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The Effects of Two Earthquakes in the Marmara Region of Turkey on the Nutritional Status of Adults

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Abstract: Earthquakes have affected public health and nutrition. Therefore; this study was conducted to evaluate the nutritional status of adults living in the areas affected by Turkey's two largest earthquakes 18 months after they occurred. This study included 285 healthy adults (111 men and 174 women) who were studied in order to highlight the effects that two earthquakes had on their nutritional status. All the participants were living in the earthquake zones and surrounding areas. The study began approximately 18 months after the Marmara Earthquake of August 17th, 1999 and the Düzce Earthquake of November 12th, 1999. The average Body Mass Index (BMI) of the study group after the earthquakes was 24.6±3.6 kg m^{-2} for the men and 23.4±4.7 kg m^{-2} for the women. Daily energy intake of the men and women was 1385.4±495.7 and 1202.9±452.1 kcal, respectively. In present study population, energy ($p<0.005$), protein ($p<0.005$), carbohydrate ($p<0.001$), thiamin, niacin ($p<0.005$), vitamin A, calcium and iron intake of the men was higher than that of the women. However, energy and nutrient intake, both in the men and women we sampled, were below daily-recommended levels. In order to provide adequate and balanced nutrition to survivors in the regions affected by earthquakes, emergency nutrition plans should be prepared and implemented. One should bear in mind the importance of nutrition to the physical and psychological health of people following natural disasters.

Key words: Earthquake, nutrition, body mass index, daily energy and nutrient intake

Introduction

The basic features of natural disasters are that they usually occur abruptly and without warning, they destroy the usual organization of daily life, render the survivors physically weak and emotionally distraught and cause the loss thousands of lives. Earthquakes are the most common type of natural disaster experienced in Turkey, where on average, an earthquake occurs every 10.6 months; whereas the earthquake rate in Iran is every 15.6 and 16.8 months in Japan. Worldwide, Turkey is ranked first in earthquake frequency and second in terms of lives lost to earthquakes (Sengezer and Koç, 2005).

The Marmara Earthquake of August 17th 1999, with a magnitude of 7.4 on the Richter scale and the Düzce Earthquake of November 12th 1999, which had a magnitude of 7.2, affected two large and densely populated regions of Turkey and were the two most destructive in Turkey's history. Official government reports state that 20,000 people died, 30,000 were lost, many thousands of people were injured and suffered from psychological problems and 307,000 homes and 45,000 office buildings were damaged as a result of these two earthquakes (TMMOB, 2000). After the August 17th and November 12th, 1999 earthquakes, people who still lived in the affected regions had to try to adjust to tumultuous change and cope with difficult living conditions just to survive, all while suffering with psychological problems related to the trauma of these events. It could be said that these two earthquakes in Turkey entered the national consciousness in a shocking way and caused stress even for those who did not live in the affected regions (Yesilyaprak *et al*., 2007). Since all disasters have direct and indirect effects on health, implementation of minimal health standards in response to disasters can reduce morbidity and mortality rates. Public health is a vital issue during natural disasters, especially earthquakes. Water supplies and sanitation, vector control, waste control, burial of corpses, nutrition and maintaining minimum health standards are very important. Nutrition is important for crisis prevention, mitigation and management. Good nutrition reduces social unrest underlying violent conflict, decreases the human vulnerability that transforms systemic shocks into humanitarian disasters, lowers the death rate and promotes a timely return to equitable and durable development in the aftermath of disasters (Marchione, 2002).

Some of the stress reactions following earthquakes are disorders such as a lack of appetite and excessive eating behaviors. Inadequate and unbalanced nutrition affects health negatively (Yesilyaprak *et al*., 2007). Nutritional aid under these conditions is one of many important issues for the community (WHO, 1989). Proper and effective targeting of aid, however, requires that group at high risk of undernutrition/malnutrition be correctly identified, process not always easy and straightforward.

Unfortunately, there haven't been many studies with regard to the nutritional status of individuals involved in disasters. The present study was planned and conducted to evaluate the nutritional status of adults living in the areas affected by Turkey's two largest earthquakes 18 months after they occurred.

Materials and Methods

Participants: Volunteers were recruited by randomly selected from the cities of Kocaeli, Sakarya, Yalova and Düzce. The sample consisted of 285 subjects (111 men and 174 women) who were 25-60 years old and didn't have any chronic diseases. This study began approximately 18 months after the Marmara Earthquake of August 17th, 1999 and the Düzce Earthquake of November 12th, 1999.

Anthropometric assessment: The body weight of homeless was measured during the noon hours, before lunch, using a medical beam scale with an accuracy of ±100 g and the measurements were recorded to the nearest 0.1 kg. Subjects were weighed without shoes, wearing the minimum clothes possible. Standing height was measured without shoes to the nearest 0.5 cm, using a portable commercial stadiometer and suitable wooden angle, with the shoulders in relax position and arms hanging freely. Body Mass Index (BMI) was calculated as weight (kg) divided by height (square meters) [weight (kg)/height (m^2)] (Gibson, 1990). Conventionally accepted cut-off points were used to indicate undernutrition (BMI<18.5 kg m^{-2}), normal weight (BMI between 18.5 and 24.9 kg m^{-2}) and over weight (BMI between 25.0-29.9 kg m^{-2}) (WHO, 2000a).

Nutritional assessment: We determined each subject's food intake with 24 h records. We estimated the volume and portion size with 2-dimensional food models and with a portion size picture booklet, which included 120 photographs of foods, each with 3-5 different portion sizes. Two dietitians assisted with the dietary recall and reviewed all questionnaires with the subjects, probing for inaccurate and omitted responses. The average energy, protein, carbohydrate, lipid, thiamin, riboflavin, niacin, vitamin A, vitamin C, calcium and iron content for each individual's diet were analyzed using food composition tables for preparing Turkish foods. Energy and nutrient intake of the participants were compared to the FAO/WHO/UNU (1985) and Dietary References Intakes (Otten *et al*., 2006).

The values of the levels of daily intake (2/3 = 67%~70±33%) recommended as cut-off points were calculated; those having energy and nutrient intake at the recommended level were accepted as sufficient (67-133%), those with intake levels below the recommended value were insufficient (<67%) and those with intake above the cut-off point (>%133) were accepted as over sufficient (Baysal *et al*., 1999).

Table 1: The evaluation of age, body weight, height and BMI according to gender (n = 285)

	Men (n = 111)		Women (n = 174)			
Variables	x	S	x	S	t	P
Age (y)	35.6	12.8	32.2	12.9	-2.16	0.03
Weight (kg)	74.3	11.4	61.9	11.1	-8.98	0.00
Height (cm)	173.9	7.1	162.8	6.3	-13.8	0.00
BMI (kg/m^2)	24.6	3.6	23.4	4.7	-2.08	0.04

Statistical analysis: Analyses were performed using SPSS version 10.0 (Statistical Package for the Social Sciences, SPSS Inc, Chicago). Means and standard deviations were calculated for all variables. Daily energy and nutrient intake were compared using t test for men and women. Sufficient intake levels of energy and nutrients were evaluated according to gender using chi-square test. In all analyses, 5% significance level was used.

Results

The average of age of the participants was 35.6±12.8 years for the men and 32.2±12.9 years for the women. Average body weight ($p<0.001$), height ($p<0.001$) and BMI ($p<0.05$) were found to be higher in the men as compared to the women (Table 1).

When the BMI of individuals were evaluated after the earthquakes, it was found that 7.2% of the men and 22.4% of the women were underweight; 57.9% of the participants were normal weight and 25.6% was overweight. Under-nutrition among women was quite common ($p<0.005$) (Table 2).

Table 3 provides the daily energy and nutrient intake of the participants. Energy ($p<0.05$), protein ($p<0.05$), carbohydrate (g,%) ($p<0.001$), thiamin, niacin ($p<0.05$), vitamin A, calcium and iron daily intake in men was higher than that in women.

Thus, 83.8% of the men and 75.9% of the women had insufficient energy intake. The incidence of those having thiamin, riboflavin and niacin were 47.7, 53.7 and 82.5%, respectively for men and women combined. Calcium insufficiency was seen in 94.8% of the women and 70.7% of them had iron insufficiency; these levels of nutrient insufficiency were higher compared to those of the men (Table 4).

Discussion

Worldwide, earthquakes have caused more than a million deaths and more than a billion dollars in property loss in the past 20 years. Earthquake magnitude, population density, degree of preparation for earthquakes, strength and design of buildings and physical disability are major factors in earthquake-related destruction and mortality (Akbari *et al*., 2004; Roces *et al*., 1992; Angus *et al*., 1997; Peek-Asa *et al*., 1998). Identification of nutritionally vulnerable groups during emergency situations is important for the proper targeting of aid and effective management.

Table 2: Distribution of BMI according to gender (n = 285)

	Men (n = 111)		Women (n = 174)		Total (n = 285)	
Classification according to BMI	n	%	n	%	n	%
Underweight	8	7.2	39	22.4	47	16.5
Normal weight	72	64.9	93	53.5	165	57.9
Over weight	34	27.9	42	24.1	73	25.6

$Chi^2 = 11.41$, $p<0.005$

Table 3: The evaluation of daily energy and nutrient intake according to gender (n = 285)

	Men (n = 111)		Women (n = 174)			
Energy and nutrient intake (d)	x	S	x	S	t value	P
Energy (kcal)	1385.4	495.7	1,202.9	452.1	-3.20	0.002
Protein (g)	54.0	24.7	45.5	24.1	-2.87	0.004
Protein (%)	15.7	4.8	15.3	5.0	-0.57	NS
Carbohydrates (g)	202.7	63.5	152.0	55.9	-7.08	0.00
Carbohydrates (%)	59.6	10.8	51.6	13.6	-5.27	0.00
Lipid (g)	39.9	28.0	45.9	31.6	1.64	NS
Lipid (%)	24.7	9.8	33.1	13.0	5.85	0.00
Thiamin (mg)	1.35	1.50	1.07	1.29	-1.60	NS
Riboflavin (mg)	0.9	0.9	1.02	1.06	0.71	NS
Niacin (mg)	7.64	3.53	6.44	3.41	-2.86	0.005
Vitamin C (mg)	103.9	93.1	108.6	62.5	0.51	NS
Vitamin A (IU)	7,903.5	9,763.8	6,381.1	4,450.1	-1.79	NS
Calcium (mg)	381.3	256.1	370.4	191.0	-0.41	NS
Iron (mg)	10.4	5.2	9.2	5.0	-1.92	NS

NS: non significantly

Such chronic disease complications as protein-energy malnutrition, diarrhea, infectious diseases, anemia, vitamin insufficiency (especially vitamin A, C, thiamin and niacin), eating disorders, diabetic coma, gastro intestinal bleeding and heart attacks can be observed after a natural disaster (WHO, 2000b).

In the present study, it was determined that daily energy and nutrient intake was insufficient according to the data collected 18 months after the earthquakes. Daily energy intake was 1385.4±495.7 kcal in men and 1202.9±452.1 kcal in women. In this respect, the sufficient intake of energy occurred in 15.3% of the men and 23.5% of the women respectively, whereas 83.8% of the men and 75.9% of the women had insufficient daily energy intake. This is not surprising, since each disaster may have a different impact on individuals with different social, economic and health backgrounds. Present knowledge and understanding of disruptive effects a sudden disaster may have on the normal eating patterns of individuals is quite limited, partly due to the fact that such events are scarce and occur unexpectedly. Magkos *et al.* (2004b) showed that, daily energy consumption was generally low in adults and the elderly. Deficient energy and protein intakes were much more widespread in the older age groups than in the younger. In general, it is believed a diet of 2100 kcal (between 1900 and 2300 kcal) and 46 g mixed-diet protein is sufficient to begin with WHOb, 2000a,b. It should contain carbohydrates, vitamins and mineral salts.

Recommended daily intake levels for adults, according to expert panels, are specified as follows: Protein: Approximately 15% of kcal; carbohydrate: 50 to 60% of kcal; total fat: 25 to 35% of daily energy requirement (NCEP, 2001; Otten *et al.*, 2006). Despite the fact that energy was taken in insufficiently by those we studied, energy levels obtained from protein, carbohydrate and fats were balanced. According to the UN World Food Program, 1.4 million disaster victims could take in only 1600 kcal of the daily recommended 2400 kcal energy intake, thanks to food support (WHO, 2000b).

Studies evaluating the effects that earthquakes have on nutrition are quite rare. In a study similar to ours, Magkos *et al.* (2004a) found that daily energy intake was sufficient at the recommended age-dependent levels, whereas that of adults was 1469±99 kcal, which was well below the recommended levels. Eventually, insufficient energy intake results in malnutrition and defects of the nervous system and unbalanced intake leads to obesity (Bowman and Russell, 2001).

In the present study, daily vitamin and mineral intake were below the recommended levels. Thiamin, riboflavin, niacin, vitamin A, vitamin C, calcium and iron were taken in insufficient levels of 47.7, 53.7, 82.5, 25.6, 20.4%, 93.0 and 48.1%, respectively. The intake of micronutrients below the minimum daily requirement causes various health problems. Physiological stress and financial difficulties might have further deteriorated their dietary intake.

Table 4: Evaluation of the levels of sufficiency of daily energy and nutrient intake according to gender (n = 285)

		Insufficient		Sufficient		Over sufficient		
		n	%	n	%	n	%	
Energy	M	93	83.8	17	15.3	1	0.9	$Chi^2 = 2.91$
	W	132	75.9	41	23.6	1	0.6	P = 0.234
	T	225	78.9	58	20.4	2	0.7	
Thiamin	M	45	40.5	39	35.1	27	24.4	$Chi^2 = 4.34$
	W	91	52.3	54	31.0	29	16.7	P = 0.11
	T	136	47.7	93	32.6	56	19.7	
Riboflavin	M	72	64.9	31	27.9	8	7.2	$Chi^2 = 9.14$
	W	81	46.6	74	42.5	19	10.9	P = 0.01
	T	153	53.7	105	36.8	27	9.5	
Niacin	M	85	76.6	25	22.5	1	0.9	$Chi^2 = 5.68$
	W	150	86.2	21	12.1	3	1.7	P = 0.06
	T	235	82.5	46	16.1	4	1.4	
Vitamin A	M	30	27.0	30	27.0	51	46.0	$Chi^2 = 1.49$
	W	43	24.7	59	33.9	72	41.4	P = 0.473
	T	73	25.6	89	31.2	123	43.2	
Vitamin C	M	31	27.9	42	37.8	38	34.3	$Chi^2 = 8.29$
	W	27	15.5	63	36.2	84	48.3	P = 0.016
	T	58	20.4	105	36.8	122	42.8	
Calcium	M	100	90.1	9	8.1	2	1.8	$Chi^2 = 4.22$
	W	165	94.8	9	5.2	-	-	P = 0.121
	T	265	93.0	18	6.3	2	0.7	
Iron	M	14	12.6	55	49.5	42	37.9	$Chi^2 = 108.0$
	W	123	70.7	46	26.4	5	2.9	P = 0.0
	T	137	48.1	101	35.4	47	16.5	

M: Men, W: Women, T: Total

Many studies have shown that micronutrients given singly or in combination have a positive influence on growth, psychomotor coordination, mental function and bone health. Studies of multiple micronutrient deficiencies have shown improvement in linear growth, psychomotor functions and correction of biochemical abnormality when more than one nutrient was supplemented. Adequate and balanced nutrition is of great importance in the prevention and treatment of such diseases as coronary disease, hypertension, diabetes, obesity and cancer (Potischman and Douglas, 1999; Rosado, 1999; Bhandari *et al*., 2001; Bowman and Russell, 2001; Langley, 2006).

If the nutritional needs of individuals, groups and populations are to be met, the average daily intake of each nutrient needs to be sufficient enough to: counter-balance the loss of each nutrient; take account of nutrient interactions in the diet; take account of environmental conditions; maintain physical size, growth, pregnancy, lactation; maintain activity, including economically necessary and socially desirable activity (WHO, 2000b). Tsuzuki and Kawakubo (1999) found that people, whose houses collapsed, in particular, had irregular eating habits after the Hansin-Awaji Earthquake in Japan and that their increased cigarette smoking reduced their levels of HDL-cholesterol and increased LDL cholesterol. The disaster had many negative effects on the health-status of survivors, especially those forced to live in tent cities. Therefore, these results suggest that we must improve the health-status of those living in post-disaster tent cities.

Unfortunately, pre-disaster data to compare with are unavailable, but the unexpected nature of the event precluded such a possibility. Also, given the extreme conditions under which the study took place, full control of the procedures was not always attainable. Nevertheless, considerable effort was made to ensure the quality of collected data, by excluding those individuals who were not living full-time in the camps or those who could not provide complete and accurate data due to lack of communication skills, resentment and/or emotional charge.

In order to protect the health of survivors from the negative effects caused by disasters, survivors should be given the opportunity to:

(i) Eat at least one well-balanced meal each day
(ii) Drink enough fluids to enable the body to function properly
(iii) Take in enough calories to enable them to do necessary work
(iv) Include vitamin, mineral and protein supplements in their stockpile to ensure adequate nutrition (WHO, 2000b).

In complex emergencies, especially those involving famine and/or widespread food insecurity, assessments of malnutrition are critical to understanding the population's health status and to assessing the effectiveness of relief interventions. Additionally, food safety and sanitation should be implemented carefully. People should be educated about cleaning, contamination, cross contamination, food-borne diseases, microorganisms, germs, microbes and

hygiene (Robinson *et al*., 2001).

Official, Non Governmental Organizations and the community were not prepared for the Marmara and Düzce earthquakes. Hospital in particular should be built earthquake-resistant and doctors, dieticians and nurses should be trained in natural disaster response procedures. In spite of all these problems, rescue teams accomplished the monumental goal of maintaining the health status of the survivors, with great effort and devotion, in the areas affected by the Marmara and Düzce earthquakes.

Because of samples of this study consisted of in Kocaeli, Sakarya, Yalova and Düzce, the results should not be generalized to all earthquake provinces. Disaster affected nutritional status acutely, therefore during a disaster, nutritional organization and nutritional safety should be supplied, the requirements for the components of energy and nutrients should be met, the principles of healthy nutrition should be taken into consideration, environmental conditions should be arranged and nutrition should be regulated according to physiological status and risk groups.

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