

Factors Associated With Worsened or Improved Mental Health in the Great East Japan

Earthquake Survivors

Running Title: Mental Health of Earthquake Survivors

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Abstract

Objective: The aim of this study was to identify factors contributing to the worsening or improved mental health of long-term evacuees over three years following the Great East Japan Earthquake.

Method: The Japanese version of the K6 questionnaire was used as a measure of mental health. The first- and third-year survey results were compared and differences in mental health status calculated. Respondents were then divided into two groups according to worsening or improved mental health status. Differences in stress factors, stress relief methods, and demographics were compared between the two groups.

Results: Factors associated with exacerbation of poor mental health were the stress factors “Uncertainty about future” ($p = 0.048$) and “Loss of purpose in life” ($p = 0.023$). Multivariable analysis identified two factors associated with improved mental health, the stress relief methods “Accepting myself” (odds ratio (OR): 2.15, 95% confidence interval (CI): 1.02–4.51) and “Interactions with others”

(OR: 3.34, 95% CI: 1.43–7.79).

Conclusion: While motivation and hope of livelihood reconstruction have gradually risen in the three years since the disaster, anxieties about an uncertain future, loss of purpose in life, and disruption of social networks continue adversely to affect the mental health of survivors.

Keywords

Disasters; Mental health; Earthquakes; Disaster Victims; Population surveys

Introduction

The Great East Japan Earthquake of March 11, 2011 was a complex disaster involving not only direct earthquake and tsunami damage but also lasting danger from the resulting Fukushima Nuclear Plant accident. The giant tsunami that occurred following the 9.0-magnitude earthquake devastated the Pacific coastal areas of Japan's northeastern region and coincidental phenomena, including the intense quakes, dam breaks, and land subsidence, fragmented life lines in a vast area ranging from southern Hokkaido(northern Japan) and Tohoku regions(north eastern Japan) to southern Kanto region(eastern Japan including Tokyo and neighbouring prefectures). The number of deaths and missing from the earthquake has been reported as 18,451, those injured as 6,152 and building damage as 400,806 for both demolished and partially destroyed (National Police Agency, 2016) .Epicentral area extended approx. 500 km to north-south and 200 km to east-west. Flooded area caused by the tsunami from the pacific side coast has been estimated to have reached 561 km² (Ministry of Agriculture, Forestry and Fisheries of Japan, 2011). The direct cost of the disaster is estimated to be 25 trillion JPY by the Japanese Government, making it the most economically-damaging earthquake in history. The disaster continues to have a devastating impact on the lives of survivors, even three years later, as many residents are still forced to live as evacuees.

Previous studies have documented a number of diverse adverse effects on disaster survivors (Armenian et al, 2000; Goenjian et al, 1994; Zhang et al, 2011). Potential mental and physical

reactions reported include insomnia, anxiety, stress, depression, headache, and fatigue (Penick et al, 1976; Raphael, 1986). Since the establishment of Post-traumatic Stress Disorder (PTSD) as an independent disease entity in the DSM-III (1980), researchers have actively studied PTSD in large-scale disaster survivors. Overviews of these findings were provided by Norris et al., who summarized findings from 102 disasters (Norris et al, 2002), and by meta-analyses focusing on post-disaster PTSD and depression (Brewin et al, 2000; Tang et al, 2014). According to Norris et al., the most common psychiatric symptoms after a disaster are PTSD followed by depression and anxiety (Norris et al, 2002). Risk factors that increased adverse events following a disaster, including PTSD, were female sex, mature age, minority race, psychiatric history, and scarce psychosocial resources. By contrast, coping, self-efficacy, self-esteem, and optimism were listed as psychosocial resources, and it was concluded that the loss of these resources increased the risk of PTSD and depression. The meta-analysis by Tang et al. reported that 5.8% to 54% of adults and 7.5% to 44.8% of children experience depression following a natural disaster (Tang et al, 2014). Risk factors for post-disaster depression identified were female sex, being single, believing in a specific religion, inferior education, past trauma history, fear/injury/bereavement experienced as a result of the disaster, loss of occupation/properties, and damage to own home owing to the disaster. Thus, it is obvious that disaster survivors not only suffer physical and social losses but also are vulnerable to chronic mental

health problems. It is therefore critical to address victims' mental health issues in addition to material losses as part of post-disaster support.

Another important factor negatively impacting mental health after the Great East Japan Earthquake is the Fukushima Nuclear Plant accident. Nuclear accidents are known to cause more extensive disruption of mental, physical, and social aspects of life than ordinary natural disasters because radioactivity is a danger invisible and mysterious to most people, and so can easily compound fears and affect mental health. The best-known case demonstrating that a nuclear accident severely affects the lives of millions of people for an extended period of time is the Chernobyl nuclear accident of 1986. There are numerous reports on the mental health effects of this accident (Bromet, 2012). In their work on health hazards in the Chernobyl nuclear disaster, Bromet et al. reported that incidences of stress-related symptoms, depression, anxiety, and other symptoms that cannot be explained by physical causes were 200% to 400% higher than in prior disasters owing to uncertainty about the long-term consequences of radiation exposure (Bromet & Havenaar, 2007). An investigation by the World Health Organization (WHO) on residents neighboring the Chernobyl nuclear plant concluded that mental health was the most prominent public health issue in relation to the disaster (Burton et al., 2006). Another report found a significant correlation between proximity to the plant and impact on mental health (Foster & Goldstein, 2007). These findings suggest that mental health problems similar to those observed in Chernobyl survivors might also occur in

residents who lived near the Fukushima Daiich Nuclear Plant, located in proximity to many residential areas (as was the Chernobyl plant). In a cross-sectional study on former neighboring residents of the Fukushima Daiichi Nuclear Plant, it was reported that the mental health level was lower than the mean level of the general Japanese population (Amagai et al., 2014). This same report also emphasized the importance of continuous observation of both physical and mental health levels in this population. However, there have been few follow-up studies focusing on mental health problems in residents neighboring the Fukushima Daiich Nuclear Plant and most past studies on survivors of the Great East Japan Earthquake are cross-sectional in design. According to Norris, over 80% of studies on natural disasters are conducted within one year of the event and early-phase studies markedly outnumber longitudinal studies (Norris, 2006). Longitudinal studies of the victims with the view of supporting them for a prolonged period of time are needed.

Both the immediate consequences of the earthquake itself and the various ensuing events, such as the nuclear accident and prolonged evacuation, are assumed to be sources of significant stress for those who long to return to their hometowns. As more than three years have passed since the earthquake, it is important to assess changes in survivors' mental health levels and to identify factors associated with those changes.

Aims of the Study

This study aimed to identify factors associated with improvement or worsening of mental health over the three years following the disaster. The subjects of this study were residents still forced to live as evacuees after the Great East Japan Earthquake and the subsequent nuclear accident.

Material and methods

1. Subjects and survey method

The subjects were long-term evacuees temporarily living in another part of Fukushima Prefecture. I informed the subjects about health examination for disaster victims and mailed the Self-recording questionnaires to them in the first year (October 2012) and then three years (October 2014) after the disaster. I offered explanation on objective and method of the study on ethical terms, and asked for their participation. Only on the condition of receiving participant's agreement, I requested them to submit their questionnaire at the health examination center.

Questionnaires were collected at a health examination site for these evacuees. The area where the subjects lived before the disaster was not only directly damaged by the earthquake and tsunami but has also been designated an exclusion zone since the nuclear accident at the Fukushima Daiichi Nuclear Plant. Over 90% of the former residents of this area were still unable to return to their native villages at the time of the second survey.

2. Questionnaire items

(1) Mental health level

A questionnaire survey on disaster survivors' mental health status was conducted twice, in the first and the third year after the disaster.

As a measure of disaster survivors' mental health level, we used the Japanese version of the K6 questionnaire format developed by Kessler et al. based on the item response theory (Kessler et al., 2002). The effectiveness of the Japanese version of the K6 questionnaire was confirmed by Furukawa et al. (Furukawa et al., 2008). The K6 questionnaire format has proven to have greater power for screening mood and anxiety disorders than the General Health Questionnaire (GHQ) (Furukawa et al., 2003). The K6 consists of six questions, including "...did you feel nervous?" and "...did you feel worthless?" The maximum score is 24, with higher scores indicative of greater risk of mood and anxiety disorders (i.e., poorer mental health). Response choices are "None of the time" (0 point), "A little of the time" (1 point), "Some of the time" (2 points), "Most of the time" (3 points), and "All of the time" (4 points), and an aggregate score is calculated for the 6 responses. The cutoff value for this K6 questionnaire was set at 9 (Furukawa et al., 2008). Respondents with aggregate scores below 9 in the first-year survey but 9 or above in the third-year survey were classified as the "exacerbated group" and respondents who scored 9 or above in the first-year survey but below 9 in the third-year survey as the "improved group".

The number of participants to be analyzed will be broadly selected if the cut-off value is used to divide the participants into two groups as described above. The analysis was carried out in line with this grouping for the following reasons.

If an element other than the cut-off value is applied as the baseline for exacerbation and improvement of the mental health state, it may be possible to use the amount of the K6 score change. For example, when the change in the K6 score is obtained using the equation “the score after one year minus the score after three years” and the value of the score change is 0 or more, it can be considered that there has been an improvement in the mental health state. In contrast, a value of less than 0 indicates that the mental health state has been exacerbated. In this case, however, there is a possibility that the score change will equal -5 for people with 10 points after one year and 15 points after three years and also those with 1 point after one year and 6 points after three years. It can be presumed that the actual clinical conditions may not be truly reflected if the group of people whose scores increased from 10 to 15 and those whose scores increased from 1 to 6 over a period of two years are classified as being in the same Exacerbated Group and are thus categorized into one group. This is because there is a possibility that the mental health condition of people with a K6 score of 15 may be substantially different from that of people with scores of 6. Therefore, the method of dividing the participants into two groups was chosen on the basis that their actual mental health status will be better reflected by applying the cut-off value as the baseline for improvement and exacerbation of their mental health state, since the effectiveness of using the cut-off value to show mental health status has been demonstrated in previous studies.

(2) 'Stress factors' and 'Stress relief methods'

At the time of the third-year survey, a survey consisting of additional questions possibly associated with mental health level: 'Stress factors' and 'Stress relief methods' were also conducted.

For identification of stress factors and stress relief methods, items extracted from responses to preliminary open-ended questions collected in advance from evacuees were used as question items. The items for stress factors were "Health concerns for myself and family," "The disaster and nuclear accident," "Being unable to return to my home/native village," "Changes in lifestyle," "Uncertainty about future due to the compensation issues and incomplete recovery of livelihood," "Being apart from family and friends," "Fear and anxiety due to invisible radiation contamination," "Loss of business/social roles," "Loss of purpose in life," and "Others" (10 items). The 12 items for stress relief methods were "Interactions with people around," "Hobbies and volunteer activities," "Being purposeful and thinking positively," "Accepting myself, whether good or bad," "Physical activities such as exercises and walking," "Not worrying too much," "Health management with regular lifestyle and appropriate care for sleep and diet habits," "Acquisition of information on social resources and others," "Having someone I can confide in when in trouble," "Laughter," "Not accusing others," and "Not particularly."

(3) Other survey items

The other survey items consisted of questions regarding demographic data (sex, age, household structure, and housing environment), physical activities (sites, opportunities, walking time, and sitting time), and stress experienced in the previous one month.

For demographic data, subjects were asked about the presence/absence of cohabiting family member(s) and housing situation in addition to sex and age. For the question regarding housing situation, four choices were presented: requisitioned housing, temporary housing, own housing, and others.

Five aspects associated with physical activities were queried: sites (spending more time at home or outside), opportunities (whether opportunities of physical activities changed after the earthquake disaster), walking time (average daily walking time), and sitting time (average daily sitting time, excluding sleeping time).

3. Analysis methods

The first- and third-year survey results were compared and differences in mental health level calculated. Respondents were then divided into two groups: a group with poor mental health exacerbated between the two surveys and a group with improved mental health during the same period. Stress factors, stress relief methods, demographics, physical activities, and stress experienced

in the previous month obtained from the third-year survey were compared between groups. Fisher's exact test and Mann-Whitney U test were used to test for differences in categorical variables and continuous variables, respectively. A multivariate logistic regression analysis was conducted using variables with significant group differences in univariable analyses as independent variables and changes in mental health level (improvement or exacerbation) as dependent variables. The SPSS 18.0 statistical package was used for all analyses with the level of significance set to 5% on both sides.

4. Ethical considerations

The objective, methodology, information protection mechanisms, and data disclosure policies of this study were explained in writing. It was clearly stated that, while the researchers would manage and retain collected data using subject IDs for follow-up studies, the IDs would be used only for data analysis and matching; the researchers would retain no personal information, including names of respondents, and would ensure that individual respondents are unidentifiable when publishing analysis results. It was also explained in writing that participation in the survey was voluntary and that refusal to participate would not result in any disadvantage. The subjects' consent to participate in this survey was deemed obtained upon submission of the questionnaires. This research was permitted by the Ethical Review Board of the Medical School of Kyoto University.

RESULTS

The number of respondents was 1,595 for the first-year survey (valid response rate of 92.7%) and 1,960 for the third-year survey (66.2%). Mental health scores from both the first-year and third-year surveys were available for 485 respondents. Of these 485 respondents, those with a mental health score below 9 in the first-year survey but scored 9 or above in the third-year survey were classified as the “exacerbated group” (n = 63) and those who scored 9 or above in the first-year survey and below 9 in the third-year survey were classified as the “improved group” (n = 69) (Chart 1).

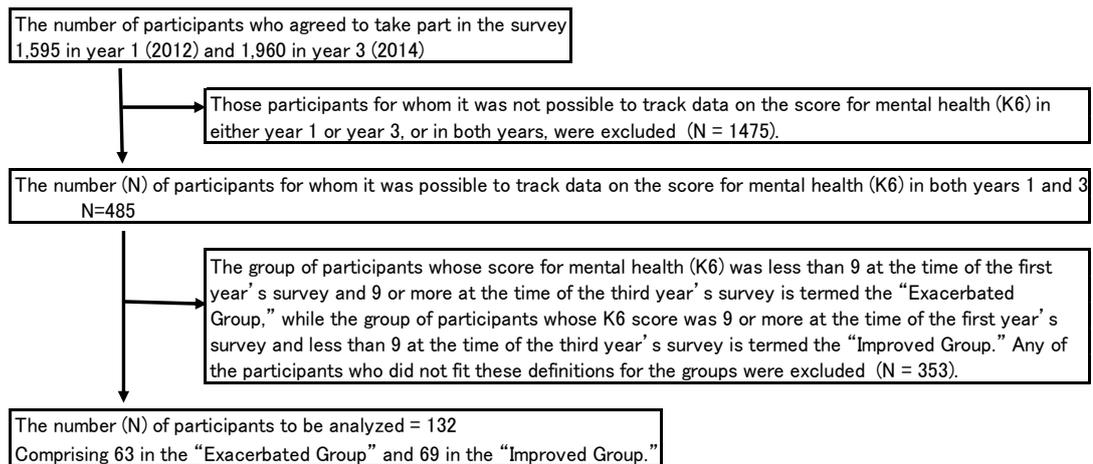


Chart 1: Flowchart showing how the participants to be analyzed were selected

1. Respondent attributes

Demographic attributes are listed in Table 1. The mean age of the respondents was 62.2 year (SD = 12.9) with a markedly higher proportion of females (60.9% vs. 39.1%). More than half were still

living in requisitioned or temporary housing while only 30.3% were in owned homes. The vast majority was currently living with family.

Table 1. Basic attributes

		Total	
		Responses	n (%)
n		485	
Age	Mean \pm SD	484	62.2 \pm 12.9
Sex		483	
	Male		189 39.1%
	Female		294 60.9%
Housing		429	
	Requisitioned		177 41.3%
	Temporary		105 24.5%
	Own		130 30.3%
	Other		17 4.0%
Cohabiting status		475	
	Living alone		67 14.1%
	Living with family		408 85.9%

2. Examination of mental health-associated factors in the improved and exacerbated groups

There were no significant differences in demographic factors between the improved and exacerbated groups (Table 2).

Table 2. Basic attributes of the improved and exacerbated groups

	Improved Group		Exacerbated Group		P-value
	Responses	n(%) or median [Interquartile range]	Responses	n(%) or median [Interquartile range]	
n	69		63		
Age, median [IQR]	69	64 [54.5 - 71]	62	65 [56 - 72]	0.400 b
Sex	69		63		0.259 a
	Male	18 26.1%	23	36.5%	
	Female	51 73.9%	40	63.5%	
Housing	60		53		0.826 a
	Requisitioned	25 41.7%	24	45.3%	
	Temporary	13 21.7%	12	22.6%	
	Own	19 31.7%	13	24.5%	
	Other	3 5.0%	4	7.5%	
Cohabiting status	68		62		>0.999 a
	Living alone	9 13.2%	9	14.5%	
	Living with family	59 86.8%	53	85.5%	

P-value: a. Fisher's exact test; b. Mann-Whitney U test.

However, several mental health-associated factors did differ between improved and exacerbated groups. The stress factor, “Being unable to return to my home/native village” ($p = 0.005$) and the stress relief method “Accepting myself” ($p = 0.034$) were associated with improved mental health. Factors associated with exacerbation were the stress factors “Uncertainty about future” ($p = 0.048$) and “Loss of purpose in life” ($p = 0.023$) (Table 3).

Table 3. Comparison of response rates between exacerbated and improved groups

	Improved Group		Exacerbated Group		P-value
	Responses	n (%)	Responses	n (%)	
n	69		63		
Activity site	68		59		0.586 a
Other than at home	43	63.2%	34	57.6%	
At home or no activity	25	36.8%	25	42.4%	
Activity opportunities	69		63		0.281 a
Decreased	52	75.4%	53	84.1%	
No change or increased	17	24.6%	10	15.9%	
Walking time	64		57		0.454 a
60 min or more	42	65.6%	33	57.9%	
Below 60 min	22	34.4%	24	42.1%	
Sitting time	63		59		0.713 a
8 hours or more	24	38.1%	25	42.4%	
Below 8 hours	39	61.9%	34	57.6%	
Stress felt in last one month	65		61		0.587 a
Yes	56	86.2%	55	90.2%	
No	9	13.8%	6	9.8%	
Stress factors					
Own health	69		63		0.160 a
No	15	21.7%	7	11.1%	
Yes	54	78.3%	56	88.9%	
Disaster and nuclear	69		63		0.709 a
No	3	4.3%	4	6.3%	
Yes	66	95.7%	59	93.7%	
Unable to return to my home/native	69		63		0.005 a **
No	0	0.0%	7	11.1%	
Yes	69	100.0%	56	88.9%	
Lifestyle change	69		63		0.064 a
No	7	10.1%	1	1.6%	
Yes	62	89.9%	62	98.4%	
Uncertainty about future	69		63		0.048 a *
No	11	15.9%	3	4.8%	
Yes	58	84.1%	60	95.2%	
Being apart from family and friends	69		63		0.169 a
No	7	10.1%	2	3.2%	
Yes	62	89.9%	61	96.8%	
Fear of radiation contamination	69		63		0.528 a
No	13	18.8%	15	23.8%	
Yes	56	81.2%	48	76.2%	
Loss of business/roles	69		63		0.545 a
No	15	21.7%	17	27.0%	
Yes	54	78.3%	46	73.0%	
Loss of purpose in life	69		63		0.023 a *
No	14	20.3%	4	6.3%	
Yes	55	79.7%	59	93.7%	
Other	69		62		0.594 a
No	60	87.0%	56	90.3%	
Yes	9	13.0%	6	9.7%	
Stress relief methods					
Interaction with	69		62		0.117 a
Not applicable	26	37.7%	32	51.6%	
Applicable	43	62.3%	30	48.4%	
Hobbies and volunteer activities	69		61		0.291 a
Not applicable	28	40.6%	31	50.8%	
Applicable	41	59.4%	30	49.2%	
Being purposeful	69		61		>0.999 a
Not applicable	32	46.4%	29	47.5%	
Applicable	37	53.6%	32	52.5%	
Accepting myself	69		61		0.034 a *
Not applicable	32	46.4%	40	65.6%	
Applicable	37	53.6%	21	34.4%	
Physical activities	69		62		0.711 a
Not applicable	21	30.4%	21	33.9%	
Applicable	48	69.6%	41	66.1%	
Not worrying too	69		62		0.845 a
Not applicable	18	26.1%	18	29.0%	
Applicable	51	73.9%	44	71.0%	
Health management	69		62		>0.999 a
Not applicable	19	27.5%	18	29.0%	
Applicable	50	72.5%	44	71.0%	
Acquisition of social	69		61		0.482 a
Not applicable	36	52.2%	36	59.0%	
Applicable	33	47.8%	25	41.0%	
Someone I can confide in	68		62		0.474 a
Not applicable	24	35.3%	26	41.9%	
Applicable	44	64.7%	36	58.1%	
Laughter	69		62		>0.999 a
Not applicable	32	46.4%	29	46.8%	
Applicable	37	53.6%	33	53.2%	
Not accusing the	69		62		0.600 a
Not applicable	35	50.7%	28	45.2%	
Applicable	34	49.3%	34	54.8%	
Not particularly	69		62		0.830 a
Not applicable	54	78.3%	50	80.6%	
Applicable	15	21.7%	12	19.4%	

P-value: * n < 0.05 ** n < 0.01 a Fisher's exact test

3. Associations between mental health improvement or exacerbation and each variable (logistic regression analysis)

To adjust for effects of latent confounding factors, including age, sex, housing, and cohabiting status, on the factors listed in Table 3, an age- and sex-adjusted logistic regression analysis and an age-, sex-, housing-, and cohabiting status-adjusted logistic regression analysis were conducted for each factor. The former identified a significant association with the stress factor “Loss of purpose in life” (odds ratio (hereinafter OR): 3.42, 95% confidence interval (hereinafter 95%CI): 1.05–11.07) and with the stress relief method “Accepting myself” (OR: 2.23, 95%CI: 1.08–4.64), and the latter revealed a significant association with the stress relief method “Interaction with others” (OR: 3.34, 95%CI: 1.43–7.79) (Table 4).

Table 4. Association between mental health improvement/exacerbation and each variable (logistic regression analysis)

	Model 1			Model 2		
	OR	95%CI	P-value	OR	95%CI	P-value
Activity site						
Other than at home	1.00			1.00		
At home or no activity	1.32	0.63 – 2.76	0.463	1.40	0.61 – 3.21	0.420
Activity opportunities						
Decreased	1.00			1.00		
No change or increased	0.57	0.23 – 1.36	0.205	0.51	0.18 – 1.41	0.193
Walking time						
60 min or more	1.00			1.00		
Below 60 min	1.62	0.75 – 3.48	0.216	2.00	0.87 – 4.60	0.103
Sitting time						
8 hours or more	1.17	0.56 – 2.44	0.685	1.20	0.53 – 2.72	0.659
Below 8 hours	1.00			1.00		
Stress felt in last one month						
Yes	1.32	0.43 – 4.01	0.626	0.89	0.24 – 3.30	0.863
No	1.00			1.00		
Stress factors						
Own health						
No	1.00			1.00		
Yes	2.56	0.93 – 7.04	0.068	2.81	0.87 – 9.11	0.086
Disaster and nuclear accident						
No	1.00			1.00		
Yes	0.64	0.14 – 3.01	0.570	0.67	0.13 – 3.31	0.621
Unable to return to my home/native village						
No	n.c.			n.c.		
Yes	n.c.			n.c.		
Lifestyle change						
No	1.00			1.00		
Yes	6.69	0.80 – 56.20	0.080	4.08	0.45 – 37.37	0.213
Uncertainty about future						
No	1.00			1.00		
Yes	3.57	0.94 – 13.57	0.062	2.77	0.66 – 11.67	0.164
Being apart from family and friends						
No	1.00			1.00		
Yes	3.15	0.62 – 15.95	0.165	2.65	0.48 – 14.63	0.263
Fear of radiation contamination						
No	1.00			1.00		
Yes	0.71	0.31 – 1.66	0.431	0.64	0.25 – 1.62	0.347
Loss of business/roles						
No	1.00			1.00		
Yes	0.79	0.35 – 1.78	0.568	0.70	0.28 – 1.77	0.455
Loss of purpose in life						
No	1.00			1.00		
Yes	3.42	1.05 – 11.17	0.042 *	2.80	0.81 – 9.67	0.103
Other						
No	1.00			1.00		
Yes	0.67	0.22 – 2.06	0.485	0.69	0.20 – 2.35	0.552
Stress relief methods						
Interaction with others						
Not applicable	2.11	1.00 – 4.45	0.051	3.34	1.43 – 7.79	0.005 **
Applicable	1.00			1.00		
Hobbies and volunteer activities						
Not applicable	1.61	0.78 – 3.32	0.198	2.06	0.91 – 4.65	0.083
Applicable	1.00			1.00		
Being purposeful						
Not applicable	1.12	0.55 – 2.28	0.754	1.60	0.72 – 3.58	0.249
Applicable	1.00			1.00		
Accepting myself						
Not applicable	2.23	1.08 – 4.64	0.031 *	2.05	0.90 – 4.68	0.086
Applicable	1.00			1.00		
Physical activities						
Not applicable	1.32	0.61 – 2.82	0.480	2.30	0.96 – 5.51	0.062
Applicable	1.00			1.00		
Not worrying too much						
Not applicable	1.34	0.59 – 3.06	0.490	1.86	0.73 – 4.78	0.194
Applicable	1.00			1.00		
Health management						
Not applicable	1.11	0.50 – 2.44	0.796	1.30	0.54 – 3.15	0.559
Applicable	1.00			1.00		
Acquisition of social resources and information						
Not applicable	1.42	0.70 – 2.88	0.336	1.52	0.70 – 3.34	0.293
Applicable	1.00			1.00		
Someone I can confide in						
Not applicable	1.29	0.63 – 2.65	0.491	1.62	0.72 – 3.61	0.241
Applicable	1.00			1.00		
Laughter						
Not applicable	0.90	0.44 – 1.84	0.763	1.03	0.46 – 2.31	0.936
Applicable	1.00			1.00		
Not accusing the others						
Not applicable	0.80	0.39 – 1.67	0.558	0.86	0.37 – 1.97	0.719
Applicable	1.00			1.00		
Not particularly						
Not applicable	1.18	0.49 – 2.83	0.718	1.25	0.45 – 3.44	0.665
Applicable	1.00			1.00		

OR, odds ratio; 95%CI: 95% confidence interval; n.c.: not calculatable; P-value: * p < 0.05, ** p < 0.01

Model1: Age- and sex-adjusted model

Model2: Age-, sex-, housing- and cohabiting status-adjusted model

Multiple logistic regression analyses were conducted using items with significant differences between improved and exacerbated groups as independent variables and changes in mental health level as dependent variables adjusted for age and sex (Table 5-1) or age, sex, housing, and cohabiting status (Table 5-2). These analyses revealed two factors associated with exacerbation, absence ('NO' response) of the stress relief methods "Accepting myself" (OR: 2.15, 95%CI: 1.02-4.51), and "Interactions with others" (OR: 3.34, 95%IC: 1.43-7.79) (Table 5-1 and Table 5-2).

Table 5-1. Results of multiple logistic regression analysis on factors associated with improvement/exacerbation of mental health level (age- and sex-adjusted)

	OR	95%CI	P-value
Stress factors			
Loss of purpose in life			
No	1.00		
Yes	3.10	0.93 – 10.29	0.065
Stress relief methods			
Accepting myself			
Not applicable	2.15	1.02 – 4.51	0.043 *
Applicable	1.00		

OR: odds ratio, 95%CI: 95% confidence interval, P-value: * p < 0.05

Table 5-2. Results of multiple logistic regression analysis on factors associated with improvement/exacerbation of mental health level (age-, sex-, housing and cohabiting status-adjusted)

	OR	95%CI	P-value
Stress relief methods			
Interaction with others			
Not applicable	3.34	1.43 – 7.79	0.005 **
Applicable	1.00		

OR: odds ratio, 95%CI: 95% confidence interval, P-value: ** p < 0.01

Discussion

This study of long-term evacuees from regions impacted by the Great East Japan Earthquake and Fukushima nuclear plant accident identified several factors associated with worsening or improved

of mental health between the first and third years after the events. Univariate analyses identified two factors associated with improvement of mental health, the stress factor “Being unable to return to my home/native village” and the stress relief method “Accepting myself”. The finding that survivors suffering from the stress factor “Being unable to return to my home/native village” actually showed improvement is surprising but suggests that stress from being unable to return home may mean these individuals have not given up hope and that a persistent intention to return home is a motivating factor. In other words, disaster survivors who are unsatisfied with their current situation but have hope for the future showed superior mental health, compared to those not reporting this as a stress factor (‘NO’), who have given up hope of returning home. This result emphasizes the importance of having a concrete goal or hope in life for maintaining a favorable mental state. Describing and sharing a concrete reconstruction plan (returning home) and working toward that goal is assumed to be an effective means for disaster survivors to maintain both mental health and motivation to reconstruct their lives. Considering the high mean age of study respondents, however, a great desire to return to villages in which they had long lived might not be shared by the broad evacuee population. It is likely that a middle-aged or younger evacuee who has found work and adapted to their new life in new places might not be willing to return home, even when allowed. Therefore, flexible responses according to survivor age, domestic setting, and livelihood status — rather than universally applying the policy of aiming for return — are essential. Further, personal issues and

response measures are necessarily diversified as evacuation is prolonged, and flexible adjustment is important in every phase of reconstruction assistance plans.

The stress relief method, “Accepting myself,” might complement this attitude of not giving up hope of returning home. These improved subjects appear to have adopted the seemingly contradictory but flexible attitude of accepting current conditions while sustaining hope of returning home, which indicates the importance of providing support and fulfilling survivors’ needs in both the practical and abstract aspects of mental health assistance (i.e., supporting the survivor’s acceptance of present realities while sustaining their hope).

Factors associated with exacerbation of poor mental health were “Uncertainty about the future” and “Loss of purpose in life.” No matter how difficult the situation, one may make efforts to endure and move forward if the end can be predicted. However, it must be difficult continuously to bear the situation if there is no end in sight. The area in which the subjects lived has long been designated an exclusion zone owing to radiation contamination from the Fukushima Daiichi Nuclear Plant. Thus, the exacerbation of poor mental health appears strongly associated with “uncertainty about the future,” derived from the survivors lack of decision-making power and inability to do anything other than wait for an announcement from the national and local governments that it is safe to return. However, this study’s clear finding that “uncertainty” heightens anxiety and is detrimental to mental health has considerable implications for disaster assistance. Based on these findings, whether

responding to survivors' immediate needs or providing future assistance planning for an entire region, not leaving disaster survivors uncertain and anxious about the future will directly improve mental health. It was previously proposed that mental health problems associated with a nuclear disaster require longer-term interventions than those following an ordinary natural disaster (Tanigawa & Chhen, 2014). Victims' anxiety and degradation of mental health might be mitigated or prevented by presenting step-by-step goals in monthly, yearly, and decadal frameworks. In reality, however, Fukushima Prefecture's provision of free housing for evacuees from affected areas will end in 2017 and any subsequent aid from national and local government has yet to be announced. Evacuees obviously are paying attention with both anxiety and hope. For any future earning-based aid and housing policies intended for disaster survivors, due consideration of victims' anxiety about the future and their mental health is essential. The outcomes of this research can help in adopting appropriate practices in this respect.

Another stress factor associated with exacerbation of poor mental health was "Loss of purpose in life". There are a number of studies reporting the impact of loss of purpose in life on mental health. Loke et al. investigated factors affecting the mental health of elderly individuals using the Philadelphia Geriatric Center Morale Scale (PGC-MS), a self-reported measure of motivation in life, and found that low PGC-MS scores (low motivation in life) are associated with depression (Loke et al., 2011). Another study highlighted insufficient social support as a risk factor for depression in the

elderly (Koizumi et al., 2005). It is therefore important not only to provide social support for survivors to rebuild their purpose in life, diminished by loss of livelihood and residence in an unfamiliar environment distant from their home villages, but also to ensure that appropriate support is provided by the current local communities, so that they are not alienated or isolated.

Multiple logistic regression analysis identified the lack of the stress relief methods “Accepting myself” and “Interactions with others” as factors associated with poorer mental health. The fact that disaster survivors who are unable to accept themselves exhibited poorer mental health suggests that assistance measures to help victims accept their current situation may be beneficial. However, it could be considerably more difficult for survivors to accept their present situation after being forced to leave their home villages with little chance of returning owing to the long-term effects of radiation and difficulties re-establishing their livelihood. To assist victims in such situations, it is important first to be aware of and understand that their unacceptable situation is a source of substantial stress. Support should include methods to help survivors accept their present situation.

The finding of an association between social isolation and degradation of mental health is consistent with many previous reports. A cross-sectional survey of over 10,000 survivors of the Great East Japan Earthquake identified loss of social networks as an important risk factor for decreased mental health (Yokoyama et al., 2014). Based on a series of surveys on traumatic symptoms in survivors of the Great Hanshin and Awaji Earthquake of 1995, Kato et al. found that

the elderly exhibited fewer traumatic symptoms than the young population in their second survey and suggested access to broader social networks by the elderly as one important reason for this difference (Kato et al., 1996). Thus, it is important to consider means of helping survivors evacuate to locations that allow easier integration into local communities and staying connected with other survivors and with society.

The limitation of this research includes the following:

In this study, the participants to be analyzed were broadly selected since they were divided into two groups of mental health, the “Exacerbated Group” and the “Improved Group,” using the mental health cut-off value. This method of dividing the participants into two groups was selected on the basis that their actual mental health status would be better reflected by applying the cut-off value as the baseline for improvement and exacerbation of their mental health state, since the effectiveness of using the cut-off value to show mental health status has been demonstrated in previous studies.

However, as a result, the sample size became smaller.

In addition, since this study was conducted only in specific areas of eastern Japan, the subjects were not selected by random sampling, which means that the study may have limited generalizability to the afflicted people. Next, since the survey method applied was a self-written answer paper, the potential exists for both reporting and social desirability bias. Moreover, this research has not examined either the past history of mental illness and physical disorder or the damages caused by the

disaster. Surveys carried out amidst the emergency of earthquake damage are required to reduce the burden on disaster victims as much as possible and I therefore consider the questionnaire survey, with its contents comprising a set of carefully selected questions, to be a reasonable research method based on the fact that it is convenient and can be carried out in a short time. However, the future task is to consider the mental health of the victims in more detail by taking into consideration various impacts such as sampling bias, disaster situation, past medical history, and so on. The problem of mental health is an important and urgent issue in the support of the victims of an earthquake disaster, and more detailed reports will be awaited in the future.

CONCLUSION

Factors associated with exacerbation of mental health level were stress factors “Uncertainty about future” and “Loss of purpose in life.” On the other hand, the respondents suffering the stress factor of “Being unable to return to my home/native village” and practicing the stress relief method “Accepting myself” exhibited significantly improved mental health levels.

As a result of the multi-variable analysis, lack of the stress relief methods “Accepting myself” and “Interactions with others” was identified as a factor associated with exacerbation of mental health level.

While motivation and hope of livelihood reconstruction have gradually risen in the three years since the disaster, anxieties about an uncertain future, loss of purpose in life, and disruption of social networks continue adversely to affect the mental health of survivors.

Acknowledgements

The authors are grateful to all survey participants and public health nurses of Fukushima Prefecture for their cooperation.

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