

Regular Article

Diagnostic interview study of the prevalence of depression among public employees engaged in long-term relief work in Fukushima

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Aim: The Great East Japan Earthquake and in particular, the Fukushima Daiichi Nuclear Power Plant accident, have had a serious psychological impact on not only residents, but also relief workers in Fukushima. Although public employees work in highly stressful situations and play a very important role in long-term relief, their psychiatric features have yet to be clarified. The two aims of this study were to identify the current prevalence rate of depression and post-traumatic stress disorder among public employees working in the disaster area using diagnostic interviews, and to speculate on the psychosocial factors affecting their mental condition.

Methods: We conducted diagnostic interviews and self-administered questionnaires with 168 public employees working in two coastal towns in Fukushima.

Results: Results showed that the current prevalence of depression among public employees is as high as 17.9%, in contrast to the relatively low prevalence of post-traumatic stress disorder (4.8%). Based on the results of self-administered questionnaires and interview contents, frequent exposure to strong complaints or anger from residents and role conflicts were considered the cause of the high prevalence of depression.

Conclusion: The present study reveals the serious mental status of public employees working in Fukushima and sheds light on the urgent need to establish an efficient care network to provide adequate psychiatric intervention.

Key words: depression, Fukushima nuclear accident, occupational health, post-traumatic stress disorder, relief work.

IN 2011, THE Great East Japan Earthquake caused serious damage to vast areas of the Tohoku region, including Fukushima Prefecture. The tsunami totally destroyed the cooling system at the Fukushima Daiichi Nuclear Power Plant and led to several explosions, causing widespread diffusion of radioactive materials. Over 400 000

residents living within a 30-km radius of the plant were evacuated in the first 5 days after the disaster.¹ Although the Japanese government gradually lifted living restrictions within the evacuation zone, over 110 000 people have not returned to their original homes.²

After the disaster, several studies focusing on the mental health of people living in the Tohoku area were conducted.^{3–7} Based on a self-administered questionnaire using the Kessler 6-item Scale (K6),⁸ Yokoyama *et al.*⁷ showed that 42.6% of the respondents living in Iwate Prefecture had moderate or serious mental health problems 6–12 months after the disaster. Likewise, Koyama *et al.*³ found that

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35.9% of all respondents in Miyagi Prefecture who completed the K6 questionnaire were experiencing serious psychological distress. In Fukushima, a major epidemiological survey was performed on the approximately 210 000 original residents in the evacuation zone using several self-administered questionnaires to identify the psychological consequences caused not only by the earthquake and tsunami, but also the nuclear disaster.^{4,6} The survey revealed that 21.6% of the total respondents were estimated to be at risk of post-traumatic stress disorder (PTSD) and 14.6% were at risk of depression about 1 year after the disaster.⁷ Furthermore, in a study of the initial patients visiting psychiatric clinics in Fukushima Prefecture after the disaster, 13.9% of the total number of patients ($n = 1321$) showed PTSD or adjustment disorder related to the disaster.⁵ Although the standardized suicide mortality ratio in Fukushima decreased during the initial 2 years following the disaster, it has markedly increased very recently.⁹ Maeda and Oe comprehensively described that the various psychosocial reactions associated with the nuclear disaster in Fukushima can be summarized in five main issues: (i) post-traumatic stress response; (ii) chronic anxiety and guilt; (iii) ambiguous loss; (iv) separated families and communities; and (v) stigma.¹⁰

As well as the mental health condition of the residents and evacuees affected by the disaster, there is great concern for the various types of workers in the disaster area. In particular, many workers in Fukushima are engaged in relief and reconstruction efforts to repair the damage caused by the earthquake, tsunami, and nuclear disaster. Studies of the 'cleanup workers' in the Chernobyl accident revealed that adverse health outcomes were observed in various mental and physical morbidities.^{11,12} As with the Chernobyl workers, the workers at the Fukushima nuclear power plant were psychologically investigated 2–3 months after the accident, and 46.6% of the workers were identified as having probable depression or anxiety disorders.¹³

Incidentally, in Japan, many public employees are expected to play a crucial role in long-term disaster relief. Studies focusing on mental health issues among public employees working in Miyagi or Niigata Prefectures after the disaster and tsunami demonstrated that they were more likely to have mental health problems compared with residents or evacuees in the disaster area.^{14,15} In Fukushima, which was terribly damaged by the complex disaster,

public employees might have very serious mental health problems; however, to the best of our knowledge, there have been no studies focusing on the mental health problems among public employees in Fukushima. In addition, past studies exploring the psychological consequences of engaging in disaster relief and reconstruction on various workers used only self-administered questionnaires and not diagnostic interviews. Therefore, little is known about the prevalence of precise psychiatric diagnoses among public employees working towards long-term relief in the disaster area.

This study had two purposes. The first was to identify the prevalence of psychiatric disorders, such as depression and PTSD, among public employees working in the Fukushima disaster area with the use of structured diagnostic interviews. The second was to speculate on the psychosocial factors or stressors affecting the mental condition of these public employees.

METHODS

Participants

The participants of this study were public employees working in two municipalities (towns A and B) located within approximately 30 km of the plant; town A had approximately 5100 residents and 101 public employees, and town B had approximately 7700 residents and 82 public employees at the time of the disaster. In Fukushima, all the residents and public employees living in the 13 municipalities (approximately 212 000 in total), including towns A and B, were forced to evacuate by a government order in the first 5 days after the disaster; these residents were therefore considered to have experienced more stress than those living in other municipalities.

Several months after the evacuation, the government decided to lift the evacuation restriction for the residents of town A. Though all public employees were returned to the town office within several months, only about 30% of the residents returned home due to fear of exposure to radioactivity, insufficient reconstruction, the unclear future of the town, and various rumors regarding the safety of the area. On the other hand, the evacuation restriction for town B remains in effect and all residents have relocated to other areas throughout Japan. The public employees of town B have been reassigned to

offices in neighboring municipalities, but about 30% of the original workers resigned after the disaster owing to various reasons, such as great concern over or disappointment in the reconstruction plan for the town and their own burn-out.

We were asked to conduct a mental health survey of the public employees of towns A and B by the persons in charge of human resources at the local municipalities in order to identify staff that may be at risk of psychiatric disorders, especially depression. We were also asked to refer any employee diagnosed with a psychiatric disorder to adequate medical resources as needed. To meet this request, we designed a study in which participants would have individual psychiatric interviews with a psychiatrist with at least 10 years of clinical experience. Individual interviews were held at the public offices of towns A and B.

Measures

The present survey was carried out 24–30 months after the disaster. We assumed that because the participants had been exposed to severely traumatic events, such as the tsunami and explosions at the power plant, it was possible that they had strong PTSD symptoms as well as depression. Thus, we used the Impact of Event Scale–Revised Japanese version (IESR-J),¹⁶ which is a self-administrated scale used to assess symptoms of PTSD. Moreover, the participants were assessed for depression, PTSD, and suicide risk and diagnosed using the Mini-International Neuropsychiatric Interview Japanese version (MINI).^{17,18} The MINI is useful as a short, structured, diagnostic interview for the DSM-IV. Suicide risk was assessed using a subscale of the MINI, which consisted of six items asking about suicidal ideation or suicide-related behaviors. All interviews were performed by pairs of a psychiatrist and a psychologist, and took an average of 50–60 min each. During the interviews, we inquired about the following topics in addition to those in the MINI diagnostic interview system: feelings when the disaster took place and during the subsequent evacuation, methods of coping with stressors, workplace atmosphere, contact with town residents or evacuees, interactions among family members, perception of the current situation in Fukushima, and hope for their future. For instance, we asked them: ‘How did you feel when the disaster occurred?’, ‘What was the worst event or when was the hardest time for you

after the disaster?’ and ‘What do you think of your town’s future?’

Some medical advice and brief psychoeducation were also provided as needed. Demographic data (sex, age, work period, position, current living situation), exposure to traumatic events and medical information (including current smoking, drinking, and state of sleep) were gathered in advance through a separate questionnaire.

Statistical analysis

Because the prevalence of depression in the study population is not rare ($\geq 10\%$), we used binomial regression analysis to derive prevalence ratios (PR) and 95% confidence intervals (CI) for depression according to each of the following 14 factors using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).¹⁹ sex, town (A or B), age, IESR-J score (< 25 or ≥ 25), time of employment (employed before or after the disaster), drinking habit (change or no change after the disaster), smoking habit (change or no change after the disaster), sleep disorder (disturbance of sleep induction, disturbance of deep sleep, or early waking; yes or no), work position (management level or higher, or lower), current living situation (own home or evacuation facility), marital status (married or cohabitating, or living alone), bereavement of a loved one (yes or no), treatment for disease other than hypertension (yes or no), and treatment for hypertension (yes or no). Additionally, multivariate analysis was conducted using propensity scores to adjust for the above factors. Because the number of participants with depression was only 30, we could not include the 14 factors listed above as covariates in a regression model because of overfitting.²⁰ Therefore, propensity scores in each factor were calculated by multivariable logistic regression analysis using the other factors. C statistics of these models were 0.74 (sleeping disorder)–0.96 (time of employment). Then, the original Impact of Event Scale Revised (IESR) made by Weiss²¹ was required to be handled as a continuous variable. We, however, unavoidably handled IESR-J not as a continuous variable but as a categorical one (< 25 or ≥ 25), because propensity score cannot be calculated for a continuous one.²⁰ The cut-off score for the IESR-J was adopted in accordance with a past study performed in Japan.¹⁶

All *P*-values were two-tailed and differences at *P* < 0.05 were accepted as statistically significant.

Ethical considerations

The study protocol was approved by the Ethics Committee of Fukushima Medical University (Certification No. 2068, approved on 22 August 2014), and fully complied with the provisions of the World Medical Association Declaration of Helsinki. All participants were informed of the purpose of the study, that their participation was voluntary, that they could withdraw from the study at any time, and that they would not be disadvantaged in any way if they chose to withdraw or not to participate. Interviews were only conducted with those who agreed to participate and the anonymity of the participants was preserved throughout the study.

RESULTS

Data analysis

Of all public employees working in both towns A and B, 168 (91.8%) agreed to participate in our survey. The demographic characteristics of these participants are shown in Table 1. Similar to other public employees in Japan, male workers were more prevalent than female. The mean age was 42.3 years and almost 40% of the participants were still living in evacuation facilities at the time of the survey.

The results of the MINI showed that the prevalence of depression, PTSD, and suicide risk were 17.9%, 4.8%, and 8.9%, respectively. Contrary to the results of the MINI diagnosis, 21.6% of the participants were identified as at risk of PTSD based on the results of the IESR-J. Table 2 shows the number of participants diagnosed with depression, and the PR of depression with 95%CI according to each factor. PR showed a significant association with only IESR-J. Point estimates showed non-significant increases in town B, changes in drinking habit after the disaster, having a sleep disorder, living alone, bereavement, treatment for a disease other than hypertension, and treatment for hypertension, and decreases among females, changes in smoking habit after the disaster, and living in an evacuation facility.

Contents of interviews

Many participants indicated that they had experienced stressful experiences during and after the disaster and were presently distressed about both their work and family situations. Almost all participants

Table 1. Demographic data of the participants

Number of participants	168
Female (%)	27.4
Town	
A (%)	54.8
B (%)	45.2
Mean age, years (SD)	42.3 (11.9)
IESR-J score	
≥25 (%)	21.6
MINI diagnosis	
Depression (%)	17.9
PTSD (%)	4.8
Suicide risk (%)	8.9
Referred to medical facilities based on MINI (%)	12.5
Drinking habit	
Changed after the disaster (%)	23.8
Smoking habit	
Changed after the disaster (%)	15.5
Sleep disorder	
Present (%)	72.6
Treatment for hypertension	
Yes (%)	15.5
Treatment for disease other than hypertension	
Yes (%)	11.3
Time of employment	
Employed before the disaster (%)	65.5
Work position	
Management level or higher (%)	33.9
Current living situation	
Own home (%)	60.7
Evacuation facility (%)	39.3
Marital status	
Married or cohabitating (%)	66.1
Traumatic experiences	
Bereavement	
Yes (%)	17.9
Frequent exposure to residents' anger or complaints	
Yes (%)	97.0

IESR-J, Impact of Event Scale–Revised Japanese version; MINI, Mini-International Neuropsychiatric Interview Japanese version; PTSD, post-traumatic stress disorder.

(97.0%) reported that they were frequently exposed to strong negative feelings of town residents while working, such as anger and complaints. Moreover, many stated that such exposure was the most severe traumatic experience, even more so than the earthquake, tsunami, or explosion at the plant. According to the interview contents, the participants repeatedly received various types of severe,

Table 2. Risk ratio and 95% confidence intervals for depression

	Participants, <i>n</i>	Depression, <i>n</i>	Univariate	Multivariate [†]
Sex				
Male	122	24	1.00 (reference)	1.00 (reference)
Female	46	6	0.66 (0.29–1.52)	0.53 (0.23–1.22)
Town				
A	92	14	1.00 (reference)	1.00 (reference)
B	76	16	1.38 (0.72–2.65)	1.35 (0.65–2.80)
Age	168	30	1.00 (0.97–1.03)	—
IESR-J score				
<25	131	12	1.00 (reference)	1.00 (reference)
≥25	36	17	5.16 (2.72–9.78)	5.89 (2.91–11.90)
Time of employment				
Employed after the disaster	58	9	1.00 (reference)	1.00 (reference)
Employed before the disaster	110	21	1.23 (0.60–2.51)	0.84 (0.22–3.16)
Drinking habit				
No change after the disaster	128	18	1.00 (reference)	1.00 (reference)
Change after the disaster	40	12	2.13 (1.13–4.04)	1.42 (0.63–3.20)
Smoking habit				
No change after the disaster	142	24	1.00 (reference)	1.00 (reference)
Change after the disaster	26	6	1.37 (0.62–3.01)	0.62 (0.23–1.65)
Sleeping disorder				
No	46	3	1.00 (reference)	1.00 (reference)
Yes	122	27	3.39 (1.08–10.65)	1.82 (0.55–6.03)
Work position				
Lower than management level	111	20	1.00 (reference)	1.00 (reference)
Management level or higher	57	10	0.97 (0.49–1.94)	0.92 (0.32–2.65)
Living situation				
Own home	102	17	1.00 (reference)	1.00 (reference)
Evacuation facility	66	13	1.18 (0.62–2.27)	0.66 (0.29–1.47)
Marital status				
Married or cohabitating	111	18	1.00 (reference)	1.00 (reference)
Living alone	57	12	1.30 (0.67–2.50)	1.29 (0.61–2.76)
Bereavement				
No	138	22	1.00 (reference)	1.00 (reference)
Yes	30	8	1.67 (0.83–3.39)	1.73 (0.79–3.83)
Treatment for disease other than hypertension				
No	149	26	1.00 (reference)	1.00 (reference)
Yes	19	4	1.21 (0.47–3.08)	1.54 (0.51–4.64)
Treatment for hypertension				
No	142	23	1.00 (reference)	1.00 (reference)
Yes	26	7	1.66 (0.80–3.47)	1.58 (0.62–4.01)

[†]Adjusted for each propensity score calculated by multivariable logistic regression analysis using the other factors. IESR-J, Impact of Event Scale–Revised Japanese version.

sometimes violent, complaints from residents and evacuees. At the same time, they felt that the negative feelings among the residents were due to not only the critical and unclear situation in Fukushima, but also strong distrust for public employees

working for their government or community. Of all participants, 21 (12.5%) were eventually referred to local medical facilities because of severe depressive symptoms and/or their hope to receive psychiatric treatment.

DISCUSSION

The current prevalence rate of major depression among the participants of this study was 17.9% based on the MINI diagnostic system. Similar to the findings of other studies,^{14,15} the results clearly showed a high risk of depression among the public employees working in the Fukushima disaster area. This risk was much higher than we expected based on the estimated lifetime (2.2%) and 12-month (6.1%) prevalence rates of depression among the general population in Japan.²² In addition, the prevalence rate of suicide risk among our participants reached 8.9%. With regard to the current tendency for suicide among people living in Fukushima, the standardized suicide mortality ratio (SMR) decreased initially (107 in 2011, 94 in 2012, and 96 in 2013), but then rose in 2014 (to 126) to exceed the pre-disaster level.⁹ Taking into account the recent increase in SMR,⁹ public employees working in the disaster area in Fukushima, as well as other residents who may be at risk, should be provided adequate psychiatric care or treatment to prevent suicide.

According to the results of binomial regression analysis, only the severity of traumatic experiences as indicated by the total IESR-J score had a very high multivariate PR at 5.89 (2.91–11.9). Based on the results of the interviews, the participants' traumatic experiences could be attributed to frequent exposure to anger and complaints from residents or evacuees. On the other hand, we did not consider that such experiences met the definition of traumatic events in the PTSD criteria of the DSM-IV; all of the eight participants diagnosed as having PTSD worked in town B, located much nearer to the plant than town A, and experienced the tsunami and the plant explosion more directly at the time of the disaster (e.g., four of them lost family members). Thus, the prevalence rate of probable PTSD estimated by the IESR-J (21.6%) was considerably higher than the prevalence rate of PTSD identified by the MINI (4.8%). However, if we regarded exposure to the residents' anger as a traumatic experience defined by the PTSD criteria, the prevalence rate of both PTSD and major depression would be higher. Considering the close relation and comorbidity between PTSD and depression after community disasters as demonstrated in past studies,^{15,23–25} it is possible to assume that exposure to residents' strong negative feelings and anger contributed to the development of depressive symptoms and post-traumatic responses among the participants in the present

study. Such exposure might cause self-doubt and feelings of helplessness, leading not only to job-identity loss, but also depressive symptoms because of their preexisting vocation and responsibility for town residents. The vocation of the participants was also likely heightened when their community was faced with crisis, thereby inducing further stress.

Meanwhile, with the exception of IESR-J scores, none of the other variables tested showed multivariate PR significantly different from 1.00. The most likely reason for the lack of significant differences in the other variables is beta error, as the number of participants was too low. Incidentally, several past studies focusing on stress among relief workers revealed that female sex^{7,26–28} and traumatic bereavement^{7,28,29} can be predictors of developing PTSD or depression after community disasters. In the present study, the PR of the participants who experienced bereavement was high at 1.73, similar to the results of previous studies.^{7,28,29} Financial losses^{7,23,25,29,30} and damage to the home^{7,27–30} have also been shown to be associated with subsequent mental health problems. In our study, however, all of the participants had experienced involuntary relocation at least once, and all of their houses were contaminated with radioactive materials, such as cesium, to varying degrees. In contrast, because all of the participants were able to maintain a stable income after the disaster, they experienced little financial loss. All of the participants had experienced very similar stressful events, so in other words, they were highly homogenous. Therefore, it is difficult to clarify the relation between psychiatric problems and various other factors as reported in past studies.

Past studies focusing on relief workers' stressors and coping skills revealed the importance of communication among coworkers or family members in the recovery process after a disaster.^{15,29} In this study, many participants blamed themselves for continuing to work at the sacrifice of their family members. However, the decision to leave their workplace remained very difficult because they were aware that local government offices were severely understaffed. In addition to other stressors, such as exposure to residents' anger, role conflicts among the employees were considered to be one of the etiological factors that caused such a high prevalence rate of depression among our study participants.

Our study has several limitations, including the small size of the study sample, the lack of a control

group and pre-disaster information, the homogeneity of the participants, and the validity of the diagnostic procedure for PTSD. We also handled the total score of the IESR-J as a categorical variable, not as a continuous one, contrary to the original idea proposed by Weiss.²¹ In addition, we did not consider any physical conditions, except for hypertension, that might have influenced depressive states among the participants. Furthermore, we assumed that the participants of this study were representative of public employees working in Fukushima's 13 municipalities who were involuntarily evacuated by the government order, rather than representative of all public employees in Fukushima Prefecture. The public employees who participated in the present study are highly likely to have experienced more severe traumatic events than those working in other areas in Fukushima.

In spite of these limitations, the strength of our study is that it used not only self-administered questionnaires, but also structured interviews in order to correctly diagnose psychiatric disorders. As a result, we were able to reveal serious psychiatric issues among the public employees working toward long-term disaster relief in Fukushima. Furthermore, the duration of our interviews allowed us to provide brief interventions, including psychoeducation or medical advice. In fact, we referred 21 participants (12.5%) who showed severe depressive symptoms to local medical resources, such as psychiatric clinics, after brief individual psychoeducation. Given the fact that numerous epidemiological studies conducted in the disaster area have yielded considerable ethical issues,^{31,32} the procedure in the present study might have benefitted the participants, and may have led to adequate mental health care and psychiatric treatment.

Current mental health resources are not sufficient to provide efficient psychiatric interventions for the numerous public employees working in Fukushima.¹⁰ A new facility that offers treatment by mental health professionals with the specific purpose of treating PTSD, depression, and other mental health conditions among public employees would be a valuable addition in the long-term relief of Fukushima.

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DISCLOSURE STATEMENT

The authors declare no conflict of interest associated with this article.

AUTHOR CONTRIBUTIONS

M.M. conceived of and designed the study, conducted the interviews, and drafted the manuscript. Y.U. conceived of the study design, participated in the interviews, and collected the data. M.N. performed the statistical analysis, and drafted part of the manuscript and tables. S.F. and M.O. participated in the interviews and collected the data. All authors read and approved the final manuscript.

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