A Review of Factors Associated with Nutritional Problems and Improvement Initiatives after Natural Disasters

Naoko Miyagawa*1, Nobuyo Tsuboyama-Kasaoka*1, Moeka Harada*1,*2 and Nobuo Nishi*3

*1Section of the Global Disaster Nutrition, International Center for Nutrition and Information, National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health and Nutrition
*2Tokyo Kasei University
*3International Center for Nutrition and Information, National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health and Nutrition

doi:10.5264/eiyogaku.sh.78.S111

ABSTRACT

Objective: This review aimed to clarify the improvement methods for diet and nutrition at emergency shelters and the various initiatives implemented to improve health and nutrition after natural disasters in Japan.

Methods: To find scientific evidence of dietary improvement methods at emergency shelters worldwide a literature search was conducted in PubMed and J-STAGE using the following keywords: “Disaster” AND “shelter OR camp” AND “nutrition OR food OR diet”. Activity reports, reviews, articles without methods, and non-English or Japanese articles were excluded. In addition, we organized the information regarding initiatives taken to improve health and nutrition after natural disasters by governments, professional organizations, and academic research organizations in Japan.

Results: The literature search yielded seven articles. Four major factors associated with nutritional problems after natural disasters were identified from the literature review: 1) shelter size and equipment of the emergency shelter, 2) the method of provision and content of meals in emergency shelters, 3) collaboration with professionals, and 4) cooperation between shelters. After the Great East Japan Earthquake (GEJE), various initiative aimed at health and nutrition improvement after natural disasters, such as establishment of a specialized section, initiative/strategy to stockpile disaster food, development of human resources, and the nutrition standards for disasters, were started in Japan.

Conclusions: The present review identified factors associated with the improvement of nutritional problems in emergency shelters and various initiatives to reduce nutrition and health problems associated with natural disasters after the GEJE.

Key words: disaster nutrition, public health, initiatives, Great East Japan Earthquake

I. Introduction

Japan is one of the countries that are most vulnerable to natural disasters such as earthquake1). Over the past few years, huge deluges and powerful typhoons, which never occurred previously, have attacked Japan, such as the tragic flood in July 20182) and Typhoon Hagibis in 20193).

Victims are directly injured or killed in house collapses, floods, tsunamis, and fires, which occur as natural disasters. Furthermore, survivors who escape direct damage experience an increased risk of cardiometabolic factors such as hypertension and diabetes caused by indirect adverse effects such as severe stress, evacuation, difficulty finding a doctor and taking medicine, sleep deprivation, and inadequate diet and nutrition4, 5). Therefore, fatal and non-fatal cardiovascular diseases tend to occur after disasters6~11). After the Great East Japan Earthquake (GEJE), the incidence of cardiovascular diseases remarkably increased compared to that of other disaster areas in the past three years12, 13).

Various factors are related to the increased incidence of cardiovascular diseases, including food and nutrition.

Corresponding Author: Nobuyo Tsuboyama-Kasaoka. Section of the Global Disaster Nutrition, International Center for Nutrition and Information, National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health and Nutrition, 1–23–1, Toyama, Shinjuku-ku, Tokyo 162–8636, Japan
Tel: 81–3–3203–5721 Fax: 81–3–3202–3278 E-mail: ntsubo@nibiohn.go.jp
However, meals at emergency shelters have many nutritional imbalances such as excessive carbohydrate and low protein, dietary fiber, vitamins, and mineral content\(^{14, 15}\) and are therefore insufficient in terms of dietary volume and quality. It is difficult to prevent the risk factors of cardiovascular diseases after disasters; however, diet preparation and nutritional intake are modifiable factors available for people who have not experienced direct damage from disasters. Improving meals at shelters could potentially reduce the incidence of cardiovascular disease and disaster-related deaths, as many reports have shown favorable or adverse associations between diet and nutrition and cardiovascular disease in non-disaster situations\(^{16-21}\). This review aimed to identify methods for food and nutritional improvements and initiatives for improving health and nutrition at emergency shelters after natural disasters in Japan.

### II. Methods

A literature search of published research was conducted using the PubMed and J-STAGE databases to locate scientific evidence of dietary improvement methods at emergency shelters worldwide. Although PubMed is one of the most comprehensive databases for published health science research in the world, its coverage for non-English journals is incomplete; therefore, we conducted an additional search using the J-STAGE database to locate Japanese studies. We performed the search using the following key words to locate all relevant studies in the databases: “Disaster” AND “shelter OR camp” AND “nutrition OR food OR diet.” The search was performed without restrictions on date, language, or publication status. Duplicate studies extracted from the databases were removed manually. Activity reports, review articles, articles without methods, and articles written in a language other than English or Japanese were excluded from this review. We organized the extracted articles by fifteen factors and four categories narratively.

In the literature search, articles containing descriptions of factors for improvement of provided meals at emergency shelters after natural disasters were all from Japan. Consequently, we organized the information on initiatives targeted at the improvement of health and nutrition after natural disasters conducted by the government, professional organizations, and academic research organizations in Japan.

### III. Results

#### 1. Factors associated with nutritional problems at emergency shelters after natural disasters

The search resulted in 256 potential articles from PubMed (\(n = 150\)) and J-STAGE (\(n = 106\)). After screening the titles of the studies, 123 records were excluded from analysis. The remaining 133 full-text articles were assessed and five articles\(^{14, 22, 23-25}\) were found eligible for this review after excluding duplicated articles. Moreover, two additional articles\(^{26, 27}\) were found in the references of the five retained articles, and a total of seven articles\(^{14, 22-27}\) were finally included in the present review. Figure 1 shows the procedure followed for study identification and selection. The extracted studies comprised one article written in English and six articles written in Japanese. All seven extracted studies reported disasters that occurred in Japan, with six studies about the GEJE. Moreover, there were no interventional studies, as all the studies were cross-sectional observational studies.

Table 1 shows the factors associated with nutritional problems with provided meals at emergency shelters after natural disasters. Fifteen associated factors were identified from past quantitative and qualitative studies. Two studies reported that shelter size was related to dietary status after the GEJE. The meal frequency was low at large emergency shelters compared to moderately sized shelters\(^{14, 22}\). Within the utilities, the availability of gas supply was associated with meal balance\(^{14}\). A “balanced meal” was defined as two or more meals per day containing grains, vegetables, and meat or fish. Provision of cooked food is an important factor associated with both dietary volume and quality. When comparing emergency shelters with and without cooking equipment, the shelters with cooking equipment provided more meals as well as more dishes containing grains, vegetables and meat and fish\(^{14}\). Increasing the frequency of meals from two to three per day was associated with nutritional balance\(^{26}\). Furthermore, nutritional balance can be improved by increasing the frequency of providing main and side dishes, such as those made from fish, meat, and/or vegetables\(^{26}\). Morishita et al\(^{23}\) reported the importance of supplemental meals such
Records identified through database searching (n=256)

Records excluded (n=123)

Full-text articles assessed for eligibility (n=133)

Articles excluded (n=126)

Remained articles (n=7)

Duplicates removed (n=2)

Additional records identified from the reference of remained articles (n=2)

Studies included in data synthesis (n=7)

Figure 1 Flowchart of the selection process of studies

Table 1 Factors associated with nutritional problems at emergency shelters

| Factor | Dietary volume† | Dietary quality‡ | Source | Study design | Language |
|--------|-----------------|-----------------|--------|--------------|----------|
| Size and equipment of the emergency shelter |       |       |        |              |          |
| Moderate size shelter | ↑ Meal frequency | → | 14) Quantitative English |        |          |
| Gas | – | ↑ Meal balance | 14) Quantitative English |        |          |
| Water | N/A | → | 14) Quantitative English |        |          |
| Electronic | – | → | 14) Quantitative English |        |          |
| The method of provision and contents of meals |       |       |        |              |          |
| Cooking | ↑ Meal frequency, grain dish | ↑ Vegetable, meat, and fish | 14) Quantitative English |        |          |
| Meal frequency | – | ↑ Nutritional balance | 26) Quantitative Japanese |        |          |
| Main and/or side dishes | – | ↑ Nutritional balance | 26) Quantitative Japanese |        |          |
| Supplemental meal, e.g., soup, noodle | ↑ energy | ↑ Protein, vitamin B1 | 23) Quantitative Japanese |        |          |
| Mass feeding | ↑ Staple food | ↑ Main dish, side dish, fruits | 24) Quantitative Japanese |        |          |
| Dietitian created menu | – | ↑ Nutrition | 24) Quantitative Japanese |        |          |
| Lunch box | ↑ energy | ↑ Protein, fat, seafood | 25) Quantitative Japanese |        |          |
| Professional collaborations |       |       |        |              |          |
| School lunch center | – | ↑ Meal balance | 27) Qualitative Japanese |        |          |
| Self-defense force | – | ↑ Meal balance | 27) Qualitative Japanese |        |          |
| Dietitian | – | ↑ Meal balance | 27) Qualitative Japanese |        |          |
| Cooperation between shelters |       |       |        |              |          |
| Cooperation of cooking and management of food | – | ↑ Meal balance | 27) Qualitative Japanese |        |          |

† ↑ indicates an increase in dietary volume.
‡ ↑ indicates increased dietary quality. → indicates no change in dietary quality.
as miso soup with pork and vegetables (ton-jiru), udon-noodles, and miso soup with tofu and vegetables (kenchin-jiru) after the Great Hanshin-Awaji Earthquake. Added supplemental meals to the foods provided 10% of daily energy\(^\text{(23)}\). Vitamin B\(_1\) provided by miso soup with pork and vegetables was sufficient among other items.

The meal providing system is also an important associated factor. The provision of hot meals on site is called mass feeding. In emergency shelters where the frequency of mass feeding for evacuees was higher, the frequency of provision of four of the food groups (staple foods, main dishes, side dishes, and fruits) was significantly higher\(^\text{(24)}\). Another study also revealed the importance of mass feeding where the amounts of potatoes, meat, and vegetables were high at the emergency shelters where mass feeding was conducted\(^\text{(25)}\). Furthermore, in emergency shelters where dietitians created menus for mass feeding, the frequency of provision of two of the food groups (dairy products and fruits) was significantly higher\(^\text{(24)}\). If lunch boxes were provided, the amounts of energy, protein, seafood, and fats were high, and the amounts of vitamins B\(_1\) and vitamin C, potatoes, and vegetables were low at the emergency shelters\(^\text{(26)}\). A qualitative narrative study\(^\text{(27)}\) showed that in spite of the lack of gas and water, the shelters with better meal provision were in cooperation with the neighboring emergency shelter. Moreover, cooperation between cooking, storage, and management of relief food supplies was observed between neighboring emergency shelters. In cases where cooking was impossible, shelters with appropriate meal provision received meals from the school lunch center or Self-Defense Force. These shelters had dietitians who were in charge of meal provision and cooking.

2. Initiatives for improving health and nutrition after natural disasters

1) Establishment of a special section of disaster nutrition in the national institute

In 2018, the Global Disaster Nutrition section was established at the National Institute of Biomedical Innovation, Health, and Nutrition\(^\text{(28)}\). This is the first department dedicated to dealing with disaster nutrition in Japan. The slogan of the section is “evidence to action.” The mission of this section is to reduce nutrition and health problems associated with natural disasters. To achieve this mission, there are three main components: 1) Research for reducing nutritional disparity after natural disasters, 2) development of nutritional support systems during disasters, and 3) provision of information and support tools. Specifically, this section works during natural disasters to collect information about food and water using the Ministry of Health, Labour, and Welfare (MHLW) online Emergency Medical Information System (EMIS), in addition to other information systems in disaster areas, and to share it with the ministries and institutes responsible for providing and controlling stockpiled food and water. In addition, this section provides information leaflets on disasters for nutrition and diet, hygiene control, baby and mother, and elderly and non-communicable diseases in English, Spanish, Tagalog, Hangul, Vietnamese, and Chinese on their website\(^\text{(29)}\).

2) Strategy for stockpiling of disaster foods

The “Food Stock Guide to Preparing for Disasters” is an updated guideline on stockpiling disaster foods at home by the Ministry of Agriculture and Fisheries since March 2019\(^\text{(30)}\). It recommends that people store enough food and water at home for at least three days and preferably for a week. The rolling stock method was suggested, and involves both consuming stock food in daily life and storing it. In addition, the “Food Stock Guide to Preparing for Disasters for Persons Requiring Special Care” – which is the guideline for vulnerable people who cannot eat food provided at shelters, such as infants, the elderly, and persons with dysphagia, food allergy, or metabolic disorders such as diabetes mellitus, hypertension and chronic kidney disease – suggested stockpiling food for at least two weeks as obtaining special food would be problematic after the disaster\(^\text{(31)}\).

The Japan Disaster Food Society started a certification system for stockpiling disaster food in 2014. The main standards of this certification are as follows\(^\text{(32)}\): 1) edible foods without cooking, 2) manufacturing companies are able to stably produce products with sufficient hygiene standards, such as HACCP (Hazard Analysis Critical Control Point) and JAS (Japanese Agricultural Standard: the Japanese national standards in the field of agriculture, forestry, fisheries and the food industry\(^\text{(33)}\)), 3) the product has an expiration date longer than 6 months, and the quality of food during storage has been tested by registered inspection organizations regulated by the Food Sanitation Act or the Health Promotion Act or the Japan Accredita-
tion Board, 4) the product is transportable, storable, and sellable at normal temperature, and 5) the product has been sold for longer than a year.

3) Human resource development in emergency nutrition after natural disasters

In March 2018, the MHLW declared to local government that personnel training had started for the Disaster Health Emergency Assistance Team (DHEAT). The aim of DHEAT is to support and organize the disaster health emergency system, gather and analyze information, and coordinate various supporting teams in disaster areas. DHEAT consists mainly of specially trained medical doctors, dentists, pharmacists, veterinarians, public health nurses, laboratory technicians, registered dietitians, mental health workers, environmental health monitors, food hygiene monitors, and logistics experts among local government employees.

In 2012, the Japan Dietetic Association (JDA) created the Japan Dietetic Association-Disaster Assistance Team (JDA-DAT) to provide nutritional support after natural disasters. This team consists of dietitians who undertook special training to work in disaster areas within 72 hours after a disaster. In addition, JDA-DAT also established systems to provide a special diet for people with dysphagia and food allergies. This special diet was provided by food companies from all over Japan and abroad to supporting members of the JDA as relief food. Before the establishment of such systems, these special diets were buried in many relief foods and were not being utilized efficiently. The JDA is preparing to make an agreement with several food companies that support members of the JDA to provide special care food at the time of a natural disaster. When the local government of a disaster area requests help, the JDA-DAT will set up temporary stations (the Special Nutritional Diet Station) in shelters, local city halls, and other similar venues to provide special diets.

4) Nutrition standards for disasters

Table 2 shows the nutritional standard in Japan compared to the Sphere standard, which is a widely used set of humanitarian standards for people affected by disaster or conflict, as the reference.

In Japan, the MHLW set the nutritional standards for evacuees of emergency shelters with the aim of securing

| Nutrient           | Japanese Standard        | Sphere Standard<sup>37</sup> | Minimum population requirement |
|--------------------|--------------------------|-----------------------------|-------------------------------|
|                    | For dietary planning     | For dietary assessment      |                               |
| Energy             | 2,000 kcal               | 1,800~2,200 kcals           | 2,100 kcal                    |
| Protein            | 55 g                     | 55 g                        | 53 g (10% of total energy)    |
| Fat                | –                        | –                           | 40 g (17% of total energy)    |
| Vitamin A          | –                        | 300 μg RAE for 1~5 years old| 550 μg RAE                    |
| Vitamin D          | –                        | –                           | 6.1 μg                        |
| Vitamin E          | –                        | –                           | 8.0 mg alpha-TE               |
| Vitamin K          | –                        | –                           | 48.2 μg                       |
| Vitamin B<sub>1</sub> (Thiamin) | 1.1 mg | 0.9 mg | 1.1 mg |
| Vitamin B<sub>2</sub> (Riboflavine) | 1.2 mg | 1.0 mg | 1.1 mg |
| Niacin             | –                        | –                           | 13.8 mg NE                    |
| Vitamin B<sub>6</sub> (Pyridoxine) | – | – | 1.2 mg |
| Vitamin B<sub>12</sub> (Cobalamin) | – | – | 2.2 μg |
| Folate             | –                        | –                           | 363 μg DFE                    |
| Pantothenate       | –                        | –                           | 4.6 mg                        |
| Vitamin C          | 100 mg                   | 80 mg                       | 41.6 mg                       |
| Iron               | –                        | Sufficient intake for women | 32 mg                         |
| Iodine             | –                        | –                           | 138 μg                        |
| Zinc               | –                        | –                           | 12.4 mg                       |
| Copper             | –                        | –                           | 1.1 mg                        |
| Selenium           | –                        | –                           | 27.6 μg                       |
| Calcium            | –                        | 600 mg for 6-14 years old   | 989 mg                        |
| Magnesium          | –                        | –                           | 201 mg                        |
| Sodium             | –                        | –                           | 8.0 g of salt for men and 7.0 g of salt for women |

*Alpha-TE, alpha-tocopherol equivalents; RAE, retinol activity equivalents; NE, niacin equivalents; DFE, dietary folate equivalents.*
the required quantities of nutrients on June 4, 2011, three months after GEJE\(^3\). This standard for providing actual meals was based on the Dietary Reference Intakes for Japanese in 2010. It indicated reference values for energy, protein, and vitamins \(B_1\), \(B_2\), and \(C\). Additionally, with the objective of investigating whether the provision of meals was sufficient during the three months following the earthquake, MHLW presented the “Nutrition Reference Values for Dietary Assessments and Planning for the Provision of Food to Emergency Shelter”. This reference separately lists the quantities of calcium and vitamin A as special items that are essential during childhood growth. The quantity of sodium is presented primarily from the perspective of lifestyle-related disease prevention. The nutritional standards for evacuees of emergency shelters in Japan, the Dietary Reference Intakes for Japanese in 2015, were updated on 6 June 2016, one and a half months after the Kumamoto earthquake\(^4\).

The Sphere standard\(^5\) showed the minimum population requirements of nutritional intake for energy and 21 macro/micronutrients. These requirements incorporate the requirements of all age groups and both sexes.

### IV. Discussion

This study reviewed the scientific evidence and initiatives taken to improve food and nutrition after natural disasters. We identified 15 associated factors from the reviewed articles. Four major factors were associated with nutritional problems after natural disasters: 1) the size and equipment of the emergency shelter (shelter size, gas, water, outage, and cookware), 2) the method of provision and contents of meals in emergency shelters (frequency of meals, using added side dishes, mass feeding, lunch boxes, and dietician created menus for mass feeding), 3) collaboration between professionals (dietitian, Self-Defense Forces, and school meal center), and 4) cooperation between the shelters. After the GEJE, various initiatives to reduce nutrition and health problems accompanying natural disasters were started in Japan, such as the establishment of the Department of Global Disaster Nutrition, submission of the emergency stockpile food guideline, starting a disaster food certification system, development of human resources for public health and nutrition, and submitting nutrition standards for disaster.

There were some discrepancies between the Japanese and Sphere standard values. Dietary standards are set in accordance with the disease patterns and dietary habits of each country, and there are differences in nutrition labeling among countries\(^6\). Nutrition standards in Japan include sodium reference ranges, which are not set in the Sphere standard, as Japanese people consume large amounts of salt. The incidence of cardiometabolic risk factors, such as hypertension and cardiovascular disease, increased after the disaster in survivors of the GEJE\(^5\). Estimated increased salt intake, which was evaluated by spot urine testing, was associated with newly diagnosed hypertension in evacuees approximately one and a half months after GEJE\(^6\). This association was observed in the population with a high risk of salt-sensitive hypertension, such as older age, obesity, chronic kidney disease, and diabetes, and without prevalent hypertension before the natural disaster. Therefore, salt reduction is important even after disasters.

The Global Disaster Nutrition section at the National Institute is gathering information on the size and equipment of emergency shelters and how this contributes to solving these problems. Cooking conditions in shelters were related to the volume and quality of meals. Additionally, in shelters after the Hanshin-Awaji earthquake, the provision of hot meals was desired\(^2\) and higher satisfaction was observed by mass feeding\(^4\). The disaster food certification system promotes the development of food that does not require cooking. Increasing the number of main and side dishes in the lineup of these products can be expected to improve the nutrition of disaster survivors. However, there are many problems when making healthy commercial food and healthy lunch boxes not only after a disaster, but also during non-disaster periods\(^4\). It is thought that promoting nutrition education will lead to a disaster-resistant society even when no disaster has occurred. Support by dietitians improved the quality of meals in emergency shelters, suggesting the importance of dietitian teams for disasters (JDA-DAT). Implementing nutrition standards for disasters would help dietitians plan menus for mass feeding. Multidisciplinary DHEATs would help facilitate collaboration between professionals (dietitian, the Self-Defense Forces, and school meal center) and cooperation between the shelters. In summary, as shown
in Figure 2, the factors associated with food and nutrition in emergency shelters, as determined from the literature search, were related to government initiatives, professional organizations, and academic research organizations in Japan.

This review paper has several limitations. First, the literature search for factors associated with nutritional improvement in emergency shelters yielded only seven studies matching the eligibility criteria; all studies were from Japan and six out of seven reported on the GEJE. Different problems were presented and required solutions depending on the type of disaster and the area of damage. Moreover, since diet is closely associated with culture, society, and region, the improvement factors in shelters in the present review may not be generalizable. Second, because the literature search was conducted on dietary improvement factors in shelters, the information extracted from the literature was from relatively soon after the disaster, and thus the situation in the mid- to long-term post-disaster period was outside the scope of this study. A report from the United States showed that disasters affect food insecurity not only immediately following the disaster, but also in the long term and especially among the socially vulnerable. Therefore, we should continually search for factors to improve nutrition after disasters. Third, almost all the extracted reports in the present literature review were in Japanese. Japan is one of the countries most prone to natural disasters, and we have extensive experience dealing with severe health problems after a natural disaster. Papers published in Japanese have contributed to the construction of the disaster nutrition system in Japan. Our next step is to report our knowledge in English to reduce the health problems associated with natural disasters around the world. Lastly, all manuscripts extracted in the present study were from cross-sectional studies, and there were no interventional studies conducted due to the nature of disaster relief. The quality of studies is important to better understand the nutritional improvement factors post-disaster. However, studies of humanitarian responses after disasters, including nutrition, were also poor at describing the limitations of the methods and presenting confounding factors such as age, sex, and economic status, after adjustment for confounders. Additional research in the future, such as evidence-based interventions, is required to help improve the effectiveness and efficiency of nutrition improvement post-disaster.
V. Conclusion

The present review identified the factors associated with improving nutritional problems in emergency shelters and the various initiatives taken to reduce nutritional and health problems accompanying natural disasters after the GEJE. This area of research requires further studies and systems to address these problems.

Conflict of Interest

None declared.

References

1) Ministry of Foreign Affairs of Japan: Disasters and Disaster Prevention in Japan, https://www.mofa.go.jp/policy/disaster/21st/2.html (Accessed February, 12, 2020)
2) OECD: Chapter 4. Japan’s preparedness for public health emergencies, OECD Reviews of Public Health: Japan A Healthier Tomorrow: A Healthier Tomorrow, p. 195 (2019) OECD publishing, Paris
3) Tai, C.W.J., Yun, S.H., Chin, S.T., et al.: Rapid flood and damage mapping using synthetic aperture radar in response to Typhoon Hagibis, *Ipn. Sci. Data.*, 7, 100, doi: 10.1038/s41597-020-0443-5 (2020)
4) Kario, K.: Disaster hypertension - its characteristics, mechanism, and management, *Circ. J.*, 76, 553–562, doi: 10.1253/circj.cj-11-1510 (2012)
5) Ohira, T., Nakano, H., Nagai, M., et al.: Changes in cardiovascular risk factors after the Great East Japan Earthquake, *Asia Pac. J. Public Health*, 29(2_suppl), 475–555, doi: 10.1177/105915241665436 (2017)
6) Trichopoulos, D., Katsouyanni, K., Zavitsanos, X., et al.: Psychological stress and fatal heart attack: the Athens (1981) earthquake natural experiment, *Lancet*, 1, 441–444, doi: 10.1016/s0140-6736(83)91439-3 (1983)
7) Leor, J., Poole, W.K., Kloner, R.A.: Sudden cardiac death triggered by an earthquake, *N. Engl. J. Med.*, 334, 413–419, doi: 10.1056/NEJM199602153340701 (1996)
8) Kario, K., Matsuo, T., Kobayashi, H., et al.: Earthquake-induced potentiation of acute risk factors in hypertensive elderly patients: possible triggering of cardiovascular events after a major earthquake, *J. Am. Coll. Cardiol.*, 29, 926–933, doi: 10.1016/s0735-1097(97)00002-8 (1997)
9) Kario, K., Ohashi, T.: Increased coronary heart disease mortality after the Hanshin-Awaji earthquake among the older community on Awaji Island. Tsuna Medical Association, *J. Am. Geriatr. Soc.*, 45, 610–613, doi: 10.1111/j.1532-5415.1997.tb03096.x (1997)
10) Suzuki, S., Sakamoto, S., Koide, M., et al.: Hanshin-Awaji earthquake as a trigger for acute myocardial infarction, *Am. Heart. J.*, 134, 974–977, doi: 10.1016/s0002-8703 (97)80023–3 (1997)
11) Kloner, R.A., Leor, J., Poole, W.K., et al.: Population-based analysis of the effect of the Northridge Earthquake on cardiac death in Los Angeles County, California, *J. Am. Coll. Cardiol.*, 30, 1174–1180, doi: 10.1016/s0735-1097(97)00281-7 (1997)
12) Aoki, T., Fukumoto, Y., Yasuda, S., et al.: The Great East Japan Earthquake Disaster and cardiovascular diseases, *Eur. Heart J.*, 33, 2796–2803, doi: 10.1093/eurheartj/ehs288 (2012)
13) Omama, S., Yoshida, Y., Ogasawara, K., et al.: Influence of the great East Japan earthquake and tsunami 2011 on occurrence of cerebrovascular diseases in Iwate, Japan, *Stroke*, 44, 1518–1524, doi: 10.1161/STROKEAHA.111.000442 (2013)
14) Tsuboyama-Kasaoa, N., Hoshi, Y., Onodera, K., et al.: What factors were important for dietary improvement in emergency shelters after the Great East Japan Earthquake? *Asia Pac. Clin. Nutr.*, 23, 159–166, doi: 10.6133/apcn.2014.23.1.17 (2014)
15) Inoue, T., Nakao, A., Kuboyama, K., et al.: Gastrointestinal symptoms and food/nutrition concerns after the great East Japan earthquake in March 2011: survey of evacuees in a temporary shelter, *Prehosp. Disaster Med.*, 29, 303–306, doi: 10.1017/S1049023X1000533 (2014)
16) He, F.J., Nowson, C.A., Lucas, M., et al.: Increased consumption of fruit and vegetables is related to a reduced risk of coronary heart disease: meta-analysis of cohort studies, *J. Hum. Hypertens.*, 21, 717–728, doi: 10.1038/sj.jhh.1002212 (2007)
17) Okuda, N., Miura, K., Okayama, A., et al.: Fruit and vegetable intake and mortality from cardiovascular disease in Japan: a 24-year follow-up of the NIPPON DATA80 Study, *Eur. J. Clin. Nutr.*, 69, 482–488, doi: 10.1038/ejcn.2014.276 (2015)
18) Mozaffarian, D., Wu, J.H.: Omega-3 fatty acids and cardiovascular disease: effects on risk factors, molecular pathways, and clinical events, *J. Am. Coll. Cardiol.*, 58, 2047–2067, doi: 10.1016/j.jacc.2011.06.063 (2011)
19) Miyagawa, N., Miura, K., Okuda, N., et al.: Long-chain n-3 polysaturated fatty acids intake and cardiovascular disease mortality risk in Japanese: a 24-year follow-up of NIPPON DATA80, *Atherosclerosis*, 232, 384–389, doi: 10.1016/j.atherosclerosis.2013.11.073 (2014)
20) Strazzullo, P., D’Elia, L., Kandala, N.B., et al.: Salt intake, stroke, and cardiovascular disease: meta-analysis of prospective studies, *BMJ*, 339, b4567, doi: 10.1136/bmj.b4567 (2009)
21) Hooper, L., Martín, N., Abdelhamid, A., et al.: Reduction in saturated fat intake for cardiovascular disease, *Cochrane Database Syst. Rev.*, 10, CD011737, doi: 10.1002/14651858. CD011737 (2015)
22) Sasaki, Y.: Food and nutrition support and dietitians assistance in emergency shelters after the Great East Japan, *Sendai Shirayuri Women’s College*, 16, 103–118 (2012) (in Japanese)
23) Morishita, T., Kubo, K.: Survey of the diets of persons in refuge centers after the Great Hanshin-Awaji Earthquake and the effect of the latter supplements – Higashinada-ku, Kobe. *Journal of Cookery Science of Japan*, 30, 347–354 (1997) (in Japanese)

24) Harada, M., Takizawa, A., Oka, J., et al.: The effects of changes in the meal providing system on emergency shelter menus following the Great East Japan Earthquake, *Nihon Koshu Eisei Zasshi*, 64, 547–555, doi: 10.11236/jph.64.9.547 (2017) (in Japanese)

25) Mihara, M., Harada, M., Oka, J., et al.: The effect of lunch box provision and mass feeding on energy and nutrient supply at emergency shelters after the Great East Japan Earthquake, *Nihon Koshu Eisei Zasshi*, 66, 629–637, doi: 10.11236/jph.66.10.629 (2019) (in Japanese)

26) Harada, M., Tsuboyama-Kasaoka, N., Takizawa, A., et al.: Improving nutrient balance by providing main and side dishes in emergency shelters after the Great East Japan Earthquake, *Jpn. J. Disast. Med.*, 22, 17–23 (2017) (in Japanese)

27) Tsuboyama-Kasaoka, N., Hoshi, Y., Onodera, K., et al.: Factors impacting meal provision in emergency evacuation centers (shelters) after the Great East Japan Earthquake, *J. Jpn. Disast. Food Soc.*, 1, 35–43 (2014) (in Japanese)

28) National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health and Nutrition: National Institute of Health and Nutrition, https://www.nibiohn.go.jp/eiken/english/about/eiken_leaflet2014.pdf (Accessed January, 30, 2020)

29) Section of the Global Disaster Nutrition, International Center for Nutrition and Information, National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health and Nutrition: Information of disasters, https://www.nibiohn.go.jp/eiken/disasternutrition/info_saiagai_global.html (Accessed January, 30, 2020)

30) Ministry of Agriculture and Fisheries: Food Stock Guide to Preparing for Disasters (in Japanese), https://www.maff.go.jp/j/zyukyu/foodstock/attach/pdf/guidebook-3.pdf (Accessed January, 30, 2020)

31) Ministry of Agriculture and Fisheries: Food Stock Guide to Preparing for Disasters for Persons Requiring special Care (in Japanese), https://www.maff.go.jp/j/zyukyu/foodstock/guidebook/pdf/need_consideration_stockguide.pdf (Accessed January, 30, 2020)

32) Japan Disaster Food Society: The Standards of the Certification for Stockpile Disaster Food (in Japanese), http://www.mmpj.or.jp/TELEPAC/Certificationstandards 2018.08.19.pdf (Accessed January, 30, 2020)

33) Ministry of agriculture, Forestry and fisheries: Japanese Agricultural Standard, https://www.maff.go.jp/e/policies/standard/jas/ (Accessed April, 24, 2020)

34) Ministry of Health, Labour and Welfare: Guideline for Disaster Health Emergency Assistance Team (Notification). (March 20, 2018) (in Japanese), https://www.mhlw.go.jp/file/06-Seisakujouhou-10900000-Kenkoukyoku/ 000198472.pdf (Accessed January, 30, 2020)

35) Tsuboyama-Kasaoka, N., Purba, M.B.: Nutrition and earthquakes: experience and recommendations, *Asia Pac. J. Clin. Nutr.*, 23, 505–513, doi: 10.6113/apcn.2014.23.4.23 (2014)

36) Ministry of Health, Labour and Welfare: The management of nutrition in supplying meal in the emergency shelters (Notification) (June 6, 2016) (in Japanese), https://www.mhlw.go.jp/file/06-Seisakujouhou-10600000-Daijinkanboukouseikagakuka/0000128571_1.pdf (Accessed January, 30, 2020)

37) Sphere Association: Nutritional requirements, The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response, fourth edition, pp. 231–232 (2018) Practical Action Publishing, Geneva

38) Ministry of Health, Labour and Welfare: The management of nutrition in supplying meal in the emergency shelters (Notification) (June 1, 2011) (in Japanese), https://www.mhlw.go.jp/stf/houdou/298520000016f3att/29852000001txu.pdf (Accessed January, 30, 2020)

39) Tsuboyama-Kasaoka, N., Takimoto, H., Ishimi, Y.: Comparison of nutrient reference values for food labeling in Japan with CODEX recommendations, based on DRIs and nutrient intake in Japan, *J. Nutr. Sci. VitaminoL* (Tokyo), 65, 102–105, doi: 10.3177/jnsv.65.102 (2019)

40) Hoshide, S., Nishizawa, M., Okawara, Y., et al.: Salt intake and risk of disaster hypertension among evacuees in a shelter after the Great East Japan Earthquake, *Hypertension*, 74, 564–571, doi: 10.1161/HYPERTENSIONAHA.119.12943 (2019)

41) Hirai, K., Okuda, T., Masuda, T., et al.: Food intake and diet considerations among victims living in evacuation centers after the Great Hanshin-Awaji Earthquake, *Nihon Shokuseikatsu Gakkaishi*, 9, 28–35 (1998) (in Japanese)

42) Isebo, E., Murayama, N.: Characteristics of bentos sold in convenience stores according to nutrition facts label and food weight, *Bull. Soc. Hum. Life Studies*, 8, 1–14 (2017) (in Japanese)

43) Clay, L.A., Papas, M.A., Gill, K.B., et al.: Factors associated with continued food insecurity among households recovering from Hurricane Katrina, *Int. J. Environ. Res. Public Health*, 15, pii: E1647, doi: 10.3390/ijerph15081647 (2018)

44) Blanchet, K., Ramesh, A., Frison, S., et al.: Evidence on public health interventions in humanitarian crises, *Lancet*, 390, 2287–2296, doi: 10.1016/S0140-6736(16)30768-1 (2017)

(Received February 13, 2020; Accepted June 15, 2020)
自然災害後の栄養問題と改善の取り組みに関連する要因のレビュー

宮川 尚子*1, 笠岡（坪山）宜代*1, 原田 萌香*1,2
西 信雄*3

*1国立研究開発法人医薬基盤・健康・栄養研究所国立健康・栄養研究所
国際栄養情報センター 国際災害栄養研究室
*2東京家政大学
*3国立研究開発法人医薬基盤・健康・栄養研究所国立健康・栄養研究所
国際栄養情報センター

【目的】このレビューの目的は、避難所での食事と栄養問題の改善方法と、日本における自然災害後の健康と栄養を改善するためのさまざまな取り組みを明らかにすることである。

【方法】世界の避難所における栄養問題の改善方法を明らかにするため、PubMedおよびJ-STAGEにて、「災害」および「避難所 OR キャンプ」AND「栄養 OR 食品 OR 食事」をキーワードとして文献検索した。活動報告、レビュー、方法のない記事、英語と日本語以外の言語で書かれた論文は、本レビューから除外した。また、日本の政府、専門機関、学術研究機関による自然災害後の健康と栄養改善の取り組みに関する情報を整理した。

【結果】条件に合致した7編の論文から、自然災害後の避難所における栄養問題の改善に関連する4つの主要な要素、1）避難所のサイズと設備、2）避難所での食事の提供方法と内容、3）専門家との共同作業、4）避難所間の協力が抽出された。また、東日本大震災以降に日本で開始された自然災害後の健康・栄養問題改善のための取り組みとして、国の研究機関への災害栄養に特化した部署の設置、災害食の備蓄の推奨や認証制度、人材の開発育成、災害時の栄養基準などがあった。

【結論】本レビューにより、緊急時の避難所における栄養問題の改善に関連する要因と日本における自然災害に伴う栄養と健康の問題を軽減するための様々な取り組みを明らかにした。

栄養学雑誌、78(Suppl) S111～S120 (2020)

キーワード：災害栄養学、健康、取り組み