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Perceived Workplace Interpersonal Support Among Workers of the Fukushima Daiichi Nuclear Power Plants Following the 2011 Accident: The Fukushima Nuclear Energy Workers' Support (NEWS) Project Study

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ABSTRACT

Objective: The 2011 Fukushima Daiichi nuclear accident was the worst nuclear disaster since Chernobyl. The Daiichi workers faced multiple stressors (workplace trauma, victim experiences, and public criticism deriving from their company's post-disaster management). Literatures suggest the importance of workplace interpersonal support (WIS) in enhancing psychological health among disaster workers. We sought to elucidate the role of their demographics, disaster-related experiences, and post-traumatic stress symptoms on perceived WIS.

Methods: We analyzed self-report questionnaires of 885 workers 2-3 months post-disaster. We used sociodemographic and disaster exposure-related variables and post-traumatic stress symptoms (measured by the Impact of Event Scale-Revised) as independent variables. We asked whether WIS from colleagues, supervisors, or subordinates was perceived as helpful, and used yes or no responses as a dependent variable. Logistic regression analyses were performed to assess correlates of WIS.

Results: Of the participants, one-third (34.7%) reported WIS. WIS was associated with younger age (20-28 years [vs 49-], adjusted odds ratio [aOR]: 3.25, 95% CI: 1.99-5.32), supervisory work status (aOR: 2.30, 95% CI: 1.35-3.92), and discrimination or slur experience (aOR: 1.65, 95% CI: 1.08-2.53).

Conclusions: Educational programs focusing on WIS might be beneficial to promote psychological well-being among nuclear disaster workers, especially younger workers, supervisors, and workers with discrimination experiences. (*Disaster Med Public Health Preparedness*. 2018;12:460-463)

Key Words: workplace interpersonal support, Great East Japan Earthquake, traumatic stress, industrial and organizational psychology, Fukushima Daiichi nuclear power plant accident

On March 11, 2011, a 9.0 magnitude earthquake and tsunamis struck the north-eastern coast of Japan (the Great East Japan Earthquake). This disaster led to a series of severe nuclear accidents at the Tokyo Electric Power Company (TEPCO) Fukushima Daiichi Nuclear Power Plant (Daiichi) in Fukushima prefecture. The accident caused plant explosions and meltdowns in 3 of the 6 reactors, as well as the release of radioactive materials and mandatory evacuation in the surrounding region. This accident was the largest nuclear power plant disaster since the 1986 Chernobyl accident. Studies from the 1979 Three Mile Island and Chernobyl nuclear power plant disasters have shown that the plant workers experienced long-term adverse mental health consequences such as post-traumatic stress disorder (PTSD) and depression.¹⁻⁴ In the case of Fukushima, none of the TEPCO nuclear plant workers had acute radiation exposure symptoms. However, they were exposed to multiple stressors,

such as workplace trauma, victim experiences, line-of-duty deaths, and public criticism because of their company's post-disaster management issues.⁵ Among these, experience of discrimination or slur was a key factor related to adverse psychological outcomes 2-3 months after the disaster.⁵ Recovery efforts are expected to continue for decades, and the well-being of the workers is an ongoing concern.

A large amount of literature emphasizes the importance of workplace interpersonal support (WIS) in promoting psychological well-being and resilience among first responders and disaster workers following the experience of traumatic events.^{6,7} Prati et al⁸ reviewed the associations between social support and mental health among first responders, and report a larger effect size of perceived social support than that of received social support. Given the similarity of work roles between first responders and post-accident nuclear power plant workers, WIS – especially,

perceived WIS – may also be important for protecting the mental health of the latter workers. To our knowledge, however, no studies have examined this issue, and little is known about WIS in nuclear plant workers after major accidents. To elucidate the role of WIS, we examined perceived WIS and its correlates in the Daiichi workers.

METHODS

Participants and Procedure

This study was conducted as part of the Fukushima Nuclear Energy Workers’ Support (NEWS) Project, a mental health research study of the Daiichi and the nearby Daini workers.^{5,9} Following approval by the ethics committees of Ehime University and National Defense Medical College, full-time TEPCO employees of Fukushima Daiichi nuclear power plant (n=1053) were invited to participate 2-3 months post-disaster (May to June 2011).

Measures

After giving written consent, the participants completed a self-report questionnaire. The questionnaire items measured sociodemographic variables, disaster-related exposures,⁵ the Japanese version of the Impact of Event Scale-Revised (IES-R),¹⁰ and perceived WIS.

The IES-R is a 22-item rating scale (range: 0-88) to evaluate post-traumatic stress symptoms following the experience of traumatic events. The IES-R contains 3 symptom clusters of PTSD—intrusion, avoidance, and hypervigilance—as defined by the Diagnostic and Statistical Manual of Mental Disorders (4th edition).¹¹

To assess the participants’ perceived WIS, a leading question was given in Japanese language: “Which of the following items were helpful for your mental health (multiple answers allowed)?” The respondents responded to multiple checklist items in a yes or no fashion. “Support from their colleagues, supervisors, or subordinates” was among these items. We used this dichotomous variable as a measure of perceived WIS, our outcome variable.

Data Analysis

A total of 885 workers were enrolled for the analysis (response rate: 84.0 %). Among them, age data were missing for two individuals, and IES-R data were missing for 48 individuals. Bivariate analysis was first conducted to examine relations between WIS and the independent variables (socio-demographic variables, disaster-related exposures, and IES-R). Regarding age, we subdivided the whole group according to age quartiles. Multiple logistic regression analysis was subsequently performed to examine the multivariate correlates of WIS. Using a forward conditional method, we entered the following covariates of interest in the analysis model based on previous literature—basic sociodemographic characteristics, disaster-related experiences related to their post-disaster

mental health, and occupational factors—in particular, supervisory work status.^{5,8,9,12} In this process, we entered IES-R as an independent variable to adjust for the participants’ degree of post-traumatic stress responses. We used IBM SPSS Statistics version 22 (IBM Japan, Tokyo, Japan) for the statistical analysis. The significance level was set at *P* < 0.05 (two-tailed).

TABLE 1

Bivariate Relationships Between Perceived Workplace Interpersonal Support (WIS) and Independent Variables

Variables	WIS (–) (n = 578)		WIS (+) (n = 307)		Analysis <i>χ</i> ² or <i>t</i>
	n or M	% or SD	n or M	% or SD	
Total					
Age^a					
20-28	105	18.2	104	33.9	
29-39	149	25.8	71	23.1	
40-48	141	24.4	70	22.8	
49-	181	31.3	62	20.2	30.7***
Sex					
Male	559	96.7	294	95.8	0.52
Female	19	3.3	13	4.2	
Supervisory work status					
No	527	91.2	269	87.6	2.80
Yes	51	8.8	38	12.4	
Preexisting illness					
No	489	84.6	261	85.0	0.03
Yes	89	15.4	46	15.0	
Discrimination/slurs					
No	511	88.4	250	81.4	8.10**
Yes	67	11.6	57	18.6	
Near-death experience					
No	286	49.5	129	42.0	4.48*
Yes	292	50.5	178	58.0	
Tsunami evacuation					
No	521	90.1	277	90.2	0.002
Yes	57	9.9	30	9.8	
Witnessing plant explosions					
No	370	64.0	197	64.2	0.002
Yes	208	36.0	110	35.8	
Family member death(s)					
No	547	94.6	285	92.8	1.16
Yes	31	5.4	22	7.2	
Colleague death(s)					
No	487	84.3	225	73.3	15.3***
Yes	91	15.7	82	26.7	
Major property loss					
No	386	66.8	214	69.7	0.79
Yes	192	33.2	93	30.3	
Home evacuation					
No	181	31.3	87	28.3	0.84
Yes	397	68.7	220	71.7	
IES-R^b	18.7	15.5	19.5	16.3	–0.70

N = 885.

Abbreviations: IES-R, Impact of Event Scale-Revised.

^aRange: 20-63. Data were missing for two individuals (0.2%).

^bRange: 0-85. Data were missing for 48 individuals (5.4%).

P* < 0.05, *P* < 0.01, ****P* < 0.001.

RESULTS

Table 1 shows the bivariate relations between independent variables and WIS. The large majority of participants was male, and age quartile distribution was as follows: 20-29 years (lowest), 29-39 years (second), 40-48 years (third), and 49-63 (fourth). Approximately 1 out of 3 participants (34.7%; 95% CI: 31.5%-37.8%) reported WIS.

Table 2 shows the results of multivariate analysis. WIS was associated with younger age (20-28 years, 29-39 years, or 40-48 years [vs 49+ years]), supervisory work status (vs non-supervisors), and discrimination or slur experience (vs no experience), but not with the degree of PTSD symptoms.

DISCUSSION

In this study, Daiichi workers' WIS was associated with discrimination or slur experience, younger age, and supervisory status. To our knowledge, no studies have reported such relations among nuclear disaster workers.

In previous studies conducted with the same data set,^{5,9} we showed discrimination or slur experience to have peri-traumatic or post-traumatic mental health effects. The results of the present study permit a deeper understanding of the impact of these experiences from an occupational perspective. Our findings suggest that these workers, who were the direct victims of social criticism, may have been trying to cope with this backlash by increasing their workplace cohesion. Longitudinal studies will be important to understand the chronic effects of their discrimination experiences.

Our data showed perceived WIS to be associated with younger age and supervisory status, suggesting the significance of WIS among these groups for coping with the horrific situation. For disaster workers in general, those who are younger and who have supervisory work status are vulnerable to workplace trauma.¹³ In a meta-analysis of first responders, perceived social supports were more useful for mental health than received social supports.⁸ In the context of nuclear power plant disasters, a study of Three Mile Island workers reported that those in non-supervisory positions were likely to feel demoralization symptoms 6 months after the disaster.¹

Among our participants, we speculate that individual ability to control the situation was very limited because of the complex structures of nuclear plants. This trend is likely to be prominent among younger workers owing to their limited experience and/or work discretion. This may help to explain the tendency of younger workers to report the significance of WIS. In the same context, the chain of command was critical for responding to the crises; therefore, supervisors might have been more aware of WIS than non-supervisors. Given these findings, organizational mental health approaches to enhance workplace cohesion might be important for nuclear plant workers experiencing workplace crises.

Our results did not show relationships between perceived WIS and colleague death(s) experience. Line-of-duty deaths can have a profound impact on disaster workers' mental health. Such effects have been reported in various occupations, such as military personnel, police officers, firefighters,

TABLE 2

Factors Associated With Perceived Workplace Interpersonal Support

Variables	<i>B</i>	SE	Adjusted OR	95% CI
Age (reference: 49-) ^a				
20-28	1.18	0.25	3.25	1.99-5.32***
29-39	0.52	0.24	1.67	1.05-2.67*
40-48	0.50	0.23	1.65	1.06-2.57*
Sex, male (reference: female)	0.46	0.41	1.59	0.71-3.54
Preexisting illness, yes (reference: no)	0.15	0.22	1.16	0.75-1.80
Supervisory work status, yes (reference: no)	0.83	0.27	2.30	1.35-3.92**
Discrimination/slurs, yes (reference: no)	0.50	0.22	1.65	1.08-2.53*
Near-death experience, yes (reference: no)	0.21	0.16	1.23	0.90-1.70
Tsunami evacuation, yes (reference: no)	-0.30	0.27	0.74	0.44-1.25
Witnessing plant explosions, yes (reference: no)	-0.09	0.17	0.91	0.66-1.26
Family member death(s), yes (reference: no)	0.43	0.32	1.54	0.83-2.88
Colleague death(s), yes (reference: no)	0.39	0.20	1.47	1.00-2.18
Major property loss, yes (reference: no)	-0.11	0.17	0.90	0.64-1.26
Home evacuation, yes (reference: no)	0.24	0.17	1.27	0.91-1.76
IES-R ^b	0.00	0.01	1.00	0.99-1.01

N = 885.

Abbreviations: OR, odds ratio; IES-R, Impact of Events Scale-Revised.

^aData were missing for two individuals (0.2%).

^bData were missing for 48 individuals (5.4%).

P* < 0.05, *P* < 0.01, ****P* < 0.001.

and medical staff.^{8,14} Daiichi workers had experienced multiple disaster exposures, and their stressors were not limited to line-of-duty deaths.⁵ Therefore, the impact of the martyr might have been lower than that of other disaster exposures. As we do not know of other studies examining this issue among nuclear plant workers, we can only speculate at this point.

Our study has numerous limitations. The cross-sectional, self-report study design limits our understanding of the longitudinal effect of WIS. The study sample was limited to workers of a single company and cannot be generalized to Fukushima workers or nuclear plant workers in general. The outcome variable and disaster-related exposure variables were assessed using simple dichotomous questions. Further, several demographic variables (eg, marital status) were not assessed. These methodological issues limit in-depth interpretations of our findings.

CONCLUSIONS

Among Fukushima Daiichi nuclear power plant workers, WIS was associated with younger age, supervisory work status, and discrimination or slur experience 2-3 months after the disaster. Although our study is limited based on its methodological design, these findings permit a better understanding of the relations between WIS and its correlates. These findings also suggest that WIS might be an essential component for education and/or intervention programs to promote mental well-being among nuclear disaster workers, especially, younger workers, supervisors, and workers with discrimination experiences.

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Conflicts of Interest

ST, JS, SN, and AY provided mental health assistance to the workers of TEPCO Fukushima Daiichi and Daini Nuclear Power Plants according to official requests from the Daini plant and a Japanese government cabinet order to the Ministry of Defense. ST is a part-time psychiatrist for TEPCO Hirono Power Station. TT is a Daini plant part-time occupational physician. All other authors declare that they have no conflicts of interest.

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