

Lessons learned from psychosocial support and mental health surveys during the 10 years since the Great East Japan Earthquake: Establishing evidence-based disaster psychiatry

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Post-disaster mental health and psychosocial support have drawn attention in Japan after the 1995 Great Hanshin-Awaji Earthquake, with mental health care centers for the affected communities being organized. After the catastrophe, a reconstruction budget was allocated to organize mental health care centers to provide psychosocial support for communities affected by the 2007 Chūetsu offshore earthquake, the 2011 Great East Japan Earthquake, and the 2016 Kumamoto Earthquake. There were several major improvements in post-disaster mental health measures after the Great East Japan Earthquake. The Disaster Psychiatric Assistance Team system was organized after the earthquake to orchestrate disaster response related to the psychiatric health system and mental health of the affected communities. Special mental health care efforts were drawn to the communities affected by the nuclear power plant accident through Chemical, Biological, Radiological, Nuclear, and

high yield Explosives, being succeeded by measures against the coronavirus pandemic. As another new movement after the Great East Japan Earthquake, the number of surveys involving communities affected by disasters has soared. More than 10 times the number of scientific publications were made in English during the decade following the Great East Japan Earthquake, compared with the previous decades. In this review, we examined the results and issues acquired in the 10 years since the Great East Japan Earthquake, proposing evidence-based disaster psychiatry as the direction of future mental health measures related to emergency preparedness and response.

Keywords: cohort studies, evidence-based disaster psychiatry, Great East Japan earthquake, mental health, psychosocial support.

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Japan is one of the most disaster-prone nations in the world, where various natural disasters such as earthquakes, tsunamis, volcanic eruptions, typhoons, floods, and snow damage can devastate any part of the land, depending on the location, topography, geology, and weather. In Japan, the records of great earthquakes and tsunamis have existed for a long time, but it was only after the 1995 Great Hanshin-Awaji Earthquake (GHAE) that the need for mental health care during or after a disaster was recognized.¹ After the GHAE, mental health care centers were organized to take care of the affected communities. Reflecting from the experiences of mental health countermeasures in response to the GHAE, a reconstruction budget was allocated to organize mental health care centers for providing psychosocial support to communities affected by the 2007 Chūetsu Offshore Earthquake,² the 2011 Great East Japan Earthquake (GEJE),³ and the 2016 Kumamoto Earthquake.

There have been several major improvements in post-disaster mental health measures after the GEJE. The Disaster Psychiatric Assistance Team (DPAT) system was organized after the GEJE to orchestrate disaster response related to the psychiatric health system and mental health of the affected communities. The DPAT functions by responding to the rapid increase in mental health needs in disaster-affected areas, by supporting psychiatric hospitals, identifying local psychiatric needs, as well as collaborating with the Disaster Medical Assistance Team (DMAT), other teams, and local psychiatric facilities to provide high-quality psychiatric medicine.^{4,5}

Moreover, special mental health care efforts have been provided to the affected communities, following the nuclear power plant accident as a CBRNE (chemical, biological, radiological, nuclear, and high-yield explosives) disaster. An unprecedented public health crisis can lead to greater social confusion and broader consequences for

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people’s daily lives compared to previous natural disasters, with a variety of mental health problems being observed over the long term. These experiences have been succeeded by measures established against the COVID-19 (coronavirus disease 2019) pandemic.^{6,7}

Following the GEJE, the number of surveys conducted on communities affected by disasters has soared. More than 10 times the number of scientific publications were made in English during the decade after the GEJE, compared with previous decades (Fig. 1). As the importance of mental health in the event of a disaster is widely recognized, it has become the foundation for the construction of disaster psychiatry as a systematic academic discipline. This review outlined the achievements and challenges found in the last 10 years since the GEJE, suggesting evidence-based disaster psychiatry as a direction for mental health measures to enhance emergency preparedness and response to an upcoming disaster.

Acute Phase Mental Health and Psychosocial Support After the GEJE

After experiencing the GHAE, the need for mental health services became widespread among specialists such as psychiatrists, especially when the GEJE occurred, with a large amount of support being provided immediately after the disaster.⁸ In the Iwate Prefecture, 29 mental care teams from inside and outside the area carried out their activities, and of a total of 9811 victims, 5533 cases were medically consulted and 2083 cases were prescribed. The Miyagi Prefecture accepted the dispatch of 33 teams, with the number of people consulted reaching 12 794. In the Fukushima Prefecture, the disaster control headquarters responded to the hospital transfer of the inpatients in the evacuation zone, while the Mental Health and Welfare Centre started a consultation call and began supporting evacuation shelters in cooperation with the Fukushima Medical University. Many teams from outside the prefecture also came to support, with 54 teams being active in the Soso area, where the Fukushima Daiichi Nuclear Power Plant (FDNPP) was located; 90 teams worked in total.

The GEJE was a disaster that had an unprecedented impact on psychiatric care systems. Although the damage to the psychiatric hospital in Iwate prefecture was slight, the Miyagi prefecture had three coastal hospitals flooded by the tsunami, causing 24 patients to die and 300 to be transferred to other hospitals. In the Fukushima prefecture, one hospital was damaged by the earthquake and another was flooded by the tsunami, resulting in the inpatients of these hospitals to evacuate and move within the same facility. Moreover, five hospitals located in the Soso area became inoperable due to the accident at the FDNPP following the tsunami, and over 700 inpatients were

forced to evacuate or transfer to another hospital, with the psychiatric medical care in this area being temporarily devastated.⁹ After that, two hospitals managed to resume operations, but two hospitals located within 20 km of the nuclear power plant were closed, and one hospital was forced to retire and downsize most of the staff by opening clinics outside the evacuation area. Even though many medical institutions did not suffer the above-mentioned severe damage, they had trouble with their basic resources such as water, telephone, and staff commuting, in addition to the unavailability of food, fuel, and medicines.

Advances in Mental Health Disaster Response After the GEJE

1 The Disaster Psychiatric Assistance Team (DPAT) system

When the GEJE occurred, many psychiatric medical workers were aware of the significance of disaster support through the experience of the GHAE, and the knowledge accumulated in the previous support activities was published in the form of guidelines and attitudes. However, these manuals were not recognized by the majority of mental health workers, with most of them not being trained for disaster response prior to its occurrence. In addition, at the time of the GEJE, there was no established systematic support system for psychiatric care and mental health support activities in the affected areas. With three psychiatric hospitals in the Miyagi prefecture being severely damaged by the tsunami, this fact was not apparent to the disaster response teams for several days, which caused delays in support, including the transfer of inpatients. Mental health support teams were not systematically organized; therefore, there were large differences in the number of teams allocated to the affected area and the extent of activities, with each team acting based on their own judgment without sharing plans and information with other teams working in other areas. Based on these experiences, the DPAT was organized (Fig. 2). The establishment of DPAT has made it possible to clarify the chain of command system, gather information, build a collaborative system within the framework of disaster medical support as a whole, and introduce pre-registration and training immediately after the disaster.⁵ Therefore, in the aftermath of the Kumamoto earthquake, results such as transporting patients from the disaster-affected psychiatric hospital relatively smoothly, were achieved. In the future, it is necessary for a wider range of mental health professionals to be effectively involved in disaster support in order to prepare for situations that require a large-scale, long-term support system, such as the Tokyo metropolitan

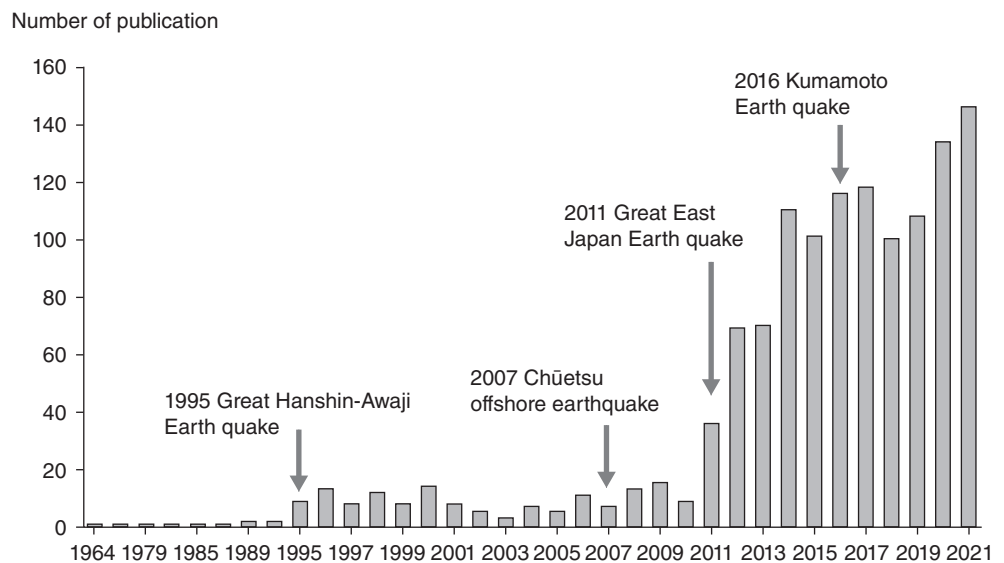


Fig. 1 Number of scientific publications on disasters in Japan written in English. We used PubMed to determine the number of scientific publications available regarding surveys of communities affected by disasters. The search date was 25 November 2021, and the search terms were “disaster AND (“mental” OR “psychological” OR “psychosocial” OR “psychiatric” OR “psychiatry” OR “depression” OR “depressive” OR “post-traumatic stress”) AND Japan.” There were 1265 articles published between 1964 and 2021.

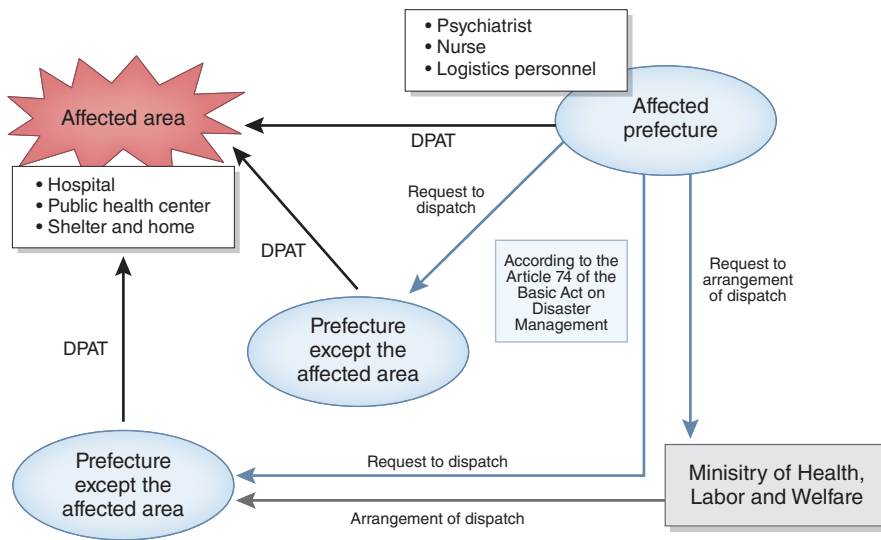


Fig. 2 Disaster Psychiatric Assistance Team (DPAT). The DPAT is a specialized team that goes into the affected area after a large-scale disaster, such as a natural disaster, to provide psychiatric care and support for mental health activities. Correction added on March 12, 2022, after first online publication: Figure 2 was corrected to reflect the new methodology utilized to calculate pyrolysis reaction energy.

area earthquake and the Nankai Trough earthquake; it is also necessary to share such a direction with the entire community.

2 Cohort studies and surveys assessing the impact of catastrophe on the mental health and psychosocial aspects of affected communities. As another new movement after the GEJE, various mental health surveys were conducted in three affected Tohoku prefectures (Miyagi, Iwate, and Fukushima prefectures) (Fig. 3), as summarized in Table 1, and the number of surveys for communities affected by disasters has since soared. More than 10 times the number of scientific publications were made in English during the decade after the GEJE, compared with the previous decades (Fig. 1).

(2)-1. Cohort studies in Yamada Town, Otsuchi Town, and Rikuzentakata City, Iwate prefecture

The Iwate Medical University School of Medicine organized cohort studies of people living in a tsunami-stricken area in Yamada Town, Otsuchi Town, and Rikuzentakata City, Iwate Prefecture. They reported the mental health problems prevalent among survivors of the GEJE, pointing out health complaints, severe economic status, relocations, and lack of social networks as important risk factors for poor mental health.¹⁰ They linked mental health conditions with risks of cardiovascular disorders,¹¹ obesity,¹² and frailty.¹³ Importantly, the researchers reported that non-responders in the follow-up survey had a higher risk of psychological distress than responders, indicating the importance of continuous health monitoring for both non-responders and responders to prevent future health deterioration.¹⁴

(2)-2. Tohoku Medical Megabank Cohort Study conducted in Iwate and Miyagi Prefectures

The Tohoku Medical Megabank Project (TMM) aims to facilitate the recovery of residents' health and health systems in the communities devastated by the GEJE, and establish a new era of personalized prevention and medicine. Tohoku University Medical Megabank Organization (ToMMo) and Iwate Medical University Iwate Tohoku Medical Megabank Organization were founded in 2012, initiating a Community-Based Cohort Study consisting of over 50 000 residents in Miyagi prefecture, and over 30 000 residents in Iwate prefecture. In addition, "Birth and Three-Generation Cohort Study," which consists of over 70 000 subjects, including over 20 000 newborn babies and their parents and grandparents, was launched in Miyagi prefecture (the cohorts comprised over 150 000 subjects in total).^{15,16,17,18} Baseline descriptive statistics indicated that coastal residents were more likely to have higher degrees of psychological distress than the inland residents, regardless of sex. The age-adjusted rates in men with a certain level of psychological distress ranged from

3.2% to 4.8% and 4.4% to 6.6% in the inland and coastal areas, respectively, and those in women ranged from 3.1% to 7.4% and 5.4% to 7.5% in inland and coastal areas, respectively. Mental health follow-up was provided when the participants showed a high risk of depression or posttraumatic stress response.¹⁶ The data suggested that a combination of social isolation and severe house damage, alongside the death of family members, was associated with a higher risk of depressive symptoms, although the interaction was not statistically significant.¹⁹ In addition to the above cohorts, ToMMo conducted a cross-sectional study from 2012 to 2015 to investigate and address the health needs of school children affected by this disaster, providing follow-up support to the cases in need.²⁰ The study found factors associated with children's health in post-disaster settings, for example, a significant association between the severity of eczema and mental health problems.²¹

(2)-3. Cohort studies in Kesennuma City, Miyagi Prefecture

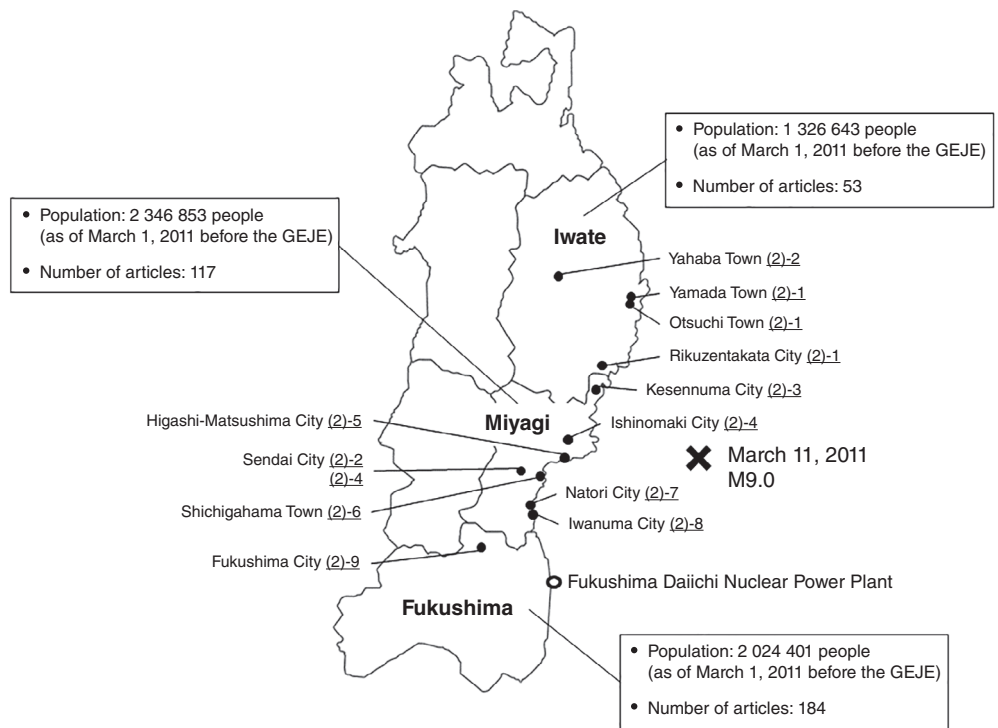
In Kesennuma, the Tohoku University Institute of Development, Aging, and Cancer conducted a survey of older adults who were forced to reside in temporary apartments. The study showed that older adults living in temporary apartments were at a high risk of cognitive impairment, and were recommended out-of-home activities and walking to maintain stability in their cognitive functions.²² The Department of Geriatric Behavioral Neurology of Tohoku University Graduate School of Medicine independently surveyed dementia residents in a group home.²³

(2)-4. Cohort studies in Ishinomaki City, Miyagi Prefecture

The Health and Life Revival Council in Ishinomaki District conducted cross-sectional household surveys, highlighting the importance of economic factors for the affected communities and emotional support, especially for the elderly disaster victims.^{24,25} The National Center for Global Health and Medicine conducted city-wide longitudinal surveys of kindergarten, elementary school, and junior high school children, observing the recovery course of traumatic symptoms.²⁶⁻³¹

The Department of Health Informatics and Public Health, Tohoku University School of Public Health, conducted longitudinal surveys of the residential registry for Ajishima, Ogatsu, Oshika, and Ishinomaki City, as well as residents who were living in prefabricated temporary housing in Wakabayashi-ku, Sendai City, and Miyagi Prefecture. The study indicated that psychological distress was associated with an increased risk of musculoskeletal pain among survivors³² and functional disability among elderly survivors of a natural disaster.^{33,34} The findings showed that the social environment of prefabricated temporary housing and public reconstruction housing were important modulating factors of mental health conditions,³⁵⁻³⁷ highlighting the

Fig. 3 Three Tohoku prefectures in which cohort studies regarding GEJE were conducted. The population before the GEJE and the number of scientific publications on GEJE in Japan written in English in Miyagi, Iwate, and Fukushima prefectures, where a large cohort was conducted, were placed in the map. The population of each prefecture represented the estimated population as of 1 March 2011. PubMed was used to determine the number of scientific publications available. The search date was 8 December 2021, and the search terms were “disaster AND (“mental” OR “psychological” OR “psychosocial” OR “psychiatric” OR “psychiatry” OR “depression” OR “depressive” OR “posttraumatic stress”) AND Miyagi AND Great East Japan Earthquake,” “disaster AND (“mental” OR “psychological” OR “psychosocial” OR “psychiatric” OR “psychiatry” OR “depression” OR “depressive” OR “posttraumatic stress”) AND Iwate AND Great East Japan Earthquake,” and “disaster AND (“mental” OR “psychological” OR “psychosocial” OR “psychiatric” OR “psychiatry” OR “depression” OR “depressive” OR “posttraumatic stress”) AND Fukushima AND Great East Japan Earthquake.” The underline numbers next to the place names indicate the sections (chapter numbers) mentioned in the manuscript.



importance of monitoring and preventing social isolation in affected communities.^{37,38}

(2)-5. Cohort studies in Higashi-Matsushima City, Miyagi Prefecture

The University of Tokyo and collaborative organizations conducted annual health check data for the general population and observed that psychological distress deteriorated 2 years after the huge natural disaster compared with one year after the disaster.³⁹ They also conducted a survey of students and pointed out the importance of considering the effect of age-dependent impact on planning a mass intervention after a disaster.⁴⁰

The National Center for Global Health and Medicine conducted cross-sectional household screenings and observed depressive reactions or posttraumatic stress reactions (PTSR) in a considerable number of resident survivors.^{41,42}

(2)-6. Cohort studies in Shichigahama Town, Miyagi Prefecture

The Graduate School of Medicine and International Research Institute of Disaster Science (IRIDeS) of Tohoku University conducted 10 years of annual surveys to assess the psychosocial aspects of all residents whose houses were majorly damaged by the disaster in the town of Shichigahama, Miyagi prefecture.⁴³⁻⁴⁶ The studies suggested associations between psychological distress and physical conditions among residents affected by the disaster.⁴⁷⁻⁴⁹ Like other affected areas, living conditions,^{43,50,51} employment status,⁴⁶ daily walking habit,⁴⁵ and social capital⁴⁴ were associated with the mental health of the affected community.

(2)-7. Cohort studies in Natori City, Miyagi Prefecture

The IRIDeS and Graduate School of Medicine of Tohoku University and Miyagi Psychiatric Center conducted mental health surveys in elementary school, junior high school, and high school students in Natori City, Miyagi Prefecture, and reported profiles of mental health conditions, posttraumatic growth, and resilience of children and adolescents affected by a disaster.⁵²⁻⁵⁵

(2)-8. Cohort studies in Iwanuma City, Miyagi Prefecture

The Department of International and Community Oral Health, Tohoku University Graduate School of Dentistry and Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public

Health, and other collaborative organizations conducted a cohort study of community-dwelling older adults in Iwanuma City. The study reported that depression was associated with mortality during 3.3 years of follow-up among older disaster survivors,⁵⁶ and mental illness symptoms persisted for more than 5 years among half of the disaster survivors, although the community-wide prevalence of depression remained stable.⁵⁷ The study also suggested associations between mental health conditions of the affected community and adverse childhood experiences,⁵⁸ living conditions,⁵⁹ employment,⁶⁰ group exercises or regular walking,⁶¹ optimism,⁶² social capital,⁶³ social interaction,⁶⁴ and social support.^{65,66}

(2)-9. Cohort studies in Fukushima Prefecture

The Fukushima Health Management Survey was another major large cohort survey conducted after the GEJE. As mentioned above, in Fukushima prefecture, the GEJE and accompanying tsunami resulted in an accident at the FDNPP, resulting in an unprecedented nuclear disaster in which radioactive material continued being dispersed over the long term. Looking at past nuclear disasters, a major problem that has been pointed out as a long-term health effect in the Chernobyl nuclear accident is psychosomatic abnormality. Even after the Fukushima disaster, the WHO regarded mental health as a major challenge. The residents of Fukushima Prefecture were not only severely damaged by the earthquake and tsunami, but also the sustained leakage of radioactive material due to a succession of accidents at the FDNPP, remaining a significant source of fear and anxiety. Therefore, in order to provide appropriate mental care, mainly for evacuees who were at a higher risk of developing mental health problems, the Fukushima Medical University implemented a “Mental Health and Lifestyle survey,” which targeted around 210 000 residents of the evacuation zone. By examining this cohort, valuable knowledge regarding mental health during disasters has been accumulated.^{67,68} The first large-scale and systematic study to elucidate the mental health status of residents in the evacuation zone around the FDNPP revealed that the earthquake, tsunami, and subsequent nuclear accident likely caused severe psychological distress among these residents in the Fukushima Prefecture; the close relationship between psychological distress and radiation levels suggested that the nuclear accident seriously influenced the residents’ mental health, which

Table 1. The main large-scale cohort studies on the mental health problems after the GEJE that occurred on 11 March 2011

Projects	The implementing agencies	Participants	Period of recruitment or data collection	Measurements regarding mental health	Main references
Cohort studies in Yamada Town, Otsuchi Town, and Rikuzentakata City, Iwate Prefecture (RIAS)	Iwate Medical University School of Medicine	<ul style="list-style-type: none"> • Over 10 000 people • All residents of Yamada Town, Otsuchi Town and Rikuzentakata City, Iwate prefecture aged 18 years or older 	<ul style="list-style-type: none"> • September 2011 to February 2012 • Follow-up surveys were repeated annually 	<ul style="list-style-type: none"> • K6 • AIS • LSNS-6 	<ul style="list-style-type: none"> Yokoyama <i>et al.</i> (2014) Takahashi <i>et al.</i> (2016 a,b) Tsubota-Utsugi <i>et al.</i> (2018) Tsubota-Utsugi <i>et al.</i> (2021)
The Tohoku Medical Megabank Cohort Study conducted in Iwate and Miyagi Prefectures (TMM)					
The TMM Birth and Three-Generation Cohort Study	ToMMo and IMM	<ul style="list-style-type: none"> • Over 70 000 people • Pregnant women, their fetuses, partners, parents, children, and extended family living in Miyagi and Iwate prefectures 	<ul style="list-style-type: none"> • July 2013 to September 2016 for pregnant women • July 2013 to March 2017 for family members 	<ul style="list-style-type: none"> • K6 • AIS • EPDS, etc. 	<ul style="list-style-type: none"> Hozawa <i>et al.</i> (2021) Kotozaki <i>et al.</i> (2021) Kuriyama <i>et al.</i> (2020)
The TMM Community-Based Cohort Study	ToMMo and IMM	<ul style="list-style-type: none"> • Over 80 000 people • Residents aged 20 years or older who lived in Miyagi and Iwate prefectures 	May 2013 to March 2016	<ul style="list-style-type: none"> • K6 • AIS • CES-D, etc. 	Murakami <i>et al.</i> (2021)
Cohort studies in Ishinomaki City, Miyagi Prefecture	RCI	<ul style="list-style-type: none"> • Over 10 000 people • Residents who lived in areas where households experienced tsunami inundation above a floor level, or in which more than 70% of houses were completely destroyed 	October 2011 to December 2012	K6	Inoue & Yamaoka (2017) Ishiguro <i>et al.</i> (2019)
	<ul style="list-style-type: none"> • The National Center for Global Health and Medicine • The Ishinomaki City Educational Board 	<ul style="list-style-type: none"> • Over 12 000 children who attended five kindergartens, 43 elementary schools, and 21 junior high schools in Ishinomaki City • Over 12 000 teachers of the same elementary, middle, and junior high school students in Ishinomaki City • Over 8000 parents of elementary school (fourth to sixth grade) students and junior high school (seventh to ninth grade) students in Ishinomaki City 	November 2011 to November 2012	<ul style="list-style-type: none"> • PTSSC-15 • SDQ 	<ul style="list-style-type: none"> Iwaware <i>et al.</i> (2014) Usami <i>et al.</i> (2012) Usami <i>et al.</i> (2013) Usami <i>et al.</i> (2014)
	Department of Health Informatics and Public Health, Tohoku University School of Public Health	<ul style="list-style-type: none"> • About 8000 people • Residents of Ajishima, Ogatsu, and Oshika, Ishinomaki city, Miyagi prefecture • Residents who were living in prefabricated temporary housing in Wakabayashi-ku, Sendai city, and Shichigahama town, Miyagi prefecture 	June 2011 to November 2020	<ul style="list-style-type: none"> • K6 • AIS • LSNS-6 	<ul style="list-style-type: none"> Sekiguchi <i>et al.</i> (2019) Sone <i>et al.</i> (2016) Sone <i>et al.</i> (2021) Sugawara <i>et al.</i> (2020) Tanji <i>et al.</i> (2017) Tanji <i>et al.</i> (2018) Yabe <i>et al.</i> (2018)

Table 1. (Continued)

Projects	The implementing agencies	Participants	Period of recruitment or data collection	Measurements regarding mental health	Main references
Cohort studies in Shichigahama Town, Miyagi Prefecture (The Shichigahama Health Promotion Project)	<ul style="list-style-type: none"> Graduate School of Medicine, Tohoku University IRIDeS, Tohoku University Shichigahama town, Miyagi, Japan 	<ul style="list-style-type: none"> Over or under 18 years of age Over 6000 people All residents of Shichigahama town whose houses were largely or totally destroyed by the event Over or under 18 years of age 	November 2011 to September 2020	<ul style="list-style-type: none"> K6 AIS CES-D IES-R, etc. 	<ul style="list-style-type: none"> Akaishi <i>et al.</i> (2021) Katayanagi <i>et al.</i> (2020) Nakaya <i>et al.</i> (2016) Nakaya <i>et al.</i> (2017) Suzuki <i>et al.</i> (2021) Tsuchiya <i>et al.</i> (2017) Utsumi <i>et al.</i> (2020)
Cohort studies in Natori City, Miyagi Prefecture	<ul style="list-style-type: none"> Miyagi Prefecture Psychiatric Care Center IRIDeS, Tohoku University Hokkaido University 	<ul style="list-style-type: none"> Over 7000 people Fourth to ninth grades attending elementary or junior high schools, and high school students aged 15–18 years as of 2012 in Natori city, Miyagi prefecture 	<ul style="list-style-type: none"> October 2013 for elementary or junior high school students June 2012 to July 2014 for high school students 	<ul style="list-style-type: none"> QIDS-J SAS IES-R CD-RISC-10 PTGI-C-R 	<ul style="list-style-type: none"> Okuyama <i>et al.</i> (2017a) Okuyama <i>et al.</i> (2017b) Okuyama <i>et al.</i> (2018) Yoshida <i>et al.</i> (2016)
Cohort studies in Iwanuma City, Miyagi Prefecture (The Iwanuma Study cohort, a sub-set of JAGES)	<ul style="list-style-type: none"> Harvard T.H. Chan School of Public Health Tohoku University Nihon Fukushi University Chiba University 	<ul style="list-style-type: none"> Over 5000 people All residents of Iwanuma City aged 65 years or older 	October 2013 to 2016 (baseline survey was conducted in August 2010, 7 months before the GEJE)	<ul style="list-style-type: none"> GDS SQD 	<ul style="list-style-type: none"> Gero <i>et al.</i> (2020) Inoue <i>et al.</i> (2017) Kino <i>et al.</i> (2020) Li <i>et al.</i> (2019) Sasaki <i>et al.</i> (2018) Tsuji <i>et al.</i> (2017)
Cohort studies in Fukushima Prefecture (The Fukushima Health Management Survey)	<ul style="list-style-type: none"> Fukushima prefecture Fukushima Medical University 	<ul style="list-style-type: none"> About 210 000 people Residents registered at covered areas in Fukushima prefecture from 11 March 2011 to 1 April 2012 	From January 2012 to present	<ul style="list-style-type: none"> K6 AIS PCL-S CAGE SDQ 	<ul style="list-style-type: none"> Harigane <i>et al.</i> (2021) Kunii <i>et al.</i> (2016) Mashiko <i>et al.</i> (2017) Oe <i>et al.</i> (2016)

AIS, Athens Insomnia Scale; CES-D, Center for Epidemiologic Studies Depression Scale; CD-RISC-10, 10-item Connor–Davidson Resilience Scale; EPDS, Edinburgh Postnatal Depression Scale; GEJE, Great East Japan Earthquake; GDS, 15-item Geriatric Depression Scale; IMM, Iwate Medical University Iwate Tohoku Medical Megabank Organization; IRIDeS, International Research Institute of Disaster Science; IES-R, Impact of Event Scale-Revised; JAGES, Japan Gerontological Evaluation Study; K6, Kessler Psychological Distress Scale; JAGES, Japan Gerontological Evaluation Study; K6, Kessler Psychological Distress Scale; LSNS-6, Lubben Social Network Scale; PTSSC-15, Post-Traumatic Stress Symptoms for Children-15; PTGI-C-R, Revised Posttraumatic Growth Inventory for Children; PCL-S, Posttraumatic Checklist Scale; PTSD Checklist -Stressor Specific Version; RIAS, Research project for prospective Investigation of health problems Among Survivors of the Great East Japan Earthquake and Tsunami Disaster; RCI, The Health and Life Revival Council in Ishinomaki District; SDQ, Strength and Difficulties Questionnaire; SQD, 9-item PTSD subscale of the Screening Questionnaire for Disaster-Related Mental Health; SAS, Zung Self-Rating Anxiety Scale; QIDS-J, Quick Inventory of Depressive Symptomatology; TMM, The Tohoku Medical Megabank Project; ToMMo, Tohoku University Tohoku Medical Megabank Organization. This table includes cohort studies with more than 5000 participants.

might be exacerbated by increased risk perception.⁶⁹ In addition, a systematic review consisting of 42 papers, most of which used the cohort as above, clarified that the prevalence of PTSR was higher in Fukushima (it exceeded 10% in all studies) than in other affected areas, and most risk factors for mental health problems were associated with resettlement of daily lives, preexisting illnesses, and social networks.³ Additionally, there were no reports that showed a marked decrease in depression at least 2–3 years after a disaster, although some longitudinal studies observed a gradual improvement in PTSR. These results suggested that long-term mental health support was needed for people in the affected area, because some mental health problems such as depression did not improve even 2 years after the

disaster. In another study that examined the long-term effects of the Fukushima nuclear disaster, residents in the disaster area prefecture maintained high levels of K6-measured psychological distress and PCL-S measured PTSR even 3 years after the disaster.⁷⁰ Moreover, this attenuated community resilience may have caused a substantial increase in disaster-related suicides because peculiar social problems never seen in other natural disasters, such as the so-called “radiation stigma” of the general public and the self-stigma of evacuees, had increased in Fukushima. In a study that delineated the detailed characteristics of disaster-related suicides in Fukushima, it was found that while the other two affected prefectures, Miyagi and Iwate, experienced a drop in disaster-related suicides, Fukushima did not.⁷¹ In

addition, the disaster-related suicide rates were remarkably higher in men than in women, with those of elderly women being higher than the overall suicide rates in Japan or Fukushima.

The abovementioned studies comprised an overview of research using a large-scale cohort of victims that developed after the GEJE. However, until now, a comparative survey has not been sufficiently conducted between the Miyagi and Iwate prefectures, which were greatly affected by natural disasters such as the tsunami, and the Fukushima prefecture, which included the nuclear accident. Therefore, future studies should thoroughly consider the differences in mental health among three prefectures affected by the GEJE.

Proposal to Develop Evidence-Based Mental Health and Psychosocial Support System

Integrating surveys into the total mental health support system would enable evidence-based mental health and psychosocial support. The supporting organizations can design support plans based on information regarding how communities are affected by a disaster, occasionally reconsidering strategies by evaluating the efficacy of support.

Some of the surveys introduced above were combined with mental health and psychosocial support, which can be models for evidence-based support.

For example, Fig. 4 shows the flow of mental health support and surveys conducted as a collaboration between academic facilities and the local government in Shichigahama town, being named the Shichigahama Health Promotion Project. Tohoku University started providing mental health outreach to refugee camps and damaged housing in the town immediately after the disaster in March 2011. The annual surveys were planned based on discussions with the public nurses and affected residents, who started to reconstruct their lives in prefabricated temporary housing, worrying about the potential risks of isolation among affected people who did not move into temporary housing. In November 2011, the first systematic health survey was conducted to cover all residents who lived in the town at the onset of the earthquake, and whose houses were majorly damaged, with nearly half of the residents moving into temporary housing. The summary outcome of the survey was shared with the affected communities to facilitate mental health promotion through workshops held in community spaces for temporary housing residences, and columns in town newspapers. The outcome was also used for personal outreach to residents facing psychosocial difficulties. The annual changes after the GEJE, of PTSR measured by the Impact of Event Scale-Revised (IES-R) in Table 2, indicated that the impact continues in the long term. These decades of accumulated data from the surveys provided an overview of alterations in the mental health condition of a community affected by a catastrophe.

Fukushima Medical University has provided remote counseling using the telephone, for many targeted evacuees (3000–4000 cases per year) based on results of the Mental Health and Lifestyle Survey.⁷² As numerous Fukushima evacuees voluntarily or involuntarily relocated to different areas across Japan from Okinawa to Hokkaido, face-to-face psychological interventions, including home visit services, were considerably difficult to implement. Therefore, this remote support system was one of the few feasible measures to address people requiring psychological help, which can be applied to other major disasters that involve a great number of evacuees.

Remaining Issues to Improve Post-Disaster Mental Health and Psychosocial Support

As summarized above, multiple efforts were made to survey mental health and psychosocial conditions. However, funding source, purpose, target population, duration, methods of surveys, and utilized questionnaires varied among the surveys. Measures to uniformly assess the mental health conditions of affected communities would be beneficial for understanding the current situation, estimating its future course, and designing effective support plans.

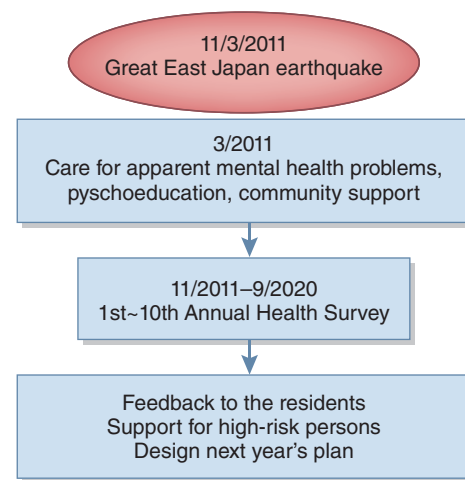


Fig. 4 Mental health support and research in Shichigahama town. This figure shows the flow of Mental health support and research in Shichigahama town. In November 2011, the systematic health survey was started. Detailed studies, including validation and biomarker studies, were conducted in parallel with support for high-risk persons. Approximately 2800 participants in Shichigahama Town were recruited. The data have been obtained every year since 2011. Correction added on March 12, 2022, after first online publication: Figure 4 was corrected to reflect the new methodology utilized to calculate pyrolysis reaction energy.

In Japan, a system for mental health support after large-scale disasters such as the Niigata-Chuetsu Earthquake, the GEJE, and the Kumamoto Earthquake, outreach support and salon activities were conducted, centering on the mental care center established as a newly designed and time-limited organization. The organizations were newly founded, staff members were newly recruited, and strategies for activities such as support for members of the affected communities and local mental health supporters were newly planned. While the organizations reached certain achievements,^{5,73,74} the following issues could be pointed out as shortcomings: (i) The measures of long-term post-disaster mental health and psychosocial support systems were not planned in advance for catastrophic disasters, such as the Tonankai earthquake; (ii) Some of the post-disaster mental health care centers did not interact with permanent mental health care systems, including little cooperation with existing institutes such as educational research, medical, and mental health institutes; (iii) Some of the post-disaster mental health care centers did not evaluate the general mental health and psychosocial conditions of residents in the affected area, with information not being systematically accumulated and analyzed; (iv) The long-term trajectory of current disasters could not be estimated in advance using information from previous disasters, and information from the current disaster could not be efficiently utilized in future disasters; (v) Conventional support activities could be achieved without sufficient evidence and evaluation of their efficacy; and (vi) The range of support methodologies was limited, while technologies such as information science, biosensing, and artificial intelligence (AI) could potentially be applied.

Furthermore, the unprecedented event of the FDNPP accident caused by the tsunami following the GEJE involved complex and critical issues, requiring verification separate from the direct damage caused by the earthquake and tsunami. Before the GEJE, disaster countermeasures were not prepared based on the assumption that a nuclear disaster occurred. It is known that the post-accident situation, which required a long time to resolve, had a wide range of effects on the mental health of residents in the evacuation zone⁶⁹; it is therefore necessary to proceed with an examination under the assumption that a nuclear disaster will occur again. Recently, the WHO issued a practical guide, *a framework for mental health and psychosocial support in radiological and nuclear emergencies*, filled with many lessons from the Fukushima disaster, which is expected to improve

Table 2. The annual changes of the prevalence of participants at high risk for posttraumatic stress reaction (PTSR)

Survey year	IES-R ≥ 25	Cochran-Armitage trend test	
	n (%)	z	P
		-22.14	<0.0001
1st survey in 2011 (n = 1631)	527 (32.3)		
2nd survey in 2012 (n = 1458)	483 (33.1)		
3rd survey in 2013 (n = 1621)	492 (30.4)		
4th survey in 2014 (n = 1356)	374 (27.6)		
5th survey in 2015 (n = 1154)	285 (24.7)		
6th survey in 2016 (n = 1215)	228 (18.8)		
7th survey in 2017 (n = 1155)	213 (18.4)		
8th survey in 2018 (n = 1183)	168 (14.2)		
9th survey in 2019 (n = 1057)	153 (14.5)		
10th survey in 2020 (n = 1082)	73 (6.7)		

Abbreviation: IES-R, the Impact of Event Scale-Revised.

preparedness for such nuclear accidents. The global COVID-19 pandemic is somewhat similar to the situation resulting after the nuclear accident, such as the invisible threat, unpredictable end, and stigma surrounding affected people. From now on, it is necessary to be fully prepared for such special and complex disasters.

Evidence-Based Disaster Psychiatry Recommendation and Novel Disaster Science Methods

As described above, mental health support after a disaster in Japan developed more with each large-scale disaster. However, considering the limited number of mental health personnel, there is a strong need to establish new methods of disaster psychiatry, such as evaluation methods, prevention, care, and treatment based on more scientific evidence. Furthermore, regarding infectious diseases such as COVID-19, it is necessary to take new measures, such as maintaining social distancing, which are unlike steps taken during conventional natural disasters. In Japan, research and educational institutions, as well as private organizations, have introduced remote support and information exchange systems at an early stage of the pandemic, while most central and local governments, and existing public mental health centers have not implemented remote systems adequately. Thus, the prompt provision of mental health services is stagnant. In Japan, despite the fact that the majority of the population has completed two doses of vaccination, it is currently difficult to create an atmosphere of optimism regarding the end of the COVID-19 pandemic. Therefore, it is thought that its effect will spread to multiple layers of society in various ways. It is suggested that complex natural disasters resulting from an emerging infectious disease will not be rare in the near future. Thus, it is considered difficult to respond to such situations using conventional systems; therefore, specific methods of

mental health and welfare administration should be employed to respond to these complex disasters.

In the present COVID-19 pandemic, remote support using online tools has been implemented⁷⁵⁻⁷⁷; several attempts have begun to use monitoring by biosensing, capturing mental and physical conditions that are difficult to grasp both subjectively and objectively, such as the amount of activity, sleep, and autonomic nervous function.^{78,79} New intervention approaches, such as AI technology processing a huge amount of information using state-of-the-art technologies, as well as brain science, robotics, and virtual reality (VR) technology, should be employed. Japanese and U.S. venture companies are actively engaged in clinical trials of the remote use of cognitive-behavioral therapy using smartphones, monitoring the pre-disease status of psychiatric conditions. As an example of utilization in the situation following COVID-19 infection, suicide risk was analyzed from messages posted on social network services using AI.⁷⁵ The technological capabilities to develop smart health backed by the acquisition and evaluation of biometric information through digital sensing at home, are also improving.⁸⁰⁻⁸² Thus, effective induction of these advanced technologies is important for overcoming the current situation and building a new mental health and welfare system in Japan in the future.

Through a decade of experience in post-disaster settings after the GEJE, we have established a system to create a database of detailed information (psychological tests, neurophysiologic findings, brain images, etc.), reflecting the knowledge of the brain science field, to develop mental health measures based on scientific evidence. To advance the development of post-disaster mental health and psychosocial support systems, instead of mental health measures being planned only by local governments, it is desirable that all regional stakeholders, including mental health care workers, government, academia, industry, and other society representatives, work together to plan and implement measures.

Conclusion

The years elapsed from the GHAE to the GEJE have instilled in professionals involved in psychiatry and health care the need to respond to mental health issues after a disaster. The assessment of mental health and psychosocial conditions has been conducted in affected communities, and data have been accumulated. However, even after experiencing these disasters, there is much more room for improvement regarding community preparedness and response measures. Whether the lessons learned from past disasters can be used without leaving any regrets in the event of an earthquake directly beneath the Tokyo metropolitan area, or a major earthquake in the Nankai Trough, depends on future efforts.

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Disclosure statement

The authors declare no conflict of interest.

Author contributions

YK and HTo designed the study. YK and HU conducted the primary literature search and analyzed them. YK and HU created figures and tables. YK wrote the first draft of this manuscript. HTo played a major role in revising and editing the draft. YK, KO, MM, HY, ST, HTa, and HTo amended or added text on the draft. All authors contributed to and approved the final manuscript.

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