traumatic Stress Disorder (2001a) Survivors of Human-Caused and Natural Disasters. Fact Sheet for the National Center for Post-Traumatic Stress Disorder, Department of Veterans Affairs


180. Norris, F.H.; Byrne, C.M.; Diaz, E.; Kaniasty, K. (2001a) *The Range, Magnitude, and Duration of Effects of Natural and Human-Caused Disasters: A Review of the Empirical Literature*. National Centre for Post-Traumatic Stress Disorder, Department of Veterans Affairs, USA


182. Norris, F.; Byrne, C.M.; and Kaniasty, K. (2001c) *Psychosocial Resources in the Aftermath of Natural and Human-Caused Disasters: A Review of the Empirical Literature, with Implications for Intervention*. National Center for Post-Traumatic Stress Disorder, Department of Veterans Affairs, US


190. Parker, DJ; Green, CH; Penning-Rowsell, EC (1983) *Swalecliffe Coast Protection Proposals – Evaluation of Potential Benefits*, Enfield: Flood Hazard Research Centre, Middlesex Polytechnic


207. Reacher, M; McKenzie, K; Lane, C; Nichols, T; Iversen, A; Hepple, P; Walter, T; Laxton, C; Simpson, J (2004) ‘Health impacts of flooding in Lewes: a comparison of reported gastrointestinal and other illness and mental health in flooded and non-flooded households’, *Communicable Disease and Public Health*, 7 (1): 1-8


257. Waelde, LC; Koopman, C; Rierdan, J; Spiegel, D (2001) ‘Symptoms of acute stress disorder and posttraumatic stress disorder following exposure to disastrous flooding’, Journal of Trauma and Dissociation, 2: 37-52


