

Disaster Health After the 2011 Great East Japan Earthquake

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Abbreviation:

DMATs: Disaster Medical Assistance Teams

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Abstract

Introduction: The March 11, 2011 disaster was unparalleled in the disaster history of Japan. There is still enormous effort required in order for Japan to recover from the damage, not only financially, but psychosocially. This paper is a review of the studies that have been undertaken since this disaster, from after the March 11th disaster in 2011 to the end of 2012, and will provide an overview of the disaster-health research literature published during this period.

Methods: The Japanese database *Ichushi Ver. 5* was used to review the literature. This database is the most frequently used database in Japanese health-sciences research. The keywords used in the search were “*Higashi Nihon Dai-shinsai*” (The Great East Japan Earthquake).

Results: A total of 5,889 articles were found. Within this selection, 163 articles were categorized as original research (*gencho ronbun*). The articles were then sorted and the top four key categories were as follows: medicine (n = 98), mental health (n = 18), nursing (n = 13), and disaster management (n = 10). Additional categories were: nutrition (n = 4), public health (n = 3), radiology, preparedness, and pharmacology (n = 2 for each category). Nine articles appeared with only one category label and were grouped as “others.”

Conclusion: This review provides the current status of disaster-health research following the Great East Japan Earthquake. The research focus over the selected period was greatly directed towards medical considerations, especially vascular conditions and renal dialysis. Considering the compounding factors of the cold temperatures at the time of the disaster, the geography, the extensive dislocation of the population, and the demographics of an aging community, it is noteworthy that the immediate and acute impact of the March 11th disaster was substantial compared with other events and their studies on the impact of disaster on chronic and long-term illness. The complexity of damage caused by the earthquake event and the associated nuclear power plant event, which possibly affected people more psychologically than physically, might also need to be investigated with respect to long term objectives for improving disaster preparedness and management.

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Introduction

Knowledge of disaster-health research in Japan has developed since the prior major earthquake in 1995, which fostered significant improvements in understanding and management of the typical health impacts of disaster. One of the achievements in medical relief activities was the establishment and coordination of Disaster Medical Assistance Teams (DMATs) at both the national and local level. However, the March 11th earthquake, and the ensuing tsunami and nuclear reactor meltdown, was a disaster unparalleled in the history of Japan. There is still enormous effort required in order for Japan to recover from the damage, not only financially, but psychosocially. The damage totaled 15,880 deaths and 2,700 missing persons with 128,913 houses completely destroyed.¹ What was learned from this experience, especially in the area of disaster health, had not been broadly discussed in an international context; however, it had been discussed in the Japanese context. This paper will review the studies that have been undertaken since the disaster took place on March 11, 2011 to the end of 2012, and overview the progress of disaster-health research in relation to this event. The findings will describe the current state of disaster-health research and identify further research requirements, particularly in relation to the March 11th disaster.

Type of Articles	No. of Articles
Conference report/abstract/summary.	2,856
Commentary: articles on specific area and themes.	1,615
General: rest of the categories, but noteworthy context.	1,137
Discussion paper.	68
General remarks: articles' specialized areas and themes based on relevant literature and resources. The articles states review and general remarks.	25
Q&A: the article composed with questions and answers.	17
Letter: letter to editor, including author's reply.	7
Total	5,725

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Table 1. The Types of Articles, Other Than Original Articles (N = 5725)

Methods

The Japanese database *Ichushi Ver. 5* was used to review the literature. This database is the most frequently used database in Japanese health-sciences research. The search keywords used were “*Higashi Nihon Dai-shinsai*” (The Great East Japan Earthquake). The use of these keywords to search articles was appropriate as they related to the particular disaster explored in this paper; the database recognized the term well. In order to categorize the article types, the sort function in the database system was used. The article types retrieved were categorized as per Table 1. The style of article categorization was unique to the *Ichushi Ver. 5* database system, which showed the article type according to the purpose of the article. To increase reliability of article selection, *gencho ronbun* (meaning that the paper is composed of methods, results, and discussion on the study, equivalent to the English journal category of “original research article”) was selected so that researchers could view and analyze whole articles. Literature, such as gray literature and formal reports, was not included to keep consistency of the review process.

The selected articles were tabulated into a spreadsheet for analysis. The articles were categorized by the main disciplinary/research area, such as medicine, nursing, and disaster management. Following the main category, research themes and subjects were used as labels to form sub-categories. After the articles were appropriately labeled, descriptive analysis was undertaken in order to identify the focus and potential contribution to progress in the disaster-research field, as well as its related research subject. Furthermore, the remaining articles on *Higashi Nihon Dai-shinsai* (The Great East Japan Earthquake) also were analyzed descriptively, according to the type of article, in order to reveal trends in disaster-health research. The integrated review approach was applied through the review process.

Results

A total of 5,889 articles were found. Within these articles, 163 articles were categorized as original research (*gencho ronbun*).

Two articles were not relevant to the March 11th disaster, and as a result, these articles were excluded and 161 articles were analyzed. The number of articles explored that included the top four categories were as follows: medicine (n = 98), mental health (n = 18), nursing (n = 13), disaster management (n = 10). In addition, there were nutrition (n = 4), public health (n = 3), and radiology, preparedness, and pharmacology (n = 2 for each category) (Table 2). Nine articles appeared with only one category label and were grouped as “others” (Table 3).

The subcategories within each main category were also allocated. In the main category of medicine, subcategories of dialysis (n = 12) and vascular-themed research (n = 11) were highly represented. In the mental health subcategory, there were five articles categorized focusing on hospital admission management.²⁻⁶ These included discussions on the disaster-affected hospitals and how they could increase their capacity for psychiatric patients who needed continuous treatment and care. The third largest group, nursing (n = 13), had two dialysis^{7,8} and two mother-and-child care^{9,10} focused papers. The other articles studied the perception of nurses towards preparedness following the disaster. Although these articles did not focus on nurses who encountered the disaster directly, the studies were motivated by the March 11th disaster occurrence in respect to reviewing current practice. The fourth largest group was disaster hospital management (n = 10). This group included the damage report system (n = 2),^{11,12} hospital surge capacity (n = 2),^{13,14} and dialysis management (n = 2)^{15,16} as sub-keywords. Within the remaining categories, the focus of the nutrition articles (n = 4) was on evacuation centers (n = 1),¹⁷ survey (n = 1),¹⁸ hospital nutrition (n = 1),¹⁹ and role of nutritionists during the disaster (n = 1).²⁰ Within the public health group (n = 3),²¹⁻²³ all articles were on the impacts of nuclear radiation upon public health. Within radiology (n = 2), a radiation-focused article²⁴ and an environmental health article²⁵ were each counted as one. Detail is provided in Table 2 in relation to the preparedness and pharmacology groups (n = 2 for each group).

There were 5,725 articles other than original articles (*gencho ronbun*). Table 1 shows the types of published articles and the number of articles. The conference report/abstract/summary category contained the highest number of articles (n = 2,846). This category included the abstracts of refereed journals, where that majority of these articles were not yet fully published.

Discussion

High Presentation of Articles in Chronic Disease Including Renal Dialysis and Vascular Problems

Renal dialysis (n = 12) and vascular condition related areas of study (n = 11) presented a significant number of papers as subcategories. The significantly disaster-impacted prefectures (Miyagi, Iwate, and Fukushima prefectures) contained a generally older population when compared with the rest of Japan. According to the 2010 population census,²⁶ those affected prefectures contained 22.3%, 27.2%, and 25.0% of residents over 65 years of age, respectively, where the national average was 23.0%. Consequently, there were a greater number of older persons who were displaced to evacuation centers after the disaster. There were still 320,000 people across Japan at the end of 2012 who were dislocated having had to evacuate the affected area, and 159 people living in evacuation centres.²⁷

In addition to the above demographic characteristics of the affected area, meteorological factors at the time of the earthquake

Main Keyword	Sub-keyword
Medicine (n = 98)	Dialysis (12), Vascular (11), Cardiology (4), Chinese medicine (4) Respiratory (4), Infection (3), Neurosurgery (3), Transport (2), Nuclear medicine (2), Chronic disease management (2). Other sub-keywords include: acute stage management, diabetes, Disaster Medical Assistant Team (DMAT), head injuries, emergency, neurology, ophthalmology, pediatrics, and others.
Mental Health (n = 18)	Hospital admission management (5), Affected workers/deployed workers (4), University students and children (2), Suicide attempt (1) and others.
Nursing (n = 13)	Dialysis (2), Mother-and-child care (2), Risk management (1), drill (1), preparedness (1), and others.
Disaster Hospital Management (n = 10)	Damage report system (2), Hospital surge capacity (2), Dialysis management (2), Preparedness (1), Survey on patient management (1), Students practice (1), and others.
Nutrition (n = 4)	Evacuation Centre (1), survey (1), hospital nutrients (1), role of nutritionists (1).
Public Health (n = 3)	Nuclear (3).
Radiology (n = 2)	Nuclear (1), and environmental health (1).
Preparedness (n = 2)	Hospital staff (1), and university (1).
Pharmacology (n = 2)	Supply (1), and disaster management (1).
"Others" (n = 9)	See Table 3.

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Table 2. Results (N = 161)

Dentistry	1
Health Evacuation	1
Media	1
Mobile Communication	1
Older People	1
Patient Support Group	1
Triage	1
Welfare	1
Physiotherapy	1

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Table 3. "Others" in the Main Keywords (N = 9)

should be considered. There is an established link between climate extremes and the acute presentation of people with chronic disease conditions.²⁸ The season was still cold, being winter in the northern part of Japan. For example, in Fukushima, the high daily temperature on the day of the disaster was 7.2°C and the low was -3.7°C.²⁹ However, it was not only environmental stress, but also the psychological and physical stress of dislocation, that may have been concerning. For example, it was argued that the living conditions in evacuation centers, such as sharing rooms with others, queuing for toilets, and limited space to spend time (unable to go outside due to the weather condition), put those people at potentially higher risk of health care problems.³⁰ In particular, two "triggers" for serious consideration were dehydration (in an attempt to avoid going to toilet), and demobilization (due to the limited space.) Therefore, studies to

consider and deepen our understanding of these problems could be a priority for future research.

Another subcategory, renal dialysis, was also highly represented in relation to the disaster. Seven out of 12 articles were focused on disaster management, such as reporting damage of dialysis clinics, evaluation of disaster plans, and review of clinical pathways.³¹⁻³⁷ The remainder of the articles focused on dialysis patient management.³⁸⁻⁴² The topic of dialysis management and patient care during a disaster was explored through the previous earthquake disaster of 1995. As the earthquake affected a populated metropolitan area, dialysis clinics, including independent institutions and hospital settings, experienced significant damage. There were also patients who were diagnosed with crush syndrome after being trapped under collapsed buildings. Dialysis was the primary treatment of this medical condition. Therefore, establishing a hospital and clinic network system for dialysis patients in the case of disaster was a critical issue after the 1995 earthquake. When the 2011 disaster happened, there was concern that many trauma patients would be trapped under the collapsed buildings, as it was with the 1995 earthquake. However, the damage caused by the tsunami that was triggered by the earthquake meant that it was more problematic to look for available medical placements for continuing dialysis on patients than to treat injured patients caused by the disaster. There were 397,746 houses and buildings that were either "totally collapsed" or "half collapsed" with many of them washed away.²⁶ The disaster affected a wide spread area and many dialysis clinics, including hospitals, were damaged. The issue of insufficient electricity to run dialysis machines was also a universal issue within disaster management scenarios.

Mental Health

There were 18 articles (11%) related to mental health research. Five articles studied hospital admission management for

psychiatric patients.²⁻⁶ Continuity of care for psychiatric patients without the necessary medical facilities was a critical issue. Two articles investigated the psychological burden on relief workers, especially health professionals.^{43,44} There were also two articles investigating the psychological effect of the disaster on university students and children.^{45,46} Investigation of the psychological effect on the population was an important focus for both the short term and long term, in relation to disaster management. It was also noteworthy that there was an article on suicide attempts resulting from the disaster. Prevention of suicide and dying alone (*kodoku-shi*) after the previous major disaster of 1995, were highlighted as psychosocial issues, especially during the recovery phase of the disaster. The loss of family and “normal life” significantly affected people who had evacuated and moved into temporary housing.⁴⁷ The urgency for mental health support also was greatly emphasized following the March 11th disaster.⁴⁸

One example in particular was the nuclear plant disaster in Fukushima (linked to the March 11th disaster), which was not only life-threatening in itself but uncertain in its short- and long-term radiation effects upon the affected population, had created a psychosocial impact. Shultz et al state that the nuclear material exposure upon those in the affected area is of serious concern, as it affects all aspects of their lives. Studies on psychosocial care for those affected people should be prioritized by not only disaster health researchers, but also local government and community organizations to support long-term planning.

Nursing Research

The category of nursing represented eight percent ($n = 13$) of the articles. As the acute phase of the disaster was focused largely upon physiological aspects rather than psychosocial aspects of health, the presentation of nursing studies in health disaster resulted in relatively small numbers in this review. Analysis of the articles in the nursing group revealed a focus on dialysis ($n = 2$)^{7,8} and mother-and-child care ($n = 2$).^{9,10} These articles considered the affected people and the issues for medical facilities. Interestingly however, there were three articles reflecting nurses' disaster preparedness in practice (although not affected by the March 11th disaster), where a review of current practice in relation to psychological impact takes place following a disaster. Although there are only a small number of articles found in this category, relevant disaster nursing articles may have been published in other categories and further monitoring in this area could be required.

Hospital Management

There were 10 articles (six percent) categorized in the hospital management group. This category pertains to the evaluation of the reporting and communication system in place during the disaster. Two articles focused on the damage report systems.^{11,12} These articles considered the best way to report when a disaster strikes and evaluated the capacity for the system to work within the predicted planning frame. The findings from these studies could be used to review the current status of the reporting system (ie, disaster damage and hospital services availability levels) and to suggest the usefulness of these systems for future disasters. One of the articles discussed “what was expected” and “what was not expected,” where the scale of the disaster was beyond expectations and the required capacity to fulfill the gap between expected and unexpected was great. For example, hospital managers did not

expect that hospitals would be taken away or that hospitals would be isolated by the tsunami. Although predictions of earthquake occurrence in the middle to northern regions of Japan had existed for a long time, people simply did not expect that the disaster would be of such a great scale. Many hospitals could not function due to infrastructure damage or isolation from their vital lifelines (such as supplies).

There were two articles which studied the establishment of a medical support system.^{13,14} Kitamura's article explores core hospitals which were situated inland and were isolated from other areas in the affected prefecture.¹³ The argument was centered upon how to supply medical relief for these isolated hospitals. The logistics of maintaining these relief activities posed a severe challenge. Another article by Kobayashi et al was also on the long-term logistical support of affected patients.¹⁴ The paper argued that the medical institution's function was limited in the affected area, where the hospital worked as a hub for patients in the community to transport them to other facilities. There were 466 people (87.3%) who were transported to other prefectures. The most frequently-used vehicle for transportation was the ambulance (43.4%). The article suggested the need for a transport coordination role within the hospital in severe disaster.

Renal dialysis management was also a highlighted issue in the March 11th disaster. Two articles discussed dialysis facility management during the disaster.^{15,16} Both articles described an unexpected level of damage. One of the articles mentioned three key points: (1) they could not ask for help as they knew that shortage of resource was prevalent and they felt that they were responsible for supporting themselves; (2) they could not make contact with the disaster management headquarters due to the infrastructure damage; and (3) there was not enough information from headquarters due to infrastructure damage, and consequently, they had difficulty in understanding the current status. This case implied a loss of communication due to telecommunication infrastructure damage where medical institutions, including small size clinics, were isolated. The development of a backup system for telecommunication infrastructure in remote areas during a disaster situation would need to be further considered.

Significant Findings From Other Categories

There were four articles on nutrition and food security.¹⁷⁻²⁰ These included articles considering damage to food sources, such as radiation released from the Fukushima Nuclear Plant, and considering food availability, especially in hospital settings and evacuation centers. The amount of sodium intake per a day was one consideration because sodium was used often to maintain the condition of food. However, in the Japanese diet, vegetable pickles and soy-based products, including miso paste and soy sauce, constitute the main diet, and these are already high in sodium compared with other foods. Yarimizu pointed out that prior consideration on the amount of sodium intake was an important issue for dislocated people in evacuation centers, as well as the need for balancing protein, fat, and carbohydrate intake, as this balance tended to get lost when the period of dislocation was extended.²⁰ It was also suggested that lifestyle at evacuation centers, which presented an unbalanced diet along with a stressful living environment, could have exacerbated chronic conditions such as diabetes and high blood pressure. Research focusing on nutrition and a well-balanced diet for evacuees is a relatively new field, as the priority in the evacuation

situation is usually centered on food supply and logistical challenges. This area of study has significant potential for further investigation.

Limitations

The inclusion criteria of literature were very limited; for example, the review only focused on the articles published in Japanese and did not including gray literature, formal reports, and articles retrieved but not indexed for analysis. This may have excluded articles and perspectives published in other languages and other types of articles that may have addressed different views. This paper also undertook an integrated approach as a review procedure, which allowed the overview of findings of the selected literature. This may limit in-depth analysis of the particular disaster area of health research.

Conclusion

This review canvassed the current status of disaster-health research arising, at least in part, from the impacts of the Great East Japan Earthquake. Over the period from March 2011 until

the end of 2012, the research focus predominantly was directed towards medical concerns, especially the risk and management of chronic disease related problems. Considering the time of year and geographic and demographic profiles associated with the disaster, it was noteworthy that the extant literature was strongly focused on the immediate response phase rather than the longer-term effects of the disaster. Mental health constituted the second most prevalent category of study, and this area appeared to be attracting more serious attention as the longer term issues of recovery from disaster were better understood. The complex nature of the medium and longer term damage to essential societal functions by the earthquake, tsunami, and the nuclear power plant disaster will need to be investigated through the next decade with the long-term objective of improving preparedness and management of catastrophic disasters such as the March 11th event.

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