Progress in Nutrition 2019; Vol. 21, Supplement 2: 107-112 DOI: 10.23751/pn.v21i2-S.6642

Assessing and comparing nutritional status and related factors among 6-48 months old children born in the damaged rural and urban areas of Varzeghan after the 2012 earthquake

Rasoul Mokhtari[1], *Faezeh Ghalichi*[2], *Asghari Jafarabadi Mohammad*[3], *Ali Barzegar*[1]

[1]Department of Nutrition in Community, Faculty of Nutrition and Food Sciences, Tabriz University of Medical Sciences, Tabriz, Iran - E-mail: alibarzegar@hotmail.com; [2] Faculty of Nutrition and Food Sciences, Tabriz University of Medical Sciences (TUOMS), Tabriz, Iran; [3]Department of Statistics and Epidemiology, Faculty of Health, Tabriz University of Medical Sciences, Tabriz, Iran

Summary. *Background:* Infants and young children have been identified as the most nutritionally vulnerable group in catastrophic situations such as earthquakes. Malnutrition and poor feeding practices during the early years of life could adversely affect child's growth, cognitive, physical and social development. *Objectives:* The objective of this study was to assess and compare nutritional status and related factors among 6-48 months old children born in the damaged rural and urban areas of Varzeghan after the 2012 earthquake. *Methods:* 250 children between 6-48 months living in Varzeghan and 60 damaged villages participated in this cross-sectional descriptive study. Anthropometric data were gathered and the three indices of malnutrition, wasting (weight/height), underweight (weight/age) and stunting (height/age) were calculated and assessed according to z-score. These data were compared with the documented files gathered in health institutes before the earthquake. *Results and Conclusion:* There were statistically significant differences in wasting, underweight and stunting before and after the earthquake in different areas. The most prevalent nutritional complications according to z-score<-2 were wasting (8.8%), underweight (6.4%) and moderate-severe stunting (2.8%), respectively. The prevalence of wasting (12.8% vs. 4.2%) and underweight (8.4% vs. 2.1%) in different areas was higher in girls in comparison to boys. This study provides evidence that natural disasters inversely effect children's nutritional health. Thus, since malnutrition still remains one of the main public health challenges in Iran and some other developing countries it is crucial to precisely assess and implement accurate intervention procedures to ensure the needs of all age groups especially young children.

Key words: nutritional status, growth disorders, malnutrition, earthquakes

Introduction

Protein-Energy malnutrition is defined as an imbalance between nutrient requirements and dietary intake that results in deficits of energy, protein, and micronutrients stores, resulting in impaired growth and development (1). Protein-Energy malnutrition is one of the common nutritional complications during early years of living causing growth retention, stunting, cognitive impairment, reduced work efficiency and educational progress; along with persistent inflammation, resistance to treatment and physical activity dismiss (2,3). Failure to thrive (FTT), a condition of delayed or cease of growth, mainly observed among children younger than 5 years is one of the main consequences of malnutrition (4).

Failure to thrive is the result of two main causes, organic factors such as acute and chronic diseases that impair nutrient absorption and metabolism or increase food demand and inorganic factors such as inadequate

intake, reduced appetite and poorly educated (5). Unsuitable environmental situation before birth and between birth until five years of age, has immanent and profound effect on children's health (6). Since nutritional status is merely affected by food chain factors such as economical and physical accessibility, food consumption and bioavailability, any feature that could influence this food chain could be a possible precursor of malnutrition (7).

Natural disasters are one of the most devastating inorganic factors threatening health and nutritional status, demanding urgent and special proceedings (5). Children are the main victims of disasters and calamities, since their physical and mental health is repeatedly injured. During natural disasters, restriction of food sources, poor energy and nutrient intake leads the population susceptible to infections and diseases and subsequently increases the rate of children morbidity and mortality (8). One of the general methods for assessing total nutritional status in vulnerable populations is measuring weight, growth and nutritional status among 6-59 months old children (9, 10). The three common index for malnutrition in researches are underweight, stunting and wasting (11).

Asia has been rated as the forth continent for the accession of natural disasters (27) and the Islamic republic of Iran is among the ten top countries with the highest prevalence of natural disasters and mortality (11). In 2012 a fatal earthquake (6.2 Richter magnitude scale) occurred in Arasbaran (10-kilometers of East-Varzeghan), East Azerbaijan, Iran, killing hundreds and dramatically affecting population's nutritional status and health. According to the severity of earthquake and lack of accurate information of children's nutritional status, efficient planning's for assessing the severity and extent of children's nutritional complications is essential. Based on the I.R. Iran Multiple Indicator Demographic and Health Survey (IrMIDHS) in 2000, the nutritional status of less than five-year-old children living in east Azerbaijan was high and stunting was prevalent (20). Thus, it seemed vital to determine the nutritional status of this area after the earthquake. The objective of this study was to assess and compare nutritional status and related factors among 6-48 months old children born in the damaged rural and urban areas of Varzeghan after the 2012 earthquake.

Methods

Participants

In this cross-sectional descriptive study, 250 children between 6-48 months living in Varzeghan and 60 damaged villages (15 villages >50% damaged) participated. Studied villages were recruited by clustering sampling among all the damaged villages, four years after the earthquake. Subjects were randomly selected, according to each village's population and by categorized sampling based on age groups (6-12 months, 1-2 years, 2-4 years). Inclusion criteria were children (6-48 months old) born and living in damaged areas caused by earthquake and willing to participate in the study by mother's permission. Based on the exclusion criteria, children or mothers who were not home after three times referral to houses were excluded from the study. Also, children or mothers with mental retardation and children with eating difficulties such as cleft lip and cleft palate were excluded.

Data collection

The basic information was gathered by referring to Varzeghan's municipal health center and rural health houses. According to the available files and the selected samples, the data for each child was registered (including their address). Subsequently, we went to each child's house and after gaining permission from their mother's, we started interviewing them for completing the data collection form. Demographic information and social-economic data were also collected. This study was approved by the ethical committee of Tabriz University of Medical Sciences (ethical code: IR.TBZMED.REC.1395.676).

Anthropometric data

A platform weighing scale (0-25 kg of capacity and 100 g of accuracy, Seca, Germany) was used for measuring body weight. Weight was measured three times to the nearest 100g in light clothes without shoes and the mean measurement was reported. Each day the scale was calibrated by a 10kg weight and adjusted if required. Recumbent length measurement was used for children younger than 2 years or shorter than 85cm using a length board.

For children older than 2 years or taller than 85cm, standing height without shoes was measured by a statiometer. Length and height were measured to the

nearest 0.1 cm. In this study, children's anthropometric data was determined according to the Centers for disease control and prevention (CDC) reference population, approved by WHO (14). The parameters used for body index were: weight-for-age as the present nutrition indicator or underweight, height-for-age as the past nutrition indicator or stunting, weight-for-height as the present and past nutrition indicator or wasting (15). Afterwards they were assessed according to z-score. The Z-score was used for nutritional classification with following category: normal: Z ≥ -1 SD, mild malnutrition: -1 SD Z ≤-2 SD, moderate malnutrition: -2 SD Z≤ -3 SD, severs malnutrition Z < -3 SD. Under nutrition was defined as underweight, stunting and wasting lower than -2 SD (Z < -2) (16).

Statistical Analysis

Data related to children's weight and height was transferred to the Epi info3.3.2 program and along with the rest of the data were analyzed using the Statistical Package for the Social Sciences (SPSS ver.22) (SPSS Inc, Chicago, IL, USA) software. Data normality was evaluated by Kolmogorov-Smirnov test and expressed by mean and standard deviation in tables. To compare the means between two groups, student t-test and Mann-Whitney U test were used for symmetric and asymmetric variables, respectively. The Pearson correlation coefficient was used to investigate the relationship between quantitative normal data ($p<0.1$ was considered statistically significant). The statistical tests were two-sided, and a P value less than 0.05 were considered statistically significant for the rest of the results.

Results

Table 1 indicates children's demographic information after the earthquake. As can be seen 4.8% of children weighed less than 2.5 kg.

Table 2 indicates the comparison of nutritional status based on wasting (weight/height) before and after the earthquake in different areas. As can be seen there were statistically significant differences for wasting in strongly damaged villages ($p=0.028$), Varzeghan ($p<0.001$) and the total area ($p=0.003$) before and after the earthquake. After comparing wasting with children's demographic, nutritional and economic status, we observed a statistically significant positive association (Confidence Inter-

Table 1. Demographic characteristics of children after the earthquake

Area	Girl (n%)	Boy (n%)	Age (month)		Type of birth		Birth weight	
	total		24≥	24≤	Natural	Cesarean	<2.5 kg	>2.5 kg
Strongly damaged villages	23 (%49)	24 (51.1%)	18 (38%)	29 (62%)	24 (51.1%)	23 (48.9%)	1 (2.1%)	46 (97.9%)
	47 (18.8%)							
Partially damaged villages	73 (%49)	76 (%51)	77 (49.7%)	75 (50.3%)	84 (56.4%)	65 (43.6%)	4 (2.7%)	145 (97.3%)
	149 (59.6%)							
Varzeghan	28 (52%)	26 (48%)	35 (64.8%)	19 (35.2%)	20 (37%)	34 (63%)	7 (13%)	47 (87%)
	54 (21.6%)							
Total area	122(48.8%)	128(51.2%)	127(50.8%)	123(49.2%)	128(51.2%)	122(48.8%)	12 (4.8%)	238 (95.2%)

Table 2. Comparison of nutritional status based on wasting (weight/height) before and after the earthquake in different areas

Index	**Nutritional status**	**Strongly damaged villages**		**Partially damaged villages**		**Varzeghan**		**Total Area**	
		Before (n=32)	After (n=47)	Before (n=101)	After (n=149)	Before (n=36)	After (n=54)	Before (n=169)	After (n=250)
weight/height	Normal	26(81.3%)	31(66%)	71(70.3%)	118(79.2%)	31(86.1%)	33 (61.1%)	128(75.7%)	182(72.8%)
	Mild	5(15.6%)	8(17%)	22(21.8%)	25(16.8%)	4(11.1%)	13(24.1%)	31(18.4%)	46(18.4%)
	Moderate-severe	1(3.1%)	8(17%)	8(7.9%)	6(4%)	1(2.8%)	8(5.4%)	10(5.9%)	22(8.8%)
	p-value	**0.028**		0.865		**<0.001**		**0.003**	

val=90%) between wasting and birth weight (p=0.077), the number of children under 5 years in the family (p=0.064), Iron supplementation (p=0.037) and a inverse association with Cesarean delivery (p=0.04).

Comparison of nutritional status based on underweight (weight/age) before and after the earthquake in different areas showed a statistically significant difference for underweight in Varzeghan (p<0.001) and the total area (p=0.011). Comparing underweight with children's demographic, nutritional and economic status indicated a statistically significant positive association (CI=90%) between weight/age and birth weight (p=0.005), duration of breast feeding (p=0.084) and a inverse association with mother's Body Mass Index (BMI) (p=0.089) and sex (p=0.057).

Table 4 declares the comparison of nutritional status based on stunting (height/age) among girls and boys in different areas after the earthquake. As can be seen there statistically significant differences for stunting strongly (p=0.019) and partially (p=0.083) damaged villages. With a 90%CI, there were statistically significant positive association between stunting and birth weight (p=0.014), economic status (p=0.062), mother's educational status (p=0.107), vitamin A and D supplementation (p=0.072) and type of feeding in the first 6 months of living (p<0.001).

When comparing moderate-severe wasting, underweight and stunting before and after the earthquake in different areas according to sex, we observed that the prevalence of underweight in different areas was higher in boys in comparison to girls (p=0.057).

Discussion

Growth monitoring is universally used to assess individual and overall nutritional status, health, development and estimate nutritional status. In comparison to other health assessment tools, measuring child growth using anthropometric indices is a relatively inexpensive, easy to perform and non-invasive process (16). According to findings, children's nutritional status significantly decreased after the earthquake. The most prevalent nutritional complications according to z-score<-2 were wasting (8.8%), underweight (6.4%) and moderate-severe stunting (2.8%). Similar results were observed after in the Wenchuan Earthquake in China (17), the 2011 Flood in Thailand (18) and Katrina Hurricane (19). Infant and young child morbidity and mortality often dramatically increase in a very short period after the earthquake even in previously healthy populations (17). However, since this study

Table 3. Comparison of nutritional status based on underweight (weight/age) before and after the earthquake in different areas

Index	Nutritional status	Strongly damaged villages		Partially damaged villages		Varzeghan		Total n(%)	
		before (n=32)	After (n=47)	before (n=101)	After (n=149)	before (n=36)	After (n=54)	before (n=169)	After (n=250)
weight/age	Normal	23(71.9%)	33(70.2%)	88(87.1%)	117(78.5%)	34(94.4%)	42(77.8%)	145(85.8%)	192(76.8%)
	Mild	7(21.9%)	9(19.1%)	10(9.9%)	24(16.1%)	2(5.6%)	9(16.7%)	19(11.2%)	42(16.8%)
	Moderate- Sever	2(6.2%)	5(10.6%)	3(3%)	8(5.4%)	-	3(5.5%)	5(3%)	16(6.4%)
	p-value	0.891		0.153		**<0.001**		**0.011**	

Table 4. Comparison of nutritional status based on stunting (height/age) among girls and boys in different areas after the earthquake

Index	Nutritional status	Strongly damaged villages		Partially damaged villages		Varzeghan		Total n(%)	
		before (n=32)	After (n=47)	before (n=101)	After (n=149)	before (n=36)	After (n=54)	before (n=169)	After (n=250)
height/age	Normal	21(65.6%)	41(87.2%)	91(90.1%)	128(85.9%)	34(94.4%)	51(94.4%)	146(86.4%)	220(88%)
	Mild	7(21.9%)	5(10.6%)	9(8.9%)	15(10.1%)	2(5.6%)	3(5.5%)	18(10.6%)	23(9.2%)
	Moderate- Severe	4(12.5%)	1(2.1%)	1(1%)	6(4%)	-	-	5(3%)	7(2.8%)
	p-value	**0.019**		**0.083**		0.673		0.930	

was accomplished four years after the earthquake, it is expected that children's nutritional status should have improved due to government policies. On the other hand, since it was a dramatic earthquake and mostly effected villages, it might take several years to compensate the damages.

Assessing 500 children's (6-59 months old) nutritional status, nine months after the Bam earthquake (2005, Bam, Iran) indicated that the prevalence of moderate-severe wasting and stunting were 15.2% and 8.9%, respectively. Also, low birth weight (<2.5kg) children were more than 7.5 and 4.5 times applicable to wasting (p=0.001), and underweight (p<0.001) (20). After the 1999 Colombian earthquake, children's nutritional status was rigorously damaged in short-time (one year after the earthquake) and partially damaged in middle-time (six years after the earthquake). However, the nutrition-educational programs and nutrient supplementation were able to diminish consequences (21). In this study, vitamin A and D supplementation reduced the prevalence of stunting (p=0.072). Also, Iron supplementation had a statistically significant association with wasting.

One year after the 2005 earthquake in Mansehra District of northern Pakistan, Nausheen Hamid et al performed a study on 102 children (12-59 months) for assessing the prevalence of acute and chronic malnutrition. There were increased odds of wasting in children in age-groups ≤35 months as compared with children in the older age-groups. Similarly, there were six-fold increased odds for stunting in children ≤23 months compared with the age-group 48–59 months. In terms of breastfeeding and infant weaning practices, the odds of children being wasted increased by 1.12 (P = 0.04) for every month if they continued to be breast-fed after 12 months of age (22). Similarly, in this study, the odds of children being wasted increased by 1.103 (P = 0.084) for every month of breastfeeding. Also, the odds of children being wasted decreased by 0.912 (p=0.096) when infant weaning was suddenly (less than a week).

The prevalence of wasting (12.8% vs. 4.2%) and underweight (8.4% vs. 2.1%) in different areas was higher in boys in comparison to girls. However, the differences of moderate-severe stunting prevalence among boys and girls was insignificant (p=0.642). In contrast, after the 2015 earthquake in Nepal, women and girls were prone to face greater risk than men and boys. Exposed from the onset to entrenched discriminations and inequalities in their daily lives, they get even more vulnerable during and after emergency situations (23). After the severe earthquake in Bam, Iran the sex ratio at birth decreased, 6–12 months later as a result of psychological tensions and stress associated with the earthquake (24). However, there was no significant difference in sex ratio after the Wenchuan Earthquake in China (25).

This study had the following limitations: one of the most important limitations of this study was that it was implemented four years after the earthquake, it would have been superior if it had been accomplished a few months after the disaster. Also, the effect of nutritional, economic and social support provided by the government on children's growth was not assessed. Since the rate of malnutrition had increased after four years, it seems that the government was not able to fully compensate the population's needs. However, the prevalence of malnutrition before the earthquake indicates that this area was not fully nourished and the earthquake had worsened the condition.

In conclusion, since malnutrition is an important determinant of child's mortality, interventions should begin immediately. In addition, nutrition intervention might play a key role in saving lives through their impact on nutrition and health for all target population aged 6 to 48 months. Therefore, encouraging and promoting breast feeding, and introducing high quality complementary foods in addition to breast milk should be an important intervention measure for the infants from six months of age.

Acknowledgement

The authors would like to gratitude the financial support of the Nutrition Research Center, Tabriz University of Medical Sciences. The authors would also like to thank all the kind people of Varzeghan.

Conflict of interest

The authors declare that there is no conflict of interest.

References

1. De Onis, M; Blössner, M. The World Health Organization global database on child growth and malnutrition: methodology and applications. International Journal of Epidemiology. 2003;32(4):518–526.
2. Berkman D. S, Lescano A.G, Gilman R. H. Lopez S. L. & Black, M. M. Effect of stunting, diarrheal disease, and parasitic infection during infancy on cognition in late childhood: a follow-up- study . Lancet . 2002.;59:564-567
3. Norgan N. G . Long- term physiological and economic consequences of growth retardation in children and adolescents. Proc. Nutr . 2000; 59:245-256
4. Berak M, AzariNamin L, Nemati A,Abbasgholizadeh N, Mirzarahimi M, Sedigh A. Risk factor of failure to thrive in less than 2 years old children Namin. Research Scientific Journal of Ardabil University of Medical Sciences and Health Services. 2004;3(10):13-7. Persian.
5. Becker S, Black RE, Brown KH. Relative effects of diarrhea, fever, and dietary intake on weight gain in rural Bangladeshi children. Am J Clin Nutr.1991;53:1499-503.
6. Almond, Douglas and Janet Currie. "Human Capital Development before Age Five." In O.Ashenfelter and D. Card (Eds), Handbook of Labor Economics. 2011; 4:1315-1486.
7. Pan American Sanitary Bureau, Regional Office of the World Health Organization Natural Disasters Protecting the Public's Health .Washington. WHO Publication cientific Publication, 2000,No, 575; 59- 67
8. Farshi. M. Education in crisis. www.emdad.com. Updated in 91.3.29
9. WHO (2000) The Management of nutrition in major emergencies, 2nd ed, p236. Geneva: World health Organization.
10. WHO (1995) Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. Geneva: World health Organization.
11. World Bank.World development report 1993.Newyork; onfork university press, 1993: 86-87.
12. Ministry of Health and Medical Education website. http://behdasht.gov.ir/
13. Arash Rashidian. I.R. Iran Multiple Indicator Demographic and Health Survey. Ministry of Health and Medical Education
14. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, et al: CDC Growth Charts for the United States: methods and development. Vital Health Stat 2002, 2000; 11(246):1-190.
15. WHO Expert Committee on Physical Status: Physical status: the use and interpretation of anthropometry, report of a WHO expert committee. Geneva, World Health Organization 1995, (WHO Technical Report Series, No. 854; (http://whqlibdoc.who.int/trs/WHO_TRS_854.pdf), accessed 20 May 2011).
16. A Srivastava, E Mahmood, P Srivastava, V Shrotriya and B Kumar. Nutritional status of school-age children – A scenario of urban slums in India. Archives of Public Health 2012, 70:8.
17. Caixia Dong, Pengfei Ge, Xiaolan Ren, Xianfeng Zhao, Jie Wang, Haoqiang Fan, Shi-an Yin. Growth and anaemia among infants and young children for two years after the Wenchuan Earthquake. Asia Pac J Clin Nutr 2014; 23(3):445-451
18. N Sanguanklin, B McFarlin, C Park, C Giurgescu, L Finnegan, R White-Traut, and J Engstrom. Effects of the 2011 Flood in Thailand on Birth Outcomes and Perceived Social Support. JOGNN, 2014; 43, 435-444.
19. Xu Xiong, E Harville, D Mattison, K Elkind-Hirsch, G Pridjian, P Buekens. Exposure to Hurricane Katrina, Post-traumatic Stress Disorder and Birth Outcomes. Am J Med Sci 2008;336(2):111–115.
20. Yarparvar A, Omidvar N, Golestan B. Assessing and comparing nutritional status and related factors among 6-59 months old children born in the damaged areas of Bam after the earthquake. Nutrition Science and Food Industry. 2006. 33-44;1
21. Bustelo, M., Arends-Kuenning, M. P., and Lucchetti, L. "Persistent impact of natural disasters on child nutrition and schooling: Evidence from the 1999 Colombian earthquake" (No. 6354). Institute for the Study of Labor (IZA). 2012february .
22. Hamid N, Bhakta D, Gilchrist B. Nutritional status of the children in areas affected by 2005 earthquake in northern Pakistan. Proceedings Nutrition Society 2008;67(OCE8):E324.
23. Government of Nepal. (2015, June 11). Nepal Disaster Risk Reduction Portal. Retrieved from drrportal.gov.np
24. Saadat M. Decline in sex ratio at birth after Bam (Kerman Province, Southern Iran) earthquake. J Biosoc Sci. 2000; 40(6): 935–937.
25. C Tan, H Li, X Zhang, H Zhang, P Han, Q An, W Ding, M Wang. The Impact of the Wenchuan Earthquake on Birth Outcomes. PLoS ONE 2009; 4(12): 1-5.

Correspondence:
Ali Barzegar,
Department of Nutrition in Community, Faculty of Nutrition and Food Sciences, Tabriz University of Medical Sciences, Tabriz, Iran
Phone: +965 50611441
Fax: +965 22513929
E-mail: alibarzegar@hotmail.com