

Original Research

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The Relationship Between the Experience of Rescue Activities in the 2024 Noto Peninsula Earthquake and Posttraumatic Stress Symptoms and Psychological Distress Among Medical Rescue Workers

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Abstract

Objective: This study aimed to investigate the association between the experience of rescue activities in the 2024 Noto Peninsula earthquake and posttraumatic stress symptoms (PTSS) and psychological distress among medical rescue workers (MRWs).

Methods: MRWs were recruited from March 8 to March 31, 2024. Outcomes were psychological distress and PTSS. Independent variables were the experiences of rescue activities in the Noto Peninsula earthquake and peritraumatic distress assessed by the Peritraumatic Distress Inventory (PDI).

Results: 1085 MRWs completed all questions. Multiple linear regression analyses showed that experiences of being overwhelmed by the tragic situation in the disaster area ($B = 0.61$, $p < 0.01$), experience of disagreement and conflict among rescuers during rescue activities ($B = 0.51$, $p < 0.01$) and PDI ($B = 0.33$, $p < 0.01$) were significantly associated with psychological distress, and experience of disagreement and conflict among rescuers during rescue activities ($B = 1.70$, $p < 0.01$) and PDI ($B = 0.65$, $p < 0.01$) were significantly associated with PTSS.

Conclusions: This study showed factors associated with PTSS and psychological distress among MRWs during the Noto Peninsula earthquake, which was an important finding for future research on the mental health of MRWs.

Introduction

A moment magnitude 7.5 earthquake struck the Noto Peninsula, which is located on the northern part of the Ishikawa Prefecture in the Sea of Japan side, on January 1, 2024.¹ Widespread damage was caused by the primary strong shaking of the ground and secondary impacts such as uplift, liquefaction, landslides, fires, and tsunamis. More than 240 people were killed, 60,000 buildings were damaged, and the inland and coastal infrastructure was compromised, disrupting roads and lifelines.² More than 25,000 people had to be evacuated.² The Japanese government declared the Noto Peninsula earthquake an “extremely severe disaster.”

Japan's disaster medical system responded immediately to the 2024 Noto Peninsula earthquake, coordinating hundreds of emergency medical teams, e.g., the Japan Disaster Medical Assistance Team (DMAT), from across the country.³ DMAT members are trained medical rescue workers who have the mobility to work in an acute phase of a disaster in Japan.⁴ DMAT members respond at the onset of a disaster and for longer periods when needed.⁵ A total of 1139 DMAT teams were deployed from within and outside Ishikawa Prefecture to help ensure an adequate medical system in the disaster area.⁶ They began rescue activities in the disaster area immediately after the earthquake; they collected information on the disaster situation, provided support for medical treatment and patient transport at affected medical institutions and welfare facilities, and provided support for health checks and medical treatment for evacuees at evacuation centers.

The mental health of rescue workers who have participated in rescue activities of large-scale disasters, such as the Noto Peninsula earthquake, is a serious health problem. Of medical rescue workers deployed to the Great East Japan Earthquake, 6.6% developed PTSD, 14.3% developed depression, and 14.5% developed high psychological distress.⁷ Meta-analysis showed that the worldwide prevalence of PTSD in medical rescue workers is 10%.⁸ Medical rescue workers have high exposure to traumatic events and are at higher risk for mental health problems than other

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occupations and the general population.⁸ The rescue activities include providing emergency medical assistance to severely injured people and searching for and recovering victims and bodies from wreckages and disasters, putting rescue workers at a high risk for PTSD.⁸ To improve mental health support and measures for medical rescue workers, it is necessary to accumulate studies on the related factors of mental health in various disasters, particularly PTSD symptoms (PTSS) and psychological distress.

Previous studies have reported that experiences before and during rescue activities are related to mental health after rescue activities among medical rescue workers. The psychological impacts of rescue activities of disasters on rescue workers were reported as pre-disaster factors (occupational factors; specialized training and preparation; life events and health), during disaster factors (exposure; duration of rescue activity and arrival time; emotional involvement; peri-traumatic distress; role-related stressors; perceptions of safety, threat and risk; harm to self or close others; social support; professional support; lack of sufficient time for self-care and exhaustion; time spent watching television about the disaster).^{4,9-14}

Some possible unique risk factors for mental health among rescue workers were identified from our interview with DMAT members who experienced rescue activities in the 2024 Noto Peninsula earthquake. These possible unique risk factors were either factors that had previously been reported as being related to the mental health of medical rescue workers responding to various types of disasters in previous studies, or factors that had not yet been reported. The disaster area was compromised, and roads and lifelines were disrupted due to primary strong ground shaking and secondary impacts such as uplift, liquefaction, and landslides. The 2024 Noto Peninsula earthquake caused many casualties, and many medical rescue workers began working and providing medical care to the casualties immediately after the disaster. Medical rescue workers experienced a sense of danger when moving to the disaster area and during rescue activities, as well as feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area.³ In addition, because the 2024 Noto Peninsula earthquake caused severe damage, many medical rescue workers from various organizations took part in long-term rescue activities, and some people experienced disagreements and conflicts among the rescuers during the rescue activities. To advance the study of the mental health of medical rescue workers, it is essential to clarify the unique experiences that are specific mental health risks in the rescue activities of the 2024 Noto Peninsula earthquake, as well as the factors related to the mental health of medical rescue workers reported in previous studies.

This study aimed to investigate the association between the experience of rescue activities in the 2024 Noto Peninsula earthquake and PTSS and psychological distress among medical rescue workers.

Method

Participants

The recruited participants in this study included almost all DMAT members in Japan who met the following inclusion criteria: (1) aged 18 years or older, (2) native Japanese speaker or non-native speaker with Japanese reading and writing skills, (3) able to receive an email with the written guide for this study from the DMAT office, and (4) physically and psychologically capable of

understanding and providing consent for study participation. DMAT members (physicians, nurses, medical office workers, and other healthcare professionals such as pharmacists and occupational therapists) usually work at their base hospitals. At a time of need, the national or prefectural government requests their deployment to disaster base hospitals. The selected members provide rescue efforts to the affected areas or major accident sites, including multi-casualty incidents, for several days and return to regular work in their hospitals after the rescue activity. DMAT members were engaged in main rescue activities from immediately after the January 1, 2024, Noto Peninsula earthquake until early March 2024.

Study Design

Medical rescue workers belonging to DMAT in Japan, regardless of their roles or occupations, were recruited for this internet-based study. The survey was conducted from March 8 to March 31, 2024, after the DMAT members had ended their main rescue activities in the 2024 Noto Peninsula earthquake. The reason for conducting this survey at this time was, firstly, to avoid causing any burden on participants by asking them to respond to this study while they were participating in rescue activities. Secondly, a systematic review and meta-analysis of medical rescue workers who participated in rescue activities in earthquakes have reported that PTSS improve with the time elapsing from earthquake occurrence, so we wanted to investigate the factors associated with poor mental health in participants immediately after rescue activities.¹⁵ An email for this study was posted to the mailing list that reaches all registered DMAT members in Japan by the DMAT office. The email recruiting was sent to almost all DMAT members in Japan, and members voluntarily participated in this study. The email contained a written explanation of the study and the URL of a web page containing a questionnaire and a consent form. Participants accessed the URL, read a detailed explanation of the study, and responded online to the consent form and the questionnaire.

This study was approved by the research ethics committee of the Graduate School of Medicine and Faculty of Medicine at the University of Tokyo (No. 2019164NI-(1)(2)(3)(4)(5)(6)) and the research ethics committee of the National Hospital Organization Disaster Medical Center (No. 2019-19). Informed consent was obtained by the participant reading an ethical document and completing a consent form on this study's web page. This study was conducted in accordance with the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.¹⁶

Measurement Tools

The outcomes of this study were psychological distress as measured by the Kessler 6 (K6) and PTSS as measured by the PTSD Checklist for DSM-5 (PCL-5).

The K6 is a six-item short measure of psychological distress used as a screening instrument for common mental disorders.¹⁷ The total score ranges from 0 to 24, with higher scores indicating more severe psychological distress. The reliability and validity of the Japanese version of the K6 have been verified.^{18,19}

The PCL-5 is a 20-item measure that can be used to monitor symptom changes, screen individuals for PTSD, and make a probable diagnosis of PTSD.²⁰ The PCL-5 was updated to correspond with the revised criteria for a PTSD diagnosis in the fifth edition of the *Diagnostic and Statistical Manual for Mental Disorders* (DSM-5). The total score ranges from 0 to 80, with higher scores

indicating more severe PTSS. The reliability and validity of the Japanese version of the PCL-5 have been verified.²¹

Independent variables

Independent variables were factors associated with PTSS and psychological distress selected based on related factors associated with mental health in previous studies among medical rescue workers exposed to rescue activities and our interviews with DMAT members who experienced rescue activities in the 2024 Noto Peninsula earthquake^{4,9–14}: the experiences of feeling a sense of danger when moving to the disaster area, feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area, feeling a sense of danger during rescue activities, feeling a sense of danger during moving in the disaster area, being overwhelmed by the tragic situation in the disaster area, engaging in rescue activities while personally being affected by the disaster, and disagreement and conflict among rescuers during rescue activities. These experiences were answered in a binary (yes/no) way. Prior to the start of this study, we interviewed several medical rescue workers who had participated in rescue activities following the 2024 Noto Peninsula earthquake. The aim was to gain an understanding of their experiences and the factors associated with mental health during these activities.

Peritraumatic distress, which was shown to be an associated factor for PTSS among DMAT members after the Great East Japan Earthquake,¹² was also included as an independent variable and assessed by the Peritraumatic Distress Inventory (PDI). This is a 13-item self-report questionnaire for assessing peritraumatic distress during and immediately after a critical incident.²² The instrument uses a five-point Likert scale that ranges from 0 to 4 (0 = not at all, 1 = slightly true, 2 = somewhat true, 3 = very true, and 4 = extremely true), with a 0–52 total score range. The Japanese version has been demonstrated to have good internal consistency (Cronbach's $\alpha = 0.83$), concurrent validity, test-retest reliability,²³ and predictive validity.²⁴ The experience of rescue activities in the 2024 Noto Peninsula earthquake was selected as the critical incident in the present study.

The demographic variables retrieved were sex, age, occupation, and years of occupational experience.

Statistical Analysis

We analyzed the dataset of participants who completed all questions of the questionnaire and experienced rescue activity in the 2024 Noto Peninsula earthquake. Univariate linear regression analysis was used to examine the association of psychological distress and PTSS with the experience of rescue activities and PDI. Multiple linear regression analysis was used to examine the association of psychological distress and PTSS with the experience of rescue activities in Model 1, and PDI was added as an independent variable in Model 2, adjusting for sex, age, and occupation (physicians: reference, nurses, other healthcare professionals, and medical office workers). Nurses, other healthcare professionals, and medical office workers were analyzed with physicians as a dummy variable for reference in the univariate linear regression and multiple regression analyses. In addition, univariate linear regression analysis was used to examine the association of psychological distress and PTSS with each PDI item. The normality of the K6, PCL-5, and PDI, which were used as the outcomes in the regression analysis, was confirmed, and they did not follow a normal distribution. For this reason, we confirmed the normality of the residuals in each regression analysis and found that there were no problems with the

normality of the residuals in any of the regression analyses, which confirms that the regression analysis in this study was acceptable. A quantile regression analysis was conducted as a sensitivity analysis of the main multiple regression analysis, with K6 and PCL-5 as the outcomes. Any association between the independent and dependent variables was shown as a regression coefficient (beta weight) and quantified by a 95% confidence interval (95% CI). All statistical analyses used 2-tailed tests. The statistical significance level was established at a *p* value of less than 0.05. All analyses were conducted using SPSS version 28.0 J for Windows (SPSS, Tokyo, Japan).

Results

Among 13,892 medical rescue workers, 1798 (12.9%) agreed to participate in this study, and 1085 participants experienced rescue activity in the 2024 Noto Peninsula earthquake and completed all questions. The mean age was 43.9 (SD = 8.8), 738 participants (68.0%) were men (Table 1). The mean score of K6 was 2.9 (SD = 3.8), and PCL-5 was 5.0 (SD = 8.8).

Univariate linear regression analysis showed that experiences of feeling a sense of danger when moving to the disaster area ($B = 1.12$, 95% CI 0.65–1.59; $p < 0.01$), feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area ($B = 1.35$, 95% CI 0.88–1.81; $p < 0.01$), experiences of feeling a sense of danger during rescue activities ($B = 1.46$, 95% CI 0.94–1.97; $p < 0.01$), experiences of feeling a sense of danger during moving in the disaster area ($B = 1.18$, 95% CI 0.70–1.66; $p < 0.01$), experiences of being overwhelmed by the tragic situation in the disaster area ($B = 2.49$, 95% CI 2.01–2.96; $p < 0.01$), experience of rescue activities while personally being affected by the disaster ($B = 2.80$, 95% CI 1.60–4.01; $p < 0.01$), experience of disagreement and conflict among rescuers during rescue activities ($B = 1.54$, 95% CI 1.08–1.99; $p < 0.01$), and PDI ($B = 0.33$, 95% CI 0.31–0.36; $p < 0.01$) were significantly and positively associated with psychological distress (Table 2). Univariate linear regression analysis also showed that experiences of feeling a sense of danger when moving to the disaster area ($B = 2.60$, 95% CI 1.54–3.67; $p < 0.01$), feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area ($B = 2.28$, 95% CI 1.22–3.35; $p < 0.01$), experiences of feeling a sense of danger during rescue activities ($B = 2.75$, 95% CI 1.57–3.92; $p < 0.01$), experiences of feeling a sense of danger during moving in the disaster area ($B = 3.06$, 95% CI 1.96–4.15; $p < 0.01$), experiences of being overwhelmed by the tragic situation in the disaster area ($B = 4.09$, 95% CI 2.99–5.20; $p < 0.01$), experience of rescue activities while personally being affected by the disaster ($B = 3.86$, 95% CI 1.10–6.63; $p < 0.01$), experience of disagreement and conflict among rescuers during rescue activities ($B = 3.73$, 95% CI 2.70–4.77; $p < 0.01$), and PDI ($B = 0.64$, 95% CI 0.57–0.70; $p < 0.01$) were significantly and positively associated with PTSS.

Multiple linear regression analysis of Model 1 showed that feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area ($B = 0.62$, 95% CI 0.01–0.34; $p = 0.04$), experiences of being overwhelmed by the tragic situation in the disaster area ($B = 2.06$, 95% CI 1.57–2.55; $p < 0.01$), experience of rescue activities while personally being affected by the disaster ($B = 1.83$, 95% CI 0.69–2.97; $p < 0.01$), and experience of disagreement and conflict among rescuers during rescue activities ($B = 1.27$, 95% CI 0.84–1.71; $p < 0.01$) were significantly and positively associated with psychological distress. In Model 2, experiences of being overwhelmed by the

Table 1. Participants' characteristics (N = 1085)

	n	%	mean	SD	Median	Range
Sex						
Male	738	68.0				
Female	347	32.0				
Age (years)			43.9	8.8	44.0	23–98
Occupational experience (years)			20.1	8.6	20.0	1–50
Occupation						
Physicians	249	22.9				
Nurses	449	41.4				
Other healthcare professionals	288	26.5				
Medical office workers	99	9.1				
Experiences of feeling a sense of danger when moving to the disaster area	410	37.8				
Feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area	413	38.1				
Experiences of feeling a sense of danger during rescue activities	284	26.2				
Experiences of feeling a sense of danger during moving in the disaster area	364	33.5				
Experiences of being overwhelmed by the tragic situation in the disaster area	334	30.8				
Experience of rescue activities while personally being affected by the disaster	40	3.7				
Experience of disagreement and conflict among rescuers during rescue activities	472	43.5				
PDI (range: 0–52)			9.5	7.1	8.0	0–44
K6 (range: 0–24)			2.9	3.8	1.0	0–24
PCL-5 (range: 0–80)			5.0	8.8	1.0	0–70

K6, Kessler 6; PCL-5, PTSD Checklist for DSM-5; PDI, Peritraumatic Distress Inventory; SD, standard deviation.

tragic situation in the disaster area ($B = 0.61$, 95% CI 0.17–1.05; $p < 0.01$), experience of disagreement and conflict among rescuers during rescue activities ($B = 0.51$, 95% CI 0.13–0.89; $p < 0.01$), and PDI ($B = 0.33$, 95% CI 0.30–0.36; $p < 0.01$) were significantly and positively associated with psychological distress.

Multiple linear regression analysis of Model 1 showed that experiences of being overwhelmed by the tragic situation in the disaster area ($B = 3.20$, 95% CI 2.04–4.36; $p < 0.01$) and the experience of disagreement and conflict among rescuers during rescue activities ($B = 3.23$, 95% CI 2.20–4.25; $p < 0.01$) were significantly and positively associated with PTSS. In Model 2, the experience of disagreement and conflict among rescuers during rescue activities ($B = 1.70$, 95% CI 0.77–2.64; $p < 0.01$) and PDI ($B = 0.65$, 95% CI 0.57–0.73; $p < 0.01$) were significantly and positively associated with PTSS.

As a result of quantile linear regression analysis, which is a sensitivity analysis, experiences of being overwhelmed by the tragic situation in the disaster area (coefficient = 0.53, 95% CI 0.21–0.86; $p < 0.01$), experience of rescue activities while personally being affected by the disaster (coefficient = 1.17, 95% CI 0.45–1.89; $p < 0.01$), experience of disagreement and conflict among rescuers during rescue activities (coefficient = 0.31, 95% CI 0.03–0.59; $p = 0.03$), and PDI (coefficient = 0.28, 95% CI 0.25–0.30; $p < 0.01$) were significantly and positively associated with psychological distress (Table 3). The experience of disagreement and conflict among rescuers during rescue activities (coefficient = 0.49, 95% CI 0.12–0.86; $p = 0.01$) and PDI (coefficient = 0.30, 95% CI 0.27–0.33; $p < 0.01$) were significantly and positively associated with PTSS.

As a result of univariate linear regression analysis with each PDI item, all the items of PDI were significantly associated with psychological distress and PTSS ($p < 0.01$) (Table 4).

Discussion

This cross-sectional study aimed to investigate the association between the experience of rescue activities in the 2024 Noto Peninsula earthquake and PTSS and psychological distress among medical rescue workers. The results of univariate linear regression analysis and multiple linear regression analysis showed that the experience of rescue activities in the 2024 Noto Peninsula earthquake and PDI were significantly associated with PTSS and psychological distress.

This study showed valuable findings for future study on the mental health of rescue workers, because, to the best of our knowledge, there have been no studies reporting on the related factors of the mental health of rescue workers who participated in rescue activities in the 2024 Noto Peninsula earthquake. Model 2 of the multiple regression analysis shows that the experience of disagreement and conflict among rescuers during rescue activities and peritraumatic distress as measured by the PDI were significantly and positively associated with psychological distress and PTSS, and the experience of being overwhelmed by the tragic situation in the disaster area was significantly associated with psychological distress. The sensitivity analysis using quantile regression analysis showed similar results to those of the multiple regression analysis, supporting these results. To the best of our knowledge, no previous studies have reported that the experience of disagreement and

Table 2. Results of univariate and multiple linear regression analysis in participants for K6 and PCL-5 (N = 1085)

Variables	Univariate linear regression			Multiple linear regression					
				Model 1			Model 2		
	B	95% CIs	p	B	95% CIs	p	B	95% CIs	p
Outcome: K6									
Experience of feeling a sense of danger when moving to the disaster area	1.12	0.65, 1.59	<0.01	0.13	−0.42, 0.67	0.65	−0.20	−0.66, 0.27	0.40
Feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area	1.35	0.88, 1.81	<0.01	0.62	0.15, 1.09	0.01	−0.48	−0.89, −0.07	0.02
Experience of feeling a sense of danger during rescue activities	1.46	0.94, 1.97	<0.01	0.37	−0.22, 0.95	0.22	−0.02	−0.52, 0.48	0.94
Experience of feeling a sense of danger during moving in the disaster area	1.18	0.70, 1.66	<0.01	0.09	−0.51, 0.68	0.78	−0.24	−0.75, 0.26	0.35
Experience of being overwhelmed by the tragic situation in the disaster area	2.49	2.01, 2.96	<0.01	2.06	1.57, 2.55	<0.01	0.61	0.17, 1.05	0.01
Experience of rescue activities while personally being affected by the disaster	2.80	1.60, 4.01	<0.01	1.83	0.69, 2.97	<0.01	0.74	−0.24, 1.71	0.14
Experience of disagreement and conflict among rescuers during rescue activities	1.54	1.08, 1.99	<0.01	1.27	0.84, 1.71	<0.01	0.51	0.13, 0.89	0.01
Age	−0.04	−0.07, −0.02	<0.01	−0.04	−0.07, −0.02	<0.01	−0.02	−0.05, 0.00	0.04
Sex: women (Reference: men)	−0.20	−0.69, 0.29	0.43	−0.04	−0.58, 0.51	0.89	−0.22	−0.68, 0.25	0.36
Occupation: nurses (Reference: physician)	0.08	−0.38, 0.55	0.73	−0.18	−0.82, 0.46	0.59	−0.40	−0.95, 0.15	0.15
Occupation: other healthcare professionals (Reference: physician)	−0.08	−0.60, 0.44	0.76	−0.30	−0.94, 0.35	0.37	−0.13	−0.68, 0.42	0.63
Occupation: medical office worker (Reference: physician)	0.03	−0.77, 0.82	0.94	0.18	−0.67, 1.03	0.68	0.09	−0.63, 0.81	0.81
PDI	0.33	0.31, 0.36	<0.01				0.33	0.30, 0.36	<0.01
R-squared					0.14			0.39	
Outcome: PCL-5									
Experience of feeling a sense of danger when moving to the disaster area	2.60	1.54, 3.67	<0.01	0.53	−0.75, 1.80	0.42	−0.12	−1.26, 1.03	0.84
Feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area	2.28	1.22, 3.35	<0.01	0.68	−0.42, 1.78	0.22	−1.52	−2.53, −0.50	<0.01
Experience of feeling a sense of danger during rescue activities	2.75	1.57, 3.92	<0.01	0.23	−1.15, 1.61	0.74	−0.53	−1.77, 0.70	0.40
Experience of feeling a sense of danger during moving in the disaster area	3.06	1.96, 4.15	<0.01	1.33	−0.06, 2.72	0.06	0.68	−0.57, 1.93	0.28
Experience of being overwhelmed by the tragic situation in the disaster area	4.09	2.99, 5.20	<0.01	3.20	2.04, 4.36	<0.01	0.32	−0.77, 1.41	0.57
Experience of rescue activities while personally being affected by the disaster	3.86	1.10, 6.63	<0.01	2.22	−0.45, 4.90	0.10	0.04	−2.36, 2.45	0.37
Experience of disagreement and conflict among rescuers during rescue activities	3.73	2.70, 4.77	<0.01	3.23	2.20, 4.25	<0.01	1.70	0.77, 2.64	<0.01
Age	−0.03	−0.09, 0.03	0.33	−0.03	−0.09, 0.03	0.31	0.01	−0.05, 0.06	0.78
Sex: women (Reference: men)	−0.82	−1.94, 0.30	0.15	−0.18	−1.46, 1.11	0.79	−0.54	−1.68, 0.61	0.36
Occupation: nurses (Reference: physician)	−0.35	−1.41, 0.72	0.52	−0.83	−2.35, 0.68	0.28	−1.27	−2.63, 0.09	0.06
Occupation: other healthcare professionals (Reference: physician)	−0.27	−1.46, 0.91	0.65	−0.90	−2.42, 0.62	0.24	−0.58	−1.94, 0.78	0.40
Occupation: medical office worker (Reference: physician)	−0.19	−2.01, 1.62	0.83	−0.36	−2.35, 1.63	0.72	−0.54	−2.32, 1.23	0.55
PDI	0.64	0.57, 0.70	<0.01				0.65	0.57, 0.73	<0.01
R-squared					0.09			0.28	

CI, Confidence interval; K6, Kessler 6; PCL-5, PTSD Checklist for DSM-5; PDI, Peritraumatic Distress Inventory.

Table 3. Results of quantile linear regression analysis in participants for K6 and PCL-5 (N = 1085)

Variables	Outcome: K6			Outcome: PCL-5		
	P ₅₀			P ₅₀		
	Coefficient	95% CIs	p	Coefficient	95% CIs	p
Outcome: K6						
Experience of feeling a sense of danger when moving to the disaster area	−0.01	−0.35, 0.34	0.96	0.19	−0.26, 0.64	0.41
Feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area	−0.41	−0.72, −0.11	0.01	−0.27	−0.67, 0.14	0.19
Experience of feeling a sense of danger during rescue activities	−0.07	−0.44, 0.30	0.72	0.12	−0.38, 0.61	0.65
Experience of feeling a sense of danger during moving in the disaster area	−0.14	−0.51, 0.24	0.48	0.24	−0.26, 0.73	0.35
Experience of being overwhelmed by the tragic situation in the disaster area	0.53	0.21, 0.86	<0.01	0.38	−0.06, 0.81	0.09
Experience of rescue activities while personally being affected by the disaster	1.17	0.45, 1.89	<0.01	0.83	−0.12, 1.78	0.09
Experience of disagreement and conflict among rescuers during rescue activities	0.31	0.03, 0.59	0.03	0.49	0.12, 0.86	0.01
Age	−0.01	−0.03, 0.01	0.20	0.01	−0.02, 0.03	0.65
Sex: women (Reference: men)	−0.11	−0.46, 0.23	0.52	0.62	0.16, 1.07	<0.01
Occupation: nurses (Reference: physician)	−0.40	−0.81, 0.01	0.05	−0.81	−1.35, −0.28	<0.01
Occupation: other healthcare professionals (Reference: physician)	−0.04	−0.45, 0.37	0.85	−0.34	−0.88, 0.20	0.21
Occupation: medical office worker (Reference: physician)	−0.14	−0.67, 0.40	0.61	−0.47	−1.17, 0.24	0.19
PDI	0.28	0.25, 0.30	<0.01	0.30	0.27, 0.33	<0.01

CI, Confidence interval; K6, Kessler 6; PCL-5, PTSD Checklist for DSM-5; PDI, Peritraumatic Distress Inventory.

Table 4. Results of univariate regression analysis of each PDI item in participants (N = 1085)

Item description	Outcome: K6			Outcome: PCL-5		
	B	95%CI	p	B	95%CI	p
1. I felt helpless to do more	1.84	1.65, 2.04	<0.001	3.37	2.89, 3.84	<0.001
2. I felt sadness and grief	1.71	1.52, 1.90	<0.001	3.23	2.78, 3.68	<0.001
3. I felt frustrated or angry I could not do more	1.69	1.50, 1.88	<0.001	3.44	2.98, 3.89	<0.001
4. I felt afraid of my safety	1.24	1.01, 1.47	<0.001	2.44	1.90, 2.98	<0.001
5. I felt guilt that more was not done	1.40	1.23, 1.58	<0.001	2.49	2.07, 2.91	<0.001
6. I felt ashamed of my emotional reactions	1.75	1.48, 2.03	<0.001	3.63	2.99, 4.26	<0.001
7. I felt worried about the safety of others	0.90	0.72, 1.08	<0.001	1.63	1.21, 2.04	<0.001
8. I had the feeling I was about to lose control of my emotions	2.50	2.20, 2.81	<0.001	5.52	4.82, 6.21	<0.001
9. I had difficulty controlling my bowel and bladder	1.17	0.64, 1.71	<0.001	2.42	1.19, 3.65	<0.001
10. I was horrified by what happened	0.86	0.69, 1.03	<0.001	1.42	1.01, 1.82	<0.001
11. I had physical reactions like sweating, shaking, and pounding heart	2.32	2.06, 2.58	<0.001	4.47	3.86, 5.09	<0.001
12. I felt might pass out	3.79	3.15, 4.43	<0.001	8.11	6.64, 9.58	<0.001
13. I felt might die	1.79	1.47, 2.12	<0.001	3.89	3.14, 4.64	<0.001

CI, Confidence interval; K6, Kessler 6; PCL-5, PTSD Checklist for DSM-5; PDI, Peritraumatic Distress Inventory.

conflict among rescuers during rescue activities is related to the mental health of medical rescue workers, which is an important finding of this study. It has been reported that interpersonal conflict and disagreement in the workplace are risk factors for mental health among healthcare workers,²⁵ and this study supports that interpersonal conflict and disagreement are also risk factors for psychological distress and PTSS among medical rescue workers during rescue activities. Rescue workers often provide medical assistance

in the wake of disasters where people are seriously injured in tragic circumstances, so there is a high probability that they experience interpersonal conflicts and disagreements due to the characteristics of their work. Therefore, it is necessary to take measures to prevent them from experiencing interpersonal conflicts and disagreements during rescue activities and to provide mental health screening and mental health care after rescue activities for those who have had such experiences. Since it may be difficult for individuals to deal

with interpersonal conflicts and disagreements during rescue activities on their own, it is necessary for organizations to take measures and create manuals and rules to prevent such interpersonal conflicts and disagreements during rescue activities from occurring. In addition, the fact that experience of being overwhelmed by the tragic situation in the disaster area was significantly associated with the mental health of medical rescue workers is consistent with previous studies that reported an association between the severity of the disaster area and mental health.^{9,26–28} While previous studies have shown an association between objective indicators of the severity of rescue sites, such as disaster areas, and mental health, this study showed an association between the subjective experience of being overwhelmed by the tragic situation in the disaster area and psychological distress. Future research investigating the association between the severity of rescue activity sites and mental health should also measure the severity of the activity sites from the subjective perspective of the medical rescue workers, in addition to using objective indicators.

Peritraumatic distress, as measured by the PDI, was significantly and positively associated with psychological distress and PTSS, which was consistent with previous studies among rescue workers who participated in the Great East Japan earthquake and those who responded to COVID-19-related activities outside of hospitals.^{4,12} The PDI was reported to be an important screening factor for medical rescue workers at risk for developing PTSS.¹² Because PDI was also significantly associated with PTSS and psychological distress among medical rescue workers in this study who participated in the 2024 Noto Peninsula earthquake rescue activities, it was thought that PDI would be a valuable measure for screening the mental health of medical rescue workers immediately after rescue activities. In addition, as a result of univariate linear regression analysis with each PDI item, “I felt I might pass out,” “I had the feeling I was about to lose control of my emotions,” and “I had physical reactions like sweating, shaking, and pounding heart” showed particularly high unstandardized regression coefficients for psychological distress and PTSS. When this result was compared with previous studies that reported the association between each PDI item and PTSS, the results were generally the same as those of medical rescue workers who participated in the Great East Japan Earthquake rescue activities,¹² but differed from the results of studies of medical rescue workers who responded to COVID-19-related activities outside of hospitals and accident survivors.^{4,29} The previous study of medical rescue workers who responded to COVID-19-related activities outside was conducted at the same time as this study, targeting Japanese DMAT members within a few months after the activities.⁴ In this previous study, medical rescue workers belonging to Japan’s DMAT conducted rescue activities such as treating and transporting COVID-19 patients outside hospitals, including on cruise ships where COVID-19 outbreaks occurred, during the early stages of the COVID-19 outbreak in Japan. Accordingly, it has been reported that the job content of COVID-19 rescue activities differed from that of rescue activities for natural disasters such as earthquakes. This suggests that the events that cause peritraumatic distress differ between earthquake rescue activities and COVID-19 rescue activities. Among the PDI items, “I felt I might pass out,” “I had the feeling I was about to lose control of my emotions,” and “I had physical reactions like sweating, shaking, and pounding heart” showed particularly high unstandardized regression coefficients in PTSS and psychological distress in medical rescue workers who participated in large-scale earthquake rescue activities, and it is necessary to pay attention to these items and check for mental health problems in medical rescue

workers with high scores in these items after large-scale earthquake rescue activities. The accumulation of studies on the association between each PDI item and mental health in each traumatic event, such as the type of disaster, has the possibility of contributing to a detailed understanding of the mental health of medical rescue workers, and further studies are needed.

Because no other studies have reported on the factors related to the mental health of rescue workers who participated in rescue activities in the 2024 Noto Peninsula earthquake, the results of the univariate linear regression analysis are also valuable findings for future studies on the mental health of rescue workers. The experiences of feeling a sense of danger during rescue activities, feeling a sense of danger when moving to the disaster area, and feeling a sense of danger while moving in the disaster area were significantly associated with psychological distress and PTSS. The result that the experience of feeling a sense of danger during rescue activities was significantly associated with mental health is consistent with previous studies,^{9,30} and this study added that feeling a sense of danger when moving to the disaster area and experience of feeling a sense of danger during moving in the disaster area are also associated with psychological distress and PTSS. Feelings of frustration and inadequacy due to the inability to fully carry out rescue activities because of the difficulty of moving to the disaster area were also significantly associated with psychological distress and PTSS. Thus, it is important for the mental health of medical rescue workers to ensure safety in how they move to disaster areas and minimize any time loss so that they can carry out sufficient rescue activities. In addition, the result that the experience of rescue activities while being personally affected by the disaster was significantly associated with mental health is consistent with previous studies.^{31,32} It is necessary for the national and local governments to make preparations in advance so that medical rescue workers who have not been affected by a disaster can provide rescue services in the event of a major disaster, rather than those who have been affected by the disaster. It is also necessary to screen for mental health problems after medical rescue workers who have been affected by a disaster participate in rescue activity. Screening medical rescue workers who have experience of rescue activities, which are the independent variable in this study, for mental health problems after the rescue activities and providing mental health support when necessary may prevent the long-term deterioration of mental health among medical rescue workers.

Limitations

This study has some limitations. First, although the independent variables were selected based on related factors associated with mental health in previous studies among medical rescue workers exposed to rescue activities and our interview with DMAT members who experienced rescue activities in the 2024 Noto Peninsula earthquake, the independent variables measured in this study may not measure all the participants’ experiences of rescue activities in the earthquake. There is a possibility that the participants may have had experiences related to their mental health in the 2024 Noto Peninsula earthquake rescue activities that were not measured in this study. Therefore, it is necessary to conduct research on the association between the experiences in rescue activity that were not measured in this study and the frequency of rescue activities experienced and mental health in order to improve the mental health of medical rescue workers. In addition, because this study asked about their experiences using a two-point scale (yes or no), the frequency of these experiences could not be measured. To the best of our knowledge, there are no validated scales that can

measure these independent variables, so we used original single-question items to measure each experience. Participants were asked about these experiences without being given clear operational definitions, so the experiences that participants recalled from these questions may vary individually. Additionally, as the experiences and mental health conditions of medical rescue workers vary from person to person during rescue activities, conducting qualitative studies, such as interviews, will provide a deeper understanding of these workers' mental health and activities in the future. Second, the response rate was low, which may limit the external validity of this study. Non-responders could be too stressed to respond or not at all stressed and, therefore, not interested in this survey. The recruitment method and the fact that some non-participants may not have seen the email could also be a reason for the low response rate. The low response rate in this study may have limited the generalizability of the findings among medical rescue workers. Although this study surveyed medical rescue workers belonging to DMAT, one of Japan's major medical rescue worker teams, and recruited participants from all over Japan, the low response rate may have introduced bias into the study population, which may have affected the results. Third, the R squared of multiple linear regression analysis in the adjusted model was low in this study. Fourth, the effects of the timing of the survey may be one of the limitations of this study. DMAT members were engaged in main rescue activities from immediately after the January 1, 2024, Noto Peninsula earthquake until early March 2024. The survey was conducted from March 8 to March 31, 2024, after the DMAT members had ended their main rescue activities. Therefore, the timing when the participants in this study participated in rescue activities and the period between the rescue activities and their responses to this study may vary from person to person. For this reason, it is possible that the psychological distress and PTSS of the participants changed depending on when they responded to this study, which may have affected the results. Finally, this study was cross-sectional, and the causality cannot be clarified. It is necessary to conduct a longitudinal survey with a higher response rate in the future.

Conclusions

This cross-sectional study showed that the experience of rescue activities in the 2024 Noto Peninsula earthquake and PDI were significantly associated with PTSS and psychological distress. This study indicated the need for countermeasures for factors associated with PTSS and psychological distress in the 2024 Noto Peninsula earthquake and mental health support for medical rescue workers who experienced these factors, which was an important finding for future research on the mental health of medical rescue workers.

Authors' Contribution. DN was in charge of this study, supervising the process and providing his expert opinion. HA and DN conceived and designed the study. HA, YKo, YKa, MI, YM, and DN contributed to creating questionnaires. YKa recruited the participants. HA and DN developed the analysis plan. YKo managed the enrolment procedure and overall control of the study. HA wrote the first draft of the manuscript, and all other authors revised the manuscript critically. All authors approved the final version of the manuscript.

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