Mental Health in Local Public Employees Affected by the Great East Japan Earthquake[1]

Naoya Takahashi[2]
Takeshi Furuya[3]
Shigeki Sakata[4]

Abstract

The Great East Japan Earthquake was a complex disaster with a variety of destructive effects, including tsunami damage and damage due to the nuclear power plant accident. Local public employees who work for disaster-struck municipalities, while themselves disaster victims, are engaged in unimaginably difficult work including disaster relief and recovery. This study presents the outcomes of a two-stage panel survey on mental health conducted once in 2015 and once in 2016. The subjects were 672 local public employees in one disaster group that suffered tsunami damage and another disaster group that suffered damage from the nuclear disaster. Results showed the high-risk rate on the Impact of Event Scale-Revised (IES-R) was 11.9% for the tsunami-disaster group and 31.4% for the nuclear-accident group at Time 1. At Time 2, it was 8.9% for the tsunami-disaster group and 27.2% for the nuclear-accident group. From Time 1 to Time 2, the high-risk rate significantly decreased in both groups, but the percentage of high-risk persons remained elevated in the nuclear-accident group. In addition, factors predicting high risk for mental health issues by group were examined by logistic regression analysis. As a result, it was shown that the risk of traumatic stress and psychiatric disorders was increased by the occurrence of burnout as a result of high stress due to work experience after the disaster. Based on these results, future issues concerning stress care for local disaster public employees were discussed.

Introduction

This paper presents a quantitative study at two points in time of the mental health of local public employees affected by the Great East Japan Earthquake.

1. Great East Japan Earthquake and disaster workers

The Great East Japan Earthquake was a massive magnitude 9.0 earthquake that struck off the Pacific Coast of the Tohoku region on March 11, 2011. The earthquake triggered powerful tsunami waves that caused catastrophic damage to the Pacific coast of Japan from Tohoku to the Kanto region. The tsunami also reached the Fukushima Daiichi Nuclear Power Plant run by the Tokyo Electric Power Company (TEPCO), where it disabled the emergency generators that would have provided power necessary to cool the reactors. The insufficient cooling led to an accidental release of radioactive material. This accident was rated the highest Level 7 on the International Nuclear and Radiological Event Scale (INES). As a result, the victims of the Great East Japan Earthquake suffered the consequences of a massive, complex disaster composed of a natural disaster (the earthquake and subsequent tsunami) and a technological disaster. This posed new challenges for disaster research conducted in Japan. In other words, due to the complex disaster composed of a massive earthquake, a tsunami, and a nuclear accident, the victims who lived in municipalities in the area of the nuclear power plant were not allowed to return to their homes and were forced to live as evacuees in temporary housing. It was reported that 50,641 people were still living as evacuees as of February 2018, seven years after the disaster. In August 2013, Fujimori and Omori (2014) surveyed disaster victims who were forced to leave their homes as a result of the release of radioactive material from the Fukushima Daiichi Nuclear Plant and were living as evacuees in temporary housing built in Aizu Wakamatsu City in August 2013. They reported that an overwhelming number of the victims of the complex disaster had nothing to live for, had a low level of satisfaction with their living conditions, and experienced life stress. They also reported that 78.4% of victims had high risk of mental health issues as screened by the General Health Questionnaire – 28 (GHQ28).

As outlined above, the negative impact of this complex disaster on the mental health of people was identified, and specific recovery measures are discussed in this study. For instance, a research group at the Fukushima

Medical University conducted a survey targeting 210,000 people (the Fukushima Health Management Survey, implemented in cooperation with Fukushima Prefecture). The survey findings indicate that the K6 high-risk rate was 14.6% in 2011, 11.7% in 2012, and 9.7% in 2013 (Yagi A., et al., 2015). These results are valid at a K6 cutoff point of 13 points. This research group reports that a score of 17 points was set as a standard for providing assistance.

In complex disasters, however, the people providing professional assistance in the event of such disasters also experience strong stress. According to Matsui (2005), victims of critical incident stress can be classified into four categories: victims of 1st order (primary victims), victims of 1.5th order, victims of 2nd order (secondary victims), and victims of 3rd order. In this classification, local public employees fall into the category of secondary victims. They are considered "professional disaster workers" and their job is considered "an occupation that involves frequent disaster relief and assistance work." The category of professional disaster workers who are secondary victims also includes firefighters, journalists, and nurses. For these occupations, surveys and research, as well as stress care programs are already being provided. (Matsui, 2005; Journalists' Critical Incident Stress Research Group, 2011)

2. Mental health of local public employees affected by the Great East Japan Earthquake

Local public employees have the following characteristics in Japan. Decentralization under the public administration system in Japan has not advanced, so local governments have low discretion with regard to recovery and reconstruction. Additionally, despite the fact that local public employees play an important role in the management of shelters in the event of a natural disaster and in the post-disaster reconstruction, they tend to be viewed in a negative way by citizens as compared with other categories of disaster workers. Research also points out that local public employees are exposed to the following "three layers" of distress: (1) local public employees are disaster victims themselves; (2) local governments affected by disasters are centers for provision of support to disaster victims and for reconstruction efforts, so the workload of local public employees dramatically increases; and (3) complaints from ordinary disaster victims and local residents also increase

(Wakashima and Noguchi, 2013). Furthermore, it can also be pointed out that citizens affected by a disaster demonstrate low levels of understanding of the distress experienced by local public employees, and priority is given to measures for the mental health of ordinary victims, so it is somewhat difficult to implement measures for the mental health of local public employees.

There is little research that uses a standardized measurement scale to examine the mental health of local public employees affected by complex disasters among studies targeting disaster workers suffering from critical incident stress. Furthermore, there is almost no organized research into the mental health status of local public employees in disaster areas who have been exposed to complex disasters, and this issue is without elucidation. A study by Kuwahara, Takahashi and Matsui (2014, 2015) can be cited as one of the few survey and research efforts to examine the mental health of employees of local governments in the aftermath of the Great East Japan Earthquake. In that study, the authors carried out surveys of employees in three local governments in Miyagi Prefecture, and the results showed that the rate of respondents in the high-risk category of the Impact of Event Scale-Revised Japanese version (IES-R-J) a self-report measure that assesses subjective distress caused by traumatic events) two years and four months after the Great East Japan Earthquake was 23.2%, which is almost on the same level as the rate in the surveys conducted one year and four months earlier (Kuwahara, et al., 2014, 2015). Research has also revealed that support from supervisors and colleagues and gratitude that citizens express to public employees who perform their duties define the sense of growth of public employees after a disaster (Kuwahara, et al., 2013, 2014). According to the report from another survey of local public employees in Miyagi Prefecture (Suzuki, Kim & Fukazawa, 2013), 9.6% of respondents in the top 10% of the K6 questionnaire had a score of 10 points or higher. The situation in the areas affected by the Great East Japan Earthquake, however, differs significantly depending on the location, so while there are local governments such as Miyagi Prefecture, which was the target of a series of surveys such as those outlined above, and where recovery and reconstruction activities are steadily advancing, there are also local governments where entire towns are still evacuated as a result of the nuclear accident. Therefore, in some areas the situation is still far from post-traumatic growth, and it is difficult to examine the issue of mental health uniformity in a uniform manner.

Against this backdrop, this study was performed to clarify the mental

health status of local government employees affected by the Great East Japan Earthquake, by type of disaster. Specifically, we measured the mental health of local public employees in areas affected by the tsunami and in areas affected by the nuclear accident at two successive times using standardized scales, analyzed the changes between the two periods, and identified predictors of mental health between these two periods. As factors to predict mental health, we chose and analyzed the following three exploratory factors based on past research on critical incident stress of firefighters: social support, workplace climate, and burnout.

Method

We conducted the following two surveys on a commission by the Fund for Local Government Employees' Accident Compensation. In the analysis of this research, we used panel data adjusted to the following surveys at two points of time.

1. First survey

(1) Procedures

From November 2014 through January 2015, among local governments participating in initiatives to deal with stress after the Great East Japan Earthquake implemented by the Fund for Local Government Employees' Accident Compensation, we conducted a questionnaire survey of local public employees at two local governments in areas that were affected by the tsunami in Iwate Prefecture (tsunami-disaster group) and two local governments in areas that were forced to evacuate entire towns in Fukushima Prefecture (nuclear-accident group). The questionnaires were distributed at workplaces and collected in sealed envelopes at the workplaces. The questionnaires were distributed to the subjects via the divisions in charge of general affairs at each local government. The number of distributed questionnaires was 1,050 for the tsunami-disaster group and 305 for the nuclear-accident group. The survey was conducted in a format asking respondents to enter their names in order to enable cross-referencing with the responses in a second follow-up survey. The filled-out questionnaires were enclosed in sealed envelopes and returned to the divisions in charge of general affairs at each local government.

The divisions collected all envelopes and submitted them in one batch to the survey staff. All collected questionnaires were accepted as valid responses, and the unanswered and wrongly answered questions were processed as missing values. The number of valid respondents from the tsunami-disaster group was 739 people, and from the nuclear-accident group was 234 people, for a total of 973 people for both groups.

(2) Survey content used in the analysis

(i) Indicators concerning mental health
We used the following indicators to measure mental health: K6 for screening for mental disorders such as depression and anxiety disorder (Furukawa, T, et al., 2003); the 12-item General Health Questionnaire (GHQ-12), which measures mental health status (Narita K, et al., 2001); and the Japanese version of the Impact of Event Scale-Revised (IES-R-J), which measures levels of traumatic stress caused by disasters (Asukai, et al., 2002).

(ii) Details of workplace experience from the time of the earthquake until the time of implementation of the survey
We asked about the participants' experience at work in the aftermath of the Great East Japan Earthquake. We used the items regarding troubles at work specified by Tanno, Yamazaki, and Matsui (2012), and added to them three more items based on the content of pilot interview that we conducted with local government employees.

(iii) Social support
We used the items formulated by Hatanaka, et al., (2010) in order to question the subjects regarding social support from supervisors and colleagues at the workplace.

(iv) Characteristics of respondents
Demographic variables: gender, age, current lifestyle, current living arrangement
Basic information regarding work: years of continuous employment, years of work at the current division, overtime work hours per month for the month with the largest number of overtime work hours in the past one year, workplace position, availability or lack of work from before the earthquake,

content of work.

2. Second survey

(1) Procedures

From January through April 2016, among local governments that participated in the first survey, we distributed questionnaire surveys at the workplace of employees of one local government in Iwate Prefecture that was affected by the tsunami disaster and two local governments in areas that were forced to evacuate entire towns in Fukushima Prefecture. The completed surveys were collected in sealed envelopes at the workplace. The questionnaire surveys were distributed to the subjects via the divisions in charge of general affairs at each local government. The number of distributed questionnaires was 750 for the tsunami-disaster group and 305 for the nuclear-accident group. The survey was conducted in a format that asked respondents to enter their names to enable cross-referencing with the responses in the first survey. The filled-out questionnaires were enclosed in sealed envelopes and returned to the divisions in charge of general affairs at each local government. The divisions submitted all collected envelopes in one batch to the survey staff. In the collected questionnaires, the unanswered and wrongly questions were processed as missing values. The number of valid respondents from the tsunami-disaster group was 657 people, and from the nuclear-accident group was 235 people, for a total of 892 people.

(i) Indicators concerning mental health
We used the same three indicators as in the first survey.

(ii) Social support
As in the first survey, we questioned the subjects regarding social support from supervisors and colleagues.

(iii) Burnout
We used the Japanese version of the burnout scale developed by Kubo (1998) to measure burnout tendencies. This scale is composed of three aspects: depersonalization, decline in the sense of personal accomplishment, and emotional exhaustion.

3. Cross-referencing of responses

Based on the entered names, we compared and cross-referenced the responses in the two surveys. The responses which we were able to cross-reference totaled 672 (494 people in the tsunami-disaster group and 178 in the nuclear-accident group). The data provided by these 672 people was used in the analysis reported in this paper.

Results

1. Demographic characteristics of the respondents

Looking at the demographic characteristics of the respondents, the gender composition was approximately 70% male and 30% female, and there were no differences among groups in terms of gender (Table 1). The average age of the respondents was 43.78 years (*SD*10.49) in the tsunami-disaster group and 42.94 years (*SD*11.61) in the nuclear-accident group (t (286) = 0.84, *n.s.*). As for their current lifestyle, respondents living alone accounted for approximately 15% of the tsunami-disaster group and approximately 40% of the nuclear-accident group (Table 2). As for the current living arrangements, in the tsunami-disaster group more than 70% of the respondents lived in their own homes, while nearly 60% of the respondents in the nuclear-accident group lived in rented housing (Table 3).

Table 1—Composition of respondents by gender

	Male		Female	
	n	(%)	*n*	(%)
Tsunami-disaster group	336	(68.2%)	157	(31.8%)
Nuclear-accident group	125	(70.2%)	53	(29.8%)

Fisher's exact test, *n.s.*

Table2—Respondents' lifestyle

	Living alone		Other	
	n	(%)	*n*	(%)
Tsunami-disaster group	77	(15.7%)	415	(84.3%)
Nuclear-accident group	73	(41.0%)	105	(59.0%)

Fisher's exact test, $p < .001$

Table 3—Respondent's living arrangements

	Temporary housing		Rented housing		Own homes		Other	
	n	(%)	*n*	(%)	*n*	(%)	*n*	(%)
Tsunami-disaster group	7	(1.4%)	75	(15.2%)	365	(74.2%)	45	(9.1%)
Nuclear-accident group	2	(1.1%)	101	(57.1%)	37	(20.9%)	37	(20.9%)

$\chi^2(3)=162.79$, $p < .001$

Looking at the basic information regarding work, the average number of years of continuous employment was 17.47 years in the tsunami-disaster group (*SD*10.49) and 14.35 years in the nuclear-accident group (*SD*12.61), indicating that the average number of years of continuous employment was longer in the tsunami-disaster group than in the nuclear-accident group (t (295) = 2.87, $p < .05$). The number of years of continuous employment at the current division was 48.25 months in tsunami-disaster group (*SD* 44.79) and 31.14 months in the nuclear-accident group (*SD* 45.30), indicating that the number of years of continuous employment at the current division was longer in the tsunami-disaster group than in the nuclear-accident group (t (440) = 3.55, $p < .001$). The number of overtime work hours for the month with the largest number of overtime work hours in the past one year was 41.78 hours in the tsunami-disaster group (*SD* 34.74) and 25.33 hours in the nuclear-accident group (*SD* 43.51), indicating that the number of overtime work hours per month was longer in the tsunami-disaster group than in the nuclear-accident group (t (489) = 4.05, $p < .05$). As for the position of the respondents, for both areas approximately 10% were employed in managerial positions and approximately 70% were employed in general positions (Table 4). As for the availability or lack of work before the earthquake, in the tsunami-disaster group, approximately 80% of the respondents were employed

prior to the earthquake, while in the nuclear-accident group, after the earthquake the ratio of employed respondents was only a bit over 30% (Table 5). As for the content of work of the respondents, in the tsunami-disaster group, the ratio of respondents engaged in ordinary work duties was high, at over 70%, while in the nuclear-accident group, the ratio of respondents engaged in disaster response and operations for residents affected by the disaster had increased to over 30% (Table 6).

Table4—Respondents' position

	Managerinal positions		General positions		Other	
	n	(%)	*n*	(%)	*n*	(%)
Tsunami-disaster group	44	(9.0%)	360	(73.5%)	86	(17.6%)
Nuclear-accident group	23	(13.1%)	125	(71.0%)	28	(15.9%)

$\chi^2(2)=2.46$, *n.s.*

Table 5—Availability or lack of work before the earthquake

	Work before the earthquake		Work after the earthquake	
	n	(%)	*n*	(%)
Tsunami-disaster group	383	(78.0%)	108	(22.0%)
Nuclear-accident group	113	(63.8%)	64	(36.2%)

Fisher's exact test, $p < .001$

Table 6—Content of work of respondents

	Disaster-response operations related to the earthquake, tsunami, and nuclear accident		Response operations for residents affected by the disaster		Other ordinary work duties	
	n	(%)	*n*	(%)	*n*	(%)
Tsunami-disaster group	72	(15.2%)	42	(8.8%)	361	(76.0%)
Nuclear-accident group	42	(25.5%)	53	(32.1%)	70	(42.4%)

$\chi^2(2)=72.50$, $p < .001$

2. Mental health and social support by location and timing

We matched the results of the IES-R-J and K6 questionnaires conducted at two points in common to the original paper and assigned points to them. As for the GHQ12, we used the 0-0-1-1 method to assign points. We also assigned points to supervisor and colleague support in line with the original paper. With regard to these indicators, we conducted two-way mixed design (disaster group x timing) analysis of variance in order to check for significant differences by disaster-group and survey timing (Table 7). The results demonstrated that both the timing and type of disaster group had a significant main effect with regard to IES-R-J, K6, and GHQ12, and that points at Time 2 were lower than Time 1. Additionally, the points on all indicators were higher in the nuclear-accident group than in the tsunami-disaster group. With regard to the two indicators for social support, there was no significant difference by timing and disaster group.

Table 7—Mental health indicators and social support by disaster group and timinig

		n	Time1		Time2		Time	group	Interaction
			M	*(SD)*	*M*	*(SD)*	*F(df)*	*F(df)*	*F(df)*
IES-R	Tsunami-disaster group	460	10.60	(11.44)	9.27	(11.26)	7.56 **	76.81 **	0.03
	Nuclear-accident group	154	20.52	(17.11)	19.34	(18.10)	(1)	(1)	(1)
K6	Tsunami-disaster group	480	5.66	(5.53)	5.00	(5.23)	23.63 **	22.27 **	3.07 †
	Nuclear-accident group	173	8.11	(6.05)	6.72	(5.68)	(1)	(1)	(1)
GHQ-12	Tsunami-disaster group	465	3.78	(3.52)	3.44	(3.43)	11.33 **	18.21 **	1.27
	Nuclear-accident group	161	5.17	(3.85)	4.50	(3.68)	(1)	(1)	(1)
Boss support	Tsunami-disaster group	476	7.99	(2.55)	7.99	(2.62)	2.40	0.01	2.51
	Nuclear-accident group	165	7.82	(2.56)	8.19	(2.46)	(1)	(1)	(1)
Colleague support	Tsunami-disaster group	477	8.10	(2.48)	8.21	(2.45)	0.65	0.12	0.04
	Nuclear-accident group	165	8.19	(2.41)	8.25	(2.47)	(1)	(1)	(1)

$p < .01$**, $p < .10$†

3. High-risk ratio in mental health indicators by disaster group and timing

Cut-off values were established in the three mental health indicators used in this research. In the IES-R, the cut-off value was 24/25, and subjects with results of 25 points or higher were conceived as high-risk subjects (Asukai, et al., 2002). Results over 24/25 points and over 15 points in the K6 were conceived as cut-off values with an over 50% probability of mental disorder (Furukawa et al., 2003). As for the GHQ12, according to a study by Honda, S. et al., (2001), information is available that supports conceiving of subjects with four or more points in the GHQ12 as high-risk subjects. Subjects with values higher than the cut-off values for each indicator were perceived as high-risk subjects, and subjects with values lower than the cut-off values were perceived as low-risk subjects. Then, we calculated the ratio of the two groups by disaster group and survey timing (Table 8).

Table 8—High-risk ration in mental health indicators by disaster group and timing

		Time1 High-risk	Time2 High-risk
IES-R (25≦)	Tsunami-disaster group	11.9%	8.9%
	Nuclear-accident group	31.4%	27.2%
K6 (15≦)	Tsunami-disaster group	7.8%	5.0%
	Nuclear-accident group	15.9%	10.9%
GHQ12 (4≦)	Tsunami-disaster group	44.1%	39.5%
	Nuclear-accident group	61.8%	54.4%

Overall, the ratios of high-risk subjects from Time 1 to Time 2 in all indicators were declining, but in the nuclear-accident group the high-risk subjects remained at a higher value.

In order to analyze the changes in the risk ratios for mental health indicators depending on the survey implementation time by location, we also cross-referenced the values for Time 1 and Time 2, established four groups, and calculated the ratios for each group (Figure 1).

As for the breakdown of IES-R high-risk subjects in Time 2, in the tsunami-disaster group, the percentage of respondents who remained at high risk was 5.2%, while the percentage of respondents who became high risk at Time

2 was 3.7%. In the nuclear-accident group, the percentage of respondents who remained at high risk was 21.4%, while the percentage of respondents who became high risk at Time 2 was 5.2%.

As for the breakdown of K6 high-risk subjects in Time 2, in the tsunami-disaster group, the percentage of respondents who remained at high risk and was 2.5%, with the same percentage becoming high risk at Time 2. In the nuclear-accident group, the percentage of respondents who remained at high risk was 7.5%, while the percentage of respondents who became high risk at Time 2 was 2.9%.

As for the breakdown of GHQ12 high-risk subjects in Time 2, in the tsunami-disaster group, the percentage of respondents who remained at high risk was 28.2%, while the percentage of respondents who became high risk at Time 2 was 11.6%. In the nuclear-accident group, the percentage of respondents who remained at high risk was 46.0%, while the percentage of respondents who became high risk at Time 2 was 8.7%.

In all three mental health indicators, in the tsunami-disaster group, there were numerous low-risk respondents at both points in time, while in the nuclear-accident group the rate of high-risk respondents was significantly higher at both points in time.

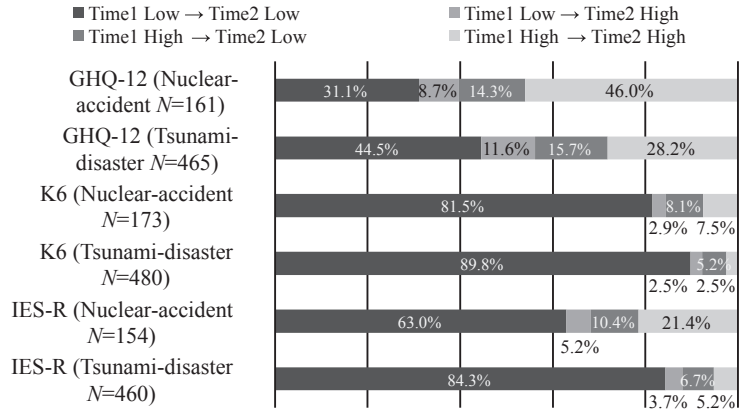

Fig. 1 Changes in the risk ration of mental health indicators by location

4. Experience at work from the time of the disaster until present day

As for the 16 items that we asked about regarding experience at work from the time of the disaster until the present day, we conducted a factor analysis using the major factor method and promax rotation. The results indicated that one item, "solidarity among employees was reinforced" did not demonstrate a high load in any of the factors. We therefore removed this item and repeated the factor analysis, extracting three factors (Table 9). The pre-rotation eigenvalues were, in decreasing order, 7.24, 1.50, and 1.08, and the cumulative eigenvalue was 61.32%. The first factor was interpreted as a factor that demonstrates deterioration of the workplace atmosphere due to stricter control and instructions by supervisors, and we named it "Management-caused deterioration of atmosphere." The second factor was interpreted as a factor that demonstrates confusion of employees due to increased workload and chaos after the disaster, and we named it "Fatigue and exhaustion." The third factor was interpreted as a factor that demonstrates communication problems among fellow employees, and we named it "Workplace communication problems." We conducted simple addition of items that demonstrated high load in all factors and established them as indicators.

Table 9—Factor analysis results for experience at work after the disaster

		F1	F2	F3
Q16_12	Instructions and reprimands from supervisors increased	.858	-.074	-.059
Q16_9	Management and instructions were strict	.830	.100	-.116
Q16_11	I was often scolded over problems and responsibilities	.815	-.010	.025
Q16_10	Mistakes and troubles at the workplace increased	.553	.098	.178
Q16_8	I did not receive fair evaluation of my work	.528	.048	.180
Q16_7	The workplace atmosphere deteriorated	.488	-.036	.328
Q16_2	Hardships increased due to manpower shortage	-.002	.853	-.033
Q16_1	It was physically hard	.022	.826	-.127
Q16_3	There was prolonged confusion at the workplace	.017	.739	.020
Q16_4	I felt inexperienced in the work	.000	.403	.219
Q16_5	I felt a gap between my ideal with regard to work and the reality	.015	.398	.339
Q16_15	I had fewer colleagues with whom I could speak openly	.016	-.118	.857
Q16_16	The number of new colleagues increased and communication became more difficult	.037	-.100	.856
Q16_14	There was less time to discuss with colleagues	-.056	.174	.658
Q16_6	The number of new colleagues increased and I had difficulties with education and information transfer	.045	.198	.476
	[Correlation between factors] F1		.722	.637
	F2			.590

Regarding the three indicators for experience at work from the disaster until the present day, all comparisons between locations demonstrated significant differences, and all three indicators were higher in the nuclear-accident group than in the tsunami-disaster group (Table 10).

Table 10—Experience at work by disaster group

		N	Average Value	Standard deviation	*t* value *(df)*
Management-caused deterioration of atmosphere	Tsunami-disaster group	477	12.85	3.55	-3.26 **
	Nuclear-accident group	166	13.92	3.80	(641)
Fatigue and exhaustion	Tsunami-disaster group	482	14.30	2.98	-3.89 **
	Nuclear-accident group	173	15.46	3.51	(266)
Workplace communication problems	Tsunami-disaster group	482	9.14	2.46	-5.22 **
	Nuclear-accident group	172	10.36	2.70	(279)

$p < .01$**

5. Burnout

As for burnout, we created the following three indicators in line with the original paper: depersonalization, decline in the sense of personal accomplishment, and emotional exhaustion. A comparison between disaster groups with regard to these three indicators demonstrated significant differences in depersonalization and emotional exhaustion. The points for depersonalization and emotional exhaustion were higher in the nuclear-accident group than in the tsunami-disaster group (Table 11).

Table 11—Burnout by disaster group

		N	Average Value	Standard deviation	*t* value *(df)*
Depersonalization	Tsunami-disaster group	474	1.97	.81	-3.44 **
	Nuclear-accident group	173	2.22	.85	(645)
Decline in the sense of personal accomplishment	Tsunami-disaster group	475	3.74	.77	.07
	Nuclear-accident group	171	3.74	.77	(644)
Emotional exhaustion	Tsunami-disaster group	478	2.59	.98	-2.25 *
	Nuclear-accident group	175	2.79	1.06	(651)

$p < .01$**, $p < .05$*

6. Analysis of factors to predict high risk at Time 2

In order to identify the variables for the high-risk ratio at Time 2, we conducted a logistic regression analysis by disaster group. The criterion variables were set as high-risk ratios in IES-R, K6, and GHQ12 at Time 2. The explanatory variables were social support and experience at work at Time 1, social support and burnout at Time 2, and high-risk ratios in IES-R, K6, and GHQ12 at Time 1. As an analysis method, we used the step-up procedure by Ward. See the tables below for the analysis results by disaster group (tsunami-disaster group shown in Table 12, nuclear-accident group shown in Table 13).

In the tsunami-disaster group, the relative risk equivalent to the IES-R high risk at Time 2 was 15 times higher when the risk was high at Time 1, and 2.5 times higher when depersonalization points were high. The relative risk equivalent to the K6 high risk at Time 2 was 13 times higher when the risk was high at Time 1, 5.7 times higher when depersonalization points were high, and 0.7 times higher when supervisor support was high at Time 2. The relative risk equivalent to GHQ12 high risk at Time 2 was 3.2 times higher when emotional fatigue was high, 1.8 times higher when the sense of personal accomplishment was low, 0.23 times higher when the risk was low at Time 1, and 0.9 times higher when the support from colleagues was high at Time 2. This indicates that in the tsunami-disaster group, with regard to the IES-R and K6, the high risk and depersonalization at Time 1 were risk factors. On the other hand, despite the fact that the GHQ12 has risk impact at Time 1, immediate decline in the sense of personal accomplishment and emotional fatigue were identified as risk factors. Social support was barely a resiliency factor.

Table 12—Factors predicting high risk in the tsunami-disaster group

		Time2 IES-R High risk					Time2 K6 High risk					Time2 GHQ12 High risk				
		β	*SE*	Wald	*df*	Estimated odds ratio	*β*	*SE*	Wald	*df*	Estimated odds ratio	*β*	*SE*	Wald	*df*	Estimated odds ratio
Time1	Supervisor support															
	Colleague support															
	Management-caused deterioration of atmosphere															
	Fatigue and exhaustion															
	Communication problems at the workplace															
Time1	Low risk											-1.45	.25	32.61	1**	.23
	High risk	2.74	.42	43.01	1**	15.45	2.59	.65	16.02	1**	13.35					
Time2	Supervisor support						-.36	.14	6.37	1**	.70					
	Colleague support											-.11	.05	3.84	1*	.90
	Depersonalization	.92	.22	17.39	1**	2.52	1.73	.34	26.54	1**	5.65					
	Decline in the sense of personal accomplishment											.59	.18	10.87	1**	1.80
	Emotional exhaustion											1.15	.16	51.16	1**	3.17
	Invariable	-8.01	.88	83.50	1**	.000	-8.57	1.54	31.14	1**	.00	-4.12	1.00	16.84	1**	.02

$p < .01$**

Table 13—Factors predicting high risk in the nuclear-accident group

		Time2 IES-R High risk					Time2 K6 High risk					Time2 GHQ12 High risk				
		β	*SE*	Wald	*df*	Estimated odds ratio	*β*	*SE*	Wald	*df*	Estimated odds ratio	*β*	*SE*	Wald	*df*	Estimated odds ratio
Time1	Supervisor support															
	Colleague support															
	Management-caused deterioration of atmosphere															
	Fatigue and exhaustion															
	Communication problems at the workplace															
Time1	Low risk											-2.75	.66	17.60	1**	.06
	High risk	3.27	.53	38.68	1**	26.31	2.98	.97	9.42	1**	19.78					
Time2	Supervisor support															
	Colleague support															
	Depersonalization						1.56	.70	5.02	1*	4.75					
	Decline in the sense of personal accomplishment															
	Emotional exhaustion						1.32	.67	3.88	1*	3.75	2.68	.52	26.69	1**	14.55
	Invariable	-5.77	.86	44.92	1**	.003	-15.67	3.54	19.66	1**	.00	-6.21	1.35	21.19	1**	.00

$p < .01$**

In the nuclear-accident group, the relative risk equivalent to the IES-R high risk at Time 2 was 26 times higher when the risk is high at Time 1. The relative risk equivalent to the K6 high risk at Time 2 was 20 times higher when the risk was high at Time 1, 4.8 times higher when depersonalization points were high, and 3.8 times higher when the emotional fatigue was high. The relative risk equivalent to GHQ high risk at Time 2 was 15 times higher when emotional fatigue was high and 0.06 times higher when the risk was low at Time 1. This indicates that in the nuclear-accident group, for all indicators, high risk at Time 1 was a risk factor, and in the K6 and GHQ12 emotional fatigue is a strong risk factor. Depersonalization was a risk factor only in the K6.

The analyses displayed in Table 12 and Table 13 demonstrated that high risk at Time 1 and burnout at Time 2 strongly predicted high risk at Time 2. We, however, could not clearly analyze the relative impact of Time 1 factors and Time 1 high-risk background factors. So, as a supplementary analysis, we conducted a discriminant analysis of the changes in risk from Time 1 through Time 2 by setting four groups as criterion variables and using social support, work experience, and burnout at two points in time as explanatory variables.

In the tsunami-disaster group, the results of a discriminant analysis using the stepwise method with four groups with regard to the IES-R as criterion variables demonstrated that fatigue and exhaustion and depersonalization were selected as significant explanatory variables. Higher fatigue and exhaustion signified H→L, higher depersonalization signified L→H, and when both depersonalization and fatigue and exhaustion were high, the outcome was likely to be H→H (discriminant rate 50.3%). The results of a discriminant analysis using the stepwise method with four groups with regard to the K6 as criterion variables demonstrated that workplace communication problems and burnout depersonalization were selected as significant explanatory variables. Higher workplace communication problems signified H→L, and when both depersonalization and workplace communication problems were high, the outcomes were likely to be, respectively, L→H and H→H (discriminant rate 66.5%). The results of a discriminant analysis using the stepwise method with four groups with regard to the GHQ12 as criterion variables demonstrated that fatigue and exhaustion, decline in the sense of personal accomplishment, and emotional exhaustion were selected as significant explanatory variables, higher fatigue and exhaustion signified H→L, and when

both decline in the sense of personal accomplishment and emotional exhaustion were high, the outcomes were likely to be L→H and H→H (discriminant rate 50.8%).

In the nuclear-accident group, the results of a discriminant analysis using the stepwise method with four groups with regard to the IES-R as criterion variables demonstrated that only depersonalization was selected as a significant explanatory variable. Higher depersonalization signified H→H, H→L, and L→H (discriminant rate 50.0%). The results of a discriminant analysis using the stepwise method with four groups with regard to the K6 as criterion variables demonstrated that management-caused deterioration of environment and depersonalization were selected as significant explanatory variables, higher depersonalization signified L→H, and when both management-caused deterioration and depersonalization were higher, the outcome was H→L and H→H (discriminant rate 70.4%). The results of a discriminant analysis using the stepwise method with four groups with regard to the GHQ12 as criterion variables demonstrated that only emotional exhaustion was selected as a significant explanatory variable, higher emotional exhaustion signified H→L and H→H (discriminant rate 39.8%).

Discussion

1. Mental health of local public employees

The aggregate results of the basic characteristics of the respondents indicated that local public employees, particularly those in the nuclear-accident group, perform numerous disaster-related work duties even today, which suggests that employees recruited before the disaster are mixed with employees recruited after the disaster. The results also indicated that local public employees in the nuclear-accident group still have an unstable livelihood, living alone or in rented housing.

This survey was implemented at two points in time after the Great East Japan Earthquake, three years and nine months after the disaster and four years and ten months after the disaster. The results indicate that even today, the ratio of respondents at high risk of PTSD at Time 2 was 27.2% in the nuclear-accident group and 8.2% in the tsunami-disaster group. In comparison with the 23.2% of local public employees with IES-R high risk at two

years and four months after the disaster in the coastal areas of Miyagi Prefecture, according to a study by Kuwahara, et al. (2015), it can be claimed that local public employees in the nuclear-accident group are at a higher risk of traumatic stress. As for the values in the tsunami-disaster group, since more time has passed after the disaster than in the study by Kuwahara, et al. (2015), the ratio of respondents at high risk was less than 10%, so it can be claimed that the risk of traumatic stress for the tsunami-disaster group has stabilized.

As for the K6 scores that measure probable cases of depression and anxiety disorders, the results indicate that at Time 2, 10.9% of the respondents in the nuclear-accident group and 5.9% of the respondents in the tsunami-disaster group show possible symptoms of depression and anxiety disorders. If we take into consideration the results of Furukawa, et al. (2003), according to which the K6 cut-off values suggest a 10% prevalence rate, although the values in the nuclear-accident group are higher than those in the tsunami-disaster group, it is impossible to conclude that these figures represent high risk.

Additionally, the scores in the GHQ12, which serves as an indicator of mental health, suggest that the share of respondents at high risk in the nuclear-accident group and the tsunami-disaster group at Time 2 is, respectively, 55% and 40%, which indicates that although local public employees in both the nuclear-accident group and the tsunami-disaster group suffer from mental ailments, they continue to perform their duties.

2. What causes deterioration in the mental health of local public employees?

The IES-R risk for both the nuclear-accident group and the tsunami-disaster group was defined by the high risk at Time 1, and the combined results of the logistic regression analysis of the tsunami-disaster group and the supplementary analysis of the nuclear-accident group indicate that burnout depersonalization is a factor that increases the risk. In the tsunami-disaster group, higher exhaustion and fatigue indicate higher risk at Time 1, while prolonged burnout depersonalization can be interpreted as a factor that increases the risk at Time 2.

The K6 risk for both the nuclear-accident group and the tsunami-disaster group was defined by the high risk at Time 1 and burnout depersonalization.

In the tsunami-disaster group, support from supervisors was a resiliency factor, and in the nuclear-accident group, emotional exhaustion was a risk factor. If these results are considered in combination with the results of the supplementary analysis, it becomes clear that in the tsunami-disaster group, workplace communication problems increased the risk at Time 1, while prolonged burnout depersonalization can be interpreted as a factor that increases the risk at Time 2. In the nuclear-accident group, management-caused deterioration of atmosphere increased the risk at Time 1, and depersonalization can be interpreted as a factor that increases the risk at any point in time.

As for the GHQ12 risk, in both groups, low risk at Time 1 reduced the risk at Time 2. In the tsunami-disaster group, fatigue and exhaustion increased the risk at Time 1 and triggered a decline in the sense of personal accomplishment with burnout and emotional exhaustion, thus increasing the risk at Time 2. In the nuclear-accident group, emotional exhaustion increased the risk at Time 2.

3. Conclusions and limitations

The first conclusion of the present research is that, as demonstrated by the GHQ12, approximately half of the local public employees affected by the disaster continue to perform their duties while struggling with mental health issues. Local public employees are essential for citizen services and basic local government operations, so going forward it will be necessary to continue to address the deterioration of the mental health of these employees adequately. This suggests that, as argued by Matsui (2005), it is necessary to consider care for local public employees dealing with critical incident stress caused by natural disasters.

The second conclusion is that, of all local public employees affected by natural disasters, local public employees in areas affected by a nuclear accident in particular are at a high risk of post-traumatic stress. Previous research with ordinary citizens as subjects has been suggesting a decline in stress values, and against this backdrop, the high levels of traumatic stress risk among local public employees in areas affected by the nuclear accident indicate that it is essential to implement continuous traumatic stress care in areas affected by nuclear accidents. Also, traumatic stress for local public employees caused by natural disasters normally is more difficult to see than it is for other disaster rescue workers, which may suggest that local public employees

have not been provided with psychological education.

The third conclusion is that, against the backdrop of the risk of post-traumatic stress, mental disorders and mental health, the experience of work during that period becomes a remote stressor, and as high stress conditions persist, burnout also advances and in turn the risk of mental health disorders further increases. This indicates that it is necessary to advance not only direct intervention with regard to mental health, but also intervention with regard to organizations and workplaces. For instance, it will be necessary to provide training for employees who work in proximity with employees demonstrating mental health disturbances on how to deal with them, or how to implement smooth communication between supervisors and subordinates in the process of work, as well as training for employees in managerial positions.

The limitations of the present research are listed here. The first limitation is that the research does not provide a sufficient understanding of stressors because its focus is on gaining insight into stress response. This research makes it possible to confirm whether local public employees demonstrate stress response, but the research does not clarify what the stressor (the burden that causes stress reaction) is. It is important to examine and clarify whether stress is caused by work duties after disasters, by personal relations at the workplace, or whether disasters themselves cause psychological trauma to local public employees. It is believed that such research will make a difference in post-disaster mental health care. The second limitation is the necessity of being mindful of the fact that, even if employees are evaluated as being at high risk, this evaluation does not address whether these employees actually demonstrate symptoms of work-related suffering, anxiety disorder or depression. It is possible that the employees may not suffer from functional disorders, and it is essential to examine in detail each individual case to determine how to handle personal circumstances. Therefore, it will become necessary to explore institutional care and response.

Notes

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2. Rissho University, Faculty of Psychology.
3. Rissho University, Faculty of Psychology.
4. Tokai University, Department of Psychological and Social Studies.

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