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Editorial: Review Series in Disaster Medicine

Progress of Disaster Medicine during Ten Years after the 2011 Great East Japan Earthquake

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The 2011 Great East Japan Earthquake (GEJE) has renewed the paradigm of disaster medicine. The Tohoku Journal of Experimental Medicine (TJEM) widened its scope to include the disaster science from the health perspectives. TJEM has been accumulating 76 articles related with "disaster" or "pandemic" out of which 69 were published after 2011. Tohoku University established the International Research Institute of Disaster Science (IRIDeS) that took initiative to impact the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) to include health aspect. Sendai Framework provided the platform for collaboration of different sectors, including the terminology that defines the concept of disaster, risk, hazard & exposure, vulnerability and coping capacity. Disaster medicine covers the diverse causes and damages of disasters by various hazards in this globalized and rapidly changing world. TJEM articles range the physical and mental health damage after the GEJE and other disasters with approved ethical consideration of investigations from the view point of affected area, mechanisms of hazard to affect human health including the radiation, virus or hazardous materials, proposal of refinement of health system to cope with disasters such as mental health support, risk communication, disaster medical coordination and hospital business continuity plan and future perspectives with reconstruction including Tohoku Medical Megabank Project. TJEM scope on disaster medicine had been widened during the 10 years after GEJE and IRIDeS can be the bridging hub not only between the health sector and other sectors, but also between disaster medicine and other medical disciplines.

Keywords: disaster medicine; Great East Japan Earthquake; health damage in disaster; Sendai Framework for Disaster Risk Reduction; transdisciplinary cooperation
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Introduction

Disaster terminology and global identifier (GLIDE) number

Disaster is defined as a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts (UNDRR, United Nations Office for Disaster Risk Reduction 2017). This terminology was officially adopted at the United Nations General Assembly on February 2nd, 2017, and for the development of a set of possible indicators to measure global progress in the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) (UNDRR 2015), coherent with the work of the Inter-Agency and Expert Group on Sustainable Development Goal (SDG) Indicators.

Disaster risk is defined as the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNDRR 2017). Thus, disaster risk reduction (DRR) is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development. Sendai Framework is the global, agreed policy of

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DRR, adopted in March 2015, whose expected outcome is: "The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries". In Sendai Framework, "the scope of disaster risk reduction has been broadened significantly to focus on both natural and man-made hazards and related environmental, technological and biological hazards and risks. Health resilience is strongly promoted throughout" (Wahlstrom, in the Foreword of Sendai Framework (UNDRR 2015). The word count of "health" in Sendai Framework has increased to 34 words from the zero in the preceding 1st framework, Yokohama Strategy (IDNDR, International Decade for Natural Disaster Reduction 1995), and the 2nd framework, Hyogo Framework for Action (HFA) (ISDR, International Strategy for Disaster Reduction 2005). Interestingly, the disaster risk index has a strong correlation with the life expectancy of the country, suggesting that health improvement is necessary in disaster risk reduction (Egawa et al. 2018).

Hence, disaster medicine covers not only the acute phase emergency medical response by natural hazards such as earthquakes, tsunamis, floods and typhoons, but also covers the anticipation and prevention of possible health damage before any disaster happens, covers health response from acute to long-term phase after disaster, dealing with the affected community people with various vulnerability and coping capacity under local context. Disaster medicine also covers the research and education in health emergency and disaster risk management (H-EDRM).

World Health Organization (WHO) established the H-EDRM framework and defined the types of hazards (WHO 2019) (Table 1). These comprise infectious disease outbreaks, natural hazards, conflicts, unsafe food and water, chemical and radiation incidents, building collapses, transport incidents, lack of water and power supply, air pollution, antimicrobial resistance, the effects of climate change, and other sources of risk. Disaster medicine also covers this broad spectrum of hazards and resulting health consequences.

The difference of disaster medicine from clinical and basic medicine is that it is about the community and people who are affected by the hazards. UNDRR defines, that directly affected are those who have suffered injury, illness or other health effects; who were evacuated, displaced, relocated or have suffered direct damage to their livelihoods, economic, physical, social, cultural and environmental assets. Indirectly affected are people who have suffered consequences, other than or in addition to direct effects, over time, due to disruption or changes in economy, critical infrastructure, basic services, commerce or work, or social, health and psychological consequences (UNDRR 2017).

A community and people have vulnerability and coping capacity. Vulnerability is the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UNDRR 2017). Capacity is the combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience. The coping capacity is ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during disasters or adverse conditions. Coping capacities contribute to the reduction of disaster risks (UNDRR 2017).

The disaster risk is, therefore, represented by the following formula (Egawa et al. 2017a):

$$Risk = \frac{Hazard\ \&\ Exposure \times Vulnerability}{Coping\ Capacity}$$

Disaster medicine is a science to reduce the health risk in disaster by decreasing the hazard & exposure and/or vulnerability, while by increasing the coping capacity.

As well as the terminology, a platform to identify the disaster enables the common understanding and discussion. Accessing disaster information can be a time consuming and laborious task. Asian Disaster Reduction Center (ADRC) proposed a globally common Unique ID code (GLIDE Numbers) for disasters jointly with international organizations. (https://www.glidenumber.net). The components of a GLIDE number consist of two letters to identify the disaster type (e.g., EQ-earthquake); the year of the disaster; a six-digit, sequential disaster number; and the three-letter international organization for standardization (ISO) code for country of occurrence. There are some disasters in this article that were not registered in the GLIDE system because they were too old, too big or, not recognized as disasters although they fit the definition of disaster.

The Great East Japan Earthquake (GEJE) and Tohoku Journal of Experimental Medicine (TJEM)

On March 11, 2011, a megathrust earthquake of magnitude 9.0 (Mw) occurred along the Pacific Coast of Tohoku Area, Japan. The earthquake moved the seafloor of Pacific Ocean 62 meter horizontally in average that created the tsunami with maximum height of 15-16m (maximum runup height 42 m). Tsunami destroyed most of the mitigation facilities along the coast line and lead to the Fukushima Daiichi nuclear power plant accident.

Shigeki Shibahara (2011) published one of the earliest English articles from Japan as News and Views in TJEM in the April issue of 2011. Shibahara, as Editor-in-Chief, declared the mission of TJEM to cover the "disaster prevention medicine and earthquake/tsunami research". TJEM invited Koji Minoura, a geologist at Tohoku University, as an executive editor in disaster prevention science. Minoura and colleagues estimated the 869 Jogan earthquake's magnitude at 8.3 and concluded that it could recur at 1,000-year

Table 1. WHO Classification of Hazards (Modified from WHO 2019).

GENERIC GROUPS	**1. NATURAL**							**2. HUMAN INDUCED**		**3. ENVIRON MENTAL**
GROUPS	1.1 GEOPHYSICAL	1.2 HYDRO-METEOROLOGICAL			1.3 BIOLOGICAL	1.4 EXTRATERRES-TRIAL	2.1 TECHNOLOGI-CAL	2.2 SOCIETAL	ENVIRONMEN-TAL DEGRADA-TION	
SUBGROUPS		1.2.1 HYDROLOGI-CAL	1.2.2 METEOROLOGI-CAL	1.2.3 CLIMATOLOGI-CAL						
MAIN TYPES - *SUBTYPES* [SUB-SUB-TYPES]	Earthquake: - *ground-shaking* Tsunami Mass Movement (Geophysical trigger): - *landslide* - *rock fall* - *subsidence* Liquefaction Volcanic activ-ity: - *ash fall* - *lahar* - *pyroclastic flow* - *lava flow*	Flood: - *riverine flood* - *flash flood* - *coastal flood* - *ice jam flood* Mass movement: (hydro-meteoro-logical trigger): - *landslide* - *avalanche (snow)* - *mudflow* - *debris flow* Wave action: - *rogue wave* - *seiche*	Storm: - *extratropical storm* - *tropical cyclone* [cyclonic wind, cyclonic rain, cyclone (storm) surge] - *convective storm* [tornado, wind, rain, winter storm, blizzard, derecho, lightning thun-derstorm, hail, sand/ dust storm] Extreme temper-ature: - *heatwave* - *coldwave* - *severe winter condition* [e.g. snow/ice, frost/ freeze, dzud] Fog	Drought Wild fire: - *land fire* [e.g. brush, bush, pasture] - *forest fire* Glacial lake out-burst (flood)	Airborne dis-eases Waterborne dis-eases Vector-borne diseases Foodborne out-breaks Insect infesta-tion: - *grasshopper* - *locust* Animal diseases Plant diseases Aeroallergens Antimicrobial resistant micro-organisms Animal-human contact - *venomous ani-mals* [snakes, spiders]	Impact - *airburst* - *meteorite* Spacer weather - *energetic parti-cles* - *geomagnetic storms* - *shockwave*	Industrial haz-ards: - *chemical spill* - *gas leak* - *radiation* [radiological, nuclear] Structural col-lapse: - *building col-lapse* - *dam/bridge failures* Occupational hazards - mining Transportation: - air, road, rail, water, space Explosions Fire Air pollution: - *haze* Infrastructure disruption: - *power outage* - *water supply* - *solid waste, waste water* - *telecommuni-cation* Cybersecurity Hazardous mate-rials in air, soil, water - *biological, chemical, radiological* Food contamina-tion	Acts of violence Armed conflicts: - *international* - *non-interna-tional* Civil unrest Stampede Terrorism - *chemical, biological, radiological, nuclear and explosives* Financial crises: - *hyper-inflation* - *currency crisis*	Erosion Deforestation Salinization Sea level rise Desertification Wetland loss/ degradation Glacier retreat/ melting Sand encroach-ment	

intervals and the possibility of a large tsunami striking the Sendai Plain is high (Minoura 2001). But that consensus did not influence seismic risk assessments, tsunami preparedness, or a review of the hardiness of the Fukushima Daiichi nuclear power plant (Normile 2011). Sendai Framework states the principle: "a clear articulation of responsibilities across public and private stakeholders, including business and academia, to ensure mutual outreach, partnership, complementarity in roles and accountability and follow-up." Minoura et al. (2015) caution the possibility of tsunami hazard along the Japan Sea Coast.

The role of International Research Institute of Disaster Science (IRIDeS)

Tohoku University established IRIDeS in 2012 that include Disaster Medical Science Division together with other research disciplines. IRIDeS had organized the International Symposium on Disaster Medical and Public Health Management: Review of Hyogo Framework for Action in Washington D.C. in 2014 May and had gathered more than 120 experts of researchers, practitioners, and policy makers in disaster medicine from ten countries and international organizations including UNDRR and WHO (Position Paper 2014). This initiative created discussions both in disaster risk reduction sector and health sector about the disaster impact on health for the post-HFA framework (i.e., Sendai Framework) (ISDR 2005; Burkle et al. 2014; Aitsi-Selmi et al. 2015). WHO and UNDRR had co-organized an International Conference in 2016, that adopted the Bangkok Principles for the Implementation of the Health Aspects of the Sendai Framework for Disaster Risk Reduction 2015-2030 (WHO and UNDRR 2016), as following seven recommendations.

i. Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.

ii. Enhance cooperation between health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and building of resilient health systems.

iii. Stimulate people-centered public and private investment in emergency and disaster risk reduction, including in health facilities and infrastructure.

iv. Integrate disaster risk reduction into health education and training and strengthen capacity building of health workers in disaster risk reduction.

v. Incorporate disaster-related mortality, morbidity and disability data into multi-hazards early warning system, health core indicators and national risk assessments.

vi. Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards.

vii. Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements.

IRIDeS had launched the Global Center for Disaster Statistics in 2015 in collaboration with UN Development Programme (UNDP) for the comprehensive analysis of disaster damage for the assessment of the implementation in member states. The close collaboration between health sector and other DRR sectors is needed.

Articles in TJEM related with disaster and/or pandemic

Search results

Searching the TJEM publication in PubMed using the keywords "the Tohoku Journal of Experimental Medicine, disaster" and "the Tohoku Journal of Experimental Medicine, pandemic", as of Feb. 7, 2021, yielded 82 articles out of 8,631 publications since 1950. There was one article overlapped (attributed to "pandemic") and four articles irrelevant neither with disaster nor pandemic, resulting in 76 relevant articles (Fig. 1). Pandemic was added as a keyword because of coronavirus disease 2019 (COVID-19) pandemic and it is a disaster caused by a biological hazard (UNDRR 2017; WHO 2019). Out of 76 articles, seven articles were published before 2011.

Articles in TJEM before 2011

There were two articles examining the histopathological changes in the canine and human lungs by the volcanic ash and gas from Sakurajima active volcano in Kyushu Island, Japan (Kariya 1922; Kariya et al. 1992). Satoh (2003) reviewed the animal (rodents) experiments concerning "behavioral teratology" of mercury to validate the epidemiological findings of the neurotoxic agent, methylmercury, that caused the disaster in Minamata, Japan in 1930-60s and Iraq in 1971-72. An epidemiological study revealed the psychological effect of the 1999 Marmara Earthquake in Turkey (GLIDE #EQ-1999-000008-TUR) (Vehid et al. 2006). This paper became the first article in TJEM that mentioned the mental health damage by a disaster. More than 70% of 3,609 students survived from the Marmara Earthquake had mild depression level and 9.6% had serious depression. The prevalence of suicidal tendency/thought was 16.7% and was higher in the students who were injured, who lost their relatives, and who saw extensive damage in their home. Suicide thought was lower in females than males (Vehid et al. 2006). This article receives 15% of its citations in the past two years, suggesting that it is currently receiving a lot of interest (Dimensions: https://www.dimensions.ai).

Na-Bangchang and Congpuong (2007) reviewed the reappearance of malaria in many parts of the world, after the continual efforts of eradication, concluding that drug resistance created the disaster. Over 90% of the disease burden is in sub-Saharan Africa and especially children under 5 years of age and pregnant women are at high risk.

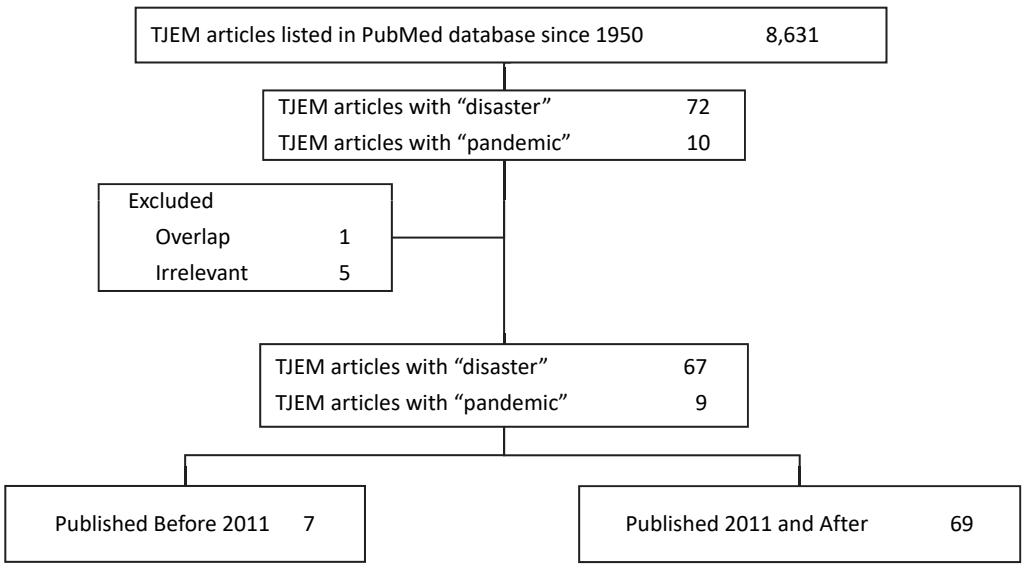

Fig. 1. Results of PubMed search on TJEM articles using keyword "disaster" or "pandemic".
Out of overall 82 articles, there was one overlap and five irrelevant articles. Of remaining 76, 67 articles were related with disaster and nine were related with pandemic. Sixty-nine articles were published after 2011 when TJEM widened its scope on disaster medicine.

The article pointed out the increasing number of imported cases of malaria as a result of increasing worldwide travel, suggesting the same mechanisms of on-going COVID-19 pandemic.

TJEM has two articles related with the 2004 Chuetsu Earthquake (GILDE#EQ-2004-000114-JPN) of M6.8 in Niigata Prefecture, Japan. Fujimoto et al. (2007) detected the increase of mutagenic material in Dec. 2004 two months after the earthquake in the river water during the longitudinal periodical assessment. Hyodo et al. (2010) evaluated long-term suicide mortality rates during the 5-year period preceding and the 3-year period following the 2004 Chuetsu earthquake. The long-term mortality from suicide after the earthquake decreases in men and increases in women. This article has been cited 31 times (As of Feb. 24, 2021) of which 25% was cited within recent two years (Dimensions: https://www.dimensions.ai).

Articles related with GEJE in TJEM after 2011

Out of 69 articles published after 2011, 47 articles (67.1%) are related with GEJE. Seven articles intend to describe the disaster damage itself. Following the Editor-in-Chief view (Shibahara 2011), three articles described the disaster damage on the university facilities (Sakamoto et al. 2011; Shibahara2012; Wakui et al. 2014), and an article summarized the effect on the peaceful use of nuclear power in Europe (Batsford 2013). Ishigaki et al. (2013) reviewed the historical transmission of disaster experience from the past tsunami disasters and the experience of how TJEM avoided the disruption of publication with the help of people in Philadelphia in the aftermath of 1923 Great Kanto Earthquake.

The experience of a disaster may not have a comparable impact to the readers without the experience of the disaster. That is why the terminology "lessons learned" had become part of the lexicon of disaster medicine, but is actually so ambiguous in its meaning (Schultz 2016). The role of a medical journal is to generalize the individual experience and report the scientific meaning to the global community. Ten articles in TJEM described the medical needs in GEJE. Tanaka et al. (2012) insisted the ophthalmic problems after disaster and suggests the preparation for the donated eye glasses. Ueda et al. (2012) reported the prevalence of calf deep vein thrombosis (DVT) in the evacuation centers was 200 times higher than the usual incidence in Japan. They estimated the dehydration due to the delay in supplying drinking water, vomiting, and diarrhea because of the poor sanitary condition in the evacuation centers, and due to the decreased mobility of elderly people especially in the tsunami-flooded areas. Ueda concluded that long-term shelters, therefore, should not be set up in flooded areas after tsunami and established the Society for Disaster Shelter and Refuge Life (http://dsrl.jp/riji/) to improve the environment and health in the shelters. The Society recommends the usage of cardboard beds is not only useful to prevent DVT (Nara et al. 2013) by increasing the mobility of elder people, but also to prevent the outbreak of infectious disease among the evacuees. The case reports of tsunami-associated pneumonia (Igusa et al. 2012) and victim identification (Kuroda et al. 2017; Numata et al. 2017) propose the importance of flexible way of thinking in a low-frequency large scale disaster.

The medical needs are changing according to the local context of the disaster affected area. Anticipating the possible earthquakes, the Tohoku Area strengthened the seismic resistance of the buildings and houses because the area was

periodically stricken by M7 class earthquakes in every 30-40 years (Egawa et al. 2020). This disaster risk reduction effort effectively reduced the number of injured people (n = 6,220) in GEJE compared to that in the Great Hanshin-Awaji Earthquake (GHAE: GLIDE #EQ-1995-000003-JPN) (n = 43,792) (Egawa et al. 2017a). On the other hand, the unprecedent size of tsunami and the nuclear power plant accident resulted in more than 400,000 evacuees and different medical needs in the affected area. Suda et al. (2019) used the anonymized disaster medical record (DMR) for the first time in the world to summarize the medical needs in Minamisanriku Town which lost all medical facilities including one secondary hospital and four clinics. Non-communicable disease (NCD) (68%) was the most frequent medical needs, followed by, infectious disease (21%), mental health issues (6%), trauma (4%), and mother and child health issues (0.2%). Using the same database, Nakamura et al. (2020) revealed that evacuees had high prevalence of sleep disturbance. Aged population and female gender were the risk factors, but sleep disturbance rather affected younger evacuees regardless of gender who does not have NCD but residing in evacuation center, stressing the importance of awareness of sleep disturbance in such populations especially in evacuation centers.

Sakurai et al. (2016) cautioned the increased prevalence of tuberculosis patients in the post-disaster period in the coastal region of Northern part of Miyagi Prefecture. Importantly, there were 11 evacuees who were diagnosed with latent tuberculosis infection (LTBI) with the history of contacting tuberculosis patients in the shelter in the coastal area.

Because Japan is an aging society, Yabe et al. (2020) found that the participants with poor physical function had a significantly higher rate of new-onset musculoskeletal pain suggesting the importance of rehabilitation quickly after disaster. Maeda et al. (2017) detected poor oral hygiene, inactivity, malnourishment, appetite loss, eating problems, and swallowing problems due to lack of support for frail, disabled, or elderly evacuees during the early phases after GEJE and 2016 Kumamoto earthquake. They proposed the establishment of the Disaster Feeding Support Team (D-FST) to provide comprehensive nutritional, physical, and health support and to perform interventions for swallowing exercises, activity, health condition, and cognition for eating circumstances. Kimura et al. (2020) detected increased night-time urinary frequency after GEJE in patients with prostatic hyperplasia and/or overactive bladder.

There are three prospective studies on the medical-needs assessment after GEJE. Hagiwara et al. (2017) found that sleep disturbance and psychological distress worsened the new-onset subjective shoulder pain in survivors of GEJE. Yabe et al. (2018a) showed higher incidence of sleep disturbance among survivors with musculoskeletal pain after the GEJE. Both studies used the background data from the Basic Resident Registration Network system as well as previous participation in health surveys of survivors. Yabe et al. (2018b) also showed higher incidence of low back pain in the affected population who experience sleep disturbance using a panel study at thee and four years after GEJE. All prospective and retrospective studies got approval from the relevant Ethical Committee before conducting the study.

WHO guides that the preparation is critical to ensuring that research in the field is effective, safe and contextually appropriate. This includes obtaining the necessary administrative and ethical approvals, preparing protocols and standard operating procedures, as well as careful planning in regard to equipment, data security and logistical questions. It is important to develop a good relationship between researchers and the community; this can be achieved by demonstrating reliability and communicating the value of the research to the community. WHO also guides to review ethical approvals and in-country protocols for research and follow any policies requested. Using agreements and protocols can ensure clarity as to roles and responsibilities of the researchers (Fagan et al. 2020).

Four articles proposed the improvement of medical and health system. Hino et al. (2016) stressed the importance of risk communication after the nuclear accident to promote thyroid examinations of children in Fukushima. Through the pre- and post-questionnaire surveillance, they found that participation in meetings reduced anxiety, highlighting the importance of presenting information about radiation in a manner that is easy to understand, as well as providing opportunities for the exchange of opinions. Lower number of meeting participants was associated with anxiety reduction and higher subjective comprehension. Egawa et al. (2017b) described the nation-wide implementation of disaster medical coordinators in more than 80% of prefectures in Japan. The fist disaster medical coordinator was assigned in Hyogo Prefecture soon after the 1995 GHAE, but was only followed by four prefectures including Miyagi, until the GEJE reminded its necessity. Matsuyama et al. (2018) detected that the copayment exemption policy was helping the affected people to access the health service. The Tohoku University did not lose any life of patients or staff because of the seismic resistant buildings and functional preparedness. Sasaki et al. (2020) performed a scoping review of hospital business continuity plan (BCP) and described the establishment of Tohoku University Hospital BCP. There are three important subjects as the universal components for hospital BCPs with fewer assumptions of specific hazards so that the hospital can be resilient in dealing with various situations during a disaster: i) alternative methods and resources, ii) priority of operations, and iii) resource management. Generalizability of individual experience comes from excluding the ambiguity. Regardless of the type of hazard and loco-regional context, the development of BCPs and business continuity management (BCM) needs the above-mentioned integral components.

Many articles were related with the mental health issues after GEJE. Takeda et al. (2013) found the association of post-traumatic stress disorder (PTSD) and the premenstrual syndrome (PMS) of inland high school students at 9 months after GEJE, suggesting the importance of physical and mental intervention. Koyama et al. (2014) surveyed the displaced people who had lost their homes and were living in temporary housing in Iwanuma city, Miyagi Prefecture, showing that participants without social support had a higher risk of psychological distress. Tsuchiya et al. (2015) detected the association of insomnia and oral hygiene and gum problems and difficulty in chewing using the panel survey over four surveys, suggesting the importance of oral hygiene to prevent mental adverse effect. Orui et al. (2015) reported the delayed increase of male suicide rates several years after GEJE in both coastal and inland area of Miyagi Prefecture stressing the necessity of intensive, long-term mental healthcare services in the tsunami-stricken areas. Nakaya et al. (2016) focused on the association between a partner's ongoing treatment for chronic disease and the risk of psychological distress after GEJE among couples of which 9% of the partners were under treatment of NCD. They found that women, but not men, whose partners were receiving treatment for chronic diseases, had a higher risk of psychological distress. Sakama et al. (2019) evaluated the burden and psychological characteristics of school children in 2013 in Miyagi Prefecture, and found the need for long-term psychological support.

Three articles investigated the mental health issues of high-school, college and medical school students in the affected area. Okuyama et al. (2017) revealed that 860 of the 1,432 (55.9%) high school students were at high risk of psychological trauma in 2012. School teachers, nurses, and counselors provided a school-based intervention for all high-risk students that decreased the risks. Ishikawa et al. (2015) compared the mental health issues among Japanese young people living in Fukushima, Tokyo and Kyoto immediately after GEJE and 2.5 years later, concluding that anger symptoms were high among young people who lived at or near the center of the disasters, while anxiety and depression were high among those who lived far away from the disasters. Arata et al. (2015) examined the longitudinal health survey of medical students in Tohoku University and revealed that some students' conditions remained unchanged or worsened. Arata cautioned that medical students who had participated in voluntary activities, despite their own suffering of harm and distress, were identified as the group that required the closest attention.

The largest number of articles on mental health issue is in consistent with the result of systematic review of non-communicable disease (NCD) after GEJE, in which, articles describing respiratory diseases and mental illnesses were found most frequent. Out of 101 reports describing NCDs that had developed after the GEJE, 60% were related to mental health issues (Murakami et al. 2018).

The accident of nuclear power plant in GEJE had significant impact in disaster medicine. Fukunaga and Kumakawa (2015) suggested that the patients and residents of Northeast Fukushima may be undergoing mental health crisis, by the findings that disaster-related psychological stress could have induced several physical and mental disorders, insisting the urgent needs of mid- and long-term supports for all residents in the district. Kyozuka et al. (2018) summarized the result of the nation-wide birth cohort study, Japan Environment and Children's Study (JECS) in Fukushima Prefecture confirming the rates of preterm birth, low birth weight, and major anomaly were not different from those in the national statistics. They found that hypertensive disorder of pregnancy and placental abruption, were most frequently seen among teenage mothers with low socioeconomic status. Murakami et al. (2019) compared the levels of psychological distress in both returnees and evacuees at seven years later, finding a significantly better psychological distress status in returnees than the evacuees, stressing that psychological distress among the evacuees is an urgent problem, and social support is still necessary for the returnees. Ueda et al. (2019) used the data for evacuees of the nuclear power plant accident and identified that insufficient sleep and heavy drinking ($\geq$ 4 drinks per day) were significant risk factors for the incidence of problem drinking in both men and women. Hasegawa et al. (2019) revealed the increases in healthcare and long-term care expenditure, possibly because of the poor health status of the evacuees following the evacuations, reduced availability of informal care provided by family members and neighbors, and reduced patient copayments. The recovery and reconstruction are still on-going after GEJE. Yumiya et al. (2019) found that unreliable information sources, such as "Internet" and "a combination of TV, radio, and word of mouth," were significantly associated with high mental fatigue, compared with reliable information sources, such as "municipal public relations in addition to major media (newspaper, TV, and radio)", suggesting how information sources affect mental fatigue following a disaster.

There are seven articles related with the Tohoku Medical Megabank Project that was started as the creative reconstruction from the GEJE (Kikuya et al. 2015; Miyashita et al. 2015, Ishikuro et al. 2018; Minegishi et al. 2019; Nagami et al. 2020; Tsuboi et al. 2020). TJEM played a significant role in publishing the protocols, design and progress and public relations of the project so that the world largest size of genome cohort can work as an operational research for reconstruction (Building Back Better) after GEJE. Another example of Building Back Better is the Miyagi Medical and Welfare Information Network (MMWIN), that works as a backup system of medical records. This system also facilitates the sharing of clinical information between health facilities as long as patients provide consent for this (Ido et al. 2019).

Articles related with other disasters in TJEM after 2011

Naito et al. (2020) confirmed a linear correlation between the number of completely collapsed houses and the number of direct deaths suggesting the application of the latest building codes to prevent such deaths. Tseng et al. (2019) compared the early (< 24 h from admission) to the delayed post-pyloric tube feeding to the patients with severe burn in the 2015 fire disaster in Taiwan and concluded that earlier tube feeding can be successfully initiated with beneficial outcomes of nutritional reconstruction in severely burned patients.

Four articles were on infectious disease related with disaster. Jones-Konneh et al. (2017) reviewed the trend of new patients and deaths by Ebola virus disease (EVD) and the countermeasures of affected Sierra Leone, suggesting the importance of intensive education to comply with the infection control and prevention. Jones-Konneh et al. (2018) further extrapolated this notion to an agent-based simulation model of healthcare workers' attitude and found that seeking training at the time of outbreak and appropriate care procedure have a greater effect on reducing the number of health care workers infected during EVD outbreak, while initial education alone cannot prevent nosocomial infection. Saitoh et al. (2015) recalled the awareness of leptospirosis as a re-emerging zoonosis, that might appear with higher prevalence when flood occurs through the report of four cases. Pascapurnama et al. (2016) reported the increased prevalence of tetanus after earthquakes in Indonesia, suggesting the importance of awareness, education and advocacy of health damage after disaster. Hattori et al. (2016) developed a point-of-care testing for molecular diagnosis and disease severity using loop-mediated isothermal amplification assay for leptospirosis, dengue and *Mycobacterium Tuberculosis*, which does not require a source of electricity.

Usuzawa et al. (2014) found the awareness of international framework in healthcare workers are very low. The responders tended to overestimate the risk of low probability and high consequence such as geophysical disaster. Hekimoglu et al. (2012) stressed the importance of appropriate evacuation strategy after disaster, experiencing the 19 people (small children and older persons) injured or died in the repetitive fires occurred in the tent shelters from Nov. 2011 to Feb. 2012 after the earthquake (Oct. 2011) was settled down. These are the environmental determinants of health damage and deaths related with disaster.

Burkle (2019), in an invited review for TJEM's 100-year anniversary, pointed out the emergence of complex global public health crises such as climate change and extremes, biodiversity loss, emergencies of scarcity, rapid unsustainable urbanization, migrant and refugee surges, domestic and international terrorism, cyber-security, the civilianization of war and conflict, and the global rise of resistant antibiotics has resulted in an unprecedented rise in direct and indirect mortality and morbidity. Burkle emphasized the structured development of a Health Crisis Management Framework to oversee the phase-related strategic and operational requirements for prevention, preparedness, response, recovery and rehabilitation challenges of major global public health crises and disaster.

Three articles were on the mental health aspects in other disasters. Shiratori et al. (2020) analyzed the emails of disaster mental health responders in 2015 Kinugawa Flood, and revealed that spreading information and recruiting people to provide disaster support was given the highest priority in the first week, while support and swift decision-making were essential for directing large numbers of staff in the following weeks. In later phase, support for staff to share information and experience in small groups was necessary, recommending to change the communication style accordingly. Ozaki et al. (2018) performed a nationwide cross-sectional study to assess the beneficial effect of social capital on mild mood or anxiety disorder finding that the protective effects of social support against mood/anxiety disorder vary in the Japanese population depending on disaster experience. Horiuchi et al. (2019) clarified that high social support was associated with both reduced negative emotional response and increased positive emotional response, suggesting the protective effects of social support and cognitive social capital against news media coverage of natural disasters.

Articles related with COVID-19 pandemic in TJEM

TJEM has 9 articles searched by the keyword "pandemic" and all is related with COVID-19. Mishima et al. (2020) reviewed the mechanisms of uric acid elevation by, favipiravir (Avigan), a purine nucleic acid analog and antiviral agent. Yamaya et al. (2020) showed the suppressive effects of protease inhibitors, and interferons on the replication of coronavirus. Delgado et al. (2020) gave a perspective to the importance of knowing the accurate death number by COVID-19/million population to evaluate the policy against the pandemic to know how to save lives. Razzaque (2020) gave a commentary that adequate zinc balance especially in elder population may reduce the viral replication and enhance the immunity. Ornelas-Ricardo et al. (2020) reviewed the thrombotic events in COVID-19 and pointed out that altered D-dimer, C-reactive protein, and interleukin-6 can be the prognostic biomarkers that, mainly, the D-dimer indicates the use of antithrombotic therapy at prophylactic or therapeutic doses. Alamdari et al. (2020) examined the prognostic factors in a tertiary center in Iran finding that the body mass index (BMI) > 35, lung cancer, chronic kidney disease, immunocompromised condition, and diabetes were more frequently observed in the expired group, while there was no significant difference in the antihypertensive drugs, nonsteroidal anti-inflammatory drugs, aspirin, steroids, and in the past-year influenza vaccination. Kishaba et al. (2020) also found never-smoker, high BMI, earlier artificial ventilation, and fewer lymphocytes are the predictor of mortality. Nakanishi et al. (2020) detected that the frequencies of fatigue, loose stool, diarrhea, nasal obstruction, olfactory dysfunction, taste dysfunction, under-

lying hyperlipidemia, and the prescription of angiotensin II receptor blocker (ARB) and atypical lymphocytes were significantly higher in COVID-19 patients than those in non-COVID-19 patients. Ishii et al (2021) described the history of close contact with COVID-19 patients and the presence of cough symptoms are the significant predictors of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) test positivity among the drive-through nasopharyngeal swab testing for COVID-19 in Sendai, Japan. This article is the overlapped result of "disaster" and "pandemic" keyword search. The expertise and coordinating capability of disaster medical experts assisted this operation efficiently.

Conclusion

TJEM as a general medical journal has changed its scope to include disaster medicine and disaster science and is accumulating the articles on various topics. While international frameworks (Sendai Framework, SDGs as well as the climate change adaptation agreement) strongly requires the trans-disciplinary harmonization and cooperation, the role of health workers to outreach to the other sectors are critical because disaster medicine covers any health consequences after any type of hazard attacks the human community. IRIDeS can be the bridging hub for the health sectors and other sectors so that comprehensive implementation of DRR becomes possible. Because disaster can happen anytime, anywhere and to anybody by any type of hazard & exposure, understanding the disaster risk, reducing the risk and being prepared to act can be the essential motivation of healthcare workers in all phase of disaster.

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Conflict of Interest

The author declares no conflict of interest.

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