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Food and Safe Water in Disasters

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Abstract

Disasters, which are an important part of human history, make access to food and safe water difficult and affect human health. During a disaster or emergency, everyone must be provided with food and safe water for at least 3 days. These foods should be easily prepared, have high energy, prevent dehydration, and be durable, such as canned foods, cereals, legumes, nuts, dried fruits, and meats. After the acute period is over, food stores should be designed to meet the requirements adequately. For a total of 2100 kcal/day, at least 10% of the total energy should be from protein and at least 17% from fats. It is the most practicable and healthy option that is to meet the drinking water requirement with bottled water immediately after disasters and until temporary settlement is established. Mains, water should be brought to the area without delay, regardless of temporary or permanent settlement. If water cannot be supplied with bottled water and central chlorination, appropriate techniques such as filtration, chlorination, and boiling must be applied for unsafe water, especially until safe water is provided by aid organizations. These methods, which only remove physical and microbiological contamination in water, should be applied until a long-term solution is developed.

Keywords: Disaster, earthquake, food, safe water

Introduction

Many natural disasters (e.g., flood and earthquake) are an important part of the human history experience.[1] In this context, Noah is defined as the first disaster manager. Anticipating a potential disaster, Noah planned and conducted an evacuation to lessen the effects of the "Genesis Flood" by building the Ark and organizing a mass exodus. Planning for food, water, shelter, waste disposal, medical care, and other needs of all evacuees was part of this disaster management.[2]

An earthquake, which is a disaster, is the sudden, rapid shaking of the ground caused by the shifting of rocks underneath Earth's surface. On February 6, 2022, a 7.8-magnitude earthquake occurred in southeastern Turkey and northwestern Syria. The earthquake impacted infrastructure in both countries, limiting access to electricity, drinking water, and food supplies.[3]

Short- or long-term access to food and clean water can be reduced during disasters, affecting human health. Providing a diet that includes different nutrients, including micronutrients, after a natural disaster is part of disaster management. Throughout human history, rural and agricultural societies have stored foods and meats such as grains, legumes, nuts, meat, and dried fruits to survive in emergencies (such as cereals, legumes, nuts, dried fruits, and meats).[1]

Depending on the type and duration of the disaster and the size of the affected area, the extent of nutritional problems may vary. All kinds of disasters can prevent the access of the population, even if there are food stores, as they will disrupt transportation systems, communication, and social and economic routines.[4] Therefore, in the event of a disaster or emergency, everyone should provide adequate safe food and water for at least 3 days for themselves and their families.[5]

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The dependency of household appliances on electricity in modern life also complicates these possibilities. Therefore, governments and aid organizations should make plans to store and deliver emergency and ready-to-eat foodstuffs after a disaster when people do not have access to adequate food and equipment. One of the most important responsibilities of governments and aid organizations after every natural disaster is to provide emergency foodstuffs to the victims.[1]

A group of humanitarian aid professionals to improve the quality of humanitarian work during disaster response launched the SPHERE movement in 1997. Originally developed by the Red Cross and Red Crescent Movement and nongovernmental organizations (NGOs), Sphere standards have become the primary reference tool for national and international NGOs, volunteers, United Nations agencies, governments, donors, the private sector, and others. The aim of the project is to increase the quality of humanitarian aid of these organizations and to be accountable for their actions. There are 2 basic assumptions underlying the Sphere philosophy:[6]

1. Persons affected by disaster or conflict have the right to a dignified life and therefore the right to assistance.
2. All possible steps should be taken to reduce human suffering from disaster and conflict.

The SPHERE project provides minimum standards for the following 4 main responses during a disaster:[6]

1. Water supply, sanitation, and hygiene promotion
2. Food security and nutrition
3. Shelter and settlement
4. Health

Food Security and Nutrition

Predisaster Nutrition Services

In the event of an unforeseen calamity or emergency, it is imperative to plan for a sustenance reserve of at least 3 days to

cater to the needs of individuals and their families in case of food supply disruptions. The edibles chosen for emergencies ought to possess extended shelf lives, cater to the dietary requirements of infants, domesticated animals, and family members with specific food restrictions, and should not be excessively high in sodium or spice.[7] Wien and Sabaté think that the features, ease of preparation and cultural acceptance of food products are important factors in disasters. They recommend the consumption of food items, such as dry cereals, dried fruits, and nuts for emergencies such as disasters.[8]

In an emergency, food should be stored in a cool, dry, and dark place at a temperature of 40°F-70°F (4.4°C-21.1°C). It is necessary to store food away from petroleum products, such as gasoline, oil, paints, and solvents. Following a disaster, it would be beneficial to have utensils, such as knives, forks, and spoons, paper plates, drinking glasses, and towels at one's disposal, as well as tools, such as a manual can and bottle opener, sturdy aluminum foil, a propane gas or charcoal grill, and a supply of coal.[7]

Disaster Short-Term Nutrition Services

It covers the nutrition service that starts from the first hours of disaster or emergency and is offered within 72 hours.[9] The recommended baseline for daily energy consumption per person is set at 2100 kcal. However, if the ambient temperature drops below 20°C, it is advisable to augment the energy requirement by an additional 100 kcal for every 5°C reduction in temperature below the 20°C threshold.[10] Table 1 demonstrates the daily vitamin and mineral needs of the population in disaster and emergency situations.

At this stage, priority should be given to distribute easily accessible, nonperishable, and calorie-dense edibles. These may include a variety of foods, such as bread and cereals, soups, cheeses, yogurts, olives, biscuits, canned fruits and juices, tea, and other similar items. Since such foods are both practical and easy to obtain, nutrition services can be provided more easily and faster.[11]

After the 2011 earthquake and tsunami in Japan, Inoue et al reported that affected individuals showed a preference for vegetables and fruits, even though most of the emergency food aid provided, such as rice balls or bread, was primarily carbohydrate based. This could be attributed to the ease of procurement and the abundance of such items in emergency food pantries. Furthermore, Inoue et al reported that 1 month after the disaster, 23% of the victims had lost weight, and 28% had experienced decreased food intake, with up to 25% of the participants displaying gastrointestinal symptoms.[12]

Table 1. Daily Requirements of Vitamins and Minerals for a Population Needing Emergency Food Aid

Vitamin/Mineral	Recommend Daily Intake
Vitamin A	500 µg retinol equivalents (or 1.666 IU)
Thiamine (B1)	0.9 mg
Riboflavin (B2)	1.4 mg
Niacin	12.0 mg
Folic acid	160 µg
Vitamin C	28.0 mg
Vitamin D	3.8 µg
Iron	22 mg*
Iodine	150 µg

Source: The management of nutrition in major emergencies. WHO, Geneva, 2000.
*Assuming low availability of iron in the diet (i.e., 5%-9%).

Disaster Long-Term Nutrition Services

During such periods, it is imperative to exercise caution and follow strict food safety guidelines when cooking and preparing meals. Utmost care should be taken to ensure the hygiene and sanitation of all preparation, storage, and serving utensils and equipment.[13]

As per the technical reports of FAO/WHO, protein should account for no less than 10-12% of the total energy requirements. The protein needs of a population can be effectively met through the consumption of a combination of plant-based proteins such as cereals and legumes. Additionally, at least 17% of the daily energy intake should be derived from fat. However, in the context of supplementary feeding programs, young children require a higher proportion of fat in their diet, ranging from 30% to 40% of their daily energy needs, while pregnant and lactating women require a minimum of 20%[10] (Table 2).

In the Turkish Red Crescent, there are 2 types of packages consisting of foodstuffs that can meet the nutritional needs of a family prepared for disasters for an average of 7 days. The average weight of food packages is 20.75 kg. Of these packages, Type 1 contains kidney beans, and Type 2 contains chickpeas. Type 1 food packages are consumed more in Balkan countries, and in Europe, Type 2 food packages are consumed more in Arab and Middle Eastern countries[11] (Table 3).

Nutrition Services for Vulnerable Groups

Infants and Young Children

During emergencies, it is crucial to prioritize breastfeeding and adequate feeding for infants to ensure their health. Artificial feeding should only be considered as a last resort. In the absence of a lactating mother or insufficient breast milk, babies can be fed milk, yogurt, pudding, biscuits, cereal flour, vegetable soups, fresh fruit juice, and purees from 0 to 6 months of age. It should be noted that artificial feeding increases the risk of diarrheal diseases, malnutrition, and infant mortality in emergency conditions. Using baby bottles and artificial pacifiers is discouraged because of hygiene concerns, and instead, glasses should be used, as they are easier to clean.[10]

For babies in the 6-24 month period, protein should account for at least 12% of their energy intake. Complementary foods should consist of a combination of legumes, grains, oils, and sugar, along with a variety of fruits, vegetables, eggs, and fish. Combined foods such as corn-soy or wheat-soy can be used as well.[11]

Pregnant and Breastfeeding Nutrition

Pregnant women require an additional 285 kcal of energy intake per day, while breastfeeding women require an additional 500 kcal per day. It is essential for maternal and infant health to maintain a regular intake of iron (60 mg), folic acid (400 mg), vitamin A, and iodine. Protein-rich enriched food products should contribute to 10-12% (up to 15%) of the total energy intake, while fat should provide 20-25%. These enriched food products can be combined to meet two-thirds of the daily micronutrient needs. In times of a disaster, it is advisable to supplement the daily-recommended diet with 2 glasses of milk-yogurt and fresh fruit.[10]

Table 2. Examples of Adequate Full Rations in Terms of Energy, Protein, and Fat for Populations Reliant on Food Assistance

	Rations (Quantity in g)				
Items	**Example 1**	**Example 2**	**Example 3**	**Example 4**	**Example 5**
Cereal	400	450	350	400	400
Pulses*	60	60	100	60	50
Oil (vitamin A) fortified	25	25	25	30	30
Fish/meat	—	10	—	30	—
Fortified blended foods	50	40	50	40	45
Sugar	15	—	20	—	25
Ionized salt	5	5	5	5	5
Energy (kcal)	2113	2075	2113	2146	2100
Protein (in g and in % kcal)	58 g: 11%	71 g: 13%	65 g: 12%	55 g: 10%	65 g: 12%
Fat (in g and in % kcal)	43 g: 18%	43 g: 18%	42 g: 18%	42 g: 17%	39 g: 17%

Source: The management of Nutrition in Major Emergencies. WHO, Geneva, 2004.
*Not all types of pulses are acceptable to all populations; therefore, the most familiar type of pulse must be resourced for the population.

Nutrition Services for Elderly Individuals

To meet the protein and micronutrient needs of elderly people in the disaster, mashed pulpy foods should be preferred to provide ease of swallowing and chewing.[14] To mitigate constipation in elderly individuals, it is recommended to provide them with liquid and fiber-dense food options. Additionally, offering dried fruits with laxative properties can prove helpful in alleviating constipation in this age group.[15] For disabled survivors, magnesium, iron, and zinc minerals should be added to their diets in addition to vitamin D.[11]

Emergency Medical Teams for Food Services

Emergency medical teams (EMTs) at the national level are required to carry a 3-day stock of food that should meet the minimum daily energy requirements. The specific nutritional needs of the responsible staff should also be taken into consideration.

Table 3. Turkish Red Crescent Type 1 and Type 2 Food Package Content

	Type 1 Food Carton Content			**Type 2 Food Carton Content**	
	Nutrients	**Amount (kg)**		**Nutrients**	**Amount (kg)**
1.	Rice	2.5	1.	Rice	2.5
2.	Haricot bean	2	2.	Haricot bean	2
3.	Granulated sugar	5	3.	Granulated sugar	5
4.	Flour	5	4.	Flour	5
5.	Salt	0.75	5.	Salt	0.75
6.	Pasta	2	6.	Pasta	2
7.	Kidney bean	1	7.	Chickpeas	1
8.	Bulgur wheat	2.5	8.	Bulgur wheat	1.5

Source: Türk Kızılayı. Türk Kızılayı Afetlerde Beslenme Kılavuzu. Öztürk İ, Koçak Ç, editors. 2017. Ankara: Türk Kızılayı.

International EMTs must maintain a food supply for at least 14 days. All EMTs should have at least 1 day's emergency food. Inpatient EMTs must ensure a supply of culturally appropriate cooked food for the patient and caregiver. The personnel responsible for food preparation should possess sufficient knowledge of food management and safety. The use of meals ready to eat (MREs) should be strictly controlled with alternative food solutions planned accordingly. Additionally, a field kitchen should be organized for patients who require continuous follow-up.[16]

Food Supply Chain and Food Safety in Disasters

A network of activities known as the food supply chain (FSC) maintains food security.[17] Disasters (whether man-made or natural) pose some of the biggest threats to FSCs, and studies have been conducted on how to manage FSCs throughout different crises.[18,19] Earthquakes: Damage to buildings and infrastructure is the most frequent threat that earthquakes pose to FSCs (e.g., road, water, gas, electricity). Road and transportation system damage might reduce accessibility and interfere with FSCs.[20]

Food that is safe to eat has not lost any nutritional content and is uncontaminated chemically, biologically, and physiologically.[21] The cleaning of the feeding equipment must be taken into consideration. Food service workers should practice good personal hygiene.[11] Food storage areas and hiding spots must be at least 60 m from water sources and 1 m from rubbish disposal areas.[22]

Water Supply, Sanitation, and Hygiene Promotion

Water, Sanitation, and Hygiene

Water, sanitation, and hygiene (WASH) standards constitute another expression of the right to access to water and sanitation in disasters.

Disaster victims become vulnerable to infectious diseases as well as many other illnesses and ultimately death. Adequate and appropriate provision of sanitation and water supply is of paramount importance in preventing such disease situations. In this way, WASH programs reduce the risk of disease by preventing pathogenic microorganisms from affecting individuals' health.[6]

Key activities include the following:

- Promoting good hygiene practices, providing safe drinking water, ensuring the adequacy of sanitary facilities, reducing environmental health risks, and upholding the principles necessary for a healthy, safe, and dignified life.
- The program's important objectives are to provide water supply, purification, distribution, and transportation, as well as storage and consumption management, to ensure effective and integrated sanitation management, to make healthy behavior practical, and to provide access to hygiene materials.
- Community participation is needed. Water, sanitation, and hygiene interventions and activities are a dynamic issue that practically involves community participation. In urban areas, groups at risk become less visible in parallel with population density, and community participation decreases.
- A combination of cash-based assistance and technical support should be provided. All of these minimum requirements should be implemented in collaboration with other agencies and institutions that have intervened and with local authorities.
- Water and sanitation rights are universal rights necessary for people to live with dignity and are recognized by international law. States and other actors have responsibilities for protecting and fulfilling these rights.
- In crises such as disasters, insufficient water quantity or unsuitable water quality is among the main causes of public health problems in crisis areas. Drinking water should be sufficient to ensure survival, and individuals' access to safe water should be economically feasible and fair.[6]

Critical Activities Related to Water Quantity and Quality in Emergencies

- The most suitable surface and groundwater sources should be determined in parallel with environmental impacts.
- The systems that are suitable for delivering the required amount of water and reaching those who need it should be identified, and measures should be taken to ensure fair and safe access.
- Regular research on sanitation between water sources and distribution points (DPs) should be carried out. Water containing fecal coliform bacteria (*Escherichia coli* constitutes more than 99%) carries the risk of fecal pollution and other pathogen contamination and should therefore be treated.
- Whether appropriate water drainage points are present in critical areas such as homes, bathrooms, and collective washing and cooking areas should be ensured from a hygiene standpoint.[6] Table 4 shows some important indicators.

The data on compliance with the standard water quality for drinking water are as follows:

- (1) <10 CFU/100 mL at the DP (unchlorinated water),
- (2) ≥0.2-0.5 mg/L free residual chlorine (FRC) at the DP (chlorinated water),
- (3) Turbidity should be below 5 NTU.

For health centers and hospitals:

1. About 5 L per outpatient,
2. About 40-60 L per day per inpatient,
3. About 100 L per surgical intervention and birth,
4. Additional amounts may be required for laundry equipment, toilet flushing, etc.

- After earthquakes, water supplies and transmission systems may be damaged; water supply pumps, transmission lines, treatment plants, main distribution lines and household plumbing can be damaged. Mains water should be brought to the area without delay, regardless of temporary or permanent settlement.[23]
- Although bottled water may be suitable for individuals affected by disasters in the short term, purified water will be less costly in terms of waste and transportation.
- Although surface water sources may require more treatment, they can be the most practical solution option when choosing a water source. Water that comes from membranes by gravity and/or groundwater sources is preferred. Care should be taken to ensure that water withdrawal does not exceed limits.
- The effects of different amounts of supplied water on the community, diseases that can be associated with WASH, and related mortality rates should be observed by evaluating indicator values.[6]
- The minimum goal for providing an uninterrupted water supply is that access to the source in the water distribution area is approximately 8 hours per day. The importance of equal and fair access should be considered to prevent tense situations.
- The long round-trip times to water DPs and the long waiting times in these areas may cause individual water consumption to decrease and the use of unprotected surface water to increase. Moreover, the risk of violence should not be forgotten.
- It is important to adjust the size and number of containers used to properly increase and store water at the household level. Monitoring access to containers before and after the crisis and analysis of the results will be beneficial for creating a sustainable plan for subsequent processes. There should be 2 water containers per family with a capacity of 10-20 L and a 20-L covered storage container.
- In the medium and long term, the planning, location, and design of DPs should be decided by taking into account the opinions of the community and other stakeholders.
- Regarding bathing, necessary arrangements should be made for privacy and security, taking into account human dignity, and separate facilities should be provided for men and women.
- A drainage plan should be developed in consultation with municipal authorities for water DPs, bathroom facilities, and hand and laundry washing areas.
- It should be kept in mind that if the taste of safe drinking water is not good, users may prefer unsafe sources.
- After the source or distribution, water should be treated with a residual disinfectant such as chlorine to mitigate any significant contamination risks. Safe filling, storage, and transportation practices help minimize post-distribution contamination. The cleaning of storage tanks used for residential and settlement storage should be done regularly.
- If a centralized water treatment system is not possible, use a household water treatment and safe storage approach. Boiling, chlorination, ceramic filtration, disinfection using sunlight, membrane filtration, slow sand filtration, ceramic filtration, disinfection, and flocculation are appropriate options.[6]

Table 4. Some Important Indicators for Water Quantity and Quality in Emergencies

Average water consumption per household for drinking and domestic hygiene purposes	Minimum 15 L per person per day Determine the amount based on the general situation and the stage of intervention
The maximum number of people using facilities that require water	250 people per faucet (with a flow rate of 7.5 L/min) 500 people per hand pump (with a flow rate of 17 L/min) 400 people per hand-dug well (with a flow rate of 12.5 L/min) 100 people per laundry facility 50 people per bath facility
Flow rate at water collection points	Minimum 0.125 L/s
Percentage of household income used for purchasing water for drinking and domestic hygiene purposes	Target of 5% or less
Distance from any household to the nearest water point	<500 m
Waiting time at water sources	<30 minutes
Daily water consumption for essential needs such as drinking and cooking	Varies depending on individual physiology and climate, but generally 2.5-3 L per person per day
Amount of water needed for hygiene practices	Varies depending on cultural and social norms, but generally 2-6 L per person per day
Basic water requirement for cooking	Varies depending on the type of food and social norms, but generally 3-6 L per person per day
Total basic water requirement	7.5-15 L per person per day
Amount of FRC in water transported by pipes for communities over 10 000 people or in situations where there is a risk or presence of epidemic diarrhea	0.2-0.5 mg/L
The maximum amount of coliform bacteria per 100 mL of water taken from the point of exit of an untreated source	10 coliform bacteria
Total dissolved solids	Maximum 1000 mg/L
Monthly soap consumption per person	250 g
Required number of washing pools in communal laundries	1 per 100 people

Source: Gögen S. TSK Koruyucu Hekimlik Bülteni, Afetler ve Afete Müdahalede Asgari Sağlık Standartları. 2004;3(12) and Sphere Association. *The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response*, fourth edition, Geneva, Switzerland, 2018.

Water Treatment Techniques

The use of these methods is essential until a long-term solution that eliminates microbiological and physical contamination in water is established.

Filtration

A clean piece of cloth is placed over the container to be filled with water, and water is allowed to flow through the cloth. A tighter weave increases the filtering ability. The same side of the cloth should always be used. The cloth used should be washed again with clean water and soap.[23,24] Coffee filter papers can also be used.

Aeration (cleaning by contact with air):

The oxygen level in the water is increased. As a result,

- Some volatile substances that affect the taste and odor of the water are removed.
- A decrease in the carbon dioxide level in the water is observed.
- Some dissolved minerals (iron, manganese, etc.) oxidize and form sediment, so the water can be treated by settling or filtration methods.

The simplest method of close contact with air is to shake the water in the container without spilling it for 5 minutes. Then, after the water is left to rest for 30 minutes, it becomes suitable for water treatment.[23,24]

Storage and Preservation

Water stored in a container for 48 hours is free from some microorganisms. Using water from the top of the container is more appropriate.

For household use, a 3-container system is suitable for storage and preservation. Water stored in the first container for 1 day is transferred to another container on the second day and on the third day; it is consumed from a clean container.[23,24]

Disinfection

Although microorganisms in water decrease with treatment, they are never eliminated. Disinfection is applied for this purpose, and water treated previously can be subjected to this process. Disaster victims can apply the following disinfection methods.

Boiling:

Chlorination: Being a low-cost and easy-to-use chemical makes chlorine one of the most commonly used chemicals in disinfection.

It can destroy viruses and bacteria except for those that are very resistant.

Chlorine is present in laundry bleaches. If the water is mixed with a certain amount of laundry bleach and left for 30 minutes, the process is completed. Chlorine-free laundry detergents should not be used.[23,24] There are 2 methods for chlorination:

1. Two drops of bleach containing 5% chlorine were dropped into 1 L of water. If the chlorine content of the bleach is different, it should be calculated.
2. One-fifth of a 1-L bottle is filled with bleach. The remainder is made up of water. In this way, a 1% solution was prepared. This solution is the main solution, and it should not be drunk. One teaspoon of this solution is added to 5 L of water to be disinfected. Three to 4 teaspoons are thrown into a demijohn of water (19 L).[23,24]

Conclusion

In addition to the deterioration of shelter and health during a disaster, access to nutrition and safe water is also restricted. In the fight against disasters, governments and aid organizations need to assist the affected people in providing food and safe water in a short time. Before the disaster, the organizations assigned to the disaster should be prepared and should have completed controls and plans that it will apply during the disaster. In the event of a disaster, it is important to store food and safe water that will meet the needs of the person for at least 3 days. After a disaster, it is necessary to plan the food and safe water supply to support disaster victims and those who need special nutrition. While planning nutritional services, the cultural structure of the society and the type and dimensions of the disaster should be taken into account. In addition, EMTs, which are the first responders in the event of a disaster, should have the necessary training, equipment, food, and safe water. To achieve all these goals, it is necessary to plan the disaster management process and to elaborate on the organization.

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