

Recovery after crisis: conceptual model for individual trajectories



Part of the project National Recovery Guide NL

Nederlandse Academie voor
Crisisbeheersing en Brandweezorg
Postbus 7010
6801 HA Arnhem
Kemperbergerweg 783, Arnhem
www.nipv.nl
info@nipv.nl
026 355 24 00

Colophon

© Netherlands Institute for Public Safety (NIPV), 2026

Author(s) S. ter Horst, V. Oosterveen, L. de Bruijn & A. Matser
With contributions from E. Marra, M.L.A Dückers & V. Gaspar
Contactperson S. ter Horst

Date 31 August 2026

Photo cover Shutterstock

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the granting authority. Neither the European Union nor the granting authority can be held responsible for them.

RECOVERY-GUIDE-NL, 101251407

We attach great importance to knowledge sharing. Parts of this publication may therefore be reproduced, provided the source is acknowledged.

The Netherlands Institute for Public Safety is established by law under the name Institute for Physical Safety

Contents

	Summary	4
	Abstract	6
	Introduction	7
1	Methods	10
2	Results	11
2.1	Core concepts	11
2.2	Theoretical framework	12
2.3	Domains	13
2.4	Expectations and provided support	14
2.5	Relationship between the domains	15
2.6	The Conceptual model	15
2.7	Operationalisation	17
3	Discussion	22
3.1	Assumptions	22
3.2	Strengths and limitations	23
3.3	Recommendations	24
4	Conclusion	25
	References	26

Summary

The aftercare and recovery phase is a relatively neglected part of crisis management. The international literature shows that recovery after a disaster unfolds differently from person to person, that the resources people hold before a disaster strongly determine how they fare afterwards, and that the problems that follow a disaster often weigh more heavily than the event itself. This knowledge has not yet been translated systematically into aftercare and recovery practice.

This report is part of the project NG-REC-NL (Towards a National Guideline on Recovery), in which the Netherlands Institute for Public Safety (NIPV), supported by the EU Civil Protection Mechanism, works towards a national guideline for the aftercare and recovery phase. The project consists of several work packages. The work package to which this report belongs focuses on the individual level, with the following central question: how and why does recovery unfold differently across individuals, and how can these differences be explained? To answer that question, the recovery of individuals must first be made measurable and modellable. This report takes the first step towards that end by describing a conceptual model for individual recovery after a disaster. In the subsequent steps of the work package, data sources are identified, historical recovery trajectories are analysed, and a predictive model is developed and tested.

The model is based on a narrative review of the international scientific literature on disaster recovery. Scopus was searched for studies on the long-term course of recovery, without restriction on publication year or country. The review is a narrative synthesis carried out by a single researcher, not a systematic analysis.

In this report, recovery is understood as the process through which a person's resources are restored over time after a disaster, relative to their pre-disaster level. Resources may level off below, at, or above that level. Three theoretical frameworks form the basis of the model: Conservation of Resources theory, the trajectory typology of Bonanno, and the theory of secondary stressors developed by Norris and colleagues and extended by Williams and colleagues. Recovery is made visible in four domains, mental, physical, housing, and financial, which recur most consistently in the literature and can be measured at the level of the individual. For each domain, the report describes the outcomes in which recovery becomes visible, with one primary outcome, and the predictors, that is, the characteristics of the person before the disaster and of the disaster itself that are expected to determine how recovery unfolds. The social dimension is not a separate domain in the model but acts on the resources through two mechanisms: the expectations of those affected and the support provided. A person's background characteristics, such as age, gender, and education level, shape the resources held before the disaster and continue to exert influence throughout the recovery phase. After the disaster, the resources in each domain are measured repeatedly; the pattern that emerges is the recovery trajectory.

The model rests on five assumptions (A1 to A5), which form the working agenda for the empirical follow-up research. Its limitations lie in the uneven distribution of the evidence

across the domains, strongest for mental health and thinnest for the financial domain; in the narrative character of the review; in the as yet untested relationships between the domains; and in practical measurement problems, such as establishing exposure and obtaining pre-disaster data. Two recommendations follow: to discuss the factors in the model with experts and practitioners, and to develop a research design in which the four domains are followed simultaneously, with a pre-disaster measurement drawn from continuously measuring sources and a comparison group of non-affected individuals. The two mechanisms first require qualitative exploration.

The report does not yet answer the central question of the work package, but it makes that question answerable. In doing so, it lays the foundation for enabling those involved in the aftercare and recovery phase to recognise and anticipate foreseeable problems after a disaster in a timely manner.

Abstract

This report develops a conceptual model for individual recovery after a disaster. It is the first deliverable of the work package on individual recovery trajectories within the NG-REC-NL project, in which the Netherlands Institute for Public Safety works towards a national guideline for the aftercare and recovery phase. The model rests on a narrative review of the international literature on disaster recovery. Recovery is defined as the course of a person's resources over time relative to their pre-disaster level. Three theoretical perspectives organise the model: the resource perspective of Conservation of Resources theory, the trajectory typology of Bonanno, and the work on secondary stressors of Norris and colleagues, later extended by Williams and colleagues. Recovery is made visible in four illustrative domains, mental, physical, housing, and financial, each with a primary outcome and a set of predictors drawn from the literature. Background characteristics and pre-disaster resources are linked to the trajectory a person follows, and the background characteristics continue to exert influence throughout the recovery phase. The social dimension is treated as interaction rather than as a separate domain, through two mechanisms that act on resources during recovery: the expectations of those affected and the support actually provided. The model is a provisional first step. Its assumptions are stated explicitly and remain to be tested with experts, practitioners, and longitudinal data.

Introduction

Background

The recovery phase of disasters is widely recognised as a neglected component of crisis management (Bakker et al., 2026; Bas et al., 2017; Dückers, 2012). Whereas the acute response phase has received considerable attention and investment, the longer arc of individual and community recovery has remained underdeveloped in both policy and research; internationally, recovery is likewise described as among the least understood phases of emergency management (Rubin, 2009; Serrao-Neumann et al., 2018; Smith & Wenger, 2007). This neglect is twofold: the recovery phase has attracted comparatively little empirical research, and it is rarely the focus of operational preparation by safety regions and municipalities (Bas et al., 2017). Disasters can have serious consequences for both the physical and mental health of those affected (Bonanno et al., 2010; Norris et al., 2002; Yzermans et al., 2005; Yzermans et al., 2009).

The consequences become visible when a disaster strikes. After the 2021 floods in Limburg, the southernmost province of the Netherlands, the acute response was relatively well coordinated, but long-term support was fragmented across insurance, municipal, and central-government channels; arrangements frequently failed to fit people's circumstances, producing a documented mismatch between government ambitions, legal frameworks, and the expectations of those affected (Andersson Elffers Felix, 2023). The induced earthquakes in the Groningen gas-extraction region are a contrasting, slow-onset case, in which the recovery burden has stemmed less from the initial damage than from its prolonged institutional aftermath. Residents have faced years of repeated earthquakes, housing damage, and protracted compensation procedures that have slowed repair (Parlementaire enquêtecommissie aardgaswinning Groningen, 2023) and contributed to adverse health outcomes among those with damaged homes (Stroebe et al., 2021).

In general, crises such as the floods in Limburg and the earthquakes in Groningen share a diagnosis. Not only is crisis management underprepared for the recovery phase, it also systematically underuses the capacities that already exist around it. Societal resources for recovery, such as volunteer networks, private partners, and civil society organisations, are poorly integrated into formal planning. Informal helpers typically operate outside official emergency management structures, and their contribution tends to be undervalued in formal arrangements (Whittaker et al., 2015). The result is a recovery effort that draws on far less than the help available to it (Dückers et al., 2013).

These gaps do not stem from a lack of knowledge. A growing body of literature offers a basis on which a more deliberate approach to recovery can be built. Across decades and disaster types, three observations recur. First, recovery is heterogeneous: it follows a small number of distinct trajectories rather than a single average curve (Bonanno, 2004; Bonanno et al., 2010; Newnham et al., 2022), with most people following a relatively stable course and smaller groups showing slower, chronic, or delayed difficulties. Second, pre-disaster characteristics shape which trajectory a person is likely to follow. Resource-based

perspectives conceptualise this in terms of the resources individuals possess prior to an event (Hobfoll et al., 2016). Resources are expected to shape recovery trajectories: the initial reserve provides a buffer against the immediate impact and helps protect against further losses. Consistent with this, one long-term prospective study has shown that pre-disaster characteristics, including prior mental health, predict trajectory class membership (Lowe et al., 2020). Third, the long-term course of recovery is often shaped less by the acute event than by the chronic hardships that follow it, such as job loss, displacement, and prolonged administrative procedures. These follow-on hardships, secondary stressors, frequently drive how recovery unfolds over time (Norris et al., 2002; Williams et al., 2021).

Taken together, these observations point to a key implication: if recovery follows a limited number of identifiable trajectories, then gaining insight into these patterns and their underlying determinants can help target support and interventions more effectively. Different trajectories imply different needs, not only in terms of the type of support required, but also regarding the timing and intensity of intervention.

Aim and research question

This report is part of the project NG-REC-NL (Towards a National Guideline on Recovery), in which the Netherlands Institute for Public Safety (NIPV), supported by the EU Civil Protection Mechanism, is working towards a national guideline for the aftercare and recovery phase of disasters and crises. The project follows a whole-of-society approach and is structured into several work packages, which together develop the knowledge base and instruments for that guideline. One work package focuses on bringing together and structuring existing recovery frameworks, clarifying how recovery can be organised and managed at the levels of policy, service provision, and expectations within affected communities (Bakker et al., 2026). What remains underexplored there is the individual level. The insights set out in the previous section show that recovery unfolds differently from person to person, yet this knowledge has not been systematically translated into recovery practice. A complementary work package therefore maps and models individual recovery trajectories after disasters. The question at the centre of that work package reads as follows. *How and why does recovery unfold differently across individuals, and how can these differences be explained?*

Addressing this question requires a systematic approach that makes recovery measurable and modellable at the individual level. Existing frameworks do not yet provide sufficient footing for this. The present report, the first step within this work package, therefore develops a conceptual model. Its aim is to lay the conceptual groundwork for measuring and modelling individual, long-term recovery, setting out how recovery can be made measurable, the factors expected to influence it, and how these relate to one another. In the subsequent steps of the work package, data sources are identified, historical recovery trajectories are analysed, and a predictive model is developed and tested. Together, the model and this empirical work serve the broader aim of enabling those involved in preparing and delivering the aftercare and recovery phase to recognise and anticipate foreseeable problems after a disaster in a timely manner.

Scope

The foundation described above enables subsequent analytical steps, in which data sources are identified to capture the factors and outcomes, and their usability is empirically assessed. These steps fall outside the scope of this report, which is confined to laying the conceptual foundation on which the subsequent steps build.

Reading guide

Chapter 1 describes the method used. Chapter 2 presents the results. Chapter 3 discusses the method and the results. Chapter 4 contains the conclusion.

1 Methods

This report is based on a narrative review of international scientific publications on disaster recovery. Scopus was searched between February and May 2026. Search terms related to recovery (such as recovery, trajectory, and long-term outcomes) were combined with different disaster types (such as disaster, flood, earthquake, and crisis).

Titles and abstracts were screened for relevance. Studies were included when they addressed the long-term course of recovery after a disaster the way people's lives develop in the period following an incident, rather than the acute response phase. Both empirical studies (quantitative and qualitative) and theoretical publications were included. No restrictions were placed on publication year or geographical context, although the selection was limited to Dutch- and English-language publications. Research concerned solely with the reconstruction of buildings or infrastructure, without attention to human functioning or wellbeing, was excluded.

From the selected material, possible domains were identified in which recovery becomes visible and can be followed over time (see Chapter 2), along with factors that influence the course of recovery, the relationships between these factors and outcomes, and the theoretical perspectives used to explain these relationships.

The selected studies were then thematically organised and synthesised. For each study, it was determined what it reported about how people fared after a disaster and which factors played a role. Consistent themes were clustered and consolidated into the conceptual model presented in this report. This was a narrative synthesis carried out by a single researcher, rather than a systematic analysis.

2 Results

This section presents the findings of the review. It begins with the core constructs as they are understood in this report (2.1), followed by the theoretical perspectives that recur across the literature and serve as an organising lens for the model (2.2), the resource domains in which recovery is observed (2.3), the two mechanisms through which the social dimension acts on recovery (2.4), the relationships between the domains (2.5), the conceptual model that brings these elements together (2.6), and its translation into measurable variables (2.7).

2.1 Core concepts

The literature on recovery uses several of its central terms in more than one way. To ensure consistency in the remainder of this report, this section sets out how six recurring constructs are understood here. These are recovery, resources, trajectory, secondary stressors, expectations, and provided support. These are working definitions, chosen for their clarity and applicability in empirical research.

Recovery is the process through which a person's resources are restored over time after a disaster, relative to their pre-disaster level (Hobfoll, 1989; Hobfoll et al., 2016). It is a process rather than an end state and need not return a person to their starting point, since resources can level off at, below, or above the pre-disaster level.

Resources are the things a person values and seeks to retain, including personal, social, material, and financial assets (Hobfoll, 1989; Hobfoll et al., 2016). They are the common currency of recovery in this model, since recovery is defined as their loss during and after a disaster and their restoration relative to the pre-disaster level.

A *trajectory* is the pattern that recovery follows over time in a given domain. The literature describes a small number of distinguishable patterns (Bonanno, 2004; Bonanno et al., 2010), set out in Section 2.2.2.

Secondary stressors are the social factors and life circumstances that surround a disaster rather than arising directly from it, such as job loss, displacement, or protracted compensation procedures. They include circumstances already present beforehand and those that emerge from the societal and organisational response to the event, as distinct from the primary stressors the event produces directly (Williams et al., 2021).

Expectations are the beliefs affected individuals hold during the recovery phase about what will be provided by government, by institutional arrangements such as insurance and compensation, and by those around them (Chamlee-Wright & Storr, 2010; Dückers, 2026). They can be positive or negative and may diverge from what people eventually experience.

Provided support is the assistance delivered to affected individuals during the recovery phase, through both formal arrangements and informal networks (Whittaker et al., 2015).

2.2 Theoretical framework

The review surfaced a range of theoretical perspectives on how recovery unfolds. Three of these recur across multiple studies and share a common focus, and together they serve as an organising lens for this first version of the model presented in this report (Anthopoulos et al., 2023; Janson et al., 2024; Levin et al., 2025; Raker et al., 2019; van der Velden et al., 2014; Waszczuk et al., 2022).

These are Conservation of Resources theory (Hobfoll, 1989), the trajectory typology of Bonanno (2004) and Bonanno et al. (2010), and the work on secondary stressors developed by Norris and colleagues (Norris et al., 2002) and extended more recently by Williams (Williams et al., 2021) and Stancombe (Stancombe et al., 2023). These perspectives originate largely in research on psychological responses to trauma, and they are presented here as one useful way of organising the field rather than as its only foundation. Each addresses a different aspect of recovery, and other perspectives, particularly ones better suited to the physical, financial, and social dimensions of recovery, will need to be drawn in as the model develops. Taken together, the three perspectives offer an initial account of why recovery varies between people, why circumstances before a disaster matter, and why difficulties in one area of life carry over into others. The perspectives are briefly discussed below in turn.

2.2.1 The Resource perspective

Conservation of Resources theory (Hobfoll, 1989) offers one way of understanding why some people are more affected by the same disaster than others. The theory states that people strive to acquire, retain, and protect resources, and that stress arises when those resources are lost or threatened. From this perspective, disasters are damaging because they involve large-scale loss of valued resources. The theory further states that losses tend to accumulate over time, as an initial loss of resources reduces the capacity to cope with subsequent stressors, leading to so-called loss spirals in which individuals become increasingly vulnerable (Hobfoll et al., 2016). At the same time, the theory emphasises that people with a greater initial resource reserve are better able to withstand and recover from such events, as they have more resources to invest in coping and recovery (Hobfoll et al., 2016).

The same resource principle can also be applied at the societal level, where it yields a different pattern. While at the individual level greater vulnerability is associated with a higher risk of post-traumatic stress disorder (PTSD), populations with lower vulnerability, holding greater social and economic resources, have been found to show a higher rather than a lower prevalence of PTSD. This is known as the vulnerability paradox (Dückers et al., 2016). Possible explanations are sought in differences between countries in expectations and in how symptoms are appraised and recorded, although the paradox has not yet been fully explained (Dückers et al., 2016). This cross-national pattern concerns differences between populations, whereas the resource mechanism above concerns differences between individuals.

2.2.2 Trajectory heterogeneity

A second perspective concerns the way recovery evolves over time. Bonanno (2004) and Bonanno et al. (2010) showed that exposure to a potentially traumatic event does not produce one uniform response in everyone, but a small number of distinct patterns over

time. The most common trajectory is resilience, in which functioning remains relatively stable at its usual level throughout. Some distress may be experienced, but individuals tend to continue to function and return quickly to their usual level. A second trajectory is what this typology labels recovery, not to be confused with the broader concept of recovery defined in Section 2.1. Here clear distress emerges after the event and gradually subsides within weeks or months. A small group shows chronic dysfunction, with long-term problems that do not diminish over time. A final, similarly small group initially appears stable but develops increasing problems later on (Bonanno, 2004). This typology was developed for mental health outcomes, where it is supported by longitudinal data. For disasters specifically, a multilingual review of 234 longitudinal studies confirms this pattern and shows that the course differs by outcome and by disaster type: post-traumatic stress symptoms decline steadily, whereas depressive symptoms and anxiety remain elevated for years, and prevalence is higher after earthquakes and pandemics than after other disaster types (Newnham et al., 2022). Comparable differentiation has been described for housing and financial recovery (Marín et al., 2015; Taheri Tafti & Bashiri, 2022) though this rests on comparative case analysis rather than on longitudinal studies. For physical health, longitudinal studies exist but have not yet been analysed in terms of distinct trajectories (Yzermans et al., 2005; Yzermans et al., 2009).

2.2.3 Secondary stressors

A third perspective concerns the period after a disaster. Drawing on an extensive review of two decades of empirical disaster research, Norris and colleagues (2002) found that secondary stressors increased the likelihood of adverse long-term outcomes, over and above the effects of exposure intensity and pre-existing resources. Secondary stressors are the social factors and life circumstances that surround a disaster rather than arising directly from it, such as job loss, displacement, or protracted compensation procedures. They are distinct from primary stressors, which the event produces directly, and they include both circumstances already present beforehand and those that emerge from the societal and organisational response to the event (Williams et al., 2021). More recent work continues to find secondary stressors associated with greater distress and slower recovery over time (Stancombe et al., 2023).

2.3 Domains

The perspectives describe how recovery unfolds; the review also shows in which domains it becomes visible. Four domains recur throughout. These are the mental domain, the most extensively documented in the literature (Norris et al., 2002; Bonanno, 2004; Newnham et al., 2022), the physical (Kuroda et al., 2018; Yzermans et al., 2005; Yzermans et al., 2009), housing (Taheri Tafti & Bashiri, 2022), and the financial (Akbulut-Yuksel et al., 2023; de Mel et al., 2008).

The four chosen domains are illustrative rather than exhaustive; recovery can equally become visible in other areas of life, such as employment (Arcaya et al., 2020). Any division of an individual into domains is to some extent a simplification. The four domains were chosen because they recur most consistently in the reviewed literature and because each can be measured at the level of the individual. They therefore serve as a starting point for this first version of the model rather than as a settled set; expert consultation and new insights may change them over time.

One point deserves attention here. Some frameworks treat the social dimension as a separate recovery domain (Abramson et al., 2010). In this model the social dimension is instead understood as interaction, not a separate domain but a thread that runs through every domain. The domains describe what a person holds; how the resources within those domains develop after a disaster, however, depends not only on the individual but also on what the social environment does and fails to do. This choice is consistent with the literature on secondary stressors (Williams et al., 2021). The model captures this through two mechanisms, described in Section 2.4.

2.4 Expectations and provided support

Section 2.3 introduced the social dimension of recovery as interaction. The model captures this interaction through two mechanisms that act on a person's resources during the recovery phase, namely expectations and provided support. This is a deliberate simplification, but these two mechanisms have the strongest grounding in the reviewed literature.

The first mechanism concerns expectations. After a disaster, people hold expectations towards the government, towards arrangements such as insurance and compensation, and towards the support of those around them (Chamlee-Wright & Storr, 2010; Dückers, 2026). The model proposes that what matters most for recovery is the gap between those expectations and what people actually experience. A comparable gap mechanism is well established in research on public services, where citizens' satisfaction depends on the comparison between expectations and perceived performance (Van Ryzin, 2006; Zhang et al., 2022). The 2021 floods in Limburg illustrate this, as the gap between government ambitions, legal frameworks, and residents' expectations itself became a burden (Andersson Elffers Felix, 2023). Because direct evidence for an effect on recovery is still limited, the role of expectations is treated in the model as a proposition to be examined rather than an established finding.

The second mechanism is the support actually provided. This covers formal assistance, such as government relief and compensation (Akbulut-Yuksel et al., 2023), and informal support from volunteers, neighbours, and social networks (Whittaker et al., 2015). How much this support contributes depends not only on how much is given but also on its quality, as effective post-disaster support promotes a sense of safety, calming, confidence in one's own abilities and those of the community, connectedness, and hope (Hobfoll et al., 2007). Delivering resources alone, however, does not guarantee that support helps. Support that falls short of expectations, arrives too late, or is inadequate in form can itself become a secondary stressor that deepens distress and slows recovery (Dücker, 2026; Stancombe et al., 2023; Williams et al., 2021).

Both mechanisms are hard to measure. Expectations are subjective, change over time, and appear in no administrative data; this partly explains why direct evidence for their effect remains limited, and it means they can mainly be studied through qualitative research. Provided support is more visible than expectations, but only partly so. Assistance after a disaster is often fragmented across the organisations involved (Andersson Elffers Felix, 2023), informal help operates largely outside official structures (Whittaker et al., 2015) and

therefore leaves few traces in data, and records of what was delivered say little about its quality, which requires separate assessment (Dückers & Thormar, 2015). The mechanisms are nonetheless included in the model, because alongside exposure and the initial resource reserve, they help explain how recovery unfolds.

2.5 Relationship between the domains

Within each domain, recovery follows its own trajectory (see Section 2.1), but the domains cannot be viewed in isolation from one another. What happens in one domain carries over into another. Financial strain can burden mental health (Norris et al., 2002; Raker et al., 2019), housing damage can harm health (Stroebe et al., 2021), and pre-disaster psychological problems can carry over into physical health (Soeteman et al., 2006). This carry-over partly runs through the mechanisms set out in Section 2.4, as support that falls short of expectations or is otherwise inadequate can act as a secondary stressor that arises in one domain and bears on another. A setback in one domain can thus slow recovery in the others.

In addition, a person's starting position directly affects all domains at once. The same background characteristics and the resources a person holds before the event partly determine the starting position in each of the four domains (Hobfoll et al., 2016; Lowe et al., 2020). This, too, links the four recovery trajectories of a person to one another. The model does not fix the strength or direction of these relationships in advance.

2.6 The Conceptual model

The elements from the preceding sections come together in a deliberately simple model of how recovery can be observed at the level of the individual, summarised in Figure 2.1. The model reads from top to bottom, ordered in time.

The model starts from a person's background characteristics, that is, demographic and socio-economic characteristics such as age, gender, education level, and socio-economic status. These are largely fixed and are therefore not treated as outcomes, but they partly determine where a person stands before the disaster. This works through, first of all, directly in the resources a person holds at the outset, and partly through that starting position also in the way each domain subsequently develops. The influence of the background characteristics is not confined to the starting point, however. Because these characteristics remain part of the person, they continue to act throughout the recovery phase, partly directly and partly through the resources.

Below the background characteristics sit the resources at t_0 . This is the reserve a person holds before the disaster, divided into the four domains from Section 2.3, which serve as an illustrative set for this first version of the model. These resources form the baseline values of the model. Only these resources can be depleted by the disaster and then recover, remain at the reduced level, or decline further.

After the disaster comes the recovery phase, the central part of the model. Within it, the resources are measured repeatedly, at a series of moments from t_1 to t_n . Recovery refers to the movement of these measurements relative to the level at t_0 . The pattern this movement forms across the successive measurement moments is the recovery trajectory, which is estimated separately for each domain. In line with the definition in Section 2.1, a trajectory need not return to the level of t_0 ; it can level off below, at, or above that level.

Throughout the recovery phase, the resources are acted on both by the background characteristics, which continue to exert their influence after the disaster, and by the mechanisms from Section 2.4, the expectations and the provided support. Together with the relationships between the domains from Section 2.5, these influences explain why people with a similar starting position can nonetheless follow different trajectories.

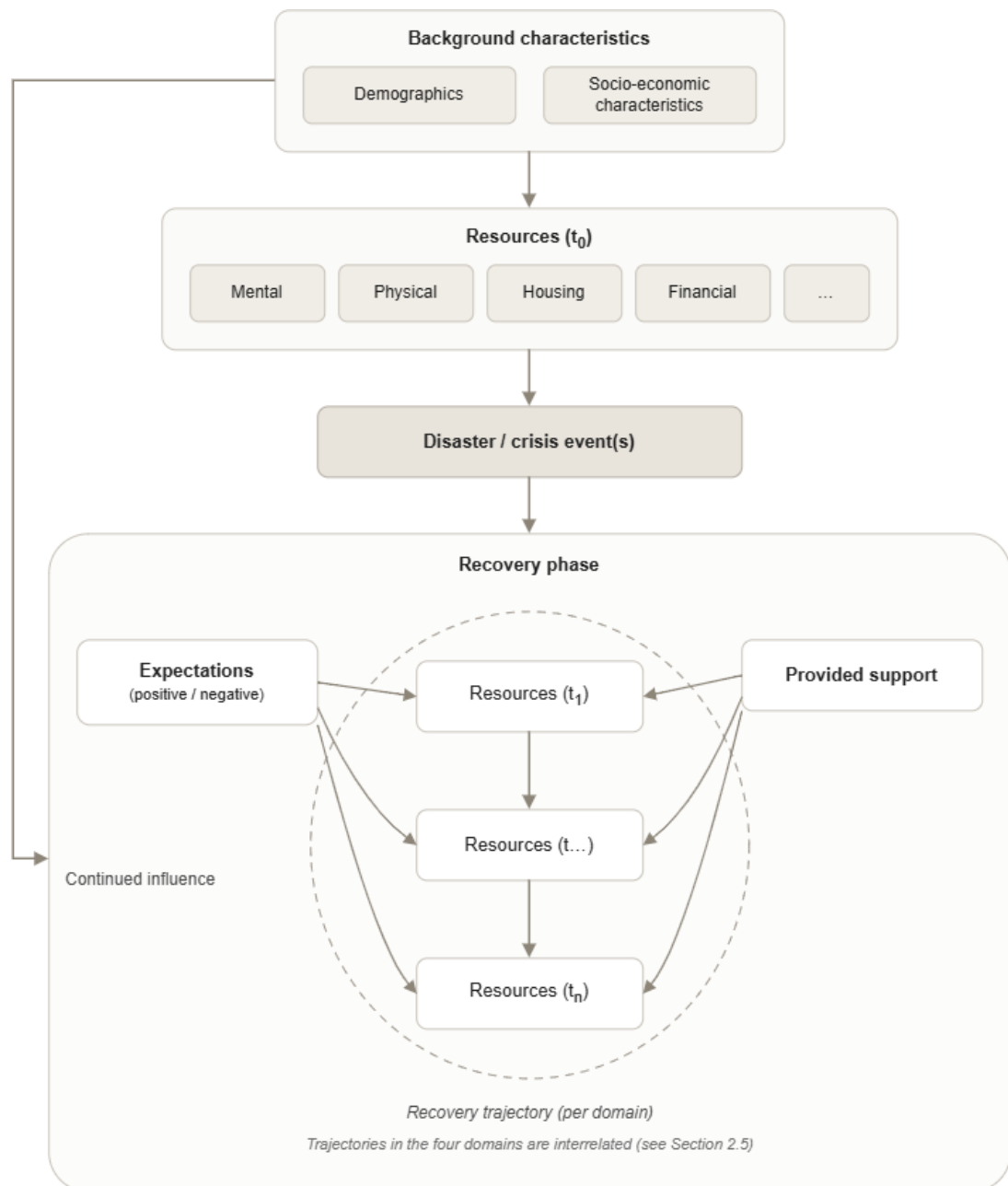


Figure 2.1 Conceptual model of recovery after a disaster

2.7 Operationalisation

Because the model must make individual recovery measurable and modellable, this section outlines which variables qualify for that purpose and how they can be operationalised. The operationalisation describes what would be measured in the ideal situation.

The first variables relate to the background characteristics, which matter for the whole model. The four domains (see Section 2.3) are then treated separately. Two kinds of variables are distinguished, namely the outcomes in which recovery becomes visible, and the predictors, the characteristics of the period before the disaster and of the disaster itself that are expected to shape how that recovery unfolds. Within each domain, one outcome is designated as the primary outcome. The course of this outcome across the measurement moments forms the recovery trajectory of that domain (see Section 2.1). The remaining outcomes serve as supplementary indicators, which can be used to test the robustness of the trajectories.

The outcomes and most predictors are first recorded at t_0 , but their roles differ from that point on. The primary outcome is measured again at each subsequent moment; its course relative to the level at t_0 forms the trajectory. The predictors are recorded once and are treated as unchanging in the model; they help explain why one trajectory unfolds favourably and another does not. Pre-disaster characteristics are recorded at t_0 ; characteristics of the disaster itself, such as the intensity of exposure, are established immediately after the event and from that moment likewise serve as fixed predictors. In the financial domain, for example, income is the primary outcome, while characteristics such as wealth and job security before the disaster serve as predictors.

The two mechanisms from Section 2.4 are not operationalised here. This is a substantive choice, not a judgement about their importance, as the model in fact expects expectations and provided support to help shape how trajectories unfold. At present, however, measuring them raises too many questions, because expectations appear in no administrative records and provided support is fragmented and only partly traceable in data (see Section 2.4). The operationalisation therefore focuses on what can already be measured; making the mechanisms measurable is an explicit task for the next steps.

2.7.1 Background characteristics

The background characteristics form the layer that runs underneath the whole recovery process. They cover both demographic characteristics, such as age, gender, and household composition, and socio-economic characteristics, such as education level and socio-economic status. They are not outcomes, but characteristics that can bear on every domain (Lowe et al., 2020; Yzermans et al., 2005). Some of these characteristics are fixed or change in a fully predictable way, such as gender and age. Others, such as socio-economic status, can indeed change, for example through job loss or the death of a household member. In the model, all background characteristics are recorded at t_0 and treated as unchanging predictors. This is a modelling choice, not a claim about reality. Changes that occur in these characteristics after t_0 are not included as predictors, but become visible in the domains themselves, for example as income loss in the financial domain. Table 2.1 presents the operationalisation.

Table 2.1 Background characteristics associated with recovery

Concept	Source
Age	Raker et al. (2019); Sasaki et al. (2019)
Gender	de Mel et al. (2008); Umaroh et al. (2026)
Socio-economic status	Raker et al. (2019); Okuzono et al. (2024)
Education level	Sasaki et al. (2019); Umaroh et al. (2026)
Migration background	Vu & Vanlandingham (2012)

2.7.2 Mental health

Most research on recovery concerns the domain of mental health. In the literature, recovery here is measured through general psychological distress; this forms the primary outcome of the domain. Post-traumatic stress and depressive symptoms are also reported (Norris et al., 2002; Raker et al., 2019). The course of general psychological distress symptoms across the measurement moments forms the trajectory of mental health; the remaining outcomes shed light on the same recovery from other angles. Table 2.2 presents the outcomes.

The literature also links pre-disaster characteristics to the course of the recovery trajectory. Pre-disaster mental health is cited most frequently, together with the intensity of exposure to the disaster itself, alongside perceived social support and prior traumatic experience (Norris et al., 2002; Raker et al., 2019; Sasaki et al., 2019). Table 2.3 presents the predictors.

Table 2.2 Outcomes of the mental health domain

Concept	Source
General psychological distress (primary outcome)	Li & Leppold (2025); Raker et al. (2019)
Post-traumatic stress symptoms	Anthopolos et al. (2023); Levin et al. (2025); Pavlacic et al. (2024)
Depressive symptoms	Kopala-Sibley et al. (2016); Sasaki et al. (2019)

Table 2.3 Predictors of the mental health domain

Concept	Source
Pre-disaster mental health	Raker et al. (2019); van der Velden et al. (2006)
Intensity of disaster exposure	Raker et al. (2019); Waszczuk et al. (2022)
Perceived social support	Sasaki et al. (2019); van der Velden et al. (2014)
Prior traumatic experience	Norris et al. (2002)

2.7.3 Physical health

Research on recovery in the physical domain concerns the bodily health of those affected. In the literature, recovery here is measured through general physical health; this forms the

primary outcome of the domain. Chronic conditions and functional limitations in daily life are also reported (Kuroda et al., 2018; Yzermans et al., 2005). Unlike mental health, the course of these outcomes has rarely been analysed in terms of distinct trajectories (Li et al., 2023). Table 2.4 presents the outcomes.

Here, too, the literature links pre-disaster characteristics to the course of recovery. Pre-disaster physical health is cited most frequently, alongside pre-disaster psychological problems and chronic conditions (Burns et al., 2024; Li et al., 2023; Yzermans et al., 2005). Table 2.5 presents the predictors.

Table 2.4 Outcomes of the physical health domain

Concept	Source
General physical health (primary outcome)	Li et al. (2023); Yzermans et al. (2005)
Chronic conditions	Kuroda et al. (2018); Yzermans et al. (2005)
Functional limitations in daily life	Kuroda et al. (2018); Wang et al. (2023)

Table 2.5 Predictors of the physical health domain

Concept	Source
Pre-disaster physical health	Burns et al. (2024); Li et al. (2023); Yzermans et al. (2005)
Pre-disaster psychological problems	Soeteman et al. (2006); Yzermans et al. (2005)
Pre-existing chronic conditions	Li et al. (2023)

2.7.4 Housing

Research on recovery in the housing domain concerns the housing situation of those affected. In the literature, recovery here is measured through the housing situation, where recovery means that a person is again durably housed; the housing situation forms the primary outcome of the domain. The progress of home repair or reconstruction and the duration of displacement are also reported (Merdjanoff et al., 2022; Rathfon et al., 2013). The course of these outcomes has so far been described in comparative case analyses, not in longitudinal studies (see Section 2.2.2). Table 2.6 presents the outcomes.

Here, too, the literature links pre-disaster characteristics to the course of recovery. Pre-disaster housing tenure is cited most frequently, together with the extent of damage caused by the disaster itself, alongside the pre-disaster value and condition of the home (Li et al., 2023; Rathfon et al., 2013; Taheri Tafti & Bashiri, 2022). Table 2.7 presents the predictors.

Table 2.6 Outcomes of the housing domain

Concept	Source
---------	--------

Current housing situation (primary outcome)	Taheri Tafti & Bashiri (2022)
Progress of home repair or reconstruction	Rathfon et al. (2013)
Duration of displacement	Merdjanoff et al. (2022)

Table 2.7 Predictors of the housing domain

Concept	Source
Pre-disaster housing tenure (owner-occupied or rented)	Rathfon et al. (2013)
Pre-disaster value of the home	Rathfon et al. (2013)
Pre-disaster condition of the home	Rathfon et al. (2013)
Extent of damage	Li et al. (2023); Taheri Tafti & Bashiri (2022)

2.7.5 Financial domain

Research on recovery in the financial domain concerns the financial position of those affected. In the literature, recovery here is measured through income; this forms the primary outcome of the domain. Wealth, debt, and the use of income support are also reported (Akbulut-Yuksel et al., 2023; de Mel et al., 2008). The course of these outcomes has rarely been studied longitudinally in terms of distinct trajectories (see Section 2.2.2). Table 2.8 presents the outcomes.

Here, too, the literature links pre-disaster characteristics to the course of recovery. Pre-disaster wealth is cited most frequently, alongside job security and the social network a person can fall back on (Akbulut-Yuksel et al., 2023; de Mel et al., 2008). Table 2.9 presents the predictors.

Table 2.8 Outcomes of the financial domain

Concept	Source
Income (primary outcome)	Akbulut-Yuksel et al. (2023); de Mel et al. (2008)
Wealth	de Mel et al. (2008)
Debt	Akbulut-Yuksel et al. (2023)
Use of income support	Akbulut-Yuksel et al. (2023)

Table 2.9 Predictors of the financial domain

Concept	Source
---------	--------

Pre-disaster wealth	de Mel et al. (2008)
Pre-disaster job security	Akbulut-Yuksel et al. (2023)
Social network to fall back on (bonding social capital)	de Mel et al. (2008)

3 Discussion

This chapter discusses the conceptual model in three parts: the assumptions on which it rests (3.1), its strengths and limitations (3.2), and recommendations for follow-up research (3.3).

3.1 Assumptions

The model rests on a number of assumptions that are theoretically grounded but not yet empirically tested. They are listed here as a working agenda for the empirical follow-up research within the work package (see the Introduction) and are labelled A1 through A5. The assumptions are largely testable with longitudinal data at the individual level, for example through repeated questionnaires, interviews, or administrative sources that record change over time.

A1. Individual recovery follows a small number of distinguishable trajectories within each domain. This is well established for mental health (Bonanno, 2004; Bonanno et al., 2010) and confirmed at review level specifically for disasters (Newnham et al., 2022). Whether the same trajectories also occur in the other domains remains uncertain. For physical health, longitudinal studies exist but have rarely been analysed in terms of distinct trajectories (Li et al., 2023), and for housing and the financial position the available research rests on comparative case analysis rather than longitudinal modelling.

A2. The background characteristics influence the outcomes partly through the resources a person holds, an expectation consistent with the literature on social vulnerability (Hobfoll et al., 2016; Lowe et al., 2020). The model additionally expects this shared influence to link a person's recovery trajectories across the domains. The background characteristics are treated as unchanging; changes in them after the disaster run through the domain outcomes in this version of the model. In later versions, such changes can be modelled explicitly, for example by measuring these characteristics at multiple moments and including them as changing predictors in the trajectory analysis. How this influence should be operationalised precisely has not yet been examined.

A3. The stock of resources a person holds before a disaster is an important predictor of the trajectory that person follows (see the resource perspective in Section 2.2.1).

A4. The four domains considered, mental, physical, housing, and financial, form an illustrative selection of the outcomes in which recovery becomes visible, not exhaustive coverage. This selection may be adjusted or extended in later versions of the model, as described in Section 2.3.

A5. Secondary stressors are among the factors that consistently shape long-term outcomes, alongside the intensity of exposure and the resources already present (Stancombe et al., 2023; Williams et al., 2021). The model expects the two mechanisms from Section 2.4,

expectations and provided support, to play a role in this, but the size of this influence has not yet been quantified. Moreover, the first empirical test of the model cannot yet include the mechanisms as variables; these first require qualitative exploration before they can be incorporated quantitatively (see Section 2.7).

3.2 Strengths and limitations

The model has both strengths and limitations. Its strengths are that it is theoretically anchored in three established frameworks, that it makes recovery measurable at the level of the individual, and that it gives the social dimension an explicit place. Against these stand limitations, which can be grouped into four themes: the nature of the evidence, the way the review was conducted, the as yet untested relationships between the domains, and the operationalisation in the empirical phase.

First, the evidence is unevenly distributed across the four domains. For mental health the basis is strongest, with several long-running studies. For physical health, longitudinal studies exist but have rarely been analysed in terms of trajectories (Li et al., 2023). The housing domain rests almost entirely on reconstruction research and comparative case analysis. For the financial domain the basis is scarcest. Moreover, the available studies are based on tsunami or flood settings in low- and middle-income countries, where social safety nets, insurance coverage, and compensation arrangements differ strongly from those in higher-income countries. A quantitative synthesis with effect sizes is therefore not justified for these domains, and transferring findings from this literature to another context is itself an assumption, not a result.

Second, the review itself has some limitations. It is a narrative synthesis, conducted by a single researcher, not a formally coded analysis with a second coder. Nor has an expert panel or focus group been consulted at this stage. The selection and grouping of concepts therefore inevitably reflect the interpretation of one researcher.

A third point concerns the relationships between the domains, which form the core of the model. As far as is known, hardly any studies examine several domains simultaneously within a longitudinal design with a baseline measurement before the disaster. One exception combines mental and physical health (Li et al., 2023), but no study covers all four domains. The cross-domain links in Section 2.5 are therefore derived from separate findings and have not been tested as a coherent whole. A related issue concerns the definition of recovery. Because individual-level pre-disaster data are largely absent in the studies reviewed, the understanding of recovery as a return towards one's own pre-disaster resources (Section 2.1) rests on theoretical assumptions. At the same time, these gaps make clear where the empirical challenges lie. There is a need for integrated, longitudinal analyses that also include pre-disaster data.

Fourth, there are practical problems in measuring variables central to this model. Exposure to a disaster is rarely recorded in a register, which forces researchers to rely on other routes to data, for example addresses within an affected area, damage or compensation registers, or the official designation of affected zones. A second challenge is data availability. Ideally, individuals are already followed before the disaster, but in practice this is difficult to achieve. Individual-level pre-disaster data are often limited or absent, and setting up repeated

measurements after a disaster, for example through questionnaires or interviews, requires considerable effort. Existing administrative data sources could be drawn on, such as municipal registrations or data from national statistical offices. However, these are only usable if they contain sufficiently frequent observations of variables that match the concepts to be measured. Finally, the two mechanisms from Section 2.4 are conceptually anchored in this version but not yet made measurable; making them measurable is an explicit task for what follows.

3.3 Recommendations

From the assumptions and limitations follow two recommendations for the next steps within the work package.

A first recommendation concerns the factors included in this model. These factors are drawn from international literature and are not fixed. A logical next step is to discuss them with experts and practitioners in the field, who could confirm and refine them, as well as identify new factors. This step also helps address a limitation noted earlier, namely the absence of independent coding. It further offers the opportunity to strengthen the domains with the least empirical basis (the housing domain and the financial domain), and to test whether the choice to treat the social dimension as interaction (Section 2.3) holds, or whether a separate social domain proves necessary after all. In addition, a systematic review, with a predefined search strategy and a second coder, can test the narrative synthesis of this report.

A second recommendation concerns the empirical design. It is desirable to develop a research design in which the four domains are examined simultaneously, with a joint pre-disaster measurement, following the measurement moments in Section 2.6. Because it cannot be predicted where and when a disaster will occur, such a baseline cannot be organised in advance; attention should therefore focus on sources that measure continuously, such as administrative registrations, general practice records, and ongoing cohort and panel studies, in which the pre-disaster data have already been recorded when a disaster occurs (Li et al., 2023; Wang et al., 2023; Yzermans et al., 2005; Yzermans et al., 2009). It is important to include a comparison group of non-affected individuals with similar characteristics. Such a design is lacking in the current literature and would form an important contribution. A comparison group is essential, because factors such as income and housing situation also change through developments unrelated to a disaster, such as broader economic conditions and housing market developments. With large-scale data on individuals, matched control groups can be composed, allowing the effect of the disaster to be distinguished from such background developments. Without such a comparison, lagging recovery cannot be distinguished from a general downward development, nor favourable recovery from a general upward one. In parallel, the two mechanisms from Section 2.4 first require qualitative exploration, for example through interviews and focus groups with those affected, before they can be included in this design.

4 Conclusion

This report presents a conceptual model for individual recovery after a disaster. The model defines recovery as the course of a person's resources relative to their pre-disaster level, makes this recovery visible in four domains (mental, physical, housing, and financial), and links the background characteristics and pre-disaster resources to the trajectory a person follows. In addition, the model gives the social dimension of recovery an explicit place, through two mechanisms that act on a person's resources during the recovery phase, namely the expectations of those affected and the support actually provided.

In doing so, this report lays the foundation for answering the question at the centre of the work package: how and why recovery unfolds differently across individuals, and how these differences can be explained. It does not yet answer that question; it makes the question answerable, by making recovery measurable and modellable. This is an initial, exploratory step, intended as a structured starting point and emphatically not an end point. In the next steps of the work package, the factors included in the model will be tested with experts and practitioners, data sources will be identified, and historical recovery trajectories will be analysed as a run-up to a predictive model. In this way, the model contributes to the ultimate aim of enabling those involved in the aftercare and recovery phase to recognise and anticipate foreseeable problems after a disaster in a timely manner.

References

- Abramson, D. M., Stehling-Ariza, T., Park, Y. S., Walsh, L., & Culp, D. (2010). Measuring individual disaster recovery: A socioecological framework. *Disaster Medicine and Public Health Preparedness*, 4(S1), S46–S54. <https://doi.org/10.1001/dmp.2010.14>
- Akbulut-Yuksel, M., Rahman, M. H., & Ulubaşoğlu, M. A. (2023). Silver lining of the water: The role of government relief assistance in disaster recovery. *European Journal of Political Economy*, 79, Article 102436. <https://doi.org/10.1016/j.ejpoleco.2023.102436>
- Andersson Elffers Felix. (2023). *Procesevaluatie afhandeling waterschade Zuid-Nederland: Eindrapportage*. WODC, Ministerie van Justitie en Veiligheid.
- Anthopolos, R., Chen, Q., Sedransk, J., Thompson, M., Meng, G., & Galea, S. (2023). A Bayesian growth mixture model for complex survey data: Clustering postdisaster PTSD trajectories. *The Annals of Applied Statistics*, 17(3), 2494–2514. <https://doi.org/10.1214/23-AOAS1729>
- Arcaya, M. C., Raker, E. J., & Waters, M. C. (2020). The social consequences of disasters: Individual and community change. *Annual Review of Sociology*, 46, 671–691. <https://doi.org/10.1146/annurev-soc-121919-054827>
- Bakker, M., Verweij, M., & Dückers, M. (2026). *Raamwerken voor nazorg en herstel: Een literatuuronderzoek*. Nederlands Instituut Publieke Veiligheid.
- Bas, M. de, Helsloot, I., & Dückers, M. (2017). De preparatie op de nafase binnen veiligheidsregio's: Een verkennend onderzoek. *Tijdschrift voor Veiligheid*, 16(1), 3–16. <https://doi.org/10.5553/TvV/187279482017016001001>
- Bonanno, G. A. (2004). Loss, trauma, and human resilience: Have we underestimated the human capacity to thrive after extremely aversive events? *American Psychologist*, 59(1), 20–28. <https://doi.org/10.1037/0003-066X.59.1.20>
- Bonanno, G. A., Brewin, C. R., Kaniasty, K., & La Greca, A. M. (2010). Weighing the costs of disaster: Consequences, risks, and resilience in individuals, families, and communities. *Psychological Science in the Public Interest*, 11(1), 1–49. <https://doi.org/10.1177/1529100610387086>

Burns, P., Myers, C., Yzermans, J., & Dückers, M. (2024). Physical health impacts of disasters. In G. FitzGerald, S. Pizzino, P. Burns, C. Myers, M. Tarrant, B. Ryan, M. Fredriksen, & P. Aitken (Eds.), *Disaster health management: A primer for students and practitioners* (2nd ed., pp. 149–160). Routledge. <https://doi.org/10.4324/9781032626604-14>

Chamlee-Wright, E., & Storr, V. H. (2010). Expectations of government's response to disaster. *Public Choice*, 144(1–2), 253–274. <https://doi.org/10.1007/s11127-009-9516-x>

Dückers, M.L.A. (2012). *Richting geven aan de laatste schakel: De nafase. Rijksbrede versterking van herstel en nazorg bij rampen en crises*. Ministerie van Veiligheid en Justitie.

Dückers, M. L. A. (2026). Crisis leadership beyond the flame: A human-centered crisis expectations model and its implications for research, policy, and practice. *Risk, Hazards & Crisis in Public Policy*, 17, Article e70065. <https://doi.org/10.1002/rhc3.70065>

Dückers, M. L. A., Alisic, E., & Brewin, C. R. (2016). A vulnerability paradox in the cross-national prevalence of post-traumatic stress disorder. *The British Journal of Psychiatry*, 209(4), 300–305. <https://doi.org/10.1192/bjp.bp.115.176628>

Dückers, M.L.A., Rooze, M., & Alexander, D. (2013). Towards resilient organisation of recovery and care after disaster. In J. J. L. M. Bierens (Ed.), *Drowning: Prevention, rescue, treatment* (2nd ed., pp. 1033–1038). Springer. https://doi.org/10.1007/978-3-642-04253-9_157

Dückers, M. L. A., & Thormar, S. B. (2015). Post-disaster psychosocial support and quality improvement: A conceptual framework for understanding and improving the quality of psychosocial support programs. *Nursing & Health Sciences*, 17(2), 159–165. <https://doi.org/10.1111/nhs.12162>

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, 44(3), 513–524. <https://doi.org/10.1037/0003-066X.44.3.513>

Hobfoll, S. E., Tirone, V., Holmgreen, L., & Gerhart, J. (2016). Conservation of resources theory applied to major stress. In G. Fink (Ed.), *Stress: Concepts, cognition, emotion, and behavior* (pp. 65–71). Academic Press.

Hobfoll, S. E., Watson, P., Bell, C. C., Bryant, R. A., Brymer, M. J., Friedman, M. J., Friedman, M., Gersons, B. P. R., de Jong, J. T. V. M., Layne, C. M., Maguen, S., Neria, Y., Norwood, A. E., Pynoos, R. S., Reissman, D., Ruzek, J. I., Shalev, A. Y., Solomon, Z., Steinberg, A. M., & Ursano, R. J. (2007). Five essential elements of immediate and mid-term

mass trauma intervention: Empirical evidence. *Psychiatry*, 70(4), 283–315.

<https://doi.org/10.1521/psyc.2007.70.4.283>

Janson, M., Felix, E. D., Jaramillo, N., Sharkey, J. D., & Barnett, M. (2024). A prospective examination of mental health trajectories of disaster-exposed young adults in the COVID-19 pandemic. *Behavioral Sciences*, 14(2), Article 121. <https://doi.org/10.3390/bs14020121>

Kopala-Sibley, D. C., Danzig, A. P., Kotov, R., Bromet, E. J., Carlson, G. A., Olino, T. M., Bhatia, V., Black, S. R., & Klein, D. N. (2016). Negative emotionality and its facets moderate the effects of exposure to Hurricane Sandy on children's postdisaster depression and anxiety symptoms. *Journal of Abnormal Psychology*, 125(4), 471–481.

<https://doi.org/10.1037/abn0000152>

Kuroda, Y., Iwasa, H., Orui, M., Moriyama, N., Suemoto, C. K., Yashiro, C., Matsuda, K., & Yasumura, S. (2018). Risk factor for incident functional disability and the effect of a preventive exercise program: A 4-year prospective cohort study of older survivors from the Great East Japan Earthquake and nuclear disaster. *International Journal of Environmental Research and Public Health*, 15(7), Article 1430. <https://doi.org/10.3390/ijerph15071430>

Levin, Y., Shmulewitz, D., Skvirsky, V., Vider, M., Kor, A., Lev-Ran, S., & Mikulincer, M. (2025). Longitudinal PTSD trajectories before and after the October 7, 2023, terror attacks: A nationwide study of Israeli adults. *European Psychiatry*, 69(1), Article e13.

<https://doi.org/10.1192/j.eurpsy.2025.10130>

Li, A., & Leppold, C. (2025). Long-term mental health trajectories across multiple exposures to climate disasters in Australia: A population-based cohort study. *The Lancet Public Health*, 10(5), e391–e400. [https://doi.org/10.1016/S2468-2667\(25\)00068-4](https://doi.org/10.1016/S2468-2667(25)00068-4)

Li, A., Toll, M., Martino, E., Wiesel, I., Botha, F., & Bentley, R. (2023). Vulnerability and recovery: Long-term mental and physical health trajectories following climate-related disasters. *Social Science & Medicine*, 320, Article 115681.

<https://doi.org/10.1016/j.socscimed.2023.115681>

Lowe, S. R., Sampson, L., Gruebner, O., Galea, S., Waters, M. C., & Rhodes, J. E. (2020). Predisaster predictors of posttraumatic stress symptom trajectories: An analysis of low-income women in the aftermath of Hurricane Katrina. *PLOS ONE*, 15(10), Article e0240038.

<https://doi.org/10.1371/journal.pone.0240038>

Marín, A., Bodin, Ö., Gelcich, S., & Crona, B. (2015). Social capital in post-disaster recovery trajectories: Insights from a longitudinal study of tsunami-impacted small-scale fisher

organizations in Chile. *Global Environmental Change*, 35, 450–462.

<https://doi.org/10.1016/j.gloenvcha.2015.09.020>

de Mel, S., McKenzie, D., & Woodruff, C. (2008). Mental health recovery and economic recovery after the tsunami: High-frequency longitudinal evidence from Sri Lankan small business owners. *Social Science & Medicine*, 66(3), 582–595.

<https://doi.org/10.1016/j.socscimed.2007.10.002>

Merdjanoff, A. A., Abramson, D. M., Park, Y. S., & Piltch-Loeb, R. (2022). Disasters, displacement, and housing instability: Estimating time to stable housing 13 years after Hurricane Katrina. *Weather, Climate, and Society*, 14(2), 535–550.

<https://doi.org/10.1175/WCAS-D-21-0057.1>

Newnham, E. A., Mergelsberg, E. L. P., Chen, Y., Kim, Y., Gibbs, L., Dzidic, P. L., Ishida DaSilva, M., Chan, E. Y. Y., Shimomura, K., Narita, Z., Huang, Z., & Leaning, J. (2022). Long term mental health trajectories after disasters and pandemics: A multilingual systematic review of prevalence, risk and protective factors. *Clinical Psychology Review*, 97, Article 102203. <https://doi.org/10.1016/j.cpr.2022.102203>

Norris, F. H., Friedman, M. J., Watson, P. J., Byrne, C. M., Diaz, E., & Kaniasty, K. (2002). 60,000 disaster victims speak: Part I. An empirical review of the empirical literature, 1981–2001. *Psychiatry*, 65(3), 207–239. <https://doi.org/10.1521/psyc.65.3.207.20173>

Okuzono, S. S., Burrows, K., Shiba, K., Yazawa, A., Hikichi, H., Aida, J., Kondo, K., & Kawachi, I. (2024). Pre-disaster income inequality and post-disaster mental health: A natural experiment from the 2011 Great East Japan Earthquake and Tsunami. *Health & Place*, 90, Article 103363. <https://doi.org/10.1016/j.healthplace.2024.103363>

Parlementaire enquêtecommissie aardgaswinning Groningen. (2023). *Groningers boven gas: Rapport parlementaire enquêtecommissie aardgaswinning Groningen*. Tweede Kamer der Staten-Generaal.

Pavlacic, J. M., Ruggiero, K. J., Andrews, A. R., III, Price, M., & Rheingold, A. A. (2024). Behavioral activation is associated with post-disaster mental health: Secondary longitudinal analysis from a population-based study. *Journal of Clinical Psychology*, 80(2), 291–305. <https://doi.org/10.1002/jclp.23610>

Raker, E. J., Lowe, S. R., Arcaya, M. C., Johnson, S. T., Rhodes, J., & Waters, M. C. (2019). Twelve years later: The long-term mental health consequences of Hurricane Katrina. *Social Science & Medicine*, 242, Article 112610. <https://doi.org/10.1016/j.socscimed.2019.112610>

Rathfon, D., Davidson, R., Bevington, J., Vicini, A., & Hill, A. (2013). Quantitative assessment of post-disaster housing recovery: A case study of Punta Gorda, Florida, after Hurricane Charley. *Disasters*, 37(2), 333–355. <https://doi.org/10.1111/j.1467-7717.2012.01305.x>

Rubin, C. B. (2009). Long term recovery from disasters: The neglected component of emergency management. *Journal of Homeland Security and Emergency Management*, 6(1), Article 46. <https://doi.org/10.2202/1547-7355.1616>

Sasaki, Y., Aida, J., Tsuji, T., Koyama, S., Tsuboya, T., Saito, T., Kondo, K., & Kawachi, I. (2019). Pre-disaster social support is protective for onset of post-disaster depression: Prospective study from the Great East Japan Earthquake & Tsunami. *Scientific Reports*, 9, Article 19427. <https://doi.org/10.1038/s41598-019-55953-7>

Serrao-Neumann, S., Crick, F., & Low Choy, D. (2018). Post-disaster social recovery: Disaster governance lessons learnt from Tropical Cyclone Yasi. *Natural Hazards*, 93(3), 1163–1180. <https://doi.org/10.1007/s11069-018-3346-4>

Smith, G. P., & Wenger, D. (2007). Sustainable disaster recovery: Operationalizing an existing agenda. In H. Rodríguez, E. L. Quarantelli, & R. R. Dynes (Eds.), *Handbook of disaster research* (pp. 234–257). Springer. https://doi.org/10.1007/978-0-387-32353-4_14

Soeteman, R. J. H., Yzermans, C. J., Kerssens, J. J., Dirkzwager, A. J. E., Donker, G. A., van den Bosch, W. J. H. M., & van der Zee, J. (2006). The course of post-disaster health problems of victims with pre-disaster psychological problems as presented in general practice. *Family Practice*, 23(3), 378–384. <https://doi.org/10.1093/fampra/cml009>

Stancombe, J., Williams, R., Drury, J., Hussey, L., Gittins, M., Barrett, A., French, P., & Chitsabesan, P. (2023). Trajectories of distress and recovery, secondary stressors and social cure processes in people who used the resilience hub after the Manchester Arena bombing. *BJPsych Open*, 9(4), Article e143. <https://doi.org/10.1192/bjo.2023.527>

Stroebe, K., Kanis, B., Richardson, J., Oldersma, F., Broer, J., Greven, F., & Postmes, T. (2021). Chronic disaster impact: The long-term psychological and physical health consequences of housing damage due to induced earthquakes. *BMJ Open*, 11(5), Article e040710. <https://doi.org/10.1136/bmjopen-2020-040710>

Taheri Tafti, M., & Bashiri, M. (2022). Navigating transition: Post-disaster housing pathways of households. *Journal of Housing and the Built Environment*, 37(4), 1745–1767.

<https://doi.org/10.1007/s10901-021-09918-w>

Umaroh, R., Amrina, D. H., & Ayun, I. Q. (2026). Tracking the multidimensional poverty post-disaster: Empirical evidence of the 2004 tsunami in Indonesia. *Poverty & Public Policy*, 18(1), Article e70051. <https://doi.org/10.1002/pop4.70051>

van der Velden, P. G., Bosmans, M. W. G., Bogaerts, S., & van Veldhoven, M. J. P. M. (2014). Social organizational stressors and post-disaster mental health disturbances: A longitudinal study. *Psychiatry Research*, 219(1), 177–182.

<https://doi.org/10.1016/j.psychres.2014.05.032>

van der Velden, P. G., Grievink, L., Kleber, R. J., Drogendijk, A. N., Roskam, A.-J. R., Marcelissen, F. G. H., Olff, M., Meewisse, M. L., & Gersons, B. P. R. (2006). Post-disaster mental health problems and the utilization of mental health services: A four-year longitudinal comparative study. *Administration and Policy in Mental Health and Mental Health Services Research*, 33(3), 279–288. <https://doi.org/10.1007/s10488-005-0027-x>

Van Ryzin, G. G. (2006). Testing the expectancy disconfirmation model of citizen satisfaction with local government. *Journal of Public Administration Research and Theory*, 16(4), 599–611. <https://doi.org/10.1093/jopart/mui058>

Vu, L., & Vanlandingham, M. J. (2012). Physical and mental health consequences of Katrina on Vietnamese immigrants in New Orleans: A pre- and post-disaster assessment. *Journal of Immigrant and Minority Health*, 14(3), 386–394. <https://doi.org/10.1007/s10903-011-9504-3>

Wang, Y., Zhang, C., Hikichi, H., Kawachi, I., & Li, X. (2023). Longitudinal associations between disaster damage and falls/fear of falling in older adults: 9-year follow-up of survivors of the 2011 Great East Japan Earthquake and Tsunami. *Innovation in Aging*, 7(3), Article igad020. <https://doi.org/10.1093/geroni/igad020>

Waszczuk, M. A., Docherty, A. R., Shabalin, A. A., Miao, J., Yang, X., Kuan, P.-F., Bromet, E., Kotov, R., & Luft, B. J. (2022). Polygenic prediction of PTSD trajectories in 9/11 responders. *Psychological Medicine*, 52(10), 1981–1989.

<https://doi.org/10.1017/S0033291720003839>

Whittaker, J., McLennan, B., & Handmer, J. (2015). A review of informal volunteerism in emergencies and disasters: Definition, opportunities and challenges. *International Journal of Disaster Risk Reduction*, 13, 358–368. <https://doi.org/10.1016/j.ijdrr.2015.07.010>

Williams, R., Ntontis, E., Alfadhli, K., Drury, J., & Amlôt, R. (2021). A social model of secondary stressors in relation to disasters, major incidents and conflict: Implications for practice. *International Journal of Disaster Risk Reduction*, 63, Article 102436.

<https://doi.org/10.1016/j.ijdrr.2021.102436>

Yzermans, C. J., van den Berg, B., & Dirkzwager, A. J. E. (2009). Physical health problems after disasters. In Y. Neria, S. Galea, & F. H. Norris (Eds.), *Mental health and disasters* (pp. 67–93). Cambridge University Press.

Yzermans, C. J., Donker, G. A., Kerssens, J. J., Dirkzwager, A. J. E., Soeteman, R. J. H., & ten Veen, P. M. H. (2005). Health problems of victims before and after disaster: A longitudinal study in general practice. *International Journal of Epidemiology*, 34(4), 820–826.

<https://doi.org/10.1093/ije/dyi096>

Zhang, J., Chen, W., Petrovsky, N., & Walker, R. M. (2022). The expectancy-disconfirmation model and citizen satisfaction with public services: A meta-analysis and an agenda for best practice. *Public Administration Review*, 82(1), 147–159. <https://doi.org/10.1111/puar.13368>