Original Article

What factors were important for dietary improvement in emergency shelters after the Great East Japan Earthquake?

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The Great East Japan Earthquake of 2011 left many evacuees with insufficient food and emergency shelter. However, there is no evidence concerning the factors affecting dietary circumstances in emergency shelters after disasters. To clarify the factors that influenced the provision of meals, we reanalyzed a data set from a dietary survey conducted in emergency shelters one month after the Great East Japan Earthquake (2011). Among the 69 shelters in "city A," 53 (79.1%) had food shortages. The possibility of cooking in the emergency shelter improved the provision of meals to evacuees. When comparing emergency shelters with and without cooking equipment, the shelters with cooking equipment provided more meals, as well as more dishes containing grains and vegetables. When there was a gas supply, the twice per day provision of "balanced" meals (containing grains, vegetables, and meat/fish) was more frequent than when there was no gas supply. Interestingly, neither the water supply nor the electricity supply affected the provision of balanced meals. Further, emergency shelters with larger numbers of evacuees had a lower possibility of cooking and lower availability of gas supply. Our results demonstrate that early improvements to post-disaster meal provision may maintain the health of evacuees. Such improvements could be achieved by 1) the speedy restoration of the gas supply to enable cooking, and 2) limiting the number of evacuees per emergency shelter.

Key Words: disaster, emergency shelter, gas, cooking, meals

INTRODUCTION

Large-scale natural disasters frequently result in mass evacuations. During these evacuations, nutrition care may be crucial for sustaining the lives of evacuees. However, little research has been undertaken to investigate the nature of diets in emergency shelters or its effects on evacuees.

Only a few studies have been reported on dietary circumstances and nutrition care after disasters. However, available results suggest that the meals provided at emergency shelters have an important effect on evacuee's health and physical condition. For example, immediately following the 1999 Greek earthquake,[1] researchers studied meals provided at two camps and, using the 24-hour recall method, and found a significant lack in dietary intake for adults (particularly the elderly). After the Great Hanshin-Awaji Earthquake in Japan, food supply distributed to emergency shelters consisted mainly of carbohydrate-rich foods, such as rice balls, bread, and instant noodles, to provide energy.[2] However, supplies of fresh food were poor.[3] Indeed, a study conducted about two months after the Great Hanshin-Awaji Earthquake found that lower intake of green vegetables was associated with more reports of common cold symptoms, coughing, weight loss, gastrointestinal disorders, stress, and irritability.[4] This association with health-related complaints was also found for a lower intake of fish.[4] However, we could find no studies on effective methods for improving meal

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provision in emergency shelters. Further, there is also no evidence on factors that might affect dietary circumstances in emergency shelters.

One recent example of a natural disaster requiring evacuation was the Great East Japan Earthquake, which occurred on March 11, 2011. This magnitude 9 earthquake generated an enormous tsunami that resulted in the destruction of houses, roads, and countless infrastructure. An estimated 450,000 evacuees were temporarily housed in over 2400 emergency shelters. These evacuees lived together in the shelters for periods of up to four months or more.[3,5] Although emergency care was the first priority, it quickly became clear that nutrition care was essential to sustain lives. Three weeks after the earthquake, the Japan Dietetic Association (JDA) dispatched 1588 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.[6]

In the present study, we report dietary supply circumstances at emergency shelters after the Great East Japan Earthquake. Data were provided by the JDA and our aim was to elucidate the important factors that influenced the provision of meals to evacuees.

METHODS

Data source

We analyzed data collected from April 4 (post-quake Day 24) to April 5 (Day 25), 2011; the Japan Dietetic Association permitted our use of the data. Data were collected using a cross-sectional survey of the all emergency shelters in city "A," one of the most damaged areas. The survey was conducted as part of a nutrition support program administered by the Japan Dietetic Association and local governments. The survey consisted of three components: 1) a questionnaire about conditions in the emergency shelters (number of evacuees, presence of nutritionally vulnerable or high risk individuals, possibility of cooking, availability of services for cooking); 2) a questionnaire about food supplies (eg, excess foods, lack of foods); and 3) a dietary record for meals provided. Nutritionally vulnerable individuals were defined as those who needed nutrition care with a special diet (ie, infants needing formula or a diet of soft foods, elderly persons including those with aphagia, and individuals with food allergies, pressure ulcers, or other health conditions). Data about the availability of services for cooking included information about the availability of electricity, gas, and water. Gas and electricity were supplied by regular utility services and by portable gas canisters and emergency generators, respectively. Water was supplied by regular utilities (eg, by faucet) and by tank truck and bottled sources.

Data collection

The survey originally included 81 emergency shelters open to the public as of March 31, 2011 in city A. The response rate was 100%. However, data from 12 shelters were excluded because incomplete answers were provided for the dietary record. Thus, we analyzed data from 69 emergency shelters in total. Questionnaires were delivered by teams of two or three dietitians to the food service managers who were in charge of providing meals in each of the emergency shelters. The 24-hour recall, one-day dietary record we used in this study was the dietary menu as reported by each emergency shelter. Menus for each meal were then categorized into six food types: grains (carbohydrate-rich foods), vegetables (vegetable-based dishes including soup), meat and fish (main protein-based dish), fruit, and milk or other dairy products. We also focused on balance of the diet. A diet was defined as "balanced" if two or more meals per day contained grains, vegetables, and meat or fish.

Statistical analyses

Data were analyzed by the size of the shelter (ie, the number of evacuees). Shelters were classified into three groups according to the tertile of the number of evacuees accommodated: T1 (<25 evacuees), T2 (25–80 evacuees), and T3 (>80 evacuees). Statistical comparisons among the emergency shelters were performed using the Trend test and Fisher's exact test. The Trend test was used for comparisons of 2×3 or 2×4 contingency tables for frequency of meal provision or shelter size. Fisher's exact test was used for comparisons of 2×2 contingency tables obtained from all categorical variables. For all tests, the significance level was set at $p<0.05$. Statistical analyses were performed using the SPSS software, version 16.0 (SPSS® Inc, Chicago, Ill).

Ethical considerations

The present analysis was approved by the institutional ethics committee of the National Institute of Health and Nutrition, Japan (approval number: 20120711-01).

RESULTS

Characteristics of emergency shelters

Included in the survey were 69 emergency shelters, housing a total of 7423 evacuees. The largest shelter housed 1100 evacuees, while the smallest housed only 2 evacuees. The median was 50 evacuees per shelter.

There were nutritionally vulnerable individuals (n=194) housed in 24 (34.8%) of the emergency shelters, as shown in Table 1. Among these vulnerable individuals, most fell into one of three groups: 1) infants, 2) elderly with aphagia, and 3) people with other health conditions (hypertension, diabetes mellitus, and renal disease).

Table 2 shows the adequacy of food distribution from warehouse to emergency shelters. Among the 69 emergency shelters, 53 (79.1%) had food shortages and 24 (35.8%) had excess food. Notable types of shortage were: milk and dairy products, meat, vegetables, beans, fish, and shellfish. Seasonings (eg, ketchup, mayonnaise, instant stock base, sauces, and pepper) were also reported as insufficient at eight shelters. Among the excess foods, cereals were reported in excess at 17 shelters.

Meal provision

As shown in Table 3, in the first month after the earthquake, one emergency shelter still provided a meal only once daily and four shelters still provided meals only twice daily. Shelters with the possibility of cooking, both frequency of meals and provision of grains and vegetables were significantly greater than in shelters with no cooking equipment or access to cooking facilities. Possi-

Table 1. Proportion of nutritionally vulnerable individuals in emergency shelters (n=69) after the Great East Japan Earthquake (2011)

		All emergency shelters (n=69)		Number of individuals
		n†	(%)‡	
Nutritionally vulnerable individuals	Presence	24	(34.8)	194
	Absence	42	(60.9)	
	Unknown	3	(4.3)	
Infants	Presence	12	(17.4)	40
	Absence	56	(81.2)	
	Unknown	1	(1.4)	
Elderly with aphagia	Presence	7	(10.1)	38
	Absence	57	(82.6)	
	Unknown	5	(7.2)	
Food allergy	Presence	7	(10.1)	11
	Absence	57	(82.6)	
	Unknown	5	(7.2)	
Pressure ulcers	Presence	7	(10.1)	20
	Absence	57	(82.6)	
	Unknown	5	(7.2)	
Other health problem	Presence	8	(11.6)	85
	Absence	58	(84.1)	
	Unknown	3	(4.3)	

† n = the number of emergency shelters (total = 69).
‡Numbers in parentheses indicate percentage of emergency shelters according to type of nutritionally vulnerable individuals.
Note. Column numbers may not sum to 100% due to rounding.

Table 2. Adequacy of food distribution from the warehouse to emergency shelters (n=67) after the Great East Japan Earthquake (2011)

	All emergency shelters (n† = 67)			
	Shortage		Excess	
	n†	(%)‡	n†	(%)‡
Total Food	53	(79.1)	24	(35.8)
Food groups§				
Cereals	2	(3.0)	17	(25.4)
Instant noodle	0	(0.0)	5	(7.5)
Sweet buns	0	(0.0)	11	(16.4)
Potatoes and starches	0	(0.0)	0	(0.0)
Vegetables	16	(23.9)	0	(0.0)
Fruits	5	(7.5)	0	(0.0)
Fish and shellfish	11	(16.4)	1	(1.5)
Meats	17	(25.4)	0	(0.0)
Eggs	7	(10.4)	0	(0.0)
Beans	13	(19.4)	1	(1.5)
Milk and dairy products	29	(43.3)	0	(0.0)
Fats and oils	2	(3.0)	0	(0.0)
Seasonings and spices	8	(11.9)	0	(0.0)

†n=number of emergency shelters (total=69). Data for two shelters was missing.
‡Numbers in parentheses indicate percentage of emergency shelters for each category of food.
§Multiple answers were allowed.

bility of cooking was associated with a significant increase in the provision of meat and fish dishes by Trend test, but not by Fisher's exact test. When comparing emergency shelters according to restoration of services, the shelters with gas and water supply provided the possibility of cooking whereas restoration of electricity was not associated with the possibility of cooking (Table 4). In the case of balanced meals, availability of gas supply for cooking was associated with a significant increase in the twice-daily provision of balanced meals (Table 5). Further, both cooking and availability of gas supply were associated with shelter size (Table 6). Emergency shelters with larger numbers of evacuees had a lower possibility of cooking and lower availability of gas supply than did shelters with smaller numbers of evacuees.

DISCUSSION

The present study revealed the generally poor dietary circumstances in emergency shelters after the Great East Japan Earthquake and found that the opportunity for cooking and the availability of gas significantly affected the provision of meals to evacuees. When cooking was not possible, meal provision tend to be inadequate. Further among the important services, the availability of gas for cooking was associated with a marked improvement in an emergency shelter's ability to provide twice-daily balanced meals. In fact, some emergency shelters could not serve food such as instant noodles because of the lack of gas to boil water. Previous studies reported that local governments generally stockpile not only food but also cooking utensils.[7] However, not many heat sources were available even in local government. In order to improve dietary and nutritional conditions in emergency shelters, we suggest that it will be necessary to provide a regular gas utility to shelters as quickly as possible and stockpile heat sources such as portable gas canisters. Furthermore, shelter size may be an important factor toward improving dietary conditions. Early post-disaster improvements in meal provision were best achieved when the numbers of evacuees per shelter were lower and by speedy restoration of the gas supply to provide a cooking environment.

Table 3. Meal provision in emergency shelters by the possibility of cooking (n=69) after the Great East Japan Earthquake

Provided frequency/day		All shelters n=69		Cooking: Shelters where possible, n=52		Cooking: Shelters where impossible, n=17		*p* for trend	*p* for Fisher's exact test
		n†	(%)‡	n †	(%)‡	n†	(%)‡		
Meals	None	0	(0.0)	0	(0.0)	0	(0.0)	0.003	0.012
	Once	1	(1.4)	0	(0.0)	1	(5.9)		
	Twice	4	(5.8)	1	(1.9)	3	(17.6)		
	3 times	64	(92.8)	51	(98.1)	13	(76.5)		
Grain dishes	None	0	(0.0)	0	(0.0)	0	(0.0)	0.009	0.029
	Once	1	(1.4)	0	(0.0)	1	(5.9)		
	Twice	5	(7.2)	2	(3.8)	3	(17.6)		
	3 times	63	(91.3)	50	(96.2)	13	(76.5)		
Vegetable dishes	None	5	(7.2)	1	(1.9)	4	(23.5)	0.005	0.041
	Once	20	(29.0)	14	(26.9)	6	(35.3)		
	Twice	34	(49.3)	28	(53.8)	6	(35.3)		
	3 times	10	(14.5)	9	(17.3)	1	(5.9)		
Vegetable dishes (including soup)	None	2	(2.9)	0	(0.0)	2	(11.8)	0.066	0.722
	Once	11	(15.9)	9	(17.3)	2	(11.8)		
	Twice	43	(62.3)	31	(59.6)	12	(70.6)		
	3 times	13	(18.8)	12	(23.1)	1	(5.9)		
Meat and fish dishes	None	5	(7.2)	2	(3.8)	3	(17.6)	0.035	0.146
	Once	20	(29.0)	14	(26.9)	6	(35.3)		
	Twice	34	(49.3)	27	(51.9)	7	(41.2)		
	3 times	10	(14.5)	9	(17.3)	1	(5.9)		
Fruit	None	23	(33.3)	15	(28.8)	8	(47.1)	0.13	0.236
	Once	37	(53.6)	29	(55.8)	8	(47.1)		
	Twice	9	(13.0)	8	(15.4)	1	(5.9)		
	3 times	0	(0.0)	0	(0.0)	0	(0.0)		
Milk and dairy products	None	58	(84.1)	41	(78.8)	17	(100.0)		0.054
	Once	11	(15.9)	11	(21.2)	0	(0.0)		
	Twice	0	(0.0)	0	(0.0)	0	(0.0)		
	3 times	0	(0.0)	0	(0.0)	0	(0.0)		

†n = number of emergency shelters (total=69).
‡Numbers in parentheses indicate percentage of emergency shelters for each meal category and for meal category according to shelter type.
Note. Column numbers may not sum to 100% due to rounding. The Trend test was used for 2×3 and 2×4 tables. Categorical variables, frequency of meal provision, and cooking possibility (2×2) were analyzed using Fisher's exact test. Meals: ≤twice vs ≥3 times, Grain dishes: ≤twice vs ≥3 times, Vegetable dishes: ≤once vs ≥twice, Meat and fish dishes: ≤once vs ≥twice, Fruits: none vs ≥once, Milk and dairy products: none vs ≥once.

Table 4. The effects of service restoration on the possibility of cooking in emergency shelters (n=69) after the Great East Japan Earthquake (2011)

		Cooking: Shelters where possible		Cooking: Shelters where impossible		*p* for Fisher's exact test
		n †	(%)‡	n†	(%)‡	
Water for cooking	Available	49	(80.3)	12	(19.7)	0.018
	Unavailable	3	(37.5)	5	(62.5)	
Gas for cooking	Available	52	(85.2)	9	(14.8)	0.000
	Unavailable	0	(0.0)	8	(100.0)	
Electricity for cooking	Available	33	(71.7)	13	(28.3)	0.387
	Unavailable	19	(82.6)	4	(17.4)	

†n=the number of emergency shelters (total=69).
‡Numbers in parentheses indicate percentage of emergency shelters according to service type.

Table 5. The effects of the possibility of cooking and of service restoration on the provision of balanced meals in emergency shelters (n=69) after the Great East Japan Earthquake

		Balanced meal provided		Unbalanced meal provided		*p* for Fisher's exact test
		n†	(%)‡	n†	(%)‡	
Cooking	Possible	30	(57.7)	22	(42.3)	0.162
	Impossible	6	(35.3)	11	(64.7)	
Water for cooking	Available	34	(55.7)	27	(44.3)	0.140
	Unavailable	2	(25.0)	6	(75.0)	
Gas for cooking	Available	35	(57.4)	26	(42.6)	0.024
	Unavailable	1	(12.5)	7	(87.5)	
Electricity for cooking	Available	24	(52.2)	22	(47.8)	1.000
	Unavailable	12	(52.2)	11	(47.8)	

†n = the number of emergency shelters (n=69).
‡Numbers in parentheses indicate the percentage of emergency shelters according to type of service restored and type of meal provided.
Note. Column numbers may not sum to 100% due to rounding.

Table 6. The effects of availability of cooking, service restoration, and balanced meals according to the number of evacuees in emergency shelters after the Great East Japan Earthquake

		Number of evacuees in shelter						*p* for trend
		T1 <25 evacuees		T2 25-80 evacuees		T3 >80 evacuees		
		n†	(%)‡	n†	(%)‡	n†	(%)‡	
Cooking	Possible	20	(38.5)	19	(36.5)	13	(25.0)	0.015
	Impossible	2	(11.8)	6	(35.3)	9	(52.9)	
Water for cooking	Available	19	(31.1)	22	(36.1)	20	(32.8)	0.640
	Unavailable	3	(37.5)	3	(37.5)	2	(25.0)	
Gas for cooking	Available	22	(36.1)	23	(37.7)	16	(26.2)	0.005
	Unavailable	0	(0.0)	2	(25.0)	6	(75.0)	
Electricity for cooking	Available	15	(32.6)	13	(28.3)	18	(39.1)	0.341
	Unavailable	7	(30.4)	12	(52.2)	4	(17.4)	
Balanced meal	Provided	14	(38.9)	12	(33.3)	10	(27.8)	0.231
	Not provided	8	(24.2)	13	(39.4)	12	(36.4)	

† n = the number of emergency shelters (total = 69).
‡ Numbers in parentheses indicate percentage of emergency shelters according to cooking, service, and meal categories.
Note. Column numbers may not sum to 100% due to rounding.

Another important reason for inadequate provision of meals was shortages of food in the emergency shelters. Indeed, more than three quarters of the shelters surveyed reported some form of food shortage. Consequently, each emergency shelter had to decide on its own menus according to the limited food distribution. For example, one shelter provided a sweet bun and coffee for breakfast, a sweet bun and instant noodles for lunch, and fried chicken, cabbage, and instant miso soup for dinner. This is consistent with previous research showing that food stockpiles tend to be carbohydrate rich.[8] Therefore, meal provision is likely to be improved both by increasing food supply and by the building of balanced food stockpiles.

The current survey also found that there were many evacuees, particularly the elderly and chronically ill, at nutritional risk.[9] This finding may be related to the finding that after the Great East Japan Earthquake, there were significant increases in the occurrence of cardiovascular disease.[10] Further, to prevent the deterioration of health conditions such as hypertension,[11] a low sodium diet is necessary but is not freely available in emergency shelters. Indeed, many food supplies provided after the earthquake were preserved in salt (eg, instant noodles, retort-packed food, and canned food) suggesting that salt intake was high in the shelters. Reports published after the Great Hanshin-Awaji Earthquake also revealed the importance of managing the diet of diabetic individuals, given the marked effect that food intake has on blood sugar levels.[12-14] The importance of the quantity of meals for individuals with diabetes was also reported after the Noto Peninsula Earthquake in Japan.[15] One possible solution is to follow a trend established in the United States, where individual households are encouraged to store non-perishable foods in case of disaster.[16]

There were several limitations to the present study. First, the sample size was relatively small. Second, we could not investigate data on the portion sizes of the meals provided. This was in part because there were concerns on the support of the evacuees, and therefore tried to reduce the burden on food service managers. Third, the meal provision data for each emergency shelter was collected for only one day of meal provision. Therefore, our results may not reflect typical diet in emergency shelters because of a lack of data for variations in day-to-day meal provision. In particular, the types of food arriving from the warehouse may differ daily. In addition, the dietary

intake level of individual evacuees is unknown because data on food consumption could not reasonably be collected. Furthermore, the present study could not directly evaluate the effect of improvements in early food supply on nutritional status of the evacuee population. In the acute phase after a disaster, it would be difficult to obtain the necessary data.

In conclusion, our analysis suggests early improvements in the provision of meals at emergency shelters could be achieved by 1) having adequate and balanced stockpiles of food, 2) speedy restoration of gas supplies to facilitate cooking, and 3) limiting the number of evacuees per emergency shelter. Improvements to cooking facilities could be achieved in part by advance preparation for disasters; therefore, it is hoped that local governments and authorities will act now and implement such measures to prepare for future disasters.

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AUTHOR DISCLOSURES

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

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Appendix.
Meals and types of food provided according the numbers of evacuees in emergency shelters after the Great East Japan Earthquake.

Provided frequency/day		All shelters n = 69 †		Number of evacuees in shelter T1, <25 evacuees n = 22		T2, 25–80 evacuees n = 25		T3, >80 evacuees n = 22		*p* for trend
		n†	(%)	n†	(%)‡	n†	(%)‡	n†	(%)‡	
Meals	None	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0.023
	Once	1	(1.4)	0	(0.0)	0	(0.0)	1	(4.5)	
	Twice	4	(5.8)	0	(0.0)	1	(4.0)	3	(13.6)	
	3 times	64	(92.8)	22	(100.0)	24	(96.0)	18	(81.8)	
Grain dishes	None	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0.084
	Once	1	(1.4)	0	(0.0)	0	(0.0)	1	(4.5)	
	Twice	5	(7.2)	1	(4.5)	1	(4.0)	3	(13.6)	
	3 times	63	(91.3)	21	(95.5)	24	(96.0)	18	(81.8)	
Vegetable dishes	None	5	(7.2)	1	(4.5)	2	(8.0)	2	(9.1)	0.191
	Once	20	(29.0)	6	(27.3)	7	(28.0)	7	(31.8)	
	Twice	34	(49.3)	10	(45.5)	12	(48.0)	12	(54.5)	
	3 times	10	(14.5)	5	(22.7)	4	(16.0)	1	(4.5)	
Vegetable dishes (including soup)	None	2	(2.9)	0	(0.0)	1	(4.0)	1	(4.5)	0.078
	Once	11	(15.9)	4	(18.2)	3	(12.0)	4	(18.2)	
	Twice	43	(62.3)	11	(50.0)	16	(64.0)	16	(72.7)	
	3 times	13	(18.8)	7	(31.8)	5	(20.0)	1	(4.5)	
Meat and fish dishes	None	5	(7.2)	1	(4.5)	1	(4.0)	3	(13.6)	0.062
	Once	20	(29.0)	4	(18.2)	8	(32.0)	8	(36.4)	
	Twice	34	(49.3)	13	(59.1)	12	(48.0)	9	(40.9)	
	3 times	10	(14.5)	4	(18.2)	4	(16.0)	2	(9.1)	
Fruits	None	23	(33.3)	8	(36.4)	6	(24.0)	9	(40.9)	1.000
	Once	37	(53.6)	12	(54.5)	15	(60.0)	10	(45.5)	
	Twice	9	(13.0)	2	(9.1)	4	(16.0)	3	(13.6)	
	3 times	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	
Milk and dairy products	None	58	(84.1)	18	(81.8)	20	(80.0)	20	(90.9)	0.605§
	Once	11	(15.9)	4	(18.2)	5	(20.0)	2	(9.1)	
	Twice	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	
	3 times	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	

† n = the number of emergency shelters (total = 69).
‡ Numbers in parentheses indicate percentage of emergency shelters according to frequency of meal and food provided.
Note. Column numbers may not sum to 100% due to rounding.
§ This 2×2 table was analyzed by Fisher's exact test.

Original Article

What factors were important for dietary improvement in emergency shelters after the Great East Japan Earthquake?

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東日本大地震後緊急避難所飲食改善有哪些重要因子？

在 2011 年的東日本大地震後，許多災民沒有足夠的食物和緊急避難所。然而，關於災難後在緊急避難所中影響飲食情況的因素目前並無確證。為澄清影響餐食供應的因素，重新分析在東日本大地震一個月後，於緊急避難所進行的膳食調查資料。在 A 城市中有 69 間避難所，其中 53 間(79.1%)有糧食短缺的問題。在緊急避難所烹調的可能性，提升膳食供應給避難者。比較有或無烹調設備之緊急避難所，有烹調設備者可以提供較多餐點，及較多包含穀物和蔬菜的菜餚。有天然氣供應的避難所，每天提供兩次"均衡"餐點(包含穀物、蔬菜和肉或魚)的頻率高於沒有天然氣者。特別的是，不論供水或電力供應狀況都不影響提供均衡餐食。再者，多數緊急避難所的難民有較少的烹調機會及較低的天然氣供應可獲性。本研究結果顯示，即早改善災難後餐食供應可維持災民的健康。下列舉措可促成這種改善：(1)迅速恢復天然氣供應以提供烹調；(2)限制每個緊急避難所的災民人數。

關鍵詞：災難、緊急避難所、天然氣、烹調、餐點