

## Mini Review

# Nutrition and earthquakes: experience and recommendations

Nobuyo Tsuboyama-Kasaoka PhD, RD<sup>1,2</sup>, Martalena Br Purba MCN, PhD<sup>3,4</sup>

<sup>1</sup>Section of the Dietary Reference Intakes, Department of Nutritional Epidemiology, National Institute of Health and Nutrition, Tokyo, Japan

<sup>2</sup>The Japan Dietetic Association, Tokyo, Japan

<sup>3</sup>Indonesian Dietetic Association, Jakarta, Indonesia

<sup>4</sup>Nutrition Department Dr Sardjito Hospital, Jogjakarta, Indonesia

In order to sustain life during the occurrence of a natural disaster, it is vital to ensure that people's intake of water and food is adequate (prioritizing first energy, then protein and water-soluble vitamins). Infants, pregnant women, patients, and the elderly are particularly vulnerable to insufficiencies in food intake, even if they are provided with the same quantity of food as others, and providing them with dietary and nutritional support becomes a high priority as their insufficient intake of energy and protein becomes long term. It is necessary to have a system in place for identifying those who are vulnerable and in need of support and providing them with the items (food) and nutritional care that they require. Eating is equivalent to living, and if the vulnerable themselves recognize the importance of food and nutrition, this will help improve the nutritional situation of the entire population. It is recommended that measures be taken in non-emergency periods such as stockpiling food for special dietary uses.

**Key Words:** insufficient intake, malnutrition, vulnerable people, preparedness, food for special dietary uses

## INTRODUCTION

Food and nutrition management during a natural disaster differ depending on the phase of the disaster. Moreover, because the conditions in the phases differ according to the natural disaster, it is difficult to present uniform descriptions of and standards for nutritional management. To manage and support food and nutrition, it is vitally important to establish a system to secure the necessary items (food) and to deliver them to the people who need them (disaster victims), including fundamental activities, such as managing the stockpile of aid supplies.

Specifically, it is necessary to carry out two approaches concurrently: a population approach, which consists of measures to secure nutrition to increase group levels; and a high-risk approach, which is comprised of individual care for people who are high priority. Infants, pregnant women, patients, and the elderly are said to be particularly in need of support during a natural disaster (vulnerable) and are therefore a high priority in terms of the provision of meals and nutrition support, and it is recommended that assistance for them be carried out at a comparatively early stage. Therefore, this paper is particularly centered upon the acute and sub-acute phases of a disaster, during which victims live in emergency shelters.

## FOOD AND NUTRITION AFTER A NATURAL DISASTER

In order to maintain life when there is a natural disaster and also maintain people's health, there are four key points that must be considered: (1) that people intake sufficient water, (2) that they intake adequate food (prioritiz-

ing energy first, and then protein and water-soluble vitamins), (3) that their intake is safe (sanitary), and (4) that they stay physically active as much as possible. In particular, from the period immediately after the natural disaster up to the time when aid supplies are distributed to emergency shelters, securing the minimum necessary levels of water and energy should be the priority.<sup>1,2</sup>

One of the concerns after a natural disaster is people's reduced intake of water, for reasons such as limitations on water availability because of the water supply being cut-off, reduced intake of water derived from foods, or the bathroom environment (unsanitary, having to access outdoor facilities some distance away). Furthermore, there are cases where the elderly reduce their water intake because of their inhibited sensitivity to feelings of having a dry mouth and also refrain from drinking water to avoid incontinence problems. Since a lack of water increases the risk of dehydration, constipation, cardiovascular disease, and deep-vein thrombosis/pulmonary embolism (economy-class syndrome), it is imperative to actively intake water.

The sphere project, which comprises a wide range of

**Corresponding Author:** Dr Nobuyo Tsuboyama-Kasaoka, Section of the Dietary Reference Intakes, Department of Nutritional Epidemiology, National Institute of Health and Nutrition 1-23-1, Toyama, Shinjuku-ku, Tokyo 162-8636, Japan.  
Tel: 81-3-3203-5721; Fax: 81-3-3202-3278  
Email: ntsubo@nih.go.jp  
Manuscript accepted 31 October 2014.  
doi: 10.6133/apjcn.2014.23.4.23

humanitarian agencies, indicated a minimum standard for use during a humanitarian response.<sup>1</sup> It is indicated that 7.5-15 liters of water per day are needed to meet total basic water needs (2.5-3 liters for water intake [drinking and food], 2-6 liters for basic hygiene practices, and 3-6 liters for basic cooking needs).

There tends to be a shortage of food immediately after a natural disaster, following which biases emerge about the food that is provided. In both the Hanshin-Awaji Earthquake and the Niigata Chūetsu Earthquake, many of the sources of energy in the food supplied to the emergency shelters were carbohydrates, such as rice balls, bread, and cups of noodles, and the supply situation for fresh foods, including vegetables, meat, fish, and dairy products, was poor.<sup>3-4</sup> Food shortages when there is a natural disaster have an effect on people's health, and it has been shown that the lower the frequency of intake of green vegetables at emergency shelters, the greater the number of non-specific complaints, such as colds, coughs, weight loss, gastrointestinal disorders, stress, and becoming short-tempered.<sup>5</sup> The number of non-specific complaints also increases when the intake of fish and seafood declines, which suggests the need to improve the meals provided at emergency shelters.

In terms of sanitation, it can be difficult to maintain sanitary conditions when the water supply is cut-off; therefore, through providing education for the meal-preparatory staff and other relevant parties, it is necessary to implement measures to prevent the occurrence of food poisoning and the spread of infectious gastroenteritis, such as the norovirus.

Furthermore, the sphere project also indicated the classifications of the public health significance of selected micronutrient deficiencies, using different indicators, and the nutritional requirements for planning purposes in the initial stage of a disaster (Table 1).<sup>1</sup>

### SPECIAL CARE FOR THE VULNERABLE

From the results of the survey of emergency shelters, it was found that the proportion of vulnerable who needed nutritional care had risen. However, at the affected areas, priority is given to emergency medical care and severe disease, and the supports for the vulnerable and the chronically diseases are postponed. The provision of meals and nutritional care should be a priority for the vulnerable, for whom an inappropriate diet can have fatal or long-term effects. In a survey of the intake at emergency shelters following the Athens Earthquake in 1999, both the elderly and adults consumed less than they were actually provided with, and in particular, their inadequate intake of energy and protein became long term.<sup>6</sup> This indicates the importance of ascertaining the food consumption of the elderly. The factors behind the decline in intake among the elderly are the difficulties in providing food suitable for them (rather than cold and hard food that is not easy to swallow, food they are not used to, etc.), that they refrain from eating as they are reserved with the younger generation, they have no appetite due to anxiety, and the lack of an eating environment where they can eat in comfort. Moreover, the needs of disaster victims living at home must not be overlooked, as well. The elderly disaster victims living at home include those with serious diseases, such as the bedridden. Their needs, including nutritional needs such as special dietary requirements or treatment for pressure ulcers, are a high priority. It is important to cooperate with other medical staff and utilize nutritional assessment sheets<sup>2</sup> to identify those elderly who are in need of support.

It has been reported that people's blood sugar and blood pressure levels worsen at the time of a natural disaster, but it has also been reported that those who are able to control their food intake at emergency shelters are able

**Table 1.** Nutritional requirements and public health significance of micronutrient deficiencies<sup>1</sup>

Nutrient	Minimum population requirement	Micronutrient deficiency
Energy	2,100 kcals	
Protein	53 g (10% of total energy)	
Fat	40 g (17% of total energy)	
Vitamin A	550 µg RAE	Night blindness, Bitot's spots, Corneal Xerosis, ulceration, or keratomalacia, Corneal scars
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	Beriberi, Wernicke's encephalopathy
Vitamin B <sub>2</sub> (Riboflavin)	1.1 mg	Angular cheilitis, Stomatitis, Glossitis, Seborrheic dermatitis
Vitamin B <sub>3</sub> (Niacin)	13.8 mg NE	Pellagra
Vitamin B <sub>6</sub> (Pyridoxine)	1.2 mg	
Vitamin B <sub>12</sub> (Cobalamin)	2.2 µg	
Folate	363 µg DFE	Megaloblastic anemia, Neural tube defects in the fetus
Pantothenate	4.6 mg	
Vitamin C	41.6 mg	Scurvy
Iron	32 mg	Anaemia
Iodine	138 µg	Goitre (visible + palpable)
Zinc	12.4 mg	
Copper	1.1 mg	
Selenium	27.6 µg	
Calcium	989 mg	
Magnesium	201 mg	

Alpha-TE: alpha-tocopherol equivalents; RAE: retinol activity equivalents; NE: niacin equivalents; DFE: dietary folate equivalents. Modified from the Sphere hand book, 2011.<sup>1</sup>

to suppress a deterioration of their blood sugar control.<sup>7</sup> During a natural disaster, many of the provided boxed meals include deep-fried foods, and food supplies frequently include items like canned food with a high salt content, boil-in-the-bag meals, and cups of noodles. Thus, in order to prevent a worsening of chronic conditions, it is important that people educate themselves about nutrition during non-emergency periods and acquire the skills to put that knowledge into practice at the time of natural disasters. Also, while food supplies may include foods for people with chronic conditions (including kidney diseases, etc.), food allergies, and swallowing difficulties (thickening agents), it can be difficult to find specific items among the various supplies delivered from warehouses and then provide them to the people who need them, particularly during the period immediately following the disaster. It is particularly necessary for the vulnerable to stockpile for themselves the food they need for special dietary uses, and also for both they and facilities to have cooking utensils and prepared heat sources to warm meals (gas, etc.).

At the time of a natural disaster, a system needs to be in place so that the people who provide assistance can locate the vulnerable individuals who need said assistance and provide them with nutritional care. At the same time, it is particularly important that the vulnerable, such as the elderly, themselves are aware of the fact that when they are in good spirits, those around will also be in good spirits, and of the need for adequate food and nutrition to maintain their health, even when priority is given to emergency medical treatment. It is thus necessary to urge them to proactively supplement their nutritional intake. To eat is to live, and it is recommended that measures be taken during non-emergency periods.

## JAPANESE EXPERIENCES

### *Food and nutrition problems after the Great East Japan Earthquake*

The magnitude 9 Great East Japan Earthquake hit on March 11, 2011, followed by a large tsunami. An estimated 450,000 evacuees were temporarily housed in over 2,400 emergency shelters.

In the Great East Japan Earthquake, even one month after its occurrence, the provision of meals at the emergency shelters was biased toward carbohydrates, and there was a lack of meals that contained a large amount of protein as the main dish (meat, fish, egg, beans, etc.) and vegetables as the side dish.<sup>8</sup> The reasons for this are considered to be the shortage of stockpiles,<sup>9</sup> the difficulties in using stockpiles, the poor state of supply procurement,<sup>10</sup> and the provision of too much of certain types of food supplies, such as carbohydrate-based food. In the Hanshin-Awaji Earthquake emergency shelters, boxed meals that included a balanced main dish were being distributed to the majority of shelters in the affected area about one month after the earthquake,<sup>4</sup> and compared to natural disasters in the past, the Great East Japan Earthquake is characterized by a delay in providing victims with sources of protein.<sup>8</sup> The distribution of cooked meals was also limited, and it was a long time before hot meals were provided. In fact, the ability to cook and gas availability significantly improved their dietary provision as

they were better enabled to serve balanced meals in the emergency shelters.<sup>8</sup> Furthermore, the states of food procurement and meal provision were made higher in facilities by cooperation with other facilities.<sup>10,11</sup> It is hoped that in the future, both the national and local governments will distribute food supplies that are not biased toward any type of food, perhaps through planned food stockpiling.

Regarding vulnerable people for whom an individualized approach is necessary, a survey conducted in emergency shelters after the Great East Japan Earthquake found that there were many “people who needed milk or baby foods” and also many “elderly or people with disabilities who were unable to eat normal meals”, and it was ascertained that there were many vulnerable who require support for meals.<sup>8</sup> It is necessary to have stockpiles in the facilities that house these vulnerable people. It was reported that great improvement were seen in terms of the quantity and quality of stocks in nursery schools after the Great East Japan Earthquake.<sup>12</sup>

During the chronic phase, a prudent dietary pattern was associated with better living conditions among survivors in temporary housing.<sup>13</sup> Therefore, disaster victims are in need of continuous nutritional supports.

### *The support activities following the Great East Japan Earthquake*

With the goal of improving food and nutrition conditions after the Great East Japan Earthquake, The Ministry of Health, Labour and Welfare aimed to secure the required number of meals and the necessary quantities of nutrients for the emergency shelters from the first through the third months following the earthquake, and it indicated Nutritional Reference Values for energy (2000 kcal), protein (55 g), and vitamins B<sub>1</sub> (1.1 mg), B<sub>2</sub> (1.2 mg), and C (100 mg) that should actually be provided in the meals (<http://www.mhlw.go.jp/stf/houdou/2r9852000001a159-img/2r9852000001a29m.pdf>, in Japanese). Those nutrients that will become deficient at an early stage because people have few internal reserves stored within their bodies have been identified, and they are considered a top priority in a nutritional plan at the time of a natural disaster. Further, a supplementary provision of vitamin B<sub>1</sub> is needed for metabolizing a diet that is high in carbohydrates.<sup>14</sup> The National Institute of Health and Nutrition has presented an example of various food compositions and a specific menu that satisfies the reference values (Table 2 and Table 3). Additionally, with the objective of investigating whether the provision of meals was sufficient during the three months following the earthquake, it presented the “Nutritional Reference Values for Dietary Assessments and Planning for the Provision of Meals to Emergency Shelter” for energy (1,800-2,200 kcal), protein (55 g), and vitamins B<sub>1</sub> (0.9 mg), B<sub>2</sub> (1.0 mg), and C (80 mg). (<http://www.mhlw.go.jp/stf/houdou/2r9852000001fjb3-att/2r9852000001fxtu.pdf>, in Japanese). Care should be taken to ensure that people’s intake at emergency shelters does not fall below the “Nutritional Reference Values for Dietary Assessments and planning.” It separately lists as special items the quantities of calcium and vitamin A that are essential during a child’s growth period. The quantity of sodium is presented primarily

**Table 2.** Example of food composition of meals in an emergency shelter

Food	Unit: grams
Cereals	550
Potatoes and starches	60
Vegetables	350
Fruits	150
Fish and shellfish	80
Meats	80
Eggs	55
Pulses	60
Milk and dairy products	200
Fats and oils	10

This example of the food composition of meals was prepared on the basis of the findings of the 2009 National Survey of Health and Nutrition. The weight of cereals is after having been cooked.

from the perspective of lifestyle-related disease prevention.

To provide support at actual sites within the disaster affected areas, national registered dietitians and general dietitians were dispatched by local governments and from the Japan Dietetic Association (JDA) to conduct activities there. Three weeks after the earthquake, the JDA dispatched 1,588 volunteer registered and general dietitians to the affected areas. Their five-month-long tasks were to

support and improve the essential food supply and provide nutrition care to protect the lives of nutritionally vulnerable evacuees. Among their efforts, the activity that produced particularly remarkable results was the JDA's distribution of rice fortified with vitamin B<sub>1</sub> and other nutrients to the emergency shelters in the disaster affected areas and to those disaster victims who were living at home. According to the results of a survey by Miyagi Prefecture, the shortfall in vitamin B<sub>1</sub> intake had been recovered by about two months after the earthquake.<sup>15</sup> It is necessary to include the provision of fortified foods, such as rice fortified with vitamins, in a stockpile plan.

#### **Disaster dietitian**

The JDA established the Japan Dietetic Association-Disaster Assistance Team (JDA-DAT, [http://www.dietitian.or.jp/english/jda01/jda\\_dat.html](http://www.dietitian.or.jp/english/jda01/jda_dat.html)). The JDA-DAT is a nutrition support team that received training in the specialty of nutrition care activity in disaster affected areas. The purpose of this team is to promote and foster registered dietitians equipped with the necessary technical knowledge and techniques required in order to provide swift emergency dietary support for the disaster-stricken region in cooperation with medical, welfare, and government nutrition specialists, etc., when a large-scale natural disaster, such as a major earthquake or typhoon, strikes

**Table 3.** Example of a specific menu of meals

Food group	Pattern 1 (when cooking with heat is impossible)		Pattern 2 (when cooking with heat is possible)	
	No of times per day*1	Example meal and standard amount per day	No of times per day*1	Example meal and standard amount per day
Cereals	3 times	•Bread roll, 2 •Convenience store rice ball, 2 •Fortified rice, 1 bowl	3 times	•Bread roll, 2 •Rice ball, 2 •Fortified rice, 1 bowl
Potatoes, vegetables	3 times	•Boil-in-the-bag sweet potatoes, 3 •Dried potatoes, 2  •Vegetable juice (200 ml), 1 can •Tomato, 1, and cucumber, 1	3 times	•One from the following list Vegetable soup with meat, 1 Boiled vegetables with meat (may use dried foods, such as edible seaweed and dried sliced daikon), 1 plate Boil-in-the-bag curry, 1 pack Boil-in-the-bag stew, 1 pack Rice bowl with beef, 1 pack •Boiled vegetables, 1 pack (100 g) •Fresh vegetables (1 tomato, etc)
Fish and shellfish, meats, eggs, pulses	3 times	•Canned fish, ½ can •Fish-meat sausage, 1 •Ham, 2 slices  — •Can of beans, ½ can •Boil-in-the-bag beans, ½ bag •Natto, 1 pack	3 times	•Canned fish, ½ can •Fish-meat sausage, 1 •Included in (curry, stew, rice with beef, potato and vegetable soup, boiled vegetable) •1 egg •Can of beans, ½ can •Boil-in-the-bag beans, 1 bag •Natto, 1 pack
Milk and dairy products	1 time	•Milk (200 ml), 1 carton •Yogurt, 1 pack + processed cheese, 1 slice	1 time	•Milk (200 ml), 1 carton •Yogurt, 1 pack + processed cheese, 1 slice
Fruits	1 time	•100% fruit juice, (200 ml), 1 can •Canned fruit, around 1 cup •Apple, banana, orange, etc 1-2	1 time	•100% fruit juice, (200 ml), 1 can •Canned fruit, around 1 cup •Apple, banana, orange, etc 1-2

Care should be taken to actively hydrate (drink water).

\*1 Select the "example meal" based on the standard "number of times per day." For example, if the number of times per day for cereals is three, select as follows: morning, bread rolls, 2; lunch, convenience store rice ball, 2; dinner, convenience store rice ball, 2.

anywhere in Japan.

Such systematic and large-scale dietary support after a disaster is rare, even worldwide. Nutritional care of evacuees could be partially improved by being better prepared for disasters.

### CHINESE EXPERIENCES

China has also experienced large earthquakes several times. After the Wenchuan Earthquake, there were several reports regarding nutritional problems. The prevalence of malnutrition significantly increased two years after the Wenchuan earthquake in vulnerable people, such as infants and young children.<sup>16</sup> Instances of children who were underweight, or experienced stunting and wasting, occurred. Furthermore, the prevalence of anemia dramatically increased in infants and young children. Interestingly, the increasing percentage of anemia was more obvious in girls than boys. Anemic prevalence and iron deficiency were also high in pregnant, nursing, and child-bearing women.<sup>17</sup> There were vitamin deficiencies, such as vitamins A, D, and B<sub>12</sub>, in pregnant, nursing, and child-bearing women. After the disaster, infants, young children, and these women should be cared for immediately and improving their nutritional status should be a priority.

### INDONESIAN EXPERIENCES

One of the most frightening and destructive phenomena of nature is a severe earthquake and the terrible after effects. An earthquake is a sudden movement of the Earth, caused by the sudden release of energy that has accumulated over a long period of time. Indonesia sits on the Pacific "Ring of Fire" where tectonic plates collide, causing frequent seismic and volcanic activity. The volcanoes in Indonesia are the most active of the Pacific Ring of Fire. They were formed due to the subduction zones of three main active tectonic plates, namely the Eurasian Plate, Pacific Plate, and the Indo-Australian Plate. Earthquakes can kill large numbers of people in one fell swoop, destroy crops, food reserves, assets, and roads, all of which can adversely impact food security; they destroy health facilities, water, and sanitation systems, which can lead to a high risk of malnutrition.<sup>18</sup>

#### *Case studies of earthquake in Indonesia*

Many earthquakes that occur throughout the Indonesian archipelago remain largely under-reported, frequently because they began a number of years ago, and some events have become chronic or long-term. One of the largest earthquakes during this century that hit Indonesia is remembered as the Aceh Tsunami. On Sunday morning, December 26, 2004, an earthquake registering 9.0 on the Richter scale struck off the western coast of North Sumatra, triggering massive waves that devastated coastal regions throughout the Indian Ocean rim. Indonesia's Aceh Province suffered the greatest mortality, with widespread destruction extending along more than 1000 km of coastline. The Indonesian government's estimation indicated 129,775 deaths, 38,786 missing, and 504,518 tsunami-displaced in Aceh Province alone.<sup>19,20</sup>

Another volcanic earthquake was the 2010 eruptions of Mount Merapi in Jogjakarta, Central Java, which began in mid-September and lasted into late November 2010.

More than 350,000 were evacuated from the area within a 10 km radius around the slopes of the volcano. Many remained behind or returned to their homes while the eruptions were continuing. Approximately 353 were killed during the eruptions, the majority of deaths being from severe burns caused by searing gas clouds. Some victims died in road and other accidents during the panicked exodus from the mountain. Acute respiratory infection, hypertension, and headache were common ailments affecting the Mount Merapi eruption survivors.

The latest volcanic earthquakes were the eruptions of Mount Kelud in East Java and Mount Sinabung in North Sumatra. On February 13, 2013, Mt Kelud exploded with a powerful eruption (the main ash cloud reached an altitude of nearly 20 km, with sections of the plume reaching to nearly 30 kilometers). As many as 76,388 people were evacuated into 293 shelters within the 10 km exclusion zone and three fatalities were caused by the eruption (two as a result of breathing difficulties caused by the ash and one person in a road accident during evacuation). Meanwhile, Mount Sinabung in North Sumatra has been erupting from September 23, 2013 until present (>1 year) and more than 20,000 people have been evacuated in a 5 km radius with 20 fatalities recorded.

#### *Impact of earthquake on access to food*

In a disaster, vulnerability will be influenced by the nature, extent, and time-scale of the disaster and the community's capacity to cope with it. That is, it is affected by their ability to use available resources and face adverse consequences. Natural disasters, for example, an earthquake in Indonesia, have a greater devastating impact on the population's health status and environment, including health systems. These disasters usually affect a comparatively large number of people. In general, the people directly affected by disasters were those who were displaced, losing access to their food entitlements. Moreover, persons trapped in disaster zones were cut off from market links and relief food, as well as lost their employment and income as a result of the resulting economic decline.<sup>21</sup> Disasters such as earthquakes and tsunami not only have an impact on people's access to food, but also on the stability of the food supply and access; the impact on prices and markets exacerbates the effects of natural disasters and weakens institutions.<sup>22</sup>

#### *Importance of nutrition after an earthquake*

It is crucial that careful attention is given to the vulnerability, capacities, and disaster preparedness of people affected by long-term disasters. Vulnerability, capacity, and disaster preparedness are examined specifically in the context of food shortages and malnutrition. Protecting the nutritional status of vulnerable groups affected by emergencies is crucial and a humanitarian right because individuals who suffer from acute malnutrition are much more likely to become sick and die. At the same time, sick individuals are more likely to become malnourished. Emergencies have an impact on a whole range of factors that can increase the risk of malnutrition, illness (morbidity), and death (mortality).

It is quite commonly observed after an earthquake that the health and nutritional status of infants and young chil-

dren is affected, particularly if the people have to stay in a temporary shelter. Poor nutritional status leads to lowered immunity and increased morbidity from infectious diseases, such as diarrhea, malaria, or tuberculosis. If further deterioration in nutritional status, from inability to eat and/or malabsorption, is not treated by nutritional intervention and medical care, this cycle continues, ultimately leading to death. In disasters, an immediate concern is to ascertain the level of malnutrition in the population. As the nutritional status of children under five years of age responds rapidly to acute food shortages, high levels of malnutrition in this age group usually indicate acute malnutrition in the overall population.<sup>23</sup>

The main nutritional concerns in disasters are acute malnutrition (wasting), especially in young children, micronutrient deficiencies, and chronic malnutrition (stunting). Of these, the greatest concern is the increased risk of moderate and severe acute malnutrition. This is because acute malnutrition is strongly associated with death. Children under five years of age are particularly vulnerable to developing acute malnutrition during emergencies and are frequently the first group in a community to show signs of malnutrition during times of hardship. For this reason, weight for height in young children is usually measured in nutrition assessments and acts as a proxy measurement for the entire community.<sup>24</sup>

A nutrition program after an earthquake, therefore, is one of the crucial elements for ensuring an adequate food supply for the entire affected population, as it prevents malnutrition and other adverse health consequences. In addition, the program can provide nutritional rehabilitation for moderately and severely malnourished people and prevent nutritional deterioration for vulnerable groups.<sup>25,26</sup>

Identification of malnutrition amongst earthquake survivors can be done through a measurement of their nutritional status. Overall nutritional status of a population is normally estimated by surveying (using cluster sampling) children under five years of age.<sup>27,28</sup> Anthropometric measurements and demographic information are obtained. Edema, especially around the ankles, is an important clinical indicator. The index "weight for height" (WFH) is most commonly used to detect acute malnutrition (wasting) in surveys. Where large numbers of children have to be screened, mid-upper arm circumference (MUAC) can be used to identify wasting. MUAC measurements <11.0 cm are indicative of severe acute malnutrition and are of value in predicting mortality. A WFH of less than 70% of the median and/or edema indicates severe acute malnutrition. Alternatively, z scores may be used, where the WFH is expressed as the number of standard deviations below the median. A z score <-3 and /or edema indicates severe acute malnutrition. Moderate acute malnutrition is indicated if the WFH is between 70% and 80% of the median, or between -3 and -2 z scores.<sup>29</sup>

#### ***Developing ready-to-eat food for an emergency***

Ready-to-eat food, particularly during a disaster, is needed to reduce the risk of malnutrition. The foods available as energy-dense pastes or biscuits are more resistant to bacterial growth, unlike milk-based liquid products. This has made it easier to care for moderately malnourished

children at home or in shelters, thus reducing the number of children in feeding centers. According to Young et al., this leads to increased access to treatment and a possible reduction in cross-infection.<sup>30</sup>

Research conducted by Almasyhuri et al.<sup>31</sup> from the Indonesia Center for Nutrition Research & Development since 2009 has led to the development of ready to eat foods for during natural disasters.<sup>31</sup> The product is based on the Indonesian Recommended Dietary Allowances for adults: 2000 kcal & 55 g of protein. They developed two types of emergency foods (solid biscuits and semi-solid pasta) based on the following ingredients: cereal as an energy source, pulses and egg as protein, vegetables to provide vitamins, minerals and fiber, and vegetable oil as a fat source. Nutrient content of the food per portion is as follows: biscuit 1 bar (62 g) = 286 kcal and 10.4 g protein, and pasta 1 cup (150 g) = 597 kcal and 19.1 g of protein. If a person can consume just three cups of pasta and one bar of biscuits, this would already meet 85–90% of their adult RDA.

The ready-to-eat food can also be used in non-emergency situations. By preventing moderate malnutrition from becoming severe, it could play an important role in disaster preparedness. So far, most of these foods are imported into the affected areas, but if production of ready-to-eat foods, such as pastas and biscuits, were to use locally available grains and legumes, it would reduce the probability of malnutrition, even during the critical period of the disaster. Encouraging local initiatives in ready-to-eat food production, as well as involving community expertise in implementation, would afford opportunities to reduce vulnerability, build community capacity, and increase disaster preparedness.<sup>32,33</sup>

#### ***Disaster preparedness in a hospital setting***

By the end of 2014, the Indonesian government targeted a minimum of five government hospitals to be accredited by the International Joint Commission (JCI) Agency. Dr Sardjito Hospital in Jogjakarta, Dr Cipto Mangunkusumo Hospital in Jakarta, and Dr Sanglah Hospital in Denpasar, Bali have passed the accreditation. Meanwhile Dr Adam Malik Hospital in Medan, North Sumatra, and Dr Wahidin Sudirohusodo Hospital in Makassar, South Sulawesi are undergoing the accreditation process. Based on JCI accreditation, every hospital should have disaster preparedness as part of its Facility and Management Standard. Health care providers need to direct their efforts at building their capacity and decrease the vulnerability of their populations, thus enhancing their preparedness for any future disaster.<sup>32,33</sup>

Each hospital develops, maintains, and tests an emergency management program to respond to emergencies, epidemics, and natural or other disasters that have the potential of occurring within their community. Community emergencies, epidemics, and disasters may directly involve the hospital, such as damage to patient care areas as a result of an earthquake that prevents staff from reporting for duty. The development of the program should begin by identifying the types of disasters that are likely to occur in the hospital's region and what the impact of these disasters would have on the hospital.

Facility damage or mass casualties, on the other hand,

could potentially occur in any hospital. It is just as important to identify the effects of a disaster as it is to identify the types of disasters. This helps in planning the strategies that are needed in the event of a disaster. For example, what is the likelihood that a natural disaster, such as an earthquake, will affect water and power? Could an earthquake prevent staff from responding to the disaster, either because roads are blocked or because they or their family members are also victims of the event? In such situations, the staff members' personal responsibilities may be in conflict with the hospital's requirements for responding to an emergency. In addition, hospitals need to identify their role within the community. For example, what resources will the hospital be expected to provide to the community in the event of a disaster, and what communication methods will be used within the community?

To respond effectively, the hospital develops a program to manage such emergencies. The program provides processes for:

- (a) determining the type, likelihood, and consequences of hazards, threats, and events;
- (b) determining the hospital's role in such events;
- (c) communication strategies for events;
- (d) the managing of resources during events, including alternative sources;
- (e) the managing of clinical activities during an event, including alternative care sites;
- (f) the identification and assignment of staff roles and responsibilities during an event;
- (g) the process to manage emergencies when the personal responsibilities of staff conflict with the hospital's responsibility to provide patient care.

The disaster preparedness program of the hospital is tested either by an annual test of the full program internally or as part of a community-wide test or testing of critical elements of the program throughout the year. If the hospital experiences an actual disaster, activates its program, and debriefs properly afterward, this situation represents the equivalent to an annual test.

There are five measurable elements of disaster preparedness according to JCI accreditation.<sup>34</sup> First, the hospital has identified the major internal and external disasters, such as community emergencies, epidemics, and natural or other disasters, as well as major epidemic events that pose significant risks of occurring, taking into consideration the hospital's geographic location. Second, the hospital identifies the probable impact that each type of disaster will have on all aspects of care and services. Third, the hospital establishes and implements a disaster program that identifies its response to likely disasters. Fourth, the entire program, or at least critical elements of the program, is tested annually. Lastly, at the conclusion of every test, a debriefing about the test is conducted.<sup>34</sup>

### **Constraints and recommendations**

There are many constraints faced by the nutrition programmer during a disaster, such as insufficient knowledge about emergency nutrition, insufficient human and natural resources, and sometimes Nutrition & Health Worker as a survivor/victims. Ideally, on-going nutritional surveillance should be standard practice so that a deteriorating situation can be identified early. This requires

expertise, for example, local fieldworkers to carry out data collection, and access to logistical, statistical, and nutritional expertise to analyze and interpret findings.

The challenges involved in building capacity in vulnerable communities must not be underestimated. A multi-disciplinary approach is needed for effective community involvement. Just as nutrition itself is multi-factorial, so knowledge and expertise from several academic and professional disciplines and the local population are needed. Listening to and respecting the community's knowledge, experience, views, and expertise, and understanding their specific cultural, social, psychological, economic, and physical needs are all critical forces in building capacity for disaster preparedness in nutrition.

Emergency feeding should not only satisfy hunger but also consider nutritional needs. Otherwise, malnutrition, with its consequences of morbidity and mortality, will remain uncontrolled. In addition to sustaining life and maintaining good health, emergency nutrition also provides relief to the condition of casualties, boosts the morale of displaced people, and enables emergency workers to perform their tasks. Special training on emergency nutrition is needed to manifest this response.

### **AUTHOR DISCLOSURES**

None of the authors had any personal or financial conflict of interest to declare.

### **REFERENCES**

1. The Sphere Project. The sphere handbook: Humanitarian charter and minimum standards in humanitarian response. Hampshire, United Kingdom: Hobbs the Printers; 2011.
2. National Institute of Health and Nutrition. The Japan Dietetic Association: Manual for nutrition and dietary habits support during a natural disaster. Tokyo: The Japan Dietetic Association; 2011. (In Japanese)
3. Tsuchida N, Isobe S, Watanabe S, Ishigami K, Yoshita K, Yoshiike N, Murayama N. Changes in access to food and the frequency of food consumption before and after the Niigata Chuetsu earthquake: comparison between households in temporary housing and disaster-stricken housing. *J Jpn Diet Assoc.* 2010;53:30-8. (In Japanese)
4. Hyogo Prefecture. Natural disaster dietary habits improvement guidelines. Hyogo: Hyogo Prefecture; 1996. (In Japanese)
5. Okuda T, Hirai K, Masuda T, Yamaguchi H, Tuzukida Y, Takao F, Miyano M. Survey of health status among victims of the Great Hanshin-Awaji Earthquake living in evacuation centers. *Jpn J Physiol Anthropol.* 1996;1:101-7. (In Japanese)
6. Magkos F, Arvaniti F, Piperkou I, Katsigaraki S, Stamatelopoulos K, Sitara M, Zampelas A. Identifying nutritionally vulnerable groups in case of emergencies: experience from the Athens 1999 earthquake. *Int J Food Sci Nutr.* 2004;55:527-36. doi: 10.1080/09637480400029324.
7. Kirizuka K, Nishizaki H, Kohriyama K, Nukata O, Arioka Y, Motobuchi M et al. Increase in HbA1c following the Great Hanshin Earthquake in diabetic patients. *J Jpn Diab Soc.* 1996; 39:655-8. (In Japanese)
8. Tsuboyama-Kasaoka N, Hoshi Y, Onodera K, Mizuno S, Sako K. What factors were important for dietary improvement in emergency shelters after the Great East Japan Earthquake? *Asia Pac J Clin Nutr.* 2014;23:159-66. doi: 10.6133/apjn.2014.23.1.17.
9. Sudo N, Seino F, Yoshiike N. Food assistance and nutri-

- tional support by local governments after natural disaster. *Jpn J Disast Med.* 2007;12:167-77. (In Japanese)
10. Nozue M, Ishikawa-Takata K, Sarukura N, Sako K, Tsuboyama-Kasaoka N. Stockpiles and food availability in feeding facilities after the Great East Japan Earthquake. *Asia Pac J Clin Nutr.* 2014;23:321-30. doi: 10.6133/apjcn.2014.23.2.14.
  11. Tsuboyama-Kasaoka N, Hoshi Y, Onodera K, Iwabuchi K, Izumi A, Saitoh C et al. Factors impacting meal provision in emergency evacuation centers (shelters) after the Great East Japan Earthquake. *J Jpn Disast Food Soc.* 2014;1:35-43. (In Japanese)
  12. Amitani Y, Sudo N, Tsuboyama-Kasaoka N, Ishikawa F, Sako K. Restructuring of the disaster countermeasures about meal services at nursery schools in a metropolitan area after the Great East Japan Earthquake. *J Jpn Diet Assoc.* 2014;57:192-200. (In Japanese)
  13. Nishi N, Yoshimura E, Ishikawa-Takata K, Tsuboyama-Kasaoka N, Kubota T, Miyachi M et al. Relationship of living circumstances with dietary patterns of Great East Japan Earthquake victims. *J Epidemiol.* 2013;23:376-81. doi: 10.2188/jea.JE20130025.
  14. International Life Sciences Institute (ILSI). Present knowledge in nutrition (10th edition). Iowa: Wiley-Blackwell; 2012.
  15. Miyagi Prefecture. Findings of the third survey on food conditions in emergency shelters and nutrition-related needs. Miyagi: Miyagi prefecture; 2011. (In Japanese)
  16. Dong C, Ge P, Ren X, Zhao X, Wang J, Fan H, Yin SA. Growth and anaemia among infants and young children for two years after the Wenchuan Earthquake. *Asia Pac J Clin Nutr.* 2014;23:445-51. doi: 10.6133/apjcn.2014.23.3.03.
  17. Dong C, Ge P, Ren X, Zhao X, Fan H, Yin SA, Weiderpass E. Evaluating the micronutrient status of women of child-bearing age living in the rural disaster areas one year after Wenchuan Earthquake. *Asia Pac J Clin Nutr.* 2014;23:671-677.
  18. Natural Disasters in Indonesia. [cited 2014/10/27]; Available from: <http://www.indonesiainvestments.com/doing-business/risks/natural-disasters/item243>.
  19. Indonesia - Disaster Statistics. [cited 2014/10/27]; Available from: <http://www.preventionweb.net/english/countries/statistics/?cid=80>.
  20. Shepard D, ed. Survivors of the tsunami: one year later. New York, NY: United Nations Development Programme; 2005. [cited 2014/10/27]; Available from: <http://www.undp.org/tsunami/UNDP-Tsunami-report-final.pdf>.
  21. Eastwood M. Principles of Human Nutrition. London: Blackwell Science Ltd; 2003.
  22. United Nations Information Management Service. Tsunami recovery status report. New York, NY: United Nations; 2005.
  23. Australian Agency for International Development, Indonesia Earthquake: 30 Mar 2005. New York, NY: United Nations Office for the Coordination of Humanitarian Affairs; March 30, 2005. [cited 2014/10/28]; Available from: <http://www.reliefweb.int/rw/rwb.nsf/db900SID/SODA-6AY5LB?OpenDocument&rc=3&cc=idn>.
  24. World Health Organization. The management of nutrition in major emergencies. Geneva, Switzerland: World Health Organization; 2000.
  25. Rehabilitation and Reconstruction Agency report. Jakarta, Indonesia: Government of Indonesia; 2005.
  26. Widayastuti E, Silaen G, Pricasca A, Handoko A, Blanton C, Handzel T, Brennan M, Mach O. Assessment of health-related needs after tsunami and earthquake - three districts, Aceh Province, Indonesia, July-August 2005. [cited 2014/10/27]; Available from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5504a1.htm>.
  27. UNICEF. UNICEF response to the Indian Ocean emergency. New York, NY: UNICEF; 2005.
  28. World Health Organization. Epidemic-prone disease surveillance after the tsunami in Aceh Province, Indonesia. *Wkly Epidemiol Rec.* 2005;80:160-4.
  29. Corbett M. Save the children alliance assessment of infant and young child feeding practices post-earthquake. Jogjakarta, Indonesia; 2006. (Report)
  30. Young H, Borrel A, Holland D, Salama P. Public nutrition in complex emergencies. *Lancet.* 2004;364:1899-909. doi: 10.1016/S0140-6736(04)17447-3.
  31. Almasyhuri, Imaningsih N, Yuniati H. Biscuit formulation as ready to eat food during emergency. *Food and Nutrition Research (Indonesia).* 2012;35:42-8.
  32. Kuntjoro I, Jamil S. Natural disasters in Indonesia: Strengthening disaster preparedness. RSIS Centre for Non-Traditional Security Studies, Nanyang Technological University. [cited 2014/10/28]; Available from: <http://www.eastasiaforum.org/2010/11/17/natural-disasters-in-indonesia-strengthening-disaster-preparedness/>.
  33. Centers for Disease Control and Prevention. Emergency Preparedness and Response: Keep Food and Water Safe After a Disaster or Emergency. [cited 2014/10/27]; Available from: <http://www.bt.cdc.gov/disasters/foodwater/facts.asp>.
  34. Joint Commission International. JCI accredited Organizations. [cited 2014/10/28] Available from: <http://www.jointcommissioninternational.org/about-jci/jci-accredited-organizations/>.



## Mini Review

# Nutrition and earthquakes: experience and recommendations

Nobuyo Tsuboyama-Kasaoka PhD, RD<sup>1,2</sup>, Martalena Br Purba MCN, PhD<sup>3,4</sup>

<sup>1</sup>*Section of the Dietary Reference Intakes, Department of Nutritional Epidemiology, National Institute of Health and Nutrition, Tokyo, Japan*

<sup>2</sup>*The Japan Dietetic Association, Tokyo, Japan*

<sup>3</sup>*Indonesian Dietetic Association, Jakarta, Indonesia*

<sup>4</sup>*Nutrition Department Dr Sardjito Hospital, Jogjakarta, Indonesia*

## 營養與地震：經驗及建議

在天然災害發生期間，確保民眾有足夠的水及食物攝取來維持生命，至為重要(優先順序，第一為熱量、再者為蛋白質及水溶性維生素)。嬰兒、孕婦、病人及老人是易受傷害族群，即便提供他們與他人等量的食物，仍可能受到食物攝取不足的影響。因此，若長期熱量及蛋白質攝取不足為必然時，給予這個族群飲食及營養的支持，成為優先的措施。需要有個系統就定位，能正確地鑑定出那些人是易感族群，需要特殊的支持，並提供他們所須的食物及營養照護。吃等同於生活，假如易感族群本身能認知食物及營養的重要性，將可幫助改善全體族群的營養狀況。建議在非緊急期間採取一些措施，如儲備特殊飲食使用的食物。

**關鍵字：**攝取不足、營養不良、易感族群、整備、特殊膳食用食物