<table>
<thead>
<tr>
<th>List of Iwanuma Project Papers (by Order of topics)</th>
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Growing attention has been focused on the role of social connections ("social capital") in assisting recovery after natural disasters. Social capital is thought to be a factor that promotes community resilience after a disaster. Seven months before the 2011 Great East Japan Earthquake, a survey was conducted on the relationship between social capital and health in Iwanuma City, Miyagi Prefecture, Japan. Survivors have been followed since, providing a unique opportunity to study the impact of social capital on their health. Through collaboration between the Japan Gerontological Evaluation Study (JAGES), Iwanuma City, and Professor Ichiro Kawachi of Harvard University's School of Public Health, the Iwanuma Study has contributed to our understanding of the factors that promote recovery among older disaster survivors.
What was your motivation to start the Iwanuma Project?

**Kawachi:** Globally, disasters are becoming increasingly severe and poorly understood. After the tragedy of the Great East Japan Earthquake in March 2011, we have had an invaluable opportunity through the Iwanuma Research Project to deepen our understanding of the impact of disasters on the health of older adults, their recovery, and the factors that contribute to it.

**Kondo:** We wanted to demonstrate scientifically, using data, not just anecdotally, that social capital or “connections” between people can contribute to disaster preparedness and resilience (recovery from a major shock).

There was an inconclusive debate in the studies that started after the disaster about which came first—health or social capital—the cause and the effect. However, Iwanuma City conducted a survey on the health and social capital of older adults in August 2010, seven months before the earthquake, which gave us a rare opportunity to settle this debate.

What was the goal of this plan?

**Our goal was to examine whether communities with high social capital could help people overcome the damage caused by disasters. Disaster preparedness involves stockpiling food, water, medicines, and arranging evacuation shelters. Our hypothesis was that resilience arises from peoples’ social connections.**

What have been the main findings so far?

**Kawachi:** First, we found a marked increase in cognitive disability and metabolic syndrome among those who moved into temporary housing. However, we also found that older adults were more resilient in terms of mental health. For example, three years after the disaster, the majority of people had recovered from their grief, and depression rates in the community had returned to pre-disaster levels.

**Kondo:** We observed other health concerns as well, including post-traumatic stress disorder (PTSD), instrumental activities of daily living (IADL), and tooth loss. What surprised me was that the greater the damage to the house, the greater the health hazard. However, we were also able to identify the factors that alleviated these health hazards.

**Kawachi:** We found that even among people who had suffered difficult experiences, such as losing their loved ones and damaging their homes, those who lived in communities with high social capital before the disaster, or who became richer in social capital before and after the disaster, were less likely to deteriorate. This means that strengthening the social capital of a community is an important strategy for disaster preparedness.

**Kondo:** There are dual aspects here: hard disaster preparedness, such as building breakwaters, and soft disaster preparedness. One such example is the development of social capital. The National Institute of Health in the United States also provided research grant for the Iwanuma Project. Was it useful for the United States?

**Kawachi:** The valuable lessons learned from the Iwanuma Project are useful, not only in Japan but also around the world. For example, we found that when rehousing people to temporary housing, it was best to do so in groups that maintained pre-existing neighborhood relationships to preserve social capital. After learning about the results of the Iwanuma Project through The Wall Street Journal, the City of Houston contacted us and made use of this insight during their response to Hurricane Harvey.

What are your plans for the future?

**Kawachi:** The next phase of the Iwanuma Project is to understand the heterogeneity of health outcomes following exposure to the same traumatic events. For example, only half of the people who experience severe trauma develop severe post-traumatic stress disorder (PTSD), while the other half remain relatively asymptomatic. Using machine learning, we can identify the characteristics of resilient individuals. This information can help focus resources more efficiently on people and communities that are vulnerable to disasters.

**Kondo:** We are also working with the National Research Institute for Earth Science and Disaster Resilience, Japan, to develop a disaster preparedness “visualization” system (see p. 29), which allows you to see which areas are resistant or vulnerable to disasters. This system will be used by residents and local governments in workshops for disaster preparedness. We hope that the Iwanuma Project will serve as an opportunity to foster social capital and connections between residents during normal times, the significance of which has been demonstrated by the project.

We would like to thank the people of Iwanuma City and everyone who cooperated with this project. We are working on a follow-up study in 2022 to examine its long-term impact and look forward to your continued cooperation.
We would like to connect the value of the pre-earthquake data with internationally useful evidence.

The Iwanuma Project started in 2007 when the Iwanuma City Care and Welfare Division, together with the Department of International and Community Oral Health, Graduate School of Dentistry, Tohoku University, jointly implemented a model project for preventive care, led by Professor Ken Osaka, under whom I worked with his department at the time.

The JAGES 2010 survey was conducted before the earthquake, which became the baseline for the Iwanuma Project, and follow-up surveys have continued every three years. In addition to the direct risk of injury and death, disasters also destroy houses, farmlands, and factories. This causes damage to jobs and the economy. Residential relocation and migration also change social relationships. From the viewpoint of social determinants of health, these changes in the physical and social environment are believed to have a significant impact on health.

The factors that contribute to protecting the health of disaster survivors and promoting their recovery are not clear. Most disaster research has been conducted after disasters have occurred. Few studies have used data on pre-disaster conditions. As a result, the Iwanuma Project has been recognized in Japan and the US as a valuable source of pre-earthquake data. Therefore, we have received funding to continue research related to health and disasters. This project is being conducted with the cooperation of citizens and the Iwanuma local government. We will continue our efforts to produce results that will be useful to the people of Iwanuma City and generate helpful evidence for global communities.

We look forward to your continued support and encouragement.

Many results of the Iwanuma Project provide lessons that will guide us in the "Era of Disasters."

After taking up the post of Mayor, I established the goal of "Building a Healthy and Happy City." As part of this effort, we conducted a health and lifestyle survey for all people over the age of 65 under the guidance of Professors Ken Osaka and Jun Aida of Tohoku University. Seven months later, the Great East Japan Earthquake struck 48% of the Iwanuma City area, claiming many victims. There were no other surveys with data on the health status of older adults and people’s connections before the disaster. The Iwanuma Project was created based on these data.

In the process of reconstruction, we decided to protect lives, work quickly, and become self-reliant. Iwanuma City was able to achieve the fastest mass relocation among the affected areas. We did not apply a lottery when transferring people from evacuation shelters to temporary housing and group relocation. Each community was relocated individually because we wanted to protect the bonds between residents. The decision on what kind of town to build was made at a meeting of village representatives, including women and young people. We were able to establish commercial facilities necessary for daily life because the six affected communities were relocated en masse to a single location. We also promoted the development of the Millennium Hope Hills, which was named as a symbol of reconstruction.

Many people throughout Japan participated in a tree-planting ceremony featuring broad-leaved trees, used as symbols for a torch-relay course for the Reconstruction Olympics. The forest on the hill will serve as a breakwater in addition to the concrete embankment. Pillars and memorabilia from houses that were washed away were also used. We became a top runner in the reconstruction process since we formulated a recovery plan early and worked to implement it. Many results were announced from the Iwanuma Project, which we communicated with the assistance of teachers. There are many lessons to be learned that will guide us in the "Era of Disasters."
Hypothesis 2

Previous Research insights into the causal relationship between social capital and health. The survey included data on social capital and health, which made it possible to compare situations before and after the disaster, providing new insights into the causal relationship between social capital and health.

In August 2010, seven months before the Great East Japan Earthquake, the Japan Gerontological Evaluation Study (JAGES) conducted a survey of all older adults in Iwanuma City.

In the Iwanuma region, with a population of approximately 44,000 people covering an area of approximately 60km², the city is located approximately 17.6 km south of Sendai, Miyagi Prefecture. The eastern border is the Pacific coast and the western border is mountainous. Sendai Airport was established, followed by the development of an adjacent industrial park.

Population of approximately 44,000 / area of approximately 60km².

No previous data

Existing previous data

Comparison of health pre- and post-earthquake

Verification of Hypothesis 2

This project was possible due to the existence of data from a survey of all older adults conducted seven months before the earthquake.

In August 2010, seven months before the Great East Japan Earthquake, the Japan Gerontological Evaluation Study (JAGES) conducted a survey of all older adults in Iwanuma City.

The survey included data on social capital and health, which made it possible to compare situations before and after the disaster, providing new insights into the causal relationship between social capital and health.

Several studies have examined the impact of earthquakes on older adults; however, this project was able to shed light on this topic.

While previous research on earthquakes mainly focused on mental health, this project was able to analyze the effects of the disaster on physical functioning, cognitive deterioration, and social participation of the older population in particular.

Research design for JAGES and Iwanuma Project

- JAGES2010 (Questionnaire)
- JAGES2013 (Questionnaire)
- JAGES2016 (Questionnaire)
- JAGES2019 (Questionnaire)

Great East Japan Earthquake (Event behind decline of health)

Health Status/ Function

Comparison of health pre- and post-earthquake

High social capital

Low social capital

Target
All older adults (65 years old and over) living in Iwanuma City.

Method 1
Postal distribution and on-site collection of the JAGES questionnaire (including earthquake-related items, Iwanuma City version) for 5,058 respondents of the JAGES 2010 after the earthquake (2013, 2016, 2019).

Method 2
Interview with public health nurses, local welfare officers, Council of Social Welfare staff, residents, etc.
The Iwanuma Project focuses on the impacts of social capital - both preceding the disaster and after the disaster - on the physical and mental health of survivors. We have classified the published papers into four phases of the disaster: “Pre-Earthquake,” “Pre- and Post-Earthquake,” “Post-Earthquake,” and “Long-term Effects.”

**Published Papers**

**2021.6**

The Iwanuma Project is the focus of the 2021.6 published papers. The project examines the effects of pre-earthquake and post-earthquake factors on the health of survivors.

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- Optimists: more resilient after the earthquake
- Social support before the earthquake reduced the risk of developing depressive symptoms by 60%
- Unpredicted higher risk of PTSD among people who did not experience early-life adversity
- Pre-disaster community social ties predict incident posttraumatic stress disorder (PTSD)
- Bending, bridging and linking social capital - Qualitative study of public health nurses
- Maintaining social ties through group relations
- Predictors of sleep problems in disaster survivors
- Increased participation in exercise and hobby groups help to reduce depressive symptoms in disaster survivors
- Physical activity helps to prevent depressive symptoms in older disaster survivors
- Community-level social capital mitigates progression of cognitive disability after a disaster
- Depressive symptoms and higher mortality on the day of the disaster
- Individual-level social ties mitigate post-earthquake progression of cognitive disability
- Community social capital helps to preserve functional independence in older survivors
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- Access to medical care is key to preserving functional independence
- Residential relocation linked to increased obesity due to changed food environment
- Long-term effects of total destruction of one’s house on cardiometabolic risks
- Relocation to prefabricated housing disabled the risk of depression
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- Housing damage is associated with increased cognitive disability
- Increased risk of developing arthritis associated with displacement
- Risk of increased BMI due to relocation to temporary housing
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- 6-year followup study of the health impacts of residential relocation

**Published Papers**

- Papers on the effects of pre-earthquake factors on post-earthquake health
- Papers on the effects of this change in factors from before to after the earthquake on post-earthquake health
- Papers on the effects of post-earthquake factors on post-earthquake health
- Papers on the effects of factors on health more than 5.5 years after the earthquake

**Iwanuma Project**

- Iwanuma Project
- Published Papers
- 2021.6

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Optimists are more resilient after the earthquake

### Social support before the earthquake reduced the risk of developing depressive symptoms by 30%

Social support before the earthquake reduced the risk of developing depressive symptoms by 30%. Survivors who had all four types of social support (giving and receiving emotional and instrumental support) prior to the disaster experienced a lower risk of developing depressive symptoms than those who did not have such support, even after adjusting for demographic and disaster-damage-related variables. This result suggests that dispositional optimism is a resilience resource among survivors of a disaster.

Dispositional optimism - the general belief that good things will happen - is considered a key asset for the preservation of mental health after a traumatic life event. However, it has been hypothesized that in extreme situations such as major disasters where positive expectations cannot overcome the grim reality on the ground, being optimistic might be a disadvantage. Given et al. (2021) tested this research hypothesis, exploring whether higher pre-disaster dispositional optimism is associated with higher postdisaster symptoms (PTSD) and depressive symptoms among 1,743 individuals who experienced the 2011 Great East Japan Earthquake and tsunami. The results showed that higher pre-disaster dispositional optimism was associated with lower odds of developing depressive and PTSD symptoms 2.5 years after the earthquake. Further, high dispositional optimism buffered the adverse impact of housing damage on depressive symptoms, but not on PTSD symptoms. In contrast to the research hypothesis, the results also showed that dispositional optimism is a resilience resource among survivors of a disaster.

### Unexpected higher risk of PTSD among people who did not experience early life adversity

Post-traumatic stress disorder (PTSD) is a disorder where a person undergoes something intensely distressing, the memory of which stays with them, and they repeatedly relive it in a frightening manner. People who had not gone through adverse experiences during their childhood, such as losing a parent, were found to have significantly higher rates of PTSD in cases of damage to the earthquake than those who had a history of such experiences. Given et al. (2019) presented the results of such a study. In a 2013 survey of older adults in Iwate, Japan, 689 adults who were not exposed to the earthquake were recruited. Approximately 2.5 years after the disaster, the researchers found that 11.4% of respondents reported severe PTSD symptoms. In the spatial Durbin model, the risk of PTSD among those who had not experienced early life adversity was significantly higher than those who had. This finding suggests that pre-disaster dispositional optimism is an important factor in reducing the risk of PTSD.

### Post-traumatic stress disorder (PTSD) after the earthquake became more pronounced in those who did not experience adverse childhood experiences

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Clarifying human connections among public health nurses, external organizations, and disaster survivor groups


In October 2013, Hikichi et al. (2015) conducted group interviews with 22 public health nurses in Miyagi prefecture involved in health care activities for disaster survivors. We obtained the following suggestions about the effects of social capital in affected areas. Social capital before the earthquake facilitated mutual aid among survivors. They were able to share emergency food and drinks, and launched community groups to exchange information. One municipality in Miyagi prefecture established a meeting room to prevent suicide by improving social connections among citizens. In other municipalities, survivors relocated to disaster relief housing in communities to preserve their pre-disaster social networks. Although some survivors had few acquaintances in the temporary housing complex, they could make connections by participating in social events. We also found that combination of different types of social capital (bonding, bridging, and linking) could be more effective for the victims’ health and livelihood. For example, public health nurses could support victims effectively by collecting information about their personalities and chronic diseases from neighbors. They would thus be able to conduct health care activities in cooperation with victims (bonding social capital), by using social networks among victims (bridging social capital).

The relationship between methods of relocation and social ties

Social connections in communities significant for residents in the aftermath of major disasters. However, it is known that how residents relocated to housing destruction affects residents’ social capital. We examined changes in social capital among survivors of the 2011 Great East Japan Earthquake and tsunami. People who lost their homes were more likely to move to new locations to continue their current status or to re-establish their pre-disaster social networks. This suggests that preserving social capital in the context of disaster is important for the long-term recovery of communities.

7 Predictors of sleep problems in disaster survivors

People facing financial hardship after a disaster had up to 1.47 times higher risk of sleep disorders


Sleep disorders are one of the most common health problems for people affected by natural disasters. Sleep disorders are reported to be associated with the development of chronic diseases such as type 2 diabetes and cardiovascular disease, as well as psychiatric disorders. U.S. et al. (2018) analyzed data from the 2010 and 2013 LGAS surveys of older adults in the Tohoku area to find ways to alleviate sleep disturbances after the disaster. As of 2011, 46% of all respondents answered “experiencing insomnia symptoms.” 27% answered they had “poor sleep quality” and 25% reported “sleep medication use.” Of the damage caused by the earthquake, “financial hardship,” “damage to the house,” and “health care disruption” were found to predict sleep disturbances. It was also found that instrumental support (“having someone to look after you”) before the disaster was more conducive to alleviating sleep problems than emotional support (“having someone listened to your concerns and complaints.”) In the first study, to follow up on the actual state of sleep problems over a long period after a disaster. For older adults, the study showed that in addition to the usual support systems, post-disaster financial support, house repairs, and medical support may be helpful in maintaining longer-term health.

| Pre-diastrophic disaster support associated with reduced risks of having sleep problems |

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<thead>
<tr>
<th>Preventive Factors</th>
<th>Availability of social support before the disaster</th>
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<tbody>
<tr>
<td>Instrumental Support</td>
<td>Preventing sleep problems</td>
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<tr>
<td>Emotional Support</td>
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| Fig. 4. Relationship between earthquake experience / presence of social support before the disaster and sleep problems 3 years after the disaster |

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<th>(Male n = 1,542 female n = 2,005)</th>
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<td>Risk ratio (95% CI)</td>
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| Pre-disaster financial support and sleep problems 3 years after the disaster |

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Increased participation in exercise and hobby groups help to reduce depressive symptoms in disaster survivors

We examined the association between changes in participation in civic associations and depressive symptoms among older survivors of the 2011 Great East Japan Earthquake. Participants were drawn from the Iwanuma Long-Term Observation of Older Adults (Iwagen) study. We analyzed data from 2,762 older adults aged 65 years and older, using the Japanese version of the Geriatric Depression Scale (GDS). The study included a control group of 3,567 adults aged 65 years and older from Okinawa. We assessed pre-disaster and post-disaster participation in civic associations and depressive symptoms using the GDS. Depressive symptoms were assessed using a 15-item GDS (0–15) as a continuous variable. Risk of depression was estimated using logistic regression analysis. We adjusted for age, sex, marital status, living status, income, physical health status, mental health status, and employment status. The results showed that increased participation in civic associations was associated with reduced depressive symptoms, with an adjusted standardized partial regression coefficient of -0.002 (P = 0.01). The association was significant for both the pre-disaster and post-disaster periods. Increased participation in civic associations was inversely associated with changes in GDS scores (B = -0.002, Cohen's f² = 0.10, P = 0.01 and B = -0.002, Cohen's f² = 0.12, P = 0.05, respectively). The association did not differ depending on the experience of housing damage caused by the disaster. In contrast, we did not observe a significant association between changes in participation frequency for volunteer groups or civic recreation clubs and changes in GDS scores after multiple adjustment for confounders. Depressive symptoms of older adult post-disaster may be mitigated through increased frequency of participation in sport and hobby groups, though civic participation did not mitigate the adverse impact of disaster experiences on mental health.

Physical activity helps to prevent depressive symptoms in older disaster survivors

We examined prospectively the association between physical activity and depressive symptoms in older survivors of the 2011 Great East Japan Earthquake. Participants were drawn from the Iwanuma Long-Term Observation of Older Adults (Iwagen) study. We analyzed data from 2,762 older adults aged 65 years and older, using the Japanese version of the Geriatric Depression Scale (GDS). The study included a control group of 3,567 adults aged 65 years and older from Okinawa. We assessed pre-disaster and post-disaster participation in civic associations and depressive symptoms using the GDS. Depressive symptoms were assessed using a 15-item GDS (0–15) as a continuous variable. Risk of depression was estimated using logistic regression analysis. We adjusted for age, sex, marital status, living status, income, physical health status, mental health status, and employment status. The results showed that increased participation in civic associations was associated with reduced depressive symptoms, with an adjusted standardized partial regression coefficient of -0.002 (P = 0.01). The association was significant for both the pre-disaster and post-disaster periods. Increased participation in civic associations was inversely associated with changes in GDS scores (B = -0.002, Cohen's f² = 0.10, P = 0.01 and B = -0.002, Cohen's f² = 0.12, P = 0.05, respectively). The association did not differ depending on the experience of housing damage caused by the disaster. In contrast, we did not observe a significant association between changes in participation frequency for volunteer groups or civic recreation clubs and changes in GDS scores after multiple adjustment for confounders. Depressive symptoms of older adult post-disaster may be mitigated through increased frequency of participation in sport and hobby groups, though civic participation did not mitigate the adverse impact of disaster experiences on mental health.

Mortality risk during disaster is four times higher for those with depressive symptoms. Post-disaster mortality risk reduced by about half through interaction with friends.

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Depressive symptoms and higher mortality on the day of the disaster.

The coastal area of Musashi-ku City was hit by a massive tsunami on March 11th 2011. Fukushima Prefecture, Japan. The tsunami caused significant damage to property and infrastructure. The area was hit by a 9.0 magnitude earthquake that triggered a tsunami, which caused significant damage to the area. The tsunami wave reached a height of 20 meters in some areas, causing widespread destruction and loss of life. The tsunami also caused significant damage to infrastructure, including roads, bridges, and buildings. The area was hit by a 9.0 magnitude earthquake that triggered a tsunami, which caused significant damage to the area. The tsunami wave reached a height of 20 meters in some areas, causing widespread destruction and loss of life. The tsunami also caused significant damage to infrastructure, including roads, bridges, and buildings.

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In this natural experiment, the baseline for our study was established 7 months before the 2011 Great East Japan Earthquake and Tsunami in a survey of older community-dwelling adults who lived 80 km north of the epicenter (94% response rate). About 2 and a half years after the disaster, which occurred on March 11, 2011, the follow-up survey collected information about personal experiences of disaster as well as incidence of cognitive disability. Our primary outcome was cognitive disability (presumed on a 0-9 level scale) assessed by in-home assessment. We obtained 2026 respondents at the baseline survey (94.6% response rate) and conducted 2344 survivors in the follow-up survey (62.1% follow-up rate). The experience of housing damage was associated with risk of cognitive impairment (coefficient $-0.05$ [95% CI $-0.03$ to $-0.07$]). Factor analysis of our analytical sample (n=3566) established two subscales of social capital: a cognitive dimension (perceptions of community social cohesion) and a structural dimension (informal socialising and social participation). Fixed effects regression indicated that improved informal socialising and social participation mitigated the risk of cognitive decline due to housing damage (coefficient $-0.04$ [95% CI $-0.04$ to $-0.05$]) and decreasing informal socialising and social participation aggravated the effect of housing damage on cognitive decline (coefficient $0.04$ [95% CI $0.03$ to $0.05$]). Improved informal socialising and social participation mitigated the risk of cognitive decline due to housing damage in the aftermath of natural disasters. Interventions to promote community participation should be tried to prevent cognitive regression of older survivors.

Individual-level social ties mitigate post-earthquake progression of cognitive disability

Social ties mitigate the progression of dementia due to a disaster

In areas with high social participation, the negative health impact of housing damage was reduced

Community social capital helps to preserve functional independence in older survivors

In densely populated areas, the negative health impact of housing damage was reduced

Increasing levels of symptoms of dementia depending on the severity of damage to housing

This review paper examines whether community-level social capital is associated with the ability to maintain functional capacity among older Iwanuma City residents. 2.5 years after the 2011 Great East Japan Earthquake and Tsunami, functional capacity was measured by the Instrumental Activities of Daily Living scale, evaluating the survivors’ ability to use public transportation, shop for daily necessities, prepare meals, pay bills, and manage deposits and withdrawals at a bank or post office independently. Three subscales of community-level social capital were measured: social cohesion, social participation, and reciprocity. The results showed that community-level social capital was associated with a lower risk of functional decline after disaster exposure. The average level of social participation in the community also mitigated the adverse impact of housing damage on functional status, suggesting a buffering mechanism.

Review article: Disaster resilience in older populations

Recovery after major disaster poses a unique set of challenges for the older population, including disruption of medical care for pre-existing conditions, functional limitations that impair recovery and social isolation following involuntary resettlement. In this review, we summarise the lessons about disaster resilience that have been learned (so far) from a unique ongoing field study based in a community that was affected by the 2011 earthquake and tsunami. In the Iwanuma Study, baseline information about the health status and living conditions of older residents was collected seven months before the disaster. Follow-up surveys were conducted 2.5 years after the disaster, allowing us to investigate the risk and protective factors in a range of disaster-related health sequelae, including mental illness and cognitive disability. A compelling finding from these studies is the critical role of social connections (the “social capital” of a community) in protecting the deteriorating adverse effects of psychological trauma and mental health deterioration following the disaster. In contrast to the emphasis on investing in material infrastructure to prepare for disasters, a review of our studies suggests that repairing (or at least preserving) the social fabric of people’s lives is a crucial ingredient in disaster resilience.

Positive effects on mental health of group relocation into temporary housing

Survivors who underwent group allocation to temporary housing were significantly more likely to report receiving social support than those who underwent lottery allocation

In this natural experiment, the baseline for our study was established 7 months before the 2011 Great East Japan Earthquake and Tsunami in a survey of older community-dwelling adults who lived 80 km north of the epicenter (94% response rate). About 2 and a half years after the disaster, which occurred on March 11, 2011, the follow-up survey collected information about personal experiences of disaster as well as incidence of cognitive disability. Our primary outcome was cognitive disability (presumed on a 0-9 level scale) assessed by in-home assessment. We obtained 2026 respondents at the baseline survey (94.6% response rate) and conducted 2344 survivors in the follow-up survey (62.1% follow-up rate). The experience of housing damage was associated with risk of cognitive impairment (coefficient $-0.05$ [95% CI $-0.03$ to $-0.07$]). Factor analysis of our analytical sample (n=3566) established two subscales of social capital: a cognitive dimension (perceptions of community social cohesion) and a structural dimension (informal socialising and social participation). Fixed effects regression indicated that improved informal socialising and social participation mitigated the risk of cognitive decline due to housing damage (coefficient $-0.04$ [95% CI $-0.04$ to $-0.05$]) and decreasing informal socialising and social participation aggravated the effect of housing damage on cognitive decline (coefficient $0.04$ [95% CI $0.03$ to $0.05$]). Improved informal socialising and social participation mitigated the risk of cognitive decline due to housing damage in the aftermath of natural disasters. Interventions to promote community participation should be tried to prevent cognitive regression of older survivors.

The victims of the Great East Japan Earthquake and Tsunami have been forced to live in temporary housing, by two different methods of resettlement: group allocation that preserved pre-existing local social ties and lottery allocation. Koyama et al. (2017) examined the effects of various factors, including the resettlement methods and social support, on mental health. Survivors who underwent group allocation to temporary housing (and thus lived in proximity to people who were their neighbors before the disaster) were significantly more likely to report receiving social support than those who underwent lottery allocation. Moreover, respondents who were receiving social support showed significantly lower psychological distress, although the resettlement approach was not significantly associated with distress.

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16 Socializing with neighbors post-earthquake reduces depressive symptoms

Pre- and Post- Earthquake

Relationship between changes in neighborhood relationships and the degree of severity of depressive symptoms

<table>
<thead>
<tr>
<th>Pre-disaster</th>
<th>Post-disaster</th>
<th>Severity of Depressive Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No change</td>
</tr>
<tr>
<td>Yes (n=257)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>No (n=230)</td>
<td>No</td>
<td>No change</td>
</tr>
</tbody>
</table>

Note: Adjusted for changes in age, gender, medical treatment, living alone, social participation, smoking habits, drinking habits, subjective economic status, and walking habits before and after the earthquake, as well as for the effects of relocation and losing loved ones.

* Indicates that there was a statistically significant association.

A study by Sasaki et al. (2020) found that older adults who increased neighborhood ties after the disaster were less likely to suffer from depressive symptoms. An analysis of data from a sample of 1,111 older adults in Iwanuma in 2010 and 2013 showed that those who increased neighborhood ties after the earthquake had 39% fewer cases of severe depressive symptoms after the earthquake than those who had neighborhood ties before and after the earthquake. Increased neighborhood ties may have played a stabilizing role in the mental health of the older survivors affected by the disaster.

17 Relocation affects social relationships in areas receiving displaced survivors

Pre- and Post- Earthquake

Changes in community relations (trust) among nonrelocated Iwanuma City residents

<table>
<thead>
<tr>
<th>Pre-disaster</th>
<th>Post-disaster</th>
<th>Change in Trust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No change</td>
</tr>
<tr>
<td>Yes (n=257)</td>
<td>No</td>
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Trust is a core component of social cohesion, facilitating cooperation and collective action in the face of adversity and enabling survivors to remain resilient. Residential stability is an important prerequisite for social interactions, and displacement can lead to a weakening of social ties. As such, the study by Sasaki et al. (2020) suggests that relocation can have a significant impact on mental health outcomes, particularly in the context of natural disasters.

18 Worsening financial status increases risk of tooth loss after disaster

Pre- and Post- Earthquake

People severely affected by the earthquake were more likely to lose their teeth

<table>
<thead>
<tr>
<th>Pre-disaster</th>
<th>Post-disaster</th>
<th>Tooth Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No change</td>
</tr>
<tr>
<td>Yes (n=2,195)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>No (n=2,706)</td>
<td>No</td>
<td>No change</td>
</tr>
</tbody>
</table>

A study by Matayoshi et al. (2017) found older people who were severely affected by the earthquake were more likely to lose their teeth. Housing damage and worsening economic conditions due to the disaster were the risk factors. The study analyzed pre- and post-disaster data (2010 and 2013, N = 3,389) and showed that 6.9% of the study participants lost one or more teeth after the disaster. Additionally, changes in subjective economic conditions and housing damage in the month after the earthquake were associated with tooth loss. After statistically adjusting for the effects of education, income, pre-disaster health status, post-disaster mental stress, and loss of loved ones, subjective economic deterioration and housing damage due to the disaster were significantly associated with 8.1% and 1.7% increases in the probability of tooth loss, respectively. Disaster survivors were more likely to have poor oral health. Measures to support oral hygiene, such as distributing toothbrushes and having space for brushing teeth in evacuation centers, are required.

19 Decreased social capital does not explain post-disaster increased depressive symptoms

Pre- and Post- Earthquake

Decrease in social support and social capital after the disaster does not explain the increase in depressive symptoms among disaster survivors

A Association between pre-disaster social capital and depressive symptoms in 2010

B Association between changes in social support/social capital and depressive symptoms after the disaster

Depressive symptoms are known to increase among survivors who have experienced trauma after a major disaster. Post-disaster decrease in social capital has been claimed to be a potential cause. However, Shiba et al. (2020) used follow-up data from approximately 3,500 survivors of the 2011 Great East Japan Earthquake and tsunami to investigate whether post-disaster changes in social capital mediated the association between disaster trauma and increased depressive symptoms using statistically rigorous methods. They found that social capital did not explain the trajectory of depressive symptoms.
A unique feature of our study was the availability of information about mental health status pre-dating the disaster. Our sample comprised community-dwelling survivors aged 65 and older, who responded to surveys in 2010 (i.e. one year before the disaster) and in 2013 (N = 3464). We categorized disaster exposure according to three types of experiences: loss of family/friends, property damage, and disruption in access to medical service. Our main outcome was change in depressive symptoms, measured by the 15-item geriatric depression scale (GDS). Among the participants, 973 (28.5%) reported losing a family member to the disaster, while a further 537 (15.5%) reported losing a friend. More than half of the participants reported some damage to their homes. After adjusting for demographics and baseline mental health, people whose homes were destroyed had significantly higher depression scores three years later (+1.22 points; 95% CI: 0.88, 1.44; p \(<\) 0.0001). Disruption of psychiatric care was also associated with change in GDS scores (+0.51 points; 95% CI: 0.27, 0.75; p \(<\) 0.001). Loss of family and property damage were associated with a significant increase in depressive symptoms (+0.51 points; 95% CI: 0.26, 0.75; p \(<\) 0.001) for those who lost friends. Three years after the disaster, the outcomes of the 2011 earthquake and tsunami appeared to have received from the loss of loved ones. By contrast, property loss and disruption of psychiatric care were associated with a persistent adverse impact on mental health.

Change in Geriatric Depression Scale (GDS)

Change in instrumental activities of daily living (IADL)

Access to medical care is key to preserving functional independence

Residential relocation linked to increased obesity due to changed food environment

Long-term effects of total destruction of one’s house on cardiometabolic risks
Many people were forced to relocate because they lost their homes due to the disaster. No previous research has examined mental and psychological problems of survivors using pre- and post-disaster data. The AESG analyzed data from a survey of 3,629 older adults in Iwate, Japan, conducted in 2010 before the earthquake and in 2011 after the earthquake. The study examined the association between relocation and the risk of developing depression symptoms after the disaster. The results showed no difference in the risk of developing depression symptoms between those who did not relocate and those who relocated to temporary private housing or newly established housing. However, the risk of developing depressive symptoms after the disaster doubled for those who moved to prefabricated housing. It suggests that older adults moving to prefabricated housing may be at risk to the development of depressive symptoms.

To assess whether post-disaster depressive and PTSD were associated with mortality in older disaster survivors, this cohort study was conducted. Prospective data were retrieved from older Japanese adults in Iwate City, Miyagi Prefecture, which was directly affected by the 2011 Great East Japan Earthquake and tsunami. The baseline for this natural experiment was established in a survey of older community-dwelling adults who lived within 80 km west of the epicenter 7 months before the earthquake and tsunami. Approximately 2.5 years after the disaster, the follow-up survey collected information about personal experiences of living alone, losing close loved ones due to the earthquake, and damage to the house. The analysis included 2,242 people who did not have depression symptoms at the time of the 2010 survey.

Increased risk of developing arthritis associated with disaster trauma

The results show the importance of identifying and treating people with arthritis in the initial stages after a disaster. It has been reported that the health effects of the disaster are long-term and wide-ranging. However, no study has examined whether experiences of a disaster were associated with cognitive decline in the aftermath of the 2011 Great East Japan Earthquake and tsunami. The baseline for our natural experiment was established in a survey of older community-dwelling adults who lived 80 km west of the epicenter 7 months before the earthquake and tsunami. Approximately 2.5 years after the disaster, the follow-up survey collected information about personal experiences of living alone, losing close loved ones due to the earthquake, and damage to the house. The analysis included 2,242 people who did not have depression symptoms at the time of the 2010 survey. No previous study has been able to examine the association by taking account of risk factors for dementia before and after the disaster. We prospectively examined whether experiences of a disaster were associated with cognitive decline in the aftermath of the 2011 Great East Japan Earthquake and tsunami. No significant difference was established in a survey of older community-dwelling adults who lived within 80 km west of the epicenter 7 months before the earthquake and tsunami. Approximately 2.5 years after the disaster, the follow-up survey collected information about personal experiences of living alone, losing close loved ones due to the earthquake, and damage to the house. The analysis included 2,242 people who did not have depression symptoms at the time of the 2010 survey. No previous study has been able to examine the association by taking account of risk factors for dementia before and after the disaster. We prospectively examined whether experiences of a disaster were associated with cognitive decline in the aftermath of the 2011 Great East Japan Earthquake and tsunami. No significant difference was established in a survey of older community-dwelling adults who lived within 80 km west of the epicenter 7 months before the earthquake and tsunami. Approximately 2.5 years after the disaster, the follow-up survey collected information about personal experiences of living alone, losing close loved ones due to the earthquake, and damage to the house. The analysis included 2,242 people who did not have depression symptoms at the time of the 2010 survey.

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After the Great East Japan Earthquake in 2011, there was an increased risk of mental illness in people who experienced property damage; however, the underlying mechanism was unclear. Shibutani et al. (2020) analyzed pre- and post-disaster (2010 and 2013) data from approximately 1,165 older survivors aged 65 years and over affected by the Great East Japan Earthquake and demonstrated that 72.6% of the effect on worsening BMI was mediated by property damage and relocation to temporary housing. Potential explanations include changes in the neighborhood environment, such as the proximity to restaurants or the difficulty of cooking in the new living environment; however, further research is needed to determine if there is a link between moving to temporary housing and increased BMI.

Empirical evidence on the relationship between property damage/relocation to temporary housing and increased BMI

<table>
<thead>
<tr>
<th>Changes from 2010 to 2013</th>
<th>Total effects</th>
<th>Effects explained by moving to temporary housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m²)</td>
<td>0.47 (72.6%)</td>
<td>0.14 (15.1%)</td>
</tr>
<tr>
<td>LDL cholesterol (mg/dL)</td>
<td>0.12*</td>
<td></td>
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<tr>
<td>USL (m²/decade)</td>
<td>0.23 (100%)</td>
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</tbody>
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We previously established that housing loss and residential dislocation in the 2011 Japan earthquake and tsunami was a risk factor for cognitive decline among older survivors. The present study extends the follow-up of survivors to six years. The baseline for our natural experiment was established in a survey of older community-dwelling adults who lived 80 km west of the epicenter seven months before the earthquake and tsunami. The experience of housing loss continued to be significantly associated with cognitive disability even six years after the disaster. The follow-up of survivors to six years. The baseline for our natural experiment was established in a survey of older community-dwelling adults who lived 80 km west of the epicenter seven months before the earthquake and tsunami. The experience of housing loss continued to be significantly associated with cognitive disability even six years after the disaster. Experiences of housing loss were persistently associated with cognitive disability (coefficient = 0.14, 95% confidence interval: 0.04 to 0.23). Experiences of housing loss were persistently associated with cognitive disability (coefficient = 0.14, 95% confidence interval: 0.04 to 0.23).

Regression Coefficient

<table>
<thead>
<tr>
<th>Risk of increased BMI due to relocation to temporary housing</th>
<th>Post-earthquake</th>
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<tbody>
<tr>
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</tbody>
</table>

Severe emotional trauma, such as the loss of a relative or damage to one’s home in a disaster, are tied to post-traumatic stress symptoms (PTSS), such as sudden flashes of past memories, and others. Kino et al. (2019) analyzed the mental health of older adults in Iwanuma City in 2013, 2016, and 2016 to examine the long-term effects of the disaster on mental health. 13.6% of people who had no depressive symptoms before the disaster had depressive symptoms in 2013. By 2016, 50% of them had recovered. In contrast, the number of people with PTSS was 11% of the total as of 2013. As of 2016, 40% had recovered, while 40% still had PTSS.

<table>
<thead>
<tr>
<th>Long-term trends in mental health after disaster</th>
<th>2013</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression (n=101)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>No Depression (n=1,063)</td>
<td>100%</td>
<td>90%</td>
</tr>
<tr>
<td>Transition of depression symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent symptoms (n = 490)</td>
<td>23.3%</td>
<td>11.2%</td>
</tr>
<tr>
<td>Delayed onset (n = 111)</td>
<td>5.8%</td>
<td>5.8%</td>
</tr>
<tr>
<td>No Depression (n=1,063)</td>
<td>100%</td>
<td>90%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression (n=63)</td>
<td>0%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>No Depression (n=168)</td>
<td>100%</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>Transition of depression symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>90%</td>
<td>95%</td>
</tr>
</tbody>
</table>

We previously established that housing loss and residential dislocation in the 2011 Japan earthquake and tsunami was a risk factor for cognitive decline among older survivors. The present study extends the follow-up of survivors to six years. The baseline for our natural experiment was established in a survey of older community-dwelling adults who lived 80 km west of the epicenter seven months before the earthquake and tsunami. The experience of housing loss continued to be significantly associated with cognitive disability even six years after the disaster.

<table>
<thead>
<tr>
<th>Long-term Impact</th>
<th>2013</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression (n=101)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>No Depression (n=1,063)</td>
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<td>No Depression (n=1,063)</td>
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<td>90%</td>
</tr>
</tbody>
</table>
### 31 Relocation linked with increased cardiometabolic risks

**Correlation between neighborhood environment and lifestyle-related diseases**

**Unadjusted bias**
- Whole
- Displaced
- Non-Displaced

**Bias adjustment**
- Whole: 2.50 (1.21, 4.60)
- Displaced: 3.00 (1.21, 7.02)
- Non-Displaced: 2.00 (1.21, 3.37)

Some people who lost their homes to the tsunami in the coastal areas of Iwami were first displaced to temporary housing and then moved to public or private permanent housing approximately 6 to 9 months after the tsunami. The people who lost their homes to the tsunami had a significantly increased risk of developing cardiometabolic problems. In non-displaced people, the risk increased by 1.8 cm; LDL cholesterol increased, and there was a decrease in HDL cholesterol. BMI increased only in females. Thus, the effects of efforts to maintain the health of survivors, such as promoting physical activities, may be cancelled out by the adverse effect of environmental changes associated with relocation.

**Unemployment and deterioration of financial status due to the earthquake affect persistent and delayed onset PTSS**

Kino et al. (2021) explored a lingering influence of persistence or delayed onset mental health problems after 5.5 years. They found that job loss was associated with persistent post traumatic stress symptoms (PTSS) while a drop in subjective economic status predicted delayed onset of PTSS. In addition, depressive symptoms pre-dating the disaster was a strong predictor of persistent and delayed onset PTSS. Bouncing back in economic situations due to the disaster rather than the uncontrollable disaster experience itself affects post-traumatic symptoms, suggesting that chronic mental health problems after the disaster would be addressable by economic support.

### 32 Long-term relationship between a traumatic experience and health

**The long-term health impacts of an earthquake may have been underestimated**

**Analysis Method**
- Unadjusted bias
- Bias adjustment method 1
- Bias adjustment method 2
- Bias adjustment method 3

**Risk ratio (95% confidence interval)**
- Unadjusted bias: 1.21 (0.85, 1.40)
- Bias adjustment method 1: 1.34 (0.96, 1.84)
- Bias adjustment method 2: 1.21 (0.70, 1.64)
- Bias adjustment method 3: 2.00 (1.21, 3.37)

The people who lost their homes had a twofold higher risk of depressive symptoms in 2016 compared to those who maintained their homes. The risk of developing cardiometabolic problems was also significantly increased in people who maintained their homes. Several studies reported that trauma causes long-term negative effects on health, but these effects are often underestimated.

### 33 Predictors of persistent mental health problems 6 years after disaster

**Unemployment and deterioration of financial status due to the earthquake affect persistent and delayed onset PTSS**

Few studies have tracked the long-term mental health outcomes following major disasters. Therefore, they sought to document the trajectories of depressive symptoms and PTSS in the aftermath of the 2011 Great East Japan earthquake and tsunami. Among people without pre-disaster depressive symptoms, 3.5% had developed depressive symptoms 5.5 years after the disaster. Of these, half of those who had lost their homes over the 5.5-year follow-up had a history of unemployment and a drop in subjective economic status, and one in four had developed depressive symptoms pre-dating the disaster. In addition, depressive symptoms pre-dating the disaster were a strong predictor of persistent and delayed onset PTSS. Bouncing back in economic situations due to the disaster rather than the uncontrollable disaster experience itself affects post-traumatic symptoms, suggesting that chronic mental health problems after the disaster would be addressable by economic support.

**Risk of symptoms persisting**
- Persistent
- Recovered

**Risk of symptom development**
- Delayed
- Never
Studies examining the long-term health consequences of residential displacement following large-scale disasters remain sparse. Following the 2011 Japan Earthquake and Tsunami, victims who lost their homes were resettled by two primary means: 1) group relocation to public housing or 2) individual relocation, in which victims moved into public housing by lottery or arranged for their own accommodation. Little is known about how the specific method of residential relocation affects survivors’ health. We examined the association between residential relocation and long-term changes in mental and physical well-being. Our baseline assessment predated the disaster by 7 months. Two follow-up surveys were conducted approximately 2.5 and 5.5 years after the disaster to ascertain the long-term association between housing arrangement and health status. Group relocation was associated with increased body mass index and depressive symptoms at 2.5-year follow-up but was no longer significantly associated with these outcomes at 5.5-year follow-up. Individual relocation at each follow-up survey was associated with lower instrumental activities of daily living as well as a higher risk of cognitive impairment. Our findings underscore the potential complexity of long-term outcomes associated with residential displacement, indicating both positive and negative impacts on mental versus physical dimensions of health.

**Long-term Impact**

Group relocation to disaster relief housing increases the risk of obesity and depression

<table>
<thead>
<tr>
<th>Housing Arrangement</th>
<th>Depression</th>
<th>Body Mass Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relocating to disaster relief housing</td>
<td>1.50*</td>
<td>0.79*</td>
</tr>
<tr>
<td>Relocating to permanent housing</td>
<td>0.10</td>
<td>0.19</td>
</tr>
</tbody>
</table>

**Development of disaster preparedness "visualization" system**

JAGES built a “visualization” system for regional analysis using health and lifestyle survey data. The name of the system is "Community-based Management Support System (JAGES HEART)." It performs visualizations like those given below:

- Which regions are vulnerable to disasters?
- Participants in disaster and emergency drills (%)
- Comparison between primary school districts and municipalities

**JAGES HEART 2019**

The Iwanuma Project compared data obtained before the disaster with that obtained afterwards to gain several insights and to answer the question of how much the reduction of social capital due to a major natural disaster affects peoples’ health.

**Conclusions of Iwanuma Project 2021.6**

The Iwanuma Project compared data obtained before the disaster with that obtained afterwards to gain several insights and to answer the question of how much the reduction of social capital due to a major natural disaster affects peoples’ health.
Implications of the Iwanuma Project

-Steps to maintain social connections-

Pre- and post-disaster factors that increase the risk of health deterioration after a disaster:

**Risk factors that aggravated health after the earthquake**

<table>
<thead>
<tr>
<th>Factors before the earthquake</th>
<th>Pre-disaster (Preparedness stage) Factors for disaster mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from coastline (mortality risk on day of disaster)</td>
<td></td>
</tr>
<tr>
<td>Severe depression before the earthquake (mortality risk on the day of the earthquake)</td>
<td></td>
</tr>
<tr>
<td>Dependence on others before the earthquake (mortality risk from the day after the earthquake)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors after the earthquake</th>
<th>Post-disaster Factors for disaster mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to the house (depression, PTSD, loss of teeth, loss of independence, risk of dementia)</td>
<td></td>
</tr>
<tr>
<td>Loss of loved ones (PTSD)</td>
<td></td>
</tr>
<tr>
<td>Facing the disaster without having experienced adversity (PTSD)</td>
<td></td>
</tr>
<tr>
<td>Loss of loved ones</td>
<td></td>
</tr>
<tr>
<td>Declining economic conditions (loss of teeth)</td>
<td></td>
</tr>
<tr>
<td>Difficulty in seeking medical attention immediately after the disaster (depression, declining degree of independence)</td>
<td></td>
</tr>
<tr>
<td>Relocation to temporary housing (depression)</td>
<td></td>
</tr>
</tbody>
</table>

Method of relocation to temporary housing post-disaster affects health

Longitudinal panel data for post-disaster relocation of socially connected groups 2010–2013

1 Social ties increase with group relocation

2 Lottery (compared to group) allocation was associated with less providing/receiving social support.

We found numerous links between areas with rich social capital (connections between people) and better health pre- and post-disaster. It suggests that increasing social capital before a disaster can lead to disaster mitigation.

The higher the pre- and post-disaster social capital, the lower the health risk after a disaster.

- Developing social capital in daily life in preparation for earthquakes and disasters
- Taking measures such as group relocation to maintain social capital after the disaster
The higher the social capital, the higher the resilience to disaster

- Developing social capital in daily life in preparation for earthquakes and disasters.
- Taking measures, such as group relocation, to maintain social capital after the disaster.

**Three types of Social Capital**

- **Bonding Type**
  - Refers to the bond between people who have something in common. While strong bonds are created inside groups, there is also an aspect of exclusivity.

- **Bridging Type**
  - Bonding type refers to ties within the same area, whereas the bridging type refers to looser ties with the outside world. Connecting with the external world provides added information and resources.

- **Linking Type**
  - The link between the general public and authority represented by the administration. It is the relationship of trust that exists between people who cross the boundaries of social power and authority.

**External Connections**

Social capital can be strengthened by allowing people from different regions to interact, instead of staying within one region.

**Exercise and Hobbies**

Social capital can be improved among local residents through exercise and hobby group activities, festivals, and other events in which participation can occur.

**Temporary Housing**

Group relocation to temporary housing after an earthquake is more likely to bring people closer together and has less impact on health when compared to individual relocation by lottery.

**Public Space**

It is possible to provide public spaces that are accessible to a wider range of local residents by focusing on places where people are likely to congregate, such as town halls, community centers, schools, and parks.

**Places for Experience**

In addition to creating places, it is important to offer a variety of events, experiences, and activity programs in parks and sports facilities.

**Neighborhood Environment**

The study demonstrated that a neighborhood environment in which local residents can go out, exercise, communicate, and shop on a daily basis has a positive impact on health.