When the *Waters Rise:*

Financial Stress and Mental Health after the 2021 Limburg Floods

Anna Locher
Sandra Latta
Jarno Richard
Ireen Edward Kerkhofs
Salman Güner
Lynn Marie Gießwein

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Abstract

Climate change is a significant global concern, with dire implications for the lives and health of individuals. Extreme and unpredictable climate disasters, such as flooding, are occurring more frequently, shaping discourses on possible future solutions to reduce health vulnerabilities.

This study focuses on the 2021 flooding that occurred in Limburg, the Netherlands. It draws attention to the effects on the wellbeing of individuals, particularly among those internally displaced. Moreover, it investigates whether internal displacement following the 2021 flooding is associated with higher levels of stress and anxiety. By addressing this gap in research, it is possible to understand how critical climate disaster prevention and adaptability is to safeguard societal wellbeing.

To test the hypotheses, a Qualtrics survey is conducted and distributed to online media platforms, such as Facebook and Reddit, to gather crucial data. Using this quantitative approach enables a more nuanced understanding of the personal experiences of climate disasters, particularly when comparing non-displaced and displaced people. Furthermore, findings reveal a remarkable correlation between extreme climate events and mental health vulnerabilities, notably among internally displaced individuals, who reported higher stress and anxiety levels. These results highlight the mental health consequences arising from climate disasters, underlining the need for greater awareness of extreme weather risks. To enhance resilience and strategic responses, institutions are encouraged to collaborate to promote further research and preparedness efforts.

1. Introduction

Climate change, as defined by the Framework Convention on Climate Change (FCCC), is "a change of climate that is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere, and that is in addition to natural climate variability over comparable time periods" (Pielke, 2004, p. 515). With advancements in global industrialisation in recent centuries, the presence of greenhouse gases has increased significantly in the Earth's atmosphere, resulting in global climate transformations (Kjellström, 2004; Pielke, 2004). Furthermore, increased year-round temperatures and the severity of weather fluctuations are projected changes, signalling a rise in global vulnerability (Kjellström, 2004).

Building on this, there is empirical evidence that extreme rainfall has already increased in Western and Central Europe and is expected to further intensify as climate change progresses (Intergovernmental Panel on Climate Change, 2023). As a consequence, extreme weather events such as floods are becoming more common, often leading to the disruption in individuals' daily lives, financial burdens, temporary displacement, and a whole range of additional challenges. For example, in July 2021, extreme rainfall caused floods across multiple European countries, including Austria, Belgium, Germany and the Netherlands, ultimately resulting in over 200 fatalities and over $54 billion in damages (Tradowsky et al., 2023). This event serves as the central case study for our current research.

Figure 1: Before and After images of the Roer tributary area showing the impact of the 2021 floods. (Kok et al., 2023)

To better understand these impacts, this study adopts an interdisciplinary approach. The following sections highlight the consequences of flood-related displacement from different

perspectives, including economic, European studies, psychological and medical dimensions. Together, these perspectives aim to provide a more clear picture of how individuals are affected by such events.

2. Literature Review

2.1. Climate Change and Economic Impacts in Europe

Within the European context, anthropogenic factors depend regionally and temporally (Kjellström, 2004; Vousdoukas et al., 2017). Whilst the entire continent faces increased temperatures, changes in precipitation intensity and quantity depend on regional weather patterns, climate, and hydrological cycles (Kjellström, 2004; Vousdoukas et al., 2017). These factors facilitate non-uniform fluctuations in rainfall across Europe (Botzen & Van Den Bergh, 2008; Kjellström, 2004, p. 196). In southern Europe precipitation is expected to decrease during summertime and increase in the winter whereas northern Europe will likely face more precipitation year-round (Botzen & Van Den Bergh, 2008; Kjellström, 2004). This is highly alarming for countries already facing substantial challenges with rising sea-levels and flooding, such as the Netherlands (Van Koningsveld et al., 2008).

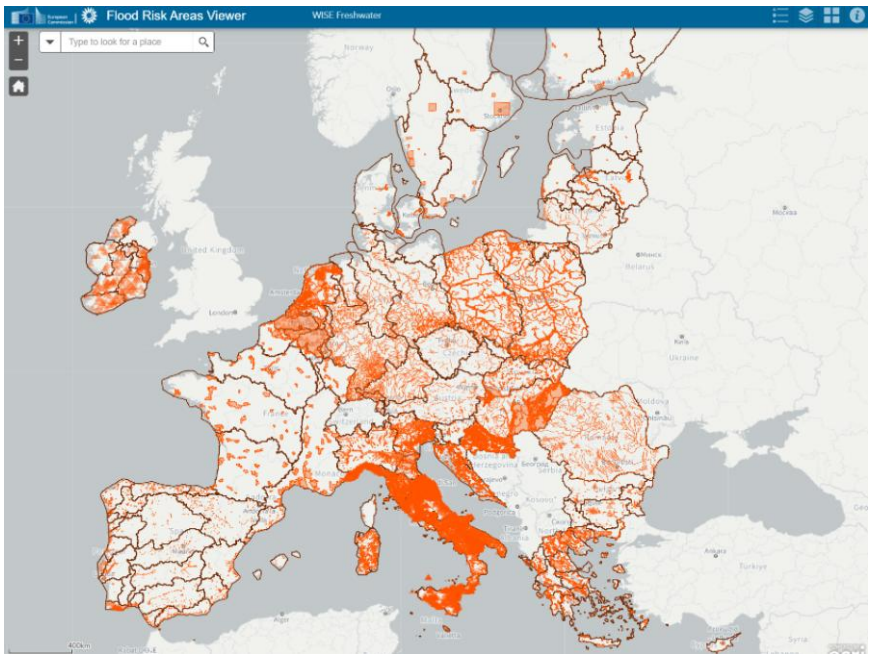


Figure 2: Depiction of flood risks in Europe (Directorate-General for Environment, 2023)

The Netherlands is often characterised as a low-lying estuarine and deltaic region, compromising the centrepoint of four large European rivers; the Meuse, Rhine, Ems, and

Scheldt (De Moel et al., 2011; Van Doorn-Hoekveld et al., 2022, p. 53). Its low-lying position in combination with its over 400 kilometer coastline along the North Sea and highly dense cities, makes it extremely susceptible to climate impacts (Van Koningsveld et al., 2008). Notably, floods–caused by rising sea-levels and heavier rainfall– are an existential challenge that the Netherlands continues to face (Botzen & Van Den Bergh, 2008; De Moel et al., 2011; Van Doorn-Hoekveld et al., 2022; Van Koningsveld et al., 2008).

Due to historical patterns, floods remain a traumatising national memory within Dutch communities, particularly after the harrowing 1953 North Sea flood which took the lives of roughly 1,800 people (Botzen & Van Den Bergh, 2008). Whilst some initial flood protection was implemented post-1953, primarily through the Delta Project, the Netherlands continued to be exposed to further flood risks (Van Doorn-Hoekveld et al., 2022; Vousdoukas et al., 2017). Furthermore, the floods of 1995 and 1998 caused large-scale damages throughout the country, fastening the innovation for better flood protectors and the European Union's (EU) development of the 2007 Floods Directive (Van Doorn-Hoekveld et al., 2022). However, despite continuous investments in flood defense, 2021 raised traumatising memories for Dutch citizens as another damaging flood occurred in Limburg, triggering internal displacement. The flood was caused by intense and long-lasting rainfalls, leading the Meuse river to overflow (Strijker et al., 2023; Van Doorn-Hoekveld, 2022). The catastrophe managed to impact Dutch communities significantly, fostering concerns and anxieties about climate change adaptability (Van Doorn-Hoekveld, 2022).

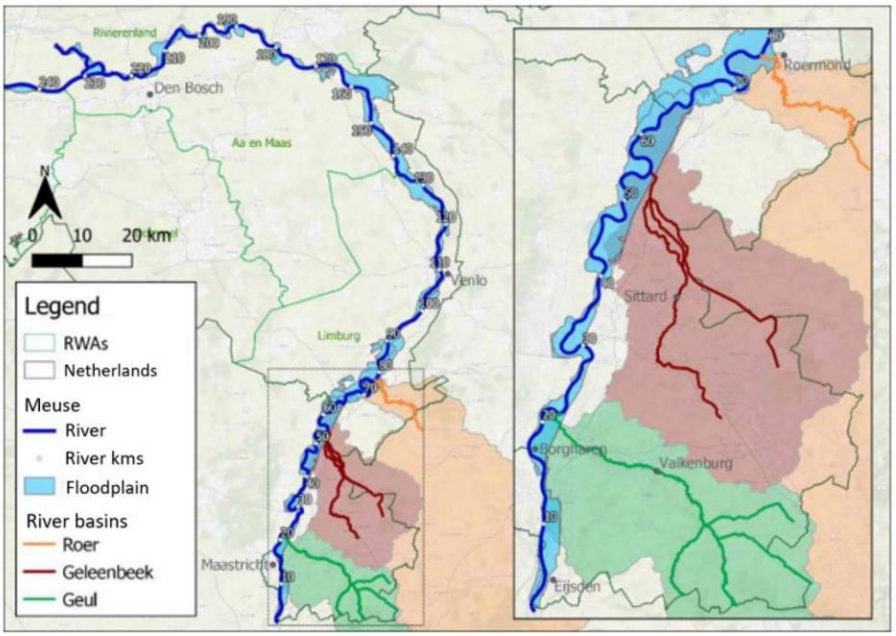


Figure 3: Overview of the affected area showing the main Meuse river channel in blue and the catchment areas of the affected tributaries. (Kok et al., 2023)

Natural disasters, such as floods, not only cause immediate property damage but also create economic uncertainty at the household level, which can have wide-ranging consequences for those affected (Bangalore et al., 2016). With regards to the 2021 flood disaster in Limburg, Kok et al. (2023) demonstrate that the impacts extend beyond direct damage and include secondary damage in the form of business interruptions, social disruption, disruption of the infrastructure or additional costs associated with the property damage and repair.

While in such circumstances the effectiveness of insurance mechanisms for risk reduction, due to risk-sharing, is often emphasised, in practice, there is frequently insufficient coverage and institutional constraints (Botzen & Van Den Bergh, 2008). Furthermore, existing literature shows that natural disasters result in a significant loss of welfare, which is the economic metric to measure well-being, when households are inadequately supported and must therefore rely on their own resources (Bangalore et al., 2016).

These financial burdens are significant because they reflect not only the objective losses but also the subjective perception of financial instability in the form of intangible losses that are difficult to monetise (Hudson et al., 2017). The World Health Organisation (2011) argues that perceived economic uncertainty acts as a stressor even independently of the objective loss, thereby increasing the risk of anxiety and mental disorders. Additionally, economic shocks can have long-term effects, as households may be forced to take on coping strategies, which can lead to the consumption of savings or the necessity to take on debt (Bangalore et al., 2016).

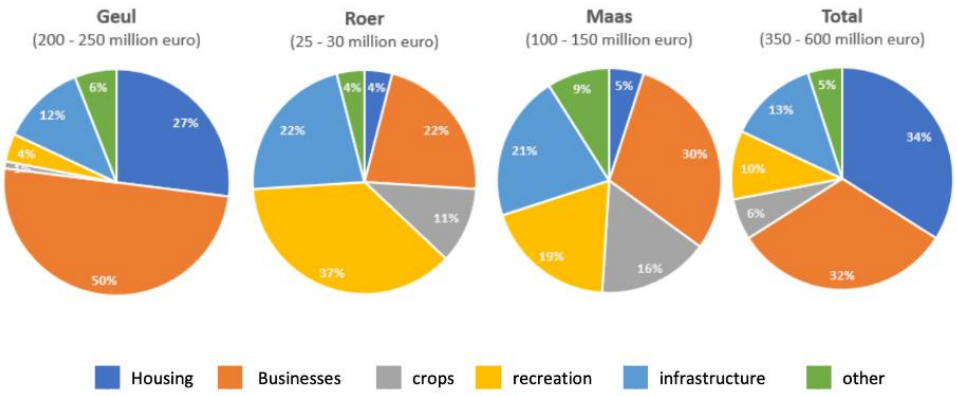


Figure 4: Preliminary estimates of physical and economic losses in the different regions affected by the 2021 floods (Kok et al., 2023).

This dynamic can be further amplified by the temporary displacement of the affected persons. The IDMC report (2020) shows that internal displacement is often accompanied by a loss of employment and a rise in living costs, thereby further reinforcing financial distress and uncertainty (Cazabat & Yasukawa, 2020). The link between financial stress and mental health is empirically proven, as Kessler et al. (2008) demonstrate, based on a large-scale survey, that loss of income is significantly associated with mental health conditions. This relationship is economically relevant, as mental disorders result in costs to individuals and society, due to reduced productivity and increased health care expenditures (Bangalore et al., 2016). Furthermore, new studies demonstrate that uncertainty shocks affect households beyond economic loss with a decline in subjective well-being (SWB), particularly when they are based on unexpected processes, such as natural disasters (Stein & Weisser, 2022).

Thereby, the existing literature demonstrates that financial distress is not only a side effect of flood disasters but also plays a central role in their impact on the mental health of those affected.

2.2. Medical and Healthcare Impact

Hydrometeorological hazards, such as floods, may form significantly dangerous situations to human health, damage to healthcare facilities and disruptions to health services (Abebe et al., 2025).

Health effects of flooding may be diverse and vary over time. Multiple types of health risks culminate at different points in time after the onset of flooding, and their effects may persist for a long period of time (Figure 3). These health effects in relation to flooding could be classified into four different units: immediate health impacts (hours after the flooding), short-term (days after the disaster), intermediate phase (start of recovery; days to weeks) and long-term (weeks to months after the onset of the disaster) health impacts (De Jong et al., 2023; Deltares, 2021).

Immediate health impacts of floods start to set in motion while the flooding spreads and the land is inundated. Depending on the severity of the floods, these impacts may include deaths from drowning, injuries such as hypothermia and wounds caused by floating debris and accidents like electrocution.

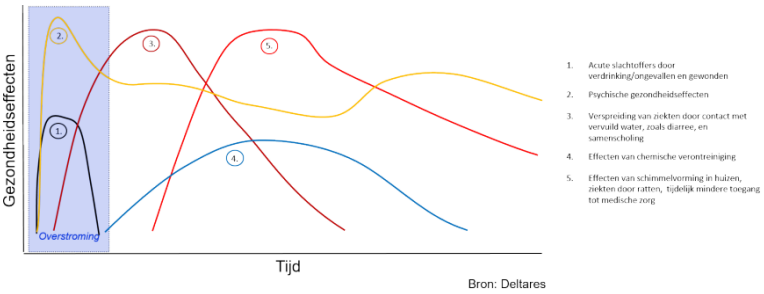
Short-term health impacts would arise within days and may include abdominal pain and diarrhoea as a result of ingesting water or food that is contaminated with pathogens. Symptoms

resembling influenza and typical cold issues may be triggered by skin exposure and inhalation of tiny droplets of contaminated water during floods and subsequent cleaning efforts (De Man et al., 2015; Mulder et al., 2019). Contamination through overflows of pathogens consisting of sewer systems poses even more risks to human health, especially the elderly, small children and immunocompromised individuals. This goes hand in hand with possible skin and eye irritations or infections due to polluted floodwater.

Intermediate phase health impacts refer to those linked to the initial phase of recovery days or weeks following the onset of flooding, when individuals begin to return to their residences.

Long-term health impacts would cover protracted psychological complaints, secondary infectious health risks, fungal presence on wet walls of houses and buildings, causing respiratory problems and reduced health services.

Although current research has thoroughly investigated the immediate and short-term physical medical outcomes of flooding, along with specific acute psychological reactions, relatively less focus has been placed on the prolonged mental and psychological effects and the preventative aspects of these impacts. This reveals a lack of comprehension regarding how flooding impacts ongoing mental wellness, stress levels, and overall psychological health over time. Consequently, this study mainly targets these enduring psychological impacts after temporary internal displacement. Even if not every particular activity or condition mentioned in the literature was evident during the 2021 floods in Southern Limburg, the general phases of impact, immediate, short-term, intermediate, and long-term, were distinctly observed.



Bron: Deltares

Figure: *Schematic drawing showing the different categories of health effects after a flood*

[In Figuur:

Linker as: Health Effects

Onder: Time Source: Deltares

In Figuur zelf: Flood

Rechter as:

1. *Acute victims as a result of drowning/accident and injuries*
2. *Effects on psychological health*
3. *Spread of disease such as diarrhoea, due to contact with contaminated water and close contacts in concentrations of people*
4. *Effects of chemical pollution*
5. *Effects of formation of fungi in homes, disease transmitted by rats, temporary difficulties with access to medical care]*

Figure 5: Schematic drawing showing the different categories of health effects after a flood (Deltares, 2021).

2.3. Psychological Impacts

Natural disasters induced by climate change are not only associated with physical and economic damage, but also have significant psychological consequences for individuals. There have been various studies that showcase the effects of natural disasters on mental health, particularly in the context of flooding. For example, a review by Fernandez et al. (2015) shows that the main mental health outcomes of floods include post-traumatic stress disorder (PTSD) (North et al., 2004), anxiety (Maltais et al., 2000), and psychosocial distress (Alderman et al., 2013), among many other factors that are discussed more extensively in their reviews.

In summary, one could argue that the higher the level of exposure to floods (measured by the destruction of one's home), the higher the levels of mental health-related problems that are reported, particularly PTSD (Collins et al., 2012). These effects on one's mental health may be further intensified in the context of internal displacement after natural disasters. A systematic review by Porter and Haslam (2005) shows that internally displaced individuals tend to experience worse mental health outcomes compared to non-displaced populations. Importantly, the study highlights that mental health outcomes are not solely determined by the flood itself,

but are also influenced by post-displacement conditions, such as housing situations, financial stability and access to economic opportunities after the flood.

Many studies mainly focus on the development of PTSD after floods and internal displacement, whereas our study will focus more broadly on the overall stress and anxiety experienced by individuals in the Netherlands. Much of the existing research in this domain has been conducted in non-European contexts, whereas European countries often get overlooked. As a result, there is still limited understanding of how temporary internal displacement in a European context affects individuals' mental health, especially when considering both psychological and financial stressors.

2.4. Research Gap and Relevance

As outlined above, existing literature already provides many insights into different perspectives on the consequences of flood-related disasters. However, despite this growing body of research, there is still an important gap that remains. More specifically, it is still unclear how prevalent temporary internal displacement is in relation to climate-related disasters such as floods, especially within a European context, and how displaced individuals experience changes in their levels of anxiety, stress and financial burden.

This study focuses on the 2021 floods in the Netherlands, specifically Southern Limburg, which led to temporary internal displacement among affected residents. Therefore, we aim to answer the following research question:

How did temporary internal displacement caused by the 2021 floods in Limburg affect residents' mental well-being ?

This study is academically relevant as it contributes to an emerging but very important area of the existing literature by focusing on a European case that remains underrepresented, while also adopting an interdisciplinary perspective that combines economic, European studies, psychological, and medical dimensions. From a societal perspective, this research study is highly relevant, as climate-related disasters are expected to increase in frequency and intensity.

3. Hypotheses

3.1. Main Hypothesis (H0)

The 2021 floods in southern Limburg, induced by increased precipitation levels, led to internal displacement, resulting in increased levels of stress and anxiety among affected individuals.

3.2. Financial Hypothesis (H1a)

Individuals who experienced greater financial losses report higher levels of stress and anxiety.

3.3. Duration Hypothesis (H1b)

Longer displacement duration is associated with higher levels of stress and anxiety.

3.4. Optional Hypothesis (H1c)

Individuals who received sufficient financial support report lower levels of stress and financial strain.

4. Methodology

4.1. Framework

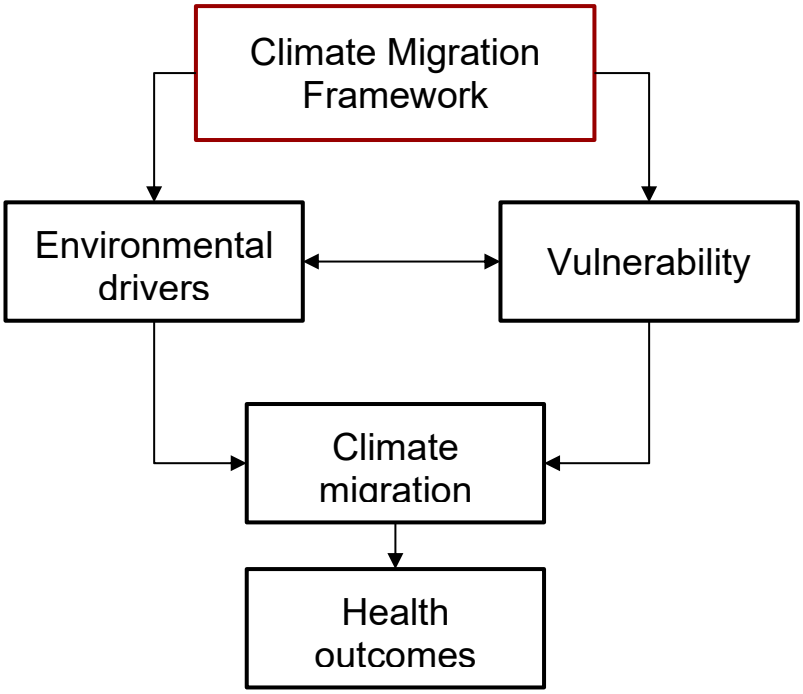


Figure 6: The Climate Migration Framework.

This research adopts the Climate Migration Framework proposed by Black et al. (2011), as it provides a comprehensive conceptualisation of the drivers of climate migration and the

capabilities of individuals to move from their place of home. In addition, it accounts for the vulnerabilities that individuals may face in response to pressures deriving from migration processes. By using this framework, this study intends to demonstrate the cascade effect where environmental drivers impact vulnerable groups and further trigger migration flows, consequently highlighting possible health repercussions arising from involuntary movement– as exemplified in Figure 6.

Within the Climate Migration Framework, migration drivers refers to versatile factors that influence migration flows either directly or indirectly (Black et al., 2011). This study will primarily focus on environmental "push factors" (Black et al., 2011, p. 434), emphasising how climate change causes internal displacement as exemplified in the 2021 Limburg floods context. Environmental "push factors"–despite their intercorrelation with other factors–are recognised as fundamental reasons generating certain migration flows internally and even internationally (Black et al., 2011). Fast-onset environmental drivers, such as unexpected natural disasters like floods, often lead to internal displacement from vulnerable areas. In contrast, slow developing environmental drivers, such as rising temperatures and sea-level rises, also influence migration flows. However, these changes are less abrupt and likely result in more permanent displacement (Black et al., 2011).

Vulnerability emphasises the capability of individuals to move from high-risk areas to safety (Black et al., 2011; Working Paper No. 163, 2020). Those residing in vulnerable areas but possessing larger resource capacities–such as financial freedom, stability, alternative shelter–are often likely to have more possibilities to migrate to safety than others (Working Paper No. 163, 2020). Hence, whilst this is not uniform, it is likely to be reflected in health outcomes, as greater capabilities tend to indicate more security and easier adaptability to unexpected changes. In contrast, the absence of adequate resources to respond to the environmental disaster increases the vulnerability of individuals by exposing them to greater risks, potentially negating their ability to migrate and increasing their likelihood of subsequent negative health outcomes by forcing them to remain in place (Black et al., 20211; Working Paper No. 163, 2020). Consequently, due to research limitations, vulnerability will not be utilised as a variable, but rather a conceptual lens in analysing the causality between environmental drivers and migration flows, highlighting the importance of resource capabilities.

As such, the Climate Migration Framework serves not only as a descriptive model, but also as a framework for analysis that forms the backbone of the following pathway: from

environmental shocks, through differentiated vulnerabilities and mobility responses, to subsequent health implications. To be able to uncover this analytical perspective, the study focuses on a dynamic understanding of exposure and temporality, as visible in the illustrated extended framework (Figure 6). Within this, climate-related events are not seen as free-standing incidents, but as processes characterised by varying patterns of exposure unfolding over time. This shows that health outcomes are conceptualised as evolving conditions shaped by continuous interactions between individuals, populations, and their environments. Especially, migration, whether voluntary, involuntary, or constrained by immobility, is centred within this temporal dimension, showing how displacement is a response to and a determinant of vulnerability and health.

Through the use of these perspectives, this research can analyse the cyclical, yet interdependent, nature of vulnerability, migration and health (Figure 7). Findings may show the need for interventions to be provided at certain critical points in order to strengthen resource capacity prior to displacement, as well as to offer more supportive systems to those who are temporarily migrated and identify and address the long-term psychological effects of climate-induced displacement on people after they have been displaced. By using this framework, a more nuanced understanding of the implications of these relationships is presented, which may aid in the development of policies and adequate prevention strategies to mitigate the mental health impacts associated with climate-induced displacement.

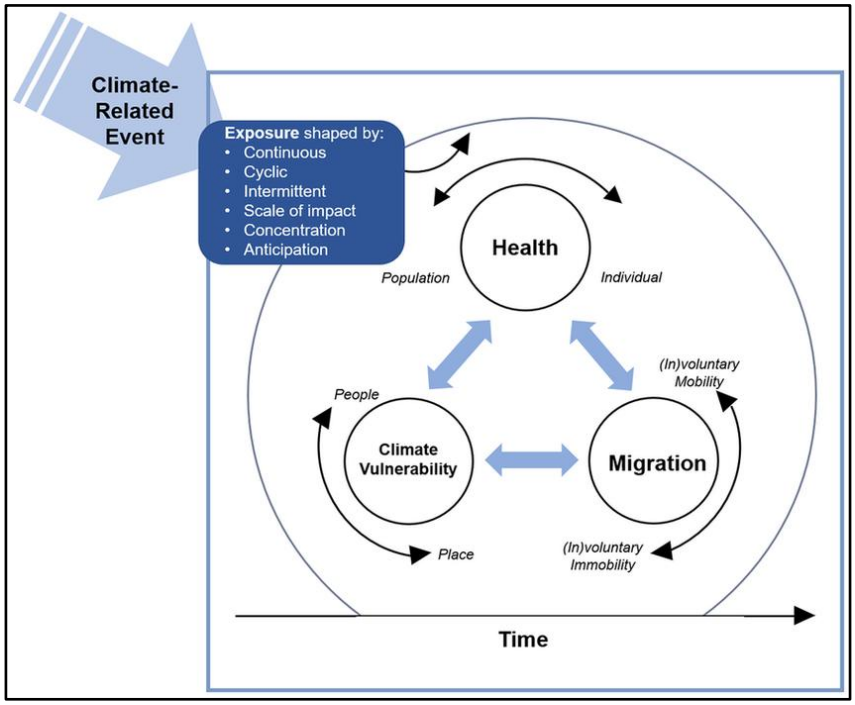


Figure 7: Conceptual framework of the climate vulnerability-migration-health nexus (Hunter et al., 2021).

4.2. Data Collection

This study employs a quantitative, cross-sectional research design through the use of a survey. A survey-based approach was chosen to capture self-reported experiences from a large group of individuals who were affected by the floods. The survey was conducted online, through the platform Qualtrics, between March 17th and April 17th. The link was sent out primarily to Facebook groups as well as a Reddit forum and personal contacts.

4.2.1. Participants and Sampling

Participants were recruited using convenience sampling. Participation was voluntary, anonymous and participants needed to be older than 18 in order to give consent. In order to be included in our results participants needed to have lived in the Limburg region during 2021 and have been affected by the floods. There were two questions in the survey targeted at these points and if either were answered as no, participants were immediately sent to the end of the survey. We had a final sample of N=76 participants who responded to the survey and were relevant for our data.

The survey consisted of three main sections: background information and demographics, flood exposure, and displacement experience as well as financial and mental-wellbeing measures.

4.2.2. Background Information

At the start of the survey information of the research project was provided as well as an overview of the researchers. Demographic information about participants was gathered, including age, gender and whether they lived in Limburg or not. Age of participants was collected by them selecting an age range (starting at 18-24). Categories for gender included ‘male’, ‘female’, ‘non-binary’, ‘other’ and ‘I prefer not to say’. Lastly, participants needed to indicate if they lived in Limburg during the 2021 floods or not. If they indicated they did not live here they were directed to the end of the survey, however, if they did, an open-text box appeared asking more specifically where they lived.

4.2.3. Flood Exposure

Flood exposure was measured by participants' own ratings of severity of their experience. Firstly, participants indicated how strong their household was affected by the floods in 2021 on a 5 point scale from 'not affected' to 'very seriously affected'. Further they indicated the level of damage done to the house also on a scale from 'none' to 'serious damage'. Based on their own opinion they were asked to rate how much climate change contributed to the severity of the floods on a likert scale from 0 (not at all) to 10 (a large role). Lastly, participants were asked to indicate if they had already experienced floods in Limburg prior to those in 2021 and if so in which year(s).

4.2.4. Displacement Experience

To measure the displacement experience, a series of questions regarding the duration of displacement, financial harm and stress levels experienced were asked. Firstly, participants needed to indicate if they were displaced from their house and if so how long they needed to stay away. This was done through closed questions based on a 5 point scale providing time slots: 'less than 24 hours', '1-3 days', '4-7' days, '1-4 weeks' and 'more than 1 month'. Participants were then asked to indicate the size of the financial impact of the damage, based on a 5 point scale from 'none' to 'very large' with the option of not wanting to say. To further evaluate the financial situation, respondents indicated to what extent their costs were covered by insurance or financial aid. This was completed with a 4 point scale from 'not at all' to 'completely covered' again with the option of not wanting to say. Besides financial impact, the mental-well being of participants was also investigated. This was done by asking participants to rank their overall stress levels at the time of the floods as well as how anxious or worried they felt on a 10 point likert scale (0=none, 10=very strong). Additionally, the participants were asked to indicate the financial stress they felt after the floods, ranking on a 5 point scale from 'none' to 'very much'. Finally, the effect on employment was asked and participants indicated on a 5 point scale to what extent the floods affected their employment from 'not at all' to 'very significantly'.

4.2.5. Ethical Considerations

The study adhered to ethical research standards outlined by Maastricht University. Participation was voluntary and informed consent was obtained by all participants prior to participation. Key ethical measures included ensuring anonymity and confidentiality of

responses and allowing participants to withdraw their response at any time. As well as avoiding the collection of any personally identifiable information. Questions were asked in a sensitive way due to the potentially distressing nature of recalling flood experiences. Finally, all participants were debriefed, and contact details of the researchers were provided in case of questions or concerns arising.

4.3. Data Analysis

The data will be analysed using statistical software R. The analysis includes descriptive statistics, comparative analysis and correlational analysis. Through the use of these analysis methods, this study aims to gather an in-depth explanation of the varying mental health outcomes arising from the 2021 floods in Limburg.

4.4. Case Study

This research will adopt a single case study design, focusing on the 2021 floods occurring in Limburg. It will give an elaborate analysis of the context behind the floods and their subsequent outcomes on individuals, highlighting the mental health impacts. By researching this specific case, it is possible to become aware of the rising risks deriving from global warming and apply it to other cases. Our research team decided to research this case as it demonstrates the real-time consequences of climate change in the Netherlands, a country that is extremely flood-prone despite its history of elaborate flood defense constructions. Thereby, this case signals the unpredictability of global warming, underscoring the continuous vulnerability of populations and need for immediate climate solutions.

4.5. Limitations

To provide our reader with a critical perception of the nature and extensiveness of this research, it is crucial to note the possible limitations of the methodology that may arise along the process. Notably, the relatively small sample size of N=76 constrains the statistical power of the analyses and limits the extent to which our results can be generalised to an alternative context. Even though the sample shows a reasonable spread across the region of Limburg and a relatively balanced demographic profile, it still limits the external validity. While the data collected aids in understanding the health outcomes in this specific case, it may not apply in more general cases, highlighting its potential inconsistency. Furthermore, the participation strategy relied on anonymous convenience sampling through social media platforms, such as

Facebook and Reddit. This approach was cost-efficient and easily accessible, but included the risk of self-selection bias, as individuals with stronger personal involvement or emotional connection to the floods in 2021 may have been more inclined to participate. Because of this, we originally expected an overrepresentation of younger, digitally active individuals. While this was not strongly visible in our final sample, we cannot completely rule out a sampling bias based on the platforms.

Additionally, all variables, such as financial impact, stress and anxiety were measured through self-reporting, which means that they need to be interpreted with caution as they are subjective on the individual level. This is further reinforced through the usage of Likert scales for ordinal variables, which introduces subjectivity in interpretation, as there is an individual threshold for categories such as moderate or large financial impact that may differ considerably between respondents.

Furthermore, the cross-sectional design of this study means that it is impossible to determine potentially confounding variables, such as pre-flood mental health status or socioeconomic background, which may introduce omitted variable bias into the analyses. Especially, unusual high R-squared values observed in some of the regression analyses should be treated with caution, as there could be multicollinearity. All in all, these limitations highlight the necessity for future research with larger samples and a long-term design to increase external validity and extend these findings.

5. Results

5.1. Sample Descriptives

In total we received 88 returned questionnaires, of which in total 12 responses were excluded. Two of these were identified as preview submissions, one respondent did not provide consent, and the other nine responses were incomplete to the extent that they did not provide valuable insights or meaningful comparison between affected and unaffected groups. This resulted in our final sample of N=76 respondents.

The respondents were categorized into six age groups, ranging from 18-24, 25-34, 35-44, 45-54, 55-64 and 65+. The frequency across these six age groups were relatively even, with valid percentages of 14.5, 22.4, 13.2, 13.2, 21.1, and 15.8, respectively. This indicates that no group is overrepresented or dominates the sample, resulting in a reasonably well distributed sample across different stages of adulthood. This is also shown by the mean of the age category being 3.513 (across a scale from 1 to 6), with a standard deviation of 1.724.

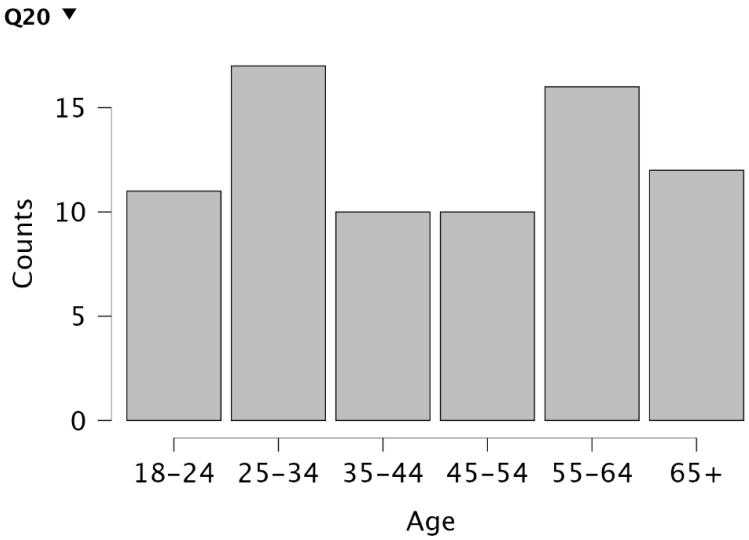


Figure 8: Age distribution of the sample.

Frequencies for Q20

Q20	Frequency	Percent	Valid Percent	Cumulative Percent
18-24	11	14.5	14.5	14.5
25-34	17	22.4	22.4	36.8
35-44	10	13.2	13.2	50.0
45-54	10	13.2	13.2	63.2
55-64	16	21.1	21.1	84.2
65+	12	15.8	15.8	100.0
Missing	0	0.0		
Total	76	100.0		

Figure 9: Frequency table of the age distribution

Descriptive Statistics

	Q20
Valid	76
Missing	0
Mean	3.513
Std. Deviation	1.724
Minimum	1.000
Maximum	6.000

Figure 10: Descriptives of age distribution.

The survey was primarily distributed via social media platforms, including Reddit and Facebook, which allowed for fast and cost-efficient data collection. However, this sampling method also is often associated with limitations, such as self-selection biases, as participation depends on the platform usage and individual willingness to engage with survey content. Due to this, such methods can lead to an overrepresentation of younger and more digital active individuals. Interestingly, this expected bias is not strongly reflected in our final sample even with the relatively small sample size of N=76. Nevertheless, it cannot be fully ruled out that the distribution channels introduced a small degree of sampling bias.

Additionally, the gender composition of the sample shows that 44.7 % of the respondents were male, 52.3% female, whilst identified 1.3% as Non-Binary and 2.6% as Other. Therefore, the sample is relatively balanced, with a slight dominance of female participants. Nevertheless, the sample is relatively balanced, which indicates that there is unlikely a gender-related bias that affects the results.

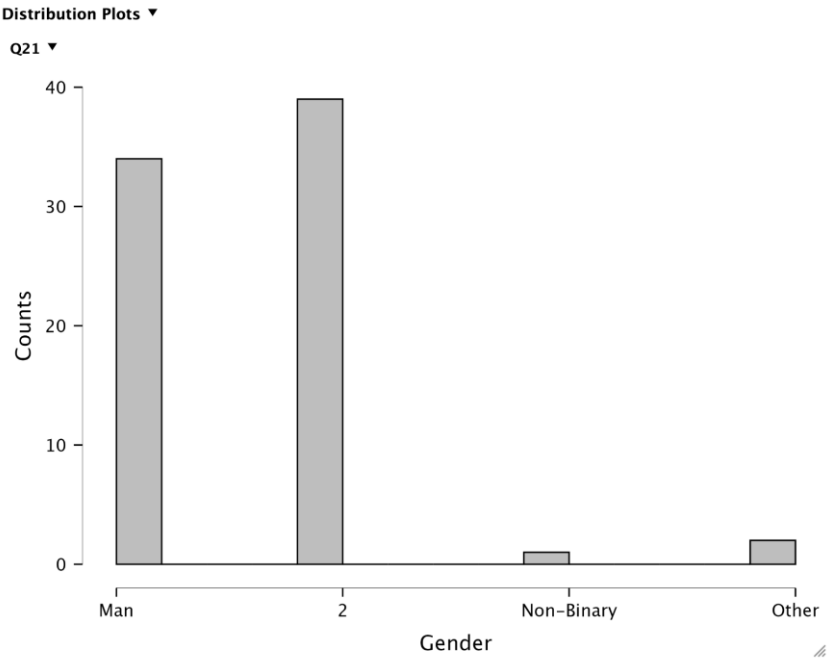


Figure 11: Gender distribution of the sample.

Valid	76
Missing	0
Mean	1.618
Std. Deviation	0.653
Minimum	1.000
Maximum	4.000

Frequency Tables ▼

Frequencies for Q21 ▼

Q21	Frequency	Percent	Valid Percent	Cumulative Percent
1	34	44.7	44.7	44.7
2	39	51.3	51.3	96.1
3	1	1.3	1.3	97.4
4	2	2.6	2.6	100.0
Missing	0	0.0		
Total	76	100.0		

Figure 12: Frequency distribution & descriptive statistics of gender.

Furthermore, our sample shows that the participants come from nearly 23 different regions and municipalities within Limburg, with one respondent living near the Belgian border. The different regions are numbered respectively in the descriptive plot, those are Brommelen, Brunssum, Bunde, Caberg, Eijsden, Beekdalen, Meerssen, Venlo, Geulle, Heerlen, Heugem, Belgian border, Landgraaf, Maasgouw, Maastricht, Midden-Limburg, Parkstad, Peel en Maas, Roermond, Simpelveld, Geleen, Vaals, and Valkenburg. This shows that our sample is geographically diverse in the region of Limburg and not limited to one single local area. This is especially relevant, as the impact of the floods in 2021 varied across the different regions. Due to the geographical diversification it allows the analysis to capture a broader spectrum of experiences rather than being driven by a single local experience. Although some clustering in some regions, such as Meerssen and Maastricht remain, due to our primary network distribution, the overall spreading suggests that the sample provides a reasonable geographical coverage of Limburg to have enough external validity to generalize our findings.

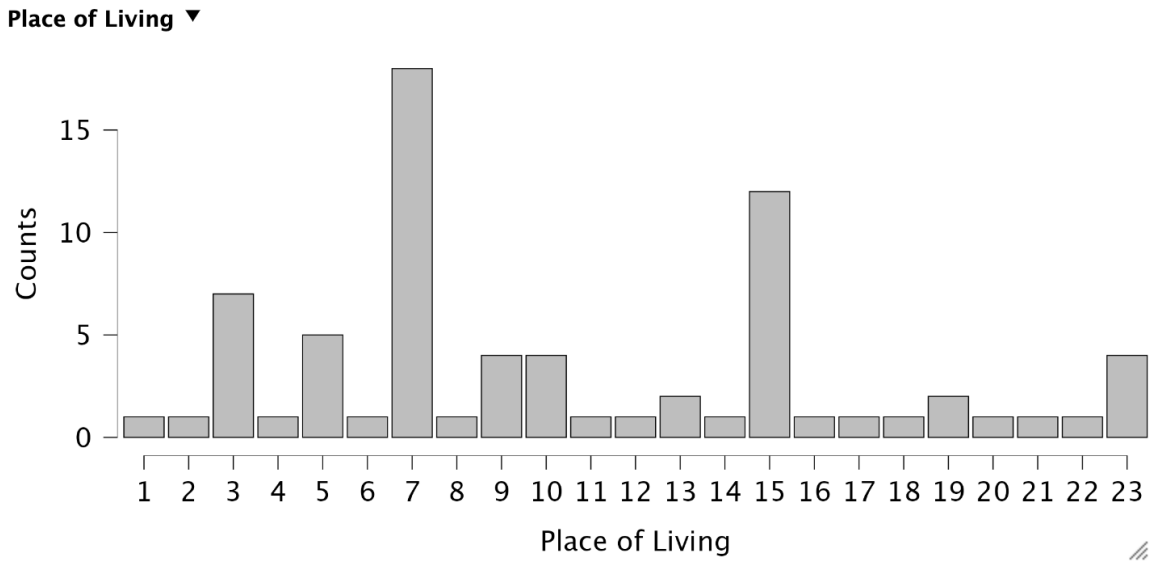


Figure 13: Place of living of the sample.

Regarding the temporary displacement, only 69 of the 76 respondents provided a valid answer, reducing the sample size for that question to (N=69). Of these, 28 respondents (40.6%) indicated that they had to temporarily leave their home due to the floods in 2021, while the majority with 41 respondents, which is 59.4% of the valid answers, reported no necessity for displacement. Among those who did experience displacement (N=28), the follow up question regarding the duration of displacement revealed the following pattern. The most common period was 1-3 days, which was reported by 11 participants, which equals 39.3% of the subsample. This was followed by less than 24 hours and more than one month, which was both reported by 7 respondents (20.5%) respectively. Furthermore a smaller group of 3 respondents (10.7%) indicated being displaced for 4-7 days. Notably, the option of a duration between 1-4 weeks was not once reported, which could hint that the consequences were polarisating, being either smaller leading to only short displacement or crucial, leading to prolonged internal displacement. In the duration category, the median is the most appropriate measurement to quickly measure the tendency of the sample, which falls in the category of 1-3 days, reflecting that the displacement of the ones affected was typically short-term.

Frequency Tables

Frequencies for Displacement

Displacement	Frequency	Percent	Valid Percent	Cumulative Percent
Ja	28	36.8	40.6	40.6
Nee	41	53.9	59.4	100.0
Missing	7	9.2		
Total	76	100.0		

Frequencies for Duration

Duration	Frequency	Percent	Valid Percent	Cumulative Percent
Minder dan 24 uur	7	9.2	25.0	25.0
1-3 dagen	11	14.5	39.3	64.3
4-7 dagen	3	3.9	10.7	75.0
Meer dan 1 maand	7	9.2	25.0	100.0
Missing	48	63.2		
Total	76	100.0		

Figure 14: Frequency table of internal displacement & duration.

Descriptive Statistics

	Duration
Valid	28
Missing	48
Median	2.000
Mean	2.607
Std. Deviation	1.524
Minimum	1.000
Maximum	5.000

Figure 15: Descriptive statistics of the duration of displacement.

Looking at the perceived financial impact of the floods, only 68 respondents provided a valid answer, as 8 answers were missing and it was subjectively measured on Likert scale with 5 categories and an option to provide no answer. The largest group of 31 participants reflecting 45.6% of the valid responses, indicated no financial impact whatsoever. Among those that did have a financial impact, the most frequently selected group was moderate impact with 14 answers, which represents 20.6%. This was followed by small impact and very large impact, each reported by 8 respondents, which are 11.8% respectively and large impact, reported by 6 participants, 8.8%. The option of prefer not to say was chosen once, which means 1.5%. This pattern shows that just under a half of the valid responses (45.6%) did not state a financial impact, while the others reported some variable financial loss as a result of the floods. As it was

measured on a Likert scale, the preferred measurement for tendencies, falls into the category small (median=2). This indicates that while the largest group chose no financial loss, when considering the whole sample, half of the answers reported at least a small degree of financial loss. This shows that our sample is meaningfully divided, having financial impacts from none at all to very large ones, which highlights the uneven financial burden that the 2021 floods pleased on the different households across Limburg.

Frequency Tables

Frequencies for financial impact

financial impact	Frequency	Percent	Valid Percent	Cumulative Percent
Geen	31	40.8	45.6	45.6
Klein	8	10.5	11.8	57.4
Matig	14	18.4	20.6	77.9
Groot	6	7.9	8.8	86.8
Zeer groot	8	10.5	11.8	98.5
Zeg ik liever niet	1	1.3	1.5	100.0
Missing	8	10.5		
Total	76	100.0		

Figure 16: Frequency table financial impact.

Descriptive Statistics

	financial impact
Valid	68
Missing	8
Median	2.000
Mean	2.338
Std. Deviation	1.492
Minimum	1.000
Maximum	6.000

Figure 17: Descriptive statistics of financial impact.

Overall, the sample is reasonably balanced across demographic and geographic dimensions, as well as a broad range of flood-related experiences. This in combination with the sample size and the central theorem allow for a solid descriptive foundation for the subsequent analyses.

5.2. Hypotheses Testing

5.2.1. Findings to Hypothesis H0

To test the main hypothesis, one-sided independent sample t-tests were conducted to compare stress and anxiety levels between displaced and non-displaced individuals. The results of the one-sided independent sample t-test indicated that displaced individuals reported significantly higher levels of stress (M=8.375, SD=2.792) than non-displaced individuals (M=5.175, SD=2.995), t=4.433, p<0.001. Similarly, anxiety was also reported significantly higher when displaced (M=7.607, SD=2.820) compared to when not displaced (M=4.975, SD=3.445), t=3.334, p<0.001.

5.2.2. Findings to Hypothesis H1a

To test the supporting hypothesis, focusing on the financial loss, multiple correlations were conducted to determine the relationship between the financial impact and stress levels. A spearman correlation between stress levels and financial impact revealed a moderate positive relationship (r=0.552, p<.001), suggesting that higher financial impact results in higher levels of stress. A regression was conducted to determine if financial distress was further increased due to the effect on employment. The overall model showed to be statistically significant (F=4.556, p=0.003), suggesting that if an individual's employment was more severely affected, stress related to financial aspects increased. However, not all individual predictors were statistically significant, ‘moderately’ (p=0.004) and ‘significantly’ (p=0.002) were the two significant predictors suggesting that effect on employment does explain increases in stress levels.

5.2.3. Findings to Hypothesis H1b

In order to test another supporting hypothesis focusing on the duration of displacement, regressions were run to test the relationship between duration and stress/anxiety. A linear regression was conducted to determine if displacement duration predicted stress levels. The results were statistically significant, F=88.93, p<.001, explaining 93.6% of the variance in stress (R^2 = 0.936). A similar regression was completed to predict anxiety levels. The results were also statistically significant, F=86.21, p<.001, explaining 93.5% of the variance in stress (R^2 = 0.935). Similar regressions were conducted to test the relationship of severity on stress and anxiety. For both regressions the tests were statistically significant, for stress 88.6% of the

variance of stress explained (F=98.02, p<.001) and for anxiety 83.8% of the variance in anxiety explained (F=65.13, p<.001). A multiple linear regression was also conducted examining the relationship between stress and duration, controlling for severity. While the overall model was still statistically significant (F=42.24, p<.001) only three of the individual predictors were still statistically significant. This is most likely explained by collinearity between duration and severity.

5.2.4. Findings to Hypothesis H1c

Finally, to test the third supporting hypothesis correlations were conducted to determine the relationship between financial support received and stress levels. A further spearman correlation was conducted between the level of financial support received and stress. This resulted in a moderate negative relationship (r=-0.585, p<.001) suggesting that as financial support levels increase, stress decreases. Additionally, a spearman correlation was conducted to determine the relationship between financial support and financial loss, which showed a strong negative relationship (r=-0.735, p<.001) suggesting that as financial loss levels increased so did financial support received. Lastly, a further spearman correlation was conducted to determine the relationship between financial support received and financial stress experienced. This showed a moderate negative relationship (r= -0.585, p<.001), suggesting that as levels of support increased stress related to financial aspects decreased.

5.3. Analysis

5.3.1. Displacement

Our findings for the main hypothesis are statistically significant, showcasing that displaced individuals reported higher levels of stress and anxiety compared to non-displaced individuals.

There are several reasons why displacement may lead to increased stress and anxiety. For instance, heightened exposure to traumatic events and increased psychological distress in the aftermath of displacement have been identified as key contributing factors (James et al., 2020). Another study further showcases that these psychological effects can persist over long periods of time (Bubeck et al., 2021). As already mentioned earlier, these mental health outcomes are not solely determined by the flood itself, but are also influenced by post-displacement conditions. These include factors such as financial stability, access to economic

opportunities, and the level of support received after the disaster (Porter & Haslam, 2005). Although this study did not directly measure all of these aspects, it is likely that many displaced individuals in the Netherlands received some form of governmental support, as also reflected in the findings of H1c.

In addition, a case study by Mostafizur Rahman et al. (2023) in Bangladesh highlights that increased anxiety levels are often the result of complex, intertwined factors, such as loss of property, disruptions to livelihoods and the psychological impact of experiencing or witnessing loss. All in all, these findings suggest that the relationship between displacement and mental health is complex and shaped by a combination of immediate and longer-term stressors.

5.3.2. Financial Impact

The finding provides support for hypothesis H1a, indicating that greater financial impact resulted in higher levels of stress. The positive association between financial impact and stress levels suggests that the psychological burden of the floods was not only linked to the displacement but also its economic repercussions. This highlights that stress is likely driven by financial uncertainty such as concerns about recovery costs, income stability and housing rather than the acute disaster itself. This aligns with existing research that perceived economic uncertainty acts as a stressor and increases the risk of anxiety and mental disorders (World Health Organization, 2011). Beyond this, employment-related effects showed to significantly contribute to financial stress. This suggests that larger disruptions to employment, such as job loss, reduced working hours or instability, play an important role in shaping financial distress and consequently stress levels. This supports existing literature stating that loss of income is strongly associated with mental health disorders (Kessler et al., 2008). Financial instability caused by the floods is not merely a secondary consequence of displacement but a key factor resulting in higher stress levels of affected individuals.

5.3.3. Duration of Displacement

The findings highlight support for hypothesis H1b, showing that the longer individuals were displaced, the higher their perceived levels of stress and anxiety were. Prior research suggests that prolonged displacement can compound the risk of mental health problems, particularly when individuals are uncertain about their future and have limited access to resources (Bozzoli et al., 2012). Another factor that may contribute to this is that internally displaced persons are often less supported when displacement continues for longer than

expected (Gülsen et al., 2010). This can further increase feelings of uncertainty and instability, which are likely to negatively affect mental well-being over time. Also, Porter and Haslam (2005) suggest that mental health problems among displaced individuals may persist for many years and can even intensify over time. Prolonged displacement is also frequently associated with ongoing social and economic difficulties (Bhugra, 2004), which can make individuals more vulnerable to mental health issues in general. All in all, these findings show that duration of displacement also plays an important role in shaping mental health outcomes.

5.3.4. Support Received

The role of support indicated to reduce the levels of stress experienced by individuals providing support for hypothesis H1c. The negative relationship between stress and financial support suggests that receiving support, from insurance or the government, plays a role in mitigating the psychological consequences of financial loss post floods. Individuals who received greater levels of financial support reported lower stress indicating that financial assistance may alleviate uncertainty and the psychological burden associated with recovery costs and economic instability. These findings are consistent with existing literature on disaster recovery, highlighting that insurance mechanisms are an effective tool for risk reduction due to risk sharing (Botzen & Van Den Bergh, 2008). Financial support may help restore a sense of control and stability, thereby limiting the extent to which financial burden translates into prolonged stress. However, putting this into an institutional context of the Netherlands, literature shows that insurance mechanisms for floods are minimal as they are not included in the basic house insurance and when purchased separately only include secondary flood defense flooding (Paudel et al., 2013). For major flood events such as the 2021 flooding, the government provided partial compensation through the "Wet tegenmoetkoming schade bij rampen" law. While compensation is typically not complete, the present finding suggests that even partial financial support may play a meaningful role in reducing stress levels among affected individuals. The results indicate that financial support functions as an important protective factor of stress in the context of flood recovery.

6. Discussions

6.1. Cross-Boarder Resilience Hub (Maastricht-Aachen)

Climate change is not going to stop and will have a greater impact on Europe in the near future, which means we can expect that extreme weather events will become more frequent and intense. This poses a rapidly growing challenge for European border regions, as we already see through the increase in rainfall events across Europe, which become more severe due to climate change and can rapidly escalate into disasters such as floods. This was particularly evident in 2021, when floods after extreme rainfall affected Germany, Belgium and the Netherlands.

Based on our survey, it is evident that in addition to direct costs, indirect consequences are becoming more present through psychological impacts on those affected or the fact that employees may lose their employment. However, our hypothesis H1b is supported by our findings, which means that subjective financial insecurity has a central influence on individual well-being. This is also supported by additional literature, which argues that economic insecurity has a central influence on individual well-being (World Health Organization, 2011). Similarly, Kessler et al. (2008) demonstrate that losses of income correlate with psychological effects, while Bangalore et al. (2016) demonstrates that households experience a significant loss of welfare following sudden disasters.

Those are precisely the reasons why we propose the project of a cross-border Resilience Hub between Maastricht University and RWTH Aachen University. The aim is to leverage the respective strengths of both institutions to combine technical, economic and social science approaches, thereby supporting and strengthening the households in the Euregio Maas-Rhine region and sustainably minimise the negative consequences of such climate disasters.

The core of the project is the combination of both infrastructural and behavioural measures. As the RWTH Aachen University offers a high level of expertise in flood modelling and infrastructure planning through its technical specialization, Maastricht University focuses on behavioural economic, psychological and policy-orientated approaches (RWTH Aachen University, 2026). Consequently, combining these two strengths could ensure that the severity of the floods is reduced, while the social vulnerability is minimised at the same time. Therefore financial advice centers could be set up following disasters, where students of the finance and law departments offer guidance and help with insurance claims or debt management, as well as applying for state funding. Before such disasters occur, smaller workshops or information nights could be organized regularly to raise awareness of the importance of insurance and to

ensure that assistance for that is provided, which would help with financial insecurity preventively.

Rather than creating completely new systems and institutions, the project could build upon already existing flood-risk and crisis-management structures. For example, it could use the current initiative coordinated by the RWTH Aachen University and StädteregionAachen, which already focuses on flood forecasting, crisis communication and warning systems established after the floods in 2021 (Lehrstuhl und Institut für Wasserbau und Wasserwirtschaft, 2024). Building on these, a cooperation across border Emergency Support Desk could allow the initiative to support and guide more households. Furthermore, using existing structures and enhancing them would increase practical feasibility and reduce operation and set up costs, while minimising administrative duplication in both regions. Maastricht University could complement such structures through behavioural, financial and policy-orientated expertise, as well as through the knowledge and network from the UN University.

Additionally, the teaching formats of the Maastricht University, in collaboration with the UN University, can be utilised in form of problem-based learning to promote education and foster long-term resilience through knowledge exchange (Kaundinya, et al., 2023). At the same time, the project offers students to gain practical experiences in various fields, such as evacuation strategy, communication and project planning to increase knowledge transfer and operate cost efficiently.

In general, the project should be launched as a pilot programme and can utilise existing structures, such as the Maastricht Aachen Campus, to ensure the highest level of efficiency in its implementation. Furthermore, EU funding programmes such as Interreg could be utilised to achieve sustainable development through regional cohesion, which "makes a real difference in people's lives" (Interreg Europe, 2021). European funding would significantly increase the practical feasibility and scalability of the project, which could be further enhanced by potential sponsors in the region.

Overall, the project adopts an evidence-based approach grounded in our research, which suggests that reduced financial security will reduce the stress and anxiety levels of those affected, thereby ensuring an improvement of the mental health of those affected. As a result, the cross-border resilience hub has a positive economic and social impact in a world increasingly characterised by climate risks.

6.2. Flood Resilience and Wellbeing Network

In order to deal with the main hypothesis (H0), which indicated excessive stress and anxiety related to displacement induced by the 2021 Limburg floods, it is important to create interventions that specifically target the psychological burden created by these events. In addition, displacement creates not only physical disruptions; it creates significant emotional distress due to; uncertainty, loss of control, and social disconnection. Maastricht University has the potential to act as an important regional knowledge centre in creating an integrated "Flood Resilience and Wellbeing Network" for the broader Limburg region.

In the pre-disaster phase, it is important to increase psychological preparedness and awareness among the community, especially amongst the students and newcomers that are likely to be unfamiliar with the history of flooding in the area or adequate ways to cope with flooding. Maastricht University could establish community-based "Resilience Labs" along with local municipalities, holding workshops, simulations, and providing accessible information about flood risk, as well as the ways in which individuals can prepare for flooding behaviourally. These initiatives could specifically be coordinated through collaboration between Studium Generale, and the Organisation of Health and Safety, including prevention officers and occupational hygienists due to their expertise in prevention and health protection (*STUDIUM GENERALE - Maastricht University*, n.d.)(*The Organisation of Health and Safety - This Is Us! - Maastricht University*, n.d.). They could use a problem-based learning approach, where students from various disciplines within the university would be involved in designing and conducting interactive sessions that educate citizens about flood risks and provide them with information on how to prepare practically for the likelihood of flooding in their homes. In addition, flood-related cases could be integrated into existing PBL sessions within study programmes, allowing students to connect their disciplinary focus to flood resilience. This would increase awareness amongst students while also preparing them to assist communities during future flood events.

At the disaster stage when people are going through the process of being displaced, the focus will change to immediate psychological support and the creation of a safe and supportive environment. At this stage, the Emergency Response Organisation (ERO) and the Head of the ERO would play a central coordinating role in managing the disaster response and the organisation of resilience shelters in conjunction with Veiligheidsregio Zuid-Limburg, Provincie Limburg, Gemeente Maastricht, Maastricht University Medical Center +, first responders and national authorities (*Emergency Response Organisation - This Is Us! -*

Maastricht University, n.d.). Resilience shelters could be created at public sites around the region of which university buildings could be included. Resilience Shelters will combine both physical and psychological assistance to displaced people. In addition to being given the basic necessities of life, resilience shelters would provide peace and quiet, areas for children to play, and access to information that helps to reduce their stress level. By having trained student volunteers from psychology, health care and other related areas provide psychological first aid with the supervision of a licensed clinician at the resilience shelters, displaced people would also benefit from maintaining their social connections with a structured buddy system. This would help to decrease feelings of isolation, which often could lead to extra anxiety in someone who has been displaced (Toren et al., 2025).

Within the post-disaster stage, long-term recovery and mental health integration should be prioritised. The university can utilise its existing knowledge to create community recovery circles throughout the disaster-affected area. These circles will create opportunities for communities to access facilitated group discussions, allowing people to discuss their experiences and deal with the feelings associated with the events of the disaster. In addition, mobile mental health support services and accessible counselling pathways can also be established to help other people who have experienced more serious or prolonged psychological effects. These post-disaster initiatives could again be coordinated through collaboration between Studium Generale, study programmes, and the Organisation of Health and Safety to ensure that recovery support remains evidence-based and connected to the university's expertise (*STUDIUM GENERALE - Maastricht University*, n.d.)(*The Organisation of Health and Safety - This Is Us! - Maastricht University*, n.d.). Furthermore, follow-up assessments can be conducted by the University of Maastricht to monitor individual well-being over time to ensure that the supports available are evidence-based and able to adjust according to the on-going needs of the community.

Overall, this three-stage approach directly responds to the empirical findings of increased stress and anxiety due to displacement by targeting its underlying mechanisms at each phase. For which the University of Maastricht has the required academic knowledge, demonstrated results from student and faculty participation and the sufficient infrastructure to lead this type of effort; thereby aiding in the overall construction of sustainable regional resilience to climate related events.

7. Conclusions

To conclude, this study demonstrates the growing vulnerability of the Netherlands, a country that is extremely prone to flooding, to the effects of climate change. The 2021 flooding of Limburg was caused by intense and prolonged rainfall, leading the Meuse river to overflow. The harrowing event illustrated the realities of climate change, signalling how climate change can translate into immediate societal impacts.

The findings of this case study indicate that climate change does not only cause physical damage, but also extends to psychological implications, significantly affecting personal wellbeing. A significant number of individuals surveyed faced vulnerabilities due to the unprecedented nature of the floods. Excessive stress and anxiety levels were measured, indicating a significant correlation between the floods and health outcomes, particularly among displaced individuals. Internal displacement alongside financial strain emerged as key factors intensifying psychological distress, with respondents exhibiting greater wellbeing effects as the economic burden increases. Therefore, resource capacity and financial security are critical indicators that emphasise the probable susceptibility of individuals facing climate challenges.

This paper suggests possible solutions to the awareness shortfall of climate change risks. Academic institutions can contribute in promoting and encouraging students to study the impacts of flooding in high-risk regions. The Maastricht University-RWTH Aachen University initiative combines the resources and specialisations of both universities, advocating for cross-border cooperation in flood prevention, adaptability, and response strategies. As Germany was severely impacted by the 2021 flooding it is critical to push for the collaboration between these two regions to ensure an effective solution to eliminate the severe consequences of climate change on individual well-being. Addressing climate change requires a multitude of academic perspectives and interdisciplinary approaches to combine expertise. Therefore, by promoting partnerships between university students, it raises climate urgency among younger generations, resulting in greater efforts to address climate change. In addition, the “Flood and Resilience Network” urges Maastricht University to have the preparedness and appropriate response strategies for acting in climate emergencies by advocating for a three stage action plan in case of a disaster.

Ultimately, this case study recentres climate change from an environmental challenge to a public health one, shaping future discourses. It contributes to ongoing debates by proposing a solution to enhance resilience and improve support systems. Whilst climate change cannot be

resolved overnight, its consequences can be mitigated through more coordinated and adaptive responses.

References

Abebe, Y. A., Pregnolato, M., & Jonkman, S. N. (2025). Flood impacts on healthcare facilities and disaster preparedness – A systematic review. *International Journal of Disaster Risk Reduction*, *119*, 105340. https://doi.org/10.1016/j.ijdrr.2025.105340

Alderman, K., Turner, L. R., & Tong, S. (2013). Assessment of the Health Impacts of the 2011 Summer Floods in Brisbane. *Disaster Medicine and Public Health Preparedness*, *7*(4), 380-386. https://doi.org/10.1017/dmp.2013.42

Bangalore, M., Hallegatte, S., & Vogt-Schilb, A. (2016). *Socioeconomic Resilience: Multi-Hazard Estimates in 117 Countries*. World Bank, Washington, DC. https://doi.org/10.1596/1813-9450-7886

Bhugra, D. (2004). Migration and mental health. *Acta Psychiatrica Scandinavica*, *109*(4), 243-258. https://doi.org/10.1046/j.0001-690x.2003.00246.x

Black, R., Kniveton, D., & Schmidt-Verkerk, K. (2011). Migration and Climate Change: Towards an Integrated Assessment of Sensitivity. *Environment and Planning A: Economy and Space*, *43*(2), 431-450. https://doi.org/10.1068/a43154

Botzen, W. J. W., & Van Den Bergh, J. C. J. M. (2008). Insurance Against Climate Change and Flooding in the Netherlands: Present, Future, and Comparison with Other Countries. *Risk Analysis*, *28*(2), 413-426. https://doi.org/10.1111/j.1539-6924.2008.01035.x

Bozzoli, C., Brück, T., & Muhumuza, T. (2012). Movers or Stayers? Understanding the Drivers of IDP Camp Decongestion During Post-Conflict Recovery in Uganda. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2030822

Bubeck, P., L. Berghäuser, P. Hudson, and A. H. Thieken. 2020. “Using Panel Data to Understand the Dynamics of Human Behavior in Response to Flooding.” Risk Analysis 40, no. 11: 2340–2359

Cazabat, C., Yasukawa, L. Y. (2020). Unveiling the Cost of Internal Displacement: 2020 report. Internal Displacement Monitoring Centre. https://api.internal-displacement.org/sites/default/files/publications/documents/IDMC_CostEstimate_final.pdf

Collins, T. W., Jimenez, A. M., & Grineski, S. E. (2012). Hispanic Health Disparities After a Flood Disaster: Results of a Population-Based Survey of Individuals Experiencing Home Site Damage in El Paso (Texas, USA). *Journal of Immigrant and Minority Health*, *15*(2), 415-426. https://doi.org/10.1007/s10903-012-9626-2

Czaika, M., & Reinprecht, C. (2020). Drivers of migration: A synthesis of knowledge. *IMI Work. Pap. Ser*, *163*, 1-45.

De Jong, A., Van Beek, J., Fischer, A., Geurts, M.-L., Mos, J., Geerling, G., Koopmans, M., & Boelee, E. (2023). Health effects of the 2021 flooding in Limburg. *Journal of Coastal and Riverine Flood Risk*, *2*. https://doi.org/10.59490/jcrfr.2023.0004

Deltares. (2021). Health risks after flooding. In *FAQ*. https://cms.deltares.nl/assets/common/FAQ08_Health-risks-after-flooding.pdf

De Man, H., Gras, L. M., Schimmer, B., Friesema, I. H. M., De Roda Husman, A. M., & Van Pelt, W. (2015). Gastrointestinal, influenza-like illness and dermatological complaints following exposure to floodwater: a cross-sectional survey in The Netherlands. *Epidemiology and Infection*, *144*(7), 1445–1454. https://doi.org/10.1017/s0950268815002654

De Moel, H., Aerts, J. C., & Koomen, E. (2011). Development of flood exposure in the Netherlands during the 20th and 21st century. *Global Environmental Change*, *21*(2), 620-627. https://doi.org/10.1016/j.gloenvcha.2010.12.005

Directorate-General for Environment. (2023, October 13). *Commission publishes new risk areas viewer to raise awareness about significant flood risks.* European Commission. Commission publishes new flood risk areas viewer to raise awareness about significant flood risks - Environment

Euripidou, E., & Murray, V. (2004). Public health impacts of floods and chemical contamination. *Journal of Public Health*, *26*(4), 376–383. https://doi.org/10.1093/pubmed/fdh163

Fernandez, A., Black, J., Jones, M., Wilson, L., Salvador-Carulla, L., Astell-Burt, T., & Black, D. (2015). Flooding and Mental Health: A Systematic Mapping Review. *PLOS ONE*, *10*(4), e0119929. https://doi.org/10.1371/journal.pone.0119929

Gülsen C, Knipscheer J, Kleber R (2010) The impact of forced migration on mental health: a comparative study on posttraumatic stress among internally displaced people and externally migrated Kurdish women. Traumatology 16 (4) 109–16.

Hudson, P., Botzen, W. J. W., Poussin, J., & Aerts, J. C. J. H. (2017). Impacts of Flooding and Flood Preparedness on Subjective Well-Being: A Monetisation of the Tangible and Intangible Impacts. *Journal of Happiness Studies*, *20*(2), 665–682. https://doi.org/10.1007/s10902-017-9916-4

Hunter, L.M., Koning, S., Fussell, E. *et al.* Scales and sensitivities in climate vulnerability, displacement, and health. *Popul Environ* 43, 61–81 (2021). https://doi.org/10.1007/s11111-021-00377-7

Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate Change 2021 – The Physical Science Basis*. Cambridge University Press. https://doi.org/10.1017/9781009157896

Interreg Europe. (2021). *Home*. https://interreg.eu

James LE, Welton-Mitchell C, Noel JR, James AS. Integrating mental health and disaster preparedness in intervention: a randomized controlled trial with earthquake and flood-affected communities in Haiti. Psychol Med. (2020) 50:342–52. doi: 10.1017/S0033291719000163

Kaundinya, P.S., Perné, N., Ramani S.V., Türkeli, S. (2023). *UNU policy brief: Building resilience to flooding.* ReliefWeb. UNU Policy Brief: Building Resilience to Flooding - World | ReliefWeb

Kessler, R. C., Heeringa, S., Lakoma, M. D., Petukhova, M., Rupp, A. E., Schoenbaum, M., Wang, P. S., & Zaslavsky, A. M. (2008). Individual and Societal Effects of Mental Disorders on Earnings in the United States: Results From the National Comorbidity Survey Replication. *American Journal of Psychiatry*, *165*(6), 703–711. https://doi.org/10.1176/appi.ajp.2008.08010126

Kjellström, E. (2004). Recent and Future Signatures of Climate Change in Europe. *Ambio*, *33*(4/5), 193–198. http://www.jstor.org/stable/4315483

Kok, M., Slager, K., Moel, H. de, Botzen, W., Bruijn, K. de, Wagenaar, D., Rikkert, S., Koks, E., & Ginkel, K. van. (2023). Rapid Damage Assessment Caused by the Flooding Event 2021 in Limburg, Netherlands. *Journal of Coastal and Riverine Flood Risk*, *2*. https://doi.org/10.59490/jcrfr.2023.0010

Lehrstuhl und Institut für Wasserbau und Wasserwirtschaft. (2024). *INFRAH | IWW | RWTH Aachen University | DE*. Rwth-Aachen.de. https://www.iww.rwth-aachen.de/cms/iww/forschung/forschungsgruppen/nachwuchsforschungsgruppe-hochwasservorh/aktuelle-projekte/~bhdeaq/infrah/

Maastricht University. (n.d.). *Emergency response organisation.* Emergency response organisation - This is us! - Maastricht University

Maastricht University. (n.d.). *Studium Generale*. STUDIUM GENERALE - Maastricht University

Maastricht University. (n.d.). *The organisation of Health and Safety*. The organisation of Health and Safety - This is us! - Maastricht University

Maltais, D., Lachance, L., Fortin, M., Lalande, G., Robichaud, S., Fortin, C., & Simard, A. (2000). L'état de santé psychologique et physique des sinistrés des inondations de juillet 1996 : étude comparative entre sinistrés et non sinistrés [Psychological and physical health of the July 1996 disaster victims: A comparative study between victims and non-victims.]. *Sante mentale au Quebec*, *25*(1), 116–137. https://pubmed.ncbi.nlm.nih.gov/18253574/

Mnookin, S. (2016). *Out of the shadows: Making Mental Health a Global Development Priority*. World Health Organization. https://documents1.worldbank.org/curated/en/270131468187759113/pdf/105052-WP-PUBLIC-wb-background-paper.pdf

Mostafizur Rahman, M., Alam Shobuj, I., Tanvir Hossain, M., & Tasnim, F. (2023). Impact of Disaster on mental health of women: A case study on 2022 flash flood in Bangladesh. *International Journal of Disaster Risk Reduction*, *96*, 103935. https://doi.org/10.1016/j.ijdrr.2023.103935

Mulder, A. C., Pijnacker, R., De Man, H., Van De Kassteele, J., Van Pelt, W., Mughini-Gras, L., & Franz, E. (2019). “Sickenin’ in the rain” – increased risk of gastrointestinal and respiratory infections after urban pluvial flooding in a population-based cross-

sectional study in the Netherlands. *BMC Infectious Diseases*, *19*(1), 377. https://doi.org/10.1186/s12879-019-3984-5

North, C. S., Kawasaki, A., Spitznagel, E. L., & Hong, B. A. (2004). The Course of PTSD, Major Depression, Substance Abuse, and Somatization After a Natural Disaster. *Journal of Nervous &Amp; Mental Disease*, *192*(12), 823-829. https://doi.org/10.1097/01.nmd.0000146911.52616.22

Paudel, Y., Botzen, W. J. W., & Aerts, J. C. J. H. (2013). Estimation of insurance premiums for coverage against natural disaster risk: an application of Bayesian Inference. *Natural Hazards and Earth System Sciences*, *13*(3), 737-754. https://doi.org/10.5194/nhess-13-737-2013

Pielke, R. A. (2004). What is Climate Change? *Energy &Amp; Environment*, *15*(3), 515-520. https://doi.org/10.1260/0958305041494576

Porter, M., & Haslam, N. (2005). Predisplacement and Postdisplacement Factors Associated With Mental Health of Refugees and Internally Displaced Persons. *JAMA*, *294*(5), 602. https://doi.org/10.1001/jama.294.5.602

RWTH Aachen University. (2026). *Warum die Hochwasser-Demenz so gefährlich ist | RWTH Aachen University | DE*. Rwth-Aachen.de. https://www.rwth-aachen.de/cms/root/wir/aktuell/pressemitteilungen/dossiers/dossiers-hochwasser/~blfcao/warum-die-hochwasser-demenz-so-gefaehrli/

Stein, W. S., & Weisser, R. A. W. (2022). Direct Shock Experience vs. Tangential Shock Exposure: Indirect Effects of Flood Shocks on Well-Being and Preferences. *The World Bank Economic Review*, *36*(4), 909–933. https://doi.org/10.1093/wber/lhac012

Strijker, B., Asselman, N., De Jong, J., & Barneveld, H. (2023). The 2021 floods in the Netherlands from a river engineering perspective. *Journal of Coastal and Riverine Flood Risk*, *2*. https://doi.org/10.59490/jcrfr.2023.0006

Toren, O., Novoseller, T., Selig, D., Bar On, M., & Madar, G. (2025). Health Perception and Anxiety Among Internally Displaced and Non-Displaced Israeli Adults: The Mediating Role of Emotional Well-Being and Functioning. *Healthcare*, *13*(22), 2994. https://doi.org/10.3390/healthcare13222994

Tradowsky, J. S., Philip, S. Y., Kreienkamp, F., Kew, S. F., Lorenz, P., Arrighi, J., Bettmann, T., Caluwaerts, S., Chan, S. C., De Cruz, L., de Vries, H., Demuth, N., Ferrone, A., Fischer, E. M., Fowler, H. J., Goergen, K., Heinrich, D., Henrichs, Y., Kaspar, F., … Wanders, N. (2023). Attribution of the heavy rainfall events leading to severe flooding in Western Europe during July 2021. *Climatic Change*, *176*(7). https://doi.org/10.1007/s10584-023-03502-7

Van Doorn-Hoekveld, W.J., Gilissen, H. K., Groothuijse, F. A. G., & Van Rijswick, H. F. M. W. (2022). Adaptation to Climate Change in Dutch Flood Risk Management: Innovative Approaches and Related Challenges. *Utrecht Law Review*, 18(2), 51–69. https://doi.org/10.36633/ulr.860

Van Koningsveld, M., Mulder, J. P. M., Stive, M. J. F., Van Der Valk, L., & Van Der Weck, A. W. (2008). Living with Sea-Level Rise and Climate Change: A Case Study of the Netherlands. *Journal of Coastal Research*, *24*(2), 367–445. http://www.jstor.org/stable/30137842

Vousdoukas, M. I., Mentaschi, L., Voukouvalas, E., Verlaan, M., & Feyen, L. (2017). Extreme sea levels on the rise along Europe's coasts. *Earth's Future*, *5*(3), 304-323. https://doi.org/10.1002/2016ef000505

World Health Organization. (2011). *Impact of economic crises on mental health.* https://iris.who.int/handle/10665/370872

Appendix

Main Hypothesis (H0)

Anxiety Influenced by Displacement

Independent Samples T-Test

	Test	Statistic	df	p
Q39	Student	3.334	66	< .001
	Mann-Whitney	802.500		.001

Note. For all tests, the alternative hypothesis specifies that group *Ja* is greater than group *Nee* .

Descriptives ▼

Group Descriptives ▼

	Group	N	Mean	SD	SE	Coefficient of variation	Mean Rank	Sum Rank
Q39	Ja	28	7.607	2.820	0.533	0.371	43.16	1209
	Nee	40	4.975	3.445	0.545	0.693	28.44	1138

Severity Influence on Anxiety ▼

Model Summary - Q39 ▼

Model	R	R^2	Adjusted R^2	RMSE
M_1	0.972	0.944	0.922	2.264

Note. M_1 includes Q24, Q35

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	1732.5	8	216.559	42.24	< .001
	Residual	102.5	20	5.126		
	Total	1835.0	28			

Note. M_1 includes Q24, Q35

Coefficients

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_1	Q24 (Niet getroffen)	4.500	1.601		2.811	.011
	Q24 (Licht getroffen)	7.500	1.601		4.685	< .001
	Q24 (Matig getroffen)	4.521	1.400		3.230	.004
	Q24 (Ernstig getroffen)	5.017	1.759		2.852	.010
	Q24 (Zeer ernstig getroffen)	3.958	1.646		2.404	.026
	Q35 (1–3 dagen)	4.758	1.515		3.140	.005
	Q35 (4–7 dagen)	−0.017	2.192		−0.008	.994
	Q35 (Meer dan 1 maand)	3.874	1.775		2.182	.041

[a] Standardized coefficients can only be computed for continuous predictors.

Severity Influence on Anxiety ▼

Model Summary - Q39

Model	R	R^2	Adjusted R^2	RMSE
M_1	0.915	0.838	0.825	2.909

Note. M_1 includes Q24

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	2755.0	5	551.004	65.13	< .001
	Residual	533.0	63	8.460		
	Total	3288.0	68			

Note. M_1 includes Q24

Coefficients ▼

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_1	Q24 (Niet getroffen)	4.259	0.560		7.609	< .001
	Q24 (Licht getroffen)	4.667	0.840		5.558	< .001
	Q24 (Matig getroffen)	8.545	0.877		9.744	< .001
	Q24 (Ernstig getroffen)	8.100	0.920		8.806	< .001
	Q24 (Zeer ernstig getroffen)	8.250	1.028		8.023	< .001

[a] Standardized coefficients can only be computed for continuous predictors.

Stress Influenced by Displacement ▼

Independent Samples T-Test

	Test	Statistic	df	p
Q38	Student	4.433	66	< .001
	Mann-Whitney	868.500		< .001

Descriptives ▼

Group Descriptives ▼

	Group	N	Mean	SD	SE	Coefficient of variation	Mean Rank	Sum Rank
Q38	Ja	28	8.357	2.792	0.528	0.334	45.52	1275
	Nee	40	5.175	2.995	0.474	0.579	26.79	1072

Severity Influence on Stress ▼

Model Summary - stress ▼

Model	R	R^2	Adjusted R^2	RMSE
M_1	0.941	0.886	0.877	2.547

Note. M_1 includes Q24

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	3178.4	5	635.688	98.02	< .001
	Residual	408.6	63	6.485		
	Total	3587.0	68			

Note. M_1 includes Q24

Coefficients

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_1	Q24 (Niet getroffen)	4.481	0.490		9.144	< .001
	Q24 (Licht getroffen)	5.000	0.735		6.801	< .001
	Q24 (Matig getroffen)	9.364	0.768		12.195	< .001
	Q24 (Ernstig getroffen)	8.400	0.805		10.431	< .001
	Q24 (Zeer ernstig getroffen)	9.125	0.900		10.135	< .001

[a] Standardized coefficients can only be computed for continuous predictors.

Financial Hypothesis (H1a)

Financial Support and Financial Stress ▼

Spearman's Correlations

			Spearman's rho	p
Financial Stress	–	support	−0.585	< .001

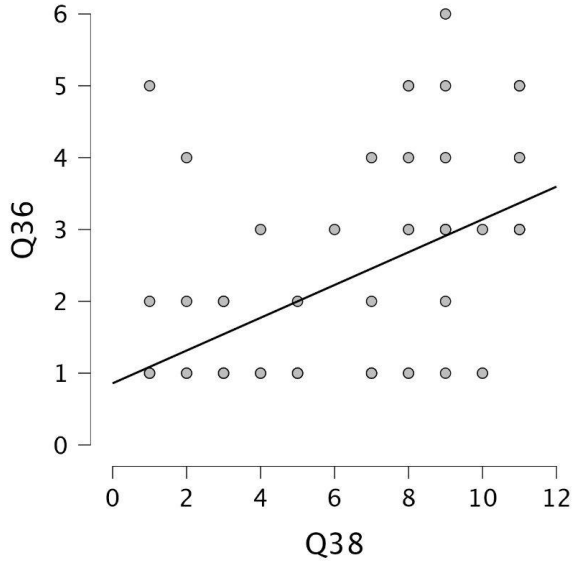
Stress and Financial Impact

Spearman's Correlations ▼

			Spearman's rho	p
Q38	–	Q36	0.522	< .001

Scatter plots

Q38 vs. Q36



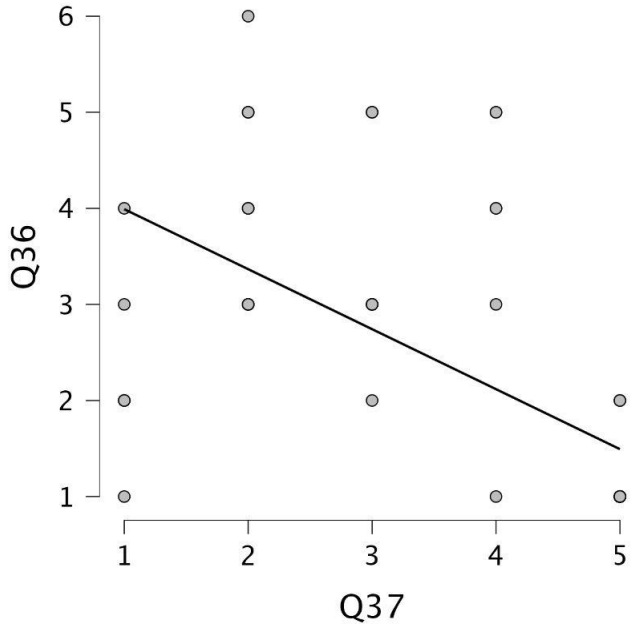
Financial Loss and Financial Support

Spearman's Correlations

			Spearman's rho	p
Q37	-	Q36	−0.735	< .001

Scatter plots

Q37 vs. Q36



Financial Distress Influenced by Employment ▾

Model Summary - Q40

Model	R	R^2	Adjusted R^2	RMSE
M_0	0.000	0.000	0.000	1.311
M_1	0.474	0.224	0.175	1.191

Note. M_1 includes Q41

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	25.85	4	6.463	4.556	.003
	Residual	89.37	63	1.419		
	Total	115.22	67			

Note. M_1 includes Q41
Note. The intercept model is omitted, as no meaningful information can be shown.

Coefficients

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_0	(Intercept)	1.838	0.159		11.559	< .001
M_1	(Intercept)	1.486	0.201		7.380	< .001
	Q41 (Licht)	−0.069	0.398		−0.173	.863
	Q41 (Matig)	1.389	0.467		2.977	.004
	Q41 (Aanzienlijk)	1.681	0.526		3.194	.002
	Q41 (Zeer aanzienlijk)	0.514	0.493		1.043	.301

[a] Standardized coefficients can only be computed for continuous predictors.

Duration Hypothesis (H1b)

Duration Influence on Stress ▾

Model Summary - Q38

Model	R	R^2	Adjusted R^2	RMSE
M_1	0.968	0.936	0.926	2.395

Note. M_1 includes Q35

ANOVA ▾

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	2028.3	4	507.080	88.39	< .001
	Residual	137.7	24	5.737		
	Total	2166.0	28			

Note. M_1 includes Q35

Coefficients

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_1	Q35 (Minder dan 24 uur)	6.143	0.905		6.786	< .001
	Q35 (1–3 dagen)	9.455	0.722		13.092	< .001
	Q35 (4–7 dagen)	6.333	1.383		4.580	< .001
	Q35 (Meer dan 1 maand)	9.714	0.905		10.731	< .001

[a] Standardized coefficients can only be computed for continuous predictors.

Duration Influence on Anxiety ▼

Model Summary - Q39

Model	R	R^2	Adjusted R^2	RMSE
M_1	0.967	0.935	0.924	2.230

Note. M_1 includes Q35

ANOVA ▼

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	1715.6	4	428.899	86.21	< .001
	Residual	119.4	24	4.975		
	Total	1835.0	28			

Note. M_1 includes Q35

Coefficients

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_1	Q35 (Minder dan 24 uur)	5.286	0.843		6.270	< .001
	Q35 (1–3 dagen)	9.364	0.673		13.923	< .001
	Q35 (4–7 dagen)	5.000	1.288		3.883	< .001
	Q35 (Meer dan 1 maand)	8.286	0.843		9.828	< .001

[a] Standardized coefficients can only be computed for continuous predictors.

Optional Hypothesis (H1c)

Financial Distress Influenced by Support ▼

Model Summary - Q40

Model	R	R^2	Adjusted R^2	RMSE
M_0	0.000	0.000	0.000	1.311
M_1	0.734	0.539	0.510	0.918

Note. M_1 includes Q37

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	62.10	4	15.524	18.41	< .001
	Residual	53.12	63	0.843		
	Total	115.22	67			

Note. M_1 includes Q37

Note. The intercept model is omitted, as no meaningful information can be shown.

Coefficients ▼

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_0	(Intercept)	1.838	0.159		11.559	< .001
M_1	(Intercept)	1.429	0.347		4.116	< .001
	Q37 (Gedeeltelijk)	1.738	0.437		3.980	< .001
	Q37 (Grotendeels)	1.662	0.444		3.744	< .001
	Q37 (Volledig)	0.405	0.511		0.792	.431
	Q37 (Niet van toepassing/Zeg ik liever niet)	−0.429	0.383		−1.119	.268

[a] Standardized coefficients can only be computed for continuous predictors.

Financial Support on Stress

Model Summary - stress

Model	R	R^2	Adjusted R^2	RMSE
M_1	0.932	0.868	0.857	2.743

Note. M_1 includes support

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	3113.2	5	622.630	82.78	< .001
	Residual	473.8	63	7.521		
	Total	3587.0	68			

Note. M_1 includes support

Coefficients

Model		Unstandardized	Standard Error	Standardized[a]	t	p
M_1	support (Helemaal niet)	4.714	1.037		4.548	< .001
	support (Gedeeltelijk)	8.333	0.792		10.526	< .001
	support (Grotendeels)	9.636	0.827		11.654	< .001
	support (Volledig)	7.333	1.120		6.550	< .001
	support (Niet van toepassing/Zeg ik liever niet)	4.937	0.485		10.184	< .001

[a] Standardized coefficients can only be computed for continuous predictors.