

# Association between probable posttraumatic stress disorder and quality of life in emergency service workers: a mediation analysis using a third potential model with both in parallel and in series effects; a cross-sectional study

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## Research

**Keywords:** emergency service worker, posttraumatic stress disorder, quality of life, stress-coping, social support, resilience, mediation analysis, Bayesian inference method

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# Abstract

## Background

The present study used a third potential model with both in parallel and in series effects to identify mediators influencing the association between probable posttraumatic stress disorder (PTSD) and quality of life (QOL). In addition, we sought to clarify how stress-coping behaviors influence components of QOL.

## Methods

Participants were 220 emergency service workers. PTSD was assessed using the Impact of Event Scale-Revised (IES-R). QOL was assessed using the MOS 36-Item Short-Form Health Survey (SF-36). Mediation analysis and moderated mediation analysis of interaction effects with a third potential model were used to examine the effects of stress-coping (Brief COPE scores), social support (Multidimensional Scale of Perceived Social Support [MSPSS] scores), and resilience (Connor-Davidson Resilience Scale [CD-RISC] scores) on the association between probable PTSD and QOL.

## Results

The mediation analysis with confounders suggested an acceptable model fit. The moderated mediation analysis did not indicate differences in the moderators. IES-R scores were significantly positively associated with Active coping, Venting, and Positive reframing in Brief COPE scores and were significantly negatively associated with MSPSS scores. Active coping, Venting, and Positive reframing in Brief COPE and MSPSS scores was significantly positively associated with CD-RISC scores, which were significantly positively associated with SF-36 scores. A sensitivity analysis comparing the results between the full information maximum likelihood method and the list-wise deletion method indicated that the 95% confidence interval included zero and a good model fit was not maintained for indices of coping strategies in Venting and Positive reframing in Brief COPE scores.

## Conclusions

Active coping in response to stressful situations is an important behavior for maintaining good mental health among emergency service workers. In addition, Active coping in stress-coping and social support may have strengthened participants' resilience, and resilience may have improved QOL. However, Positive reframing and Venting might have confounded the results because they exhibited a Not Missing At Random data distribution. Screening of mental health and QOL should include simultaneous assessment of stress-coping, social support, and resilience. Although the present findings are suggestive, because this was a cross-sectional study, causal relationships between PTSD and QOL mediated by three mediators could not be confirmed.

# Background

Emergency service workers, such as firefighters, emergency medical technicians (EMT), and military personnel, tend to have highly stressful occupations because they are commonly faced with fatalities in accidents or disasters [1–3] and dangerous environments (e.g., extremely high temperatures, poisonous dust, fire, and collapsing buildings) [4–7]. Previous studies have reported that emergency service workers often experience stress symptoms and negative mental health outcomes [8–11]. There is evidence that the stressors experienced by emergency service workers can cause mental disorders such as depression, anxiety, and posttraumatic stress disorder (PTSD) [2, 12, 13]. Factors that have been proposed to affect PTSD symptoms include age, sex, education, length of employment in emergency service work, lack of continuous psychological care, exposure to human remains, stress-coping, social support, and resilience [14–21]. The above factors may influence the association between quality of life (QOL) and PTSD among rescue workers. A previous study investigating the harmful effects of PTSD on firefighters indicated that reduced QOL was associated with PTSD [22]. QOL is an important concept for understanding the mental and physical health of workers. QOL is defined by the World Health Organization as “individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” [23]. Most previous studies of QOL have been based on this definition [24]. There has been a substantial amount of research on health-related QOL, and several studies on QOL among emergency service workers have indicated the importance of assessing QOL. Schnurr et al. reported that war veterans with mental disorders exhibited lower QOL [25]. Another study reported that non-emergency service worker retirees exhibited better mental health scores on a QOL measure compared with emergency service worker retirees [26]. A similar study by Bartlett et al. reported that emergency service workers experienced sleep disturbance caused by their work [27], and that QOL was related to sleep disturbance [22]. In addition, some research suggests that stress-coping, social support, and resilience are associated with QOL. Nachar et al. reported that stress-coping and social support predicted QOL in a clinical sample with PTSD [28]. Connor et al. argued that resilience is an important aspect of mental health state [29], and some studies have reported that resilience affects QOL in participants with mental disorders [30–32].

Owing to job-related stressors, emergency service workers may be particularly likely to experience mental disorders affecting their daily lives. To the best of our knowledge, few previous studies have simultaneously examined the relationships between stress-coping, social support, and resilience related to QOL in emergency service workers who rescue victims from fires, traffic accidents, and earthquakes. There are likely to be complex associations between QOL and other factors. Therefore, further research is needed to understand how various factors affect QOL in emergency service workers.

Previous studies have indicated that stress-coping, social support, and resilience mediate QOL in firefighters, clinical patients, and disaster victims with PTSD, respectively [28, 33, 34]. The factors of stress-coping, social support, and resilience are also related, and there is evidence that resilience is associated with stress-coping and social support [35, 36]. Based on findings from a previous study, we hypothesized the existence of several associations between factors of probable PTSD and QOL, as shown in Fig. 1 [28, 33–36]. We hypothesized that probable PTSD would be mediated in parallel by stress-coping and social support, and, in turn, these factors would be mediated in series by resilience to the effects on QOL among emergency service workers.

In Japan, because there is little mental health support for emergency service workers, most workers are required to individually manage any mental distress that arises from their work [37]. Therefore, it is necessary to identify methods to mitigate the lower QOL associated with PTSD among emergency service workers in Japan. The current study aimed to identify the mediating effects of stress-coping, social support, and resilience (and other confounding factors) on QOL scores using models with in parallel or in series effects. Specifically, we sought to examine each subscale in stress-coping to elucidate whether different types of stress-coping behaviors exert different influences on QOL among rescue workers.

## Methods

### Aim, design, and setting of the study

The present study aimed to identify mediators influencing the association between probable PTSD and QOL and to determine how stress-coping behaviors influence components of QOL in a mediation model.

A multi-center cross-sectional survey was conducted at fire stations in Japan. Participants were between 20 and 65 years old. All participants were firefighters or emergency medical technicians. A questionnaire was sent to 373 participants, 220 of whom returned completed scales (response rate = 58.9%). This research was carried out with the permission of the fire departments involved. Recruitment started in April 2015 and was completed in August 2015. Ethical approval was granted by the Clinical Research Ethics Committee of Chiba University, Japan (approval number 1731). All participants provided informed consent by post.

### Predictor variables:

The Impact of Event Scale-Revised (IES-R) scale is the most commonly used measure for screening emergency service workers for mental health problems [38–42]. The IES-R has a three-factor structure (eight items assessing intrusion, eight items assessing avoidance, and six items assessing hyperarousal). The scale was developed by Weiss to assess probable PTSD among individuals suffering from severe stressors [41]. A previous study indicated that the intrusion and hyperarousal subscales exhibited a good fit with the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition criteria developed by the American Psychiatric Association, whereas the avoidance subscale did not [43]. Importantly, the measure can distinguish between individuals with or without PTSD [43].

IES-R item responses occur on a five-point rating scale (0 = “not at all”, 1 = “a little bit”, 2 = “moderately”, 3 = “quite a bit”, and 4 = “extremely”). The cut-off value is 24 out of a maximum of 88 points. IES-R scores above 24 indicate probable PTSD [38]. We used total continuous scores of IES-R.

### Mediating variables:

The Brief COPE inventory measures how often individuals use different coping strategies to handle difficult situations [44]. The Brief COPE inventory comprises 14 factors with two items each (Self-distraction, Active coping, Denial, Substance use, Using emotional support, Using instrumental support, Behavioral disengagement, Venting, Positive reframing, Planning, Humor, Acceptance, Religion, and Self-blame). Responses are made using a four-point rating scale (1 = “I haven’t been doing this at all”, 2 = “I’ve been doing this a little bit”, 3 = “I’ve been doing this a moderate amount”, 4 = “I’ve been doing this a lot”). Higher scores indicate the use of many coping methods. We included each subscale of the scale in the analyses.

The Multidimensional Scale of Perceived Social Support (MSPSS) measures perceptions of support from three sources: family, friends, and significant others [45]. Responses are given using a seven-point rating scale (1 = “very strongly disagree,” 2 = “strongly disagree,” 3 = “mildly disagree,” 4 = “neutral,” 5 = “mildly agree,” 6 = “strongly agree,” 7 = “very strongly agree”). Higher scores indicate a greater amount of support.

The Connor-Davidson Resilience Scale (CD-RISC) screens people for high, intermediate, or low resilience. This scale comprises 25 items rated on a five-point scale (0 = “not true at all,” 1 = “rarely true,” 2 = “sometimes true,” 3 = “often true,” and 4 = “true nearly all of the time”) [29]. Higher scores indicate greater resilience.

### Outcome variables:

The MOS 36-Item Short-Form Health Survey (SF-36) [46] is frequently used to screen participants for health-related QOL issues. The SF-36 contains eight factors (physical functioning, role limitations due to physical health, role limitations due to emotional problems, vitality, mental health, social functioning, bodily pain, and general health) and two composite scores (a physical component score and a mental component score). The SF-36 measures general health status, and high scores indicate better QOL. A previous study analyzed the validity of the Japanese version of the SF-36, revealing three components: the Mental Component Summary (MCS), Physical Component Summary (PCS), and Role/social Component Summary (RCS) [47]. To summarize the items for the three components, we used an online scoring service for the SF-36.

### Analysis

We conducted three steps of analysis. First, descriptive data for participant characteristics and measures were compared using the Wilcoxon rank-sum test or chi-square test. Correlations between scores on each measure were analyzed using Spearman’s correlation analysis. In this analysis method, values of 0.90–1.00 indicate a very high correlation, values of 0.70–0.90 indicate a high correlation, values of 0.50–0.70 indicate a moderate correlation, values of 0.30–0.50 indicate a low correlation, and values of 0.00–0.30 indicate a very low correlation or no correlation [47]. Second, to examine the univariate associations [48, 49], we analyzed the associations between scores on the IES-R, the Brief COPE, the MSPSS, the CD-RISC, and the SF-36, using a linear regression model. Finally, we conducted a moderated mediation analysis using a multiple mediator model to examine the mediation pathways as a path model for the above measures. In the moderated mediation analysis, factors such as age and length of employment are potential moderator variables if the interaction effect

(independent variable  $\times$  moderator variable) is significant [50]. In the current study, the moderators were not significant. Therefore, the confounding factors controlled in the mediation analysis were: age, length of employment, and education. Partial mediation was assumed if the mediation path model produced a significant direct effect [51]. Complete mediation was assumed if the mediation path model did not produce a significant direct effect [51]. The total effect is the sum of the direct effect and the total indirect effect. That is, the effect of PTSD (IES-R scores) on QOL (SF-36 scores) was mediated by coping (Brief COPE scores), support (MSPSS scores), and resilience (CD-RISC scores). A Bayesian inference method was used for the mediation analysis. The Bayesian method of estimation is suitable for use with small samples and non-normal distributions [52], and the results can be analyzed using new computational algorithms called Markov chain Monte Carlo algorithms [53]. Model fit indices were evaluated using the posterior predictive p-value (PPP), the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). A low PPP value is considered to indicate a poor model fit [53, 54]. Following Cain et al., a cut-off value of PPP < .10 was used to determine whether the model should be rejected [55]. The model fit indices of CFI and TLI values of > 0.95 indicated an acceptable fit to the data, and an RMSEA value < 0.08 indicated an acceptable fit [56, 57].

The normality of variables was assessed using probability–probability plots and the Shapiro-Wilk test, and the homogeneity of variance was assessed using Levene's test. As the normality and homogeneity of variance assumptions were violated, non-parametric statistical tests were used.

Missing values were handled using the full information maximum likelihood (FIML) method. This approach presupposes that data were missing completely at random or missing at random. Thus, if data were missing in a non-random way, the results might be misinterpreted. To address this issue, we conducted a sensitivity analysis using re-examined data with a list-wise deletion method [58]. We conducted the linear regression, moderation, and mediation analysis using Mplus, version 8.4 (Muthén & Muthén, Los Angeles, CA, USA). Other analyses were conducted using Stata, version 13 (Stata Corp LP, College Station, TX, USA).

## Results

### Participants' characteristics

This study used a cross-sectional design. Questionnaires were sent to 373 participants, 220 of whom returned responses. All participants were male. Less than 2% of participants had missing data on the SF-36 and the CD-RISC, and less than 10% had missing data on any of the confounding factors. Table 1 shows participant demographic characteristics by IES-R scores. The IES-R scores indicated that a quarter of participants had probable PTSD (IES-R score  $\geq$  25). There were significant differences in probable PTSD indicated by CD-RISC scores, subscales of the Brief COPE scale (Self-distraction, Denial, Emotional support, Behavioral disengagement, Religion, and Self-blame), and MCS in SF-36 scores. Half of the participants were between 30 and 39 years of age. Most participants had worked at the fire station for longer than 10 years.

Table 1  
Demographic characteristics of Japanese emergency service workers

		N = 220			IES-R ≤ 24 (N = 165)			IES-R ≥ 25 (N = 55)			
Variables		Mean	SD	%	Mean	SD	%	Mean	SD	%	P
Age, y	Total	39.12	7.61	99.1	39.17	7.30		38.98	8.51		.520
	18–29			8.2							
	30–39			48.2							
	40–49			33.2							
	> 50			9.5							
Education	High school	113		51.4	81		37.2	32		14.5	.280
	Above college	105		47.7	82		37.3	23		10.5	
Period of employment, y		17.98	8.18	98.6	18.07	7.98		17.71	8.81		.600
MSPSS		70.19	10.82	100.0	71.26	10.47		66.96	11.31		.117
CD-RISC		58.76	17.25	99.5	59.63	18.37		56.13	13.13		< .010
Brief COPE											
Self-distraction		4.21	1.39		3.97	1.38		4.96	1.13		< .001
Active coping		5.43	1.37		5.36	1.46		5.65	1.04		.276
Denial		2.58	0.93		2.42	0.76		3.05	1.19		< .001
Substance use		3.52	1.68		3.42	1.62		3.84	1.82		.167
Emotional support		4.26	1.35		4.10	1.38		4.76	1.13		< .001
Instrumental support		4.69	1.55		4.62	1.60		4.93	1.36		.141
Behavioral disengagement		3.32	1.17		3.12	1.04		3.94	1.32		< .001
Venting		4.27	1.37		4.18	1.33		4.56	1.46		.088
Positive reframing		4.87	1.32		4.77	1.40		5.17	0.95		.060
Planning		5.53	1.45		5.46	1.56		5.74	1.04		.393
Humor		3.96	1.37		3.99	1.38		3.85	1.32		.522
Acceptance		5.62	1.44		5.57	1.53		5.78	1.09		.721
Religion		2.93	1.18		2.77	1.11		3.43	1.27		< .001
Self-blame		3.95	1.45		3.68	1.37		4.74	1.42		< .001
SF-36											
	MCS	55.56	8.78		57.0	8.59		51.31	7.97		< .001
	PCS	54.24	7.42		54.73	7.33		52.83	7.56		.027
	RCS	49.07	7.57		49.48	6.67		47.90	9.73		.587
Abbreviations: IES-R, the Impact of Event Scale-Revised; MSPSS, Multidimensional Scale of Perceived Social Support; CD-RISC Connor-Davidson Resilience Scale; SF-36, the MOS 36-Item Short-Form Health Survey; MCS, Mental Component Summary; PCS, Physical Component Summary; RCS, Role/social Component Summary; SD, Standard Deviation.											
*p < .05; **p < .01; ***p < .001.											

#### Correlations between each measure

Table 2 shows the correlations between each measure. There was a significant negative correlation between IES-R scores and summary scores in SF-36 (MCS:  $r = -0.28$ ,  $p < .001$ ; PCS:  $r = -0.14$ ,  $p < .005$ ). There was a significant positive correlation between IES-R scores and subscale scores in the Brief COPE (Self-distraction:  $r = 0.29$ ,  $p < .001$ ; Denial:  $r = 0.30$ ,  $p < .001$ ; Emotional support:  $r = 0.23$ ,  $p < .01$ ; Behavioral disengagement:  $r = 0.28$ ,  $p < .001$ ; Positive reframing:  $r = 0.14$ ,  $p < .005$ ; Religion:  $r = 0.27$ ,  $p < .01$ ; Self-blame:  $r = 0.31$ ,  $p < .001$ ). In contrast, there was a significant negative association between IES-R scores and MSPSS scores ( $r = -0.19$ ,  $p < .01$ ). CD-RISC scores were significantly positively correlated with seven subscale scores of the Brief COPE (Active coping:  $r = 0.24$ ,  $p < .001$ ; Instrumental support:  $r = 0.16$ ,  $p < .05$ ; Venting:  $r = 0.16$ ,  $p < .05$ ; Positive reframing:  $r = 0.30$ ,  $p < .001$ ; Planning:  $r = 0.36$ ,  $p < .001$ ; Humor:  $r = 0.22$ ,  $p < .01$ ; Acceptance:  $r = 0.19$ ,  $p < .01$ ) and MSPSS ( $r = 0.35$ ,  $p < .001$ ), whereas three subscales were significantly negatively associated with CD-RISC scores (Denial:  $r = -0.20$ ,  $p < .001$ ; Behavioral disengagement:  $r = -0.29$ ,  $p < .001$ ; Self-blame:  $r = -0.17$ ,  $p < .05$ ). CD-RISC scores exhibited a significant but relatively weak positive correlation with summary scores in the SF-36 (MCS:  $r = 0.38$ ,  $p < .001$ ).

Table 2  
Spearman's correlations between IES-R, SF-36, Brief COPE, MSPSS, and CD-RISC scores

		IES-R	p	SF-36						MSPSS	p	CD-RISC	p
				MCS	p	PCS	p	RCS	p				
IES-R		1											
SF-36	MCS	-0.28	***	1									
	PCS	-0.14	*	0.07		1							
	RCS	-0.05		-0.12		-0.31	***	1					
MSPSS		-0.19	**	0.43	***	0.15	*	-0.03		1			
CD-RISC		-0.15	*	0.38	***	0.13		0.07		0.35	***	1	
Brief-COPE	Self-distraction	0.29	***	-0.30	***	-0.11		-0.00		-0.14	*	-0.04	
	Active coping	0.06		-0.09		-0.03		0.02		0.06		0.24	***
	Denial	0.30	***	-0.14	*	-0.07		-0.09		-0.15	*	-0.20	**
	Substance use	0.09		-0.16	**	-0.08		-0.01		-0.16	*	-0.09	
	Emotional support	0.23	**	-0.19	**	-0.04		-0.07		0.12		0.06	
	Instrumental support	0.09		-0.08		0.02		0.03		0.16	*	0.16	*
	Behavioral disengagement	0.28	***	-0.27	***	-0.21	**	-0.04		-0.26	***	-0.29	***
	Venting	0.13		0.01		-0.05		0.03		0.10		0.16	*
	Positive reframing	0.14	*	-0.02		0.05		-0.06		0.07		0.30	***
	Planning	0.05		-0.01		0.02		0.05		0.15	*	0.36	***
	Humor	-0.03		0.07		-0.04		0.01		0.06		0.22	**
	Acceptance	0.02		0.02		0.04		0.02		0.05		0.19	**
	Religion	0.27	**	-0.20	**	-0.07		0.06		-0.13		-0.05	
	Self-blame	0.31	***	-0.35	***	-0.13		-0.06		-0.14	*	-0.17	*
Abbreviations: IES-R, the Impact of Event Scale-Revised; SF-36, the MOS 36-Item Short-Form Health Survey; MCS, Mental Component Summary; PCS, Physical Component Summary; RCS, Role/social Component Summary; MSPSS, Multidimensional Scale of Perceived Social Support; CD-RISC Connor-Davidson Resilience Scale.													
*p < .05; **p < .01; ***p < .001.													

Linear regression models of participant characteristics adjusted for confounding factors

Table 3 shows the results of linear regression analyses between IES-R scores, MCS scores in SF-36, subscale scores in the Brief COPE, and MSPSS scores. The analyses revealed the following associations: There was a significant negative association between IES-R scores and MCS scores in the SF-36 ( $\beta = -0.234$ , 95% confidence interval (CI) =  $-0.323$  to  $-0.147$ ,  $p < .001$ ); IES-R scores were significantly associated with subscale scores in the Brief COPE (Active coping:  $\beta = 0.020$ , 95% CI =  $0.006$  to  $0.034$ ,  $p < .001$ ; Behavioral disengagement:  $\beta = 0.038$ , 95% CI =  $0.027$  to  $0.049$ ,  $p < .001$ ; Venting:  $\beta = 0.015$ , 95% CI =  $0.001$  to  $0.030$ ,  $p < .05$ ; Positive reframing:  $\beta = 0.021$ , 95% CI =  $0.007$  to  $0.035$ ,  $p < .01$ ); IES-R scores were significantly associated with MSPSS ( $\beta = -0.187$ , 95% CI =  $-0.297$  to  $-0.076$ ,  $p < .01$ ) but not CD-RISC scores.

Table 3

Results of linear regression showing associations between IES-R and subscale scores in Brief COPE and SF-36 scores

Measures	subscale	IES-R			
		$\beta$	p	95% CI	
SF-36	MCS	-0.234	***	-0.323	-0.147
	PCS	-0.030		-0.108	0.047
	RCS	-0.091	*	-0.171	-0.012
Brief COPE	Self-distraction	0.042	***	0.028	0.056
	Active coping	0.020	***	0.006	0.034
	Denial	0.027	***	0.018	0.036
	Substance use	0.031	***	0.013	0.048
	Emotional support	0.025	***	0.011	0.039
	Instrumental support	0.016	*	-0.001	0.032
	Behavioral disengagement	0.038	***	0.027	0.049
	Venting	0.015	*	0.001	0.030
	Positive reframing	0.021	**	0.007	0.035
	Planning	0.015	*	-0.001	0.030
	Humor	-0.005		-0.019	0.010
	Acceptance	0.016	*	0.001	0.031
	Religion	0.032	***	0.021	0.040
	Self-blame	0.052	***	0.038	0.068
MSPSS		-0.187	**	-0.297	-0.076
CD-RISC		-0.126		-0.308	0.057
Abbreviations: IES-R, the Impact of Event Scale-Revised; SF-36, the MOS 36-Item Short-Form Health Survey; MCS, Mental Component Summary; PCS, Physical Component Summary; RCS, Role/social Component Summary; MSPSS, Multidimensional Scale of Perceived Social Support; CD-RISC, Connor-Davidson Resilience Scale; 95% CI, 95% confidence interval.					
Covariates adjusted for age, length of employment, and education.					
$\beta$ s are not standardized.					
* $p < .05$ ; ** $p < .01$ ; *** $p < .001$ .					

Supplementary Table 1 presents the results of the linear regression model showing associations between subscale scores of the Brief COPE, CD-RISC scores, and SF-36 scores. There were significant positive associations between CD-RISC scores, subscale scores on the Brief COPE and MSPSS scores. CD-RISC scores were significantly positively associated with three subscale scores on Brief COPE (Active coping:  $\beta = 3.130$ , 95% CI = 1.479 to 4.766,  $p < .001$ ; Venting:  $\beta = 2.447$ , 95% CI = 0.761 to 4.119,  $p < .01$ ; Positive reframing:  $\beta = 4.876$ , 95% CI = 3.239 to 6.494,  $p < .001$ ) and MSPSS scores ( $\beta = 0.276$ , 95% CI = 0.060 to 0.490,  $p < .01$ ). Conversely, Self-distraction, Behavioral disengagement, and Self-blame in Brief COPE scores exhibited a significant negative association with CD-RISC scores (Self-distraction:  $\beta = -1.883$ , 95% CI = -2.703 to -1.061,  $p < .001$ ; Behavioral disengagement,  $\beta = -2.153$ , 95% CI = -3.158 to -1.148,  $p < .001$ ; Self-blame:  $\beta = -2.102$ , 95% CI = -2.880 to -1.324,  $p < .001$ ).

CD-RISC scores showed a significant positive association with MCS scores in SF-36 ( $\beta = 0.167$ , 95% CI = 0.100 to 0.234,  $p < .001$ ).

#### Moderated mediation

In the mediation analysis without moderators and covariates, four models passed through all measures as the scores of IES-R, Brief COPE, MSPSS, CD-RISC, and SF-36, but directly, not through the pathway from IES-R to CD-RISC. These findings indicated acceptable model fits and that all direct paths were significant. The model fit indices of the four models were as follows: Active coping: PPP = .276, RMSEA = 0.076, CFI = 0.963, TLI = 0.938; Behavioral disengagement: PPP = .346, RMSEA = 0.059, CFI = 0.982, TLI = 0.943; Venting: PPP = .311, RMSEA = 0.067, CFI = 0.968, TLI = 0.897; Positive reframing: PPP = .240, RMSEA = 0.085, CFI = 0.961, TLI = 0.877 (not shown in Table). Moderated mediation analysis based on the above models yielded non-significant results, indicating that there were no significant differences in the moderators, including age and length of employment. Therefore, age and length of employment were confounding factors controlled in the mediation analysis.

#### Mediation analysis with a multiple mediator model

Table 4 and Table 5 show the results of four mediation models using a multiple mediator adjusted for confounding factors, including all scores on the IES-R, four subscale scores in the Brief COPE, MSPSS scores, and MCS scores in the SF-36. All of the model fit indices in the mediation model indicated an acceptable model fit. All of the direct effects were significant, but the specific indirect effects of Behavioral disengagement and Venting were not significant. The direct effects between IES-R scores and MCS scores in SF-36 scores ranged from  $-0.175$  to  $-0.174$ , indicating partial mediation. Direct effects in the mediation analysis revealed the following associations between measures: IES-R scores were significantly positively associated with four subscale scores in Brief COPE (Active coping:  $\beta = 0.020$ ,  $p < .01$ ; Behavioral disengagement:  $\beta = 0.038$ ,  $p < .001$ ; Venting:  $\beta = 0.015$ ,  $p < .05$ ; Positive reframing:  $\beta = 0.021$ ,  $p < .01$ ) and significantly negatively associated with MSPSS scores ( $\beta_s = -0.187$ ,  $p < .01$  to  $.001$ ); CD-RISC scores were significantly positively associated with Active coping ( $\beta = 3.206$ ,  $p < .001$ ), Venting ( $\beta = 2.244$ ,  $p < .01$ ), and Positive reframing ( $\beta = 4.783$ ,  $p < .001$ ) on subscale scores in Brief COPE scores. However, Behavioral disengagement subscale scores were significantly negatively associated with CD-RISC scores ( $\beta = -2.622$ ,  $p < .01$ ). There was a significant positive association between CD-RISC scores and MCS scores on SF-36 ( $\beta = 0.124$  to  $0.125$ ,  $ps < .001$ ). The total indirect effects were as follows: for Active coping:  $\beta = -0.043$ ,  $p < .01$ ; for Behavioral disengagement:  $\beta = -0.062$ ,  $p < .001$ ; for Venting:  $\beta = -0.046$ ,  $p < .01$ ; for Positive reframing:  $\beta = -0.038$ ,  $p < .05$ .

Table 4

Direct effects of PTSD (IES-R) on QOL (SF-36) mediated by coping (subscales in Brief COPE), support (MSPSS), and resilience

	Active coping					Behavioral disengagement					Venting			
	$\beta$	p	95% CI	Posterior		$\beta$	p	95% CI	Posterior		$\beta$	p	95% CI	
S.D.	S.D.		S.D.	S.D.		S.D.		S.D.		S.D.		S.D.		
IES-R → MCS	-0.175	***	-0.256	-0.091	0.042	-0.174	***	-0.256	-0.092	0.042	-0.174	***	-0.255	-0.092
IES-R → Brief COPE <sup>a</sup>	0.020	**	0.006	0.035	0.007	0.038	***	0.027	0.049	0.006	0.015	*	0.001	0.030
IES-R → MSPSS	-0.187	***	-0.297	-0.077	0.056	-0.187	**	-0.297	-0.076	0.056	-0.187	**	-0.298	-0.076
Brief COPE <sup>a</sup> → CD- RISC	3.206	***	1.592	4.832	0.824	-2.622	**	-4.631	-0.612	1.027	2.244	**	0.589	3.894
MSPSS → CD- RISC	0.292	**	0.084	0.500	0.106	0.220	*	0.040	0.437	0.110	0.246	*	0.032	0.461
MSPSS → MCS	0.243	***	0.142	0.345	0.052	0.243	***	0.142	0.344	0.052	0.243	***	0.143	0.344
CD- RISC → MCS	0.125	***	0.064	0.186	0.031	0.124	***	0.062	0.185	0.031	0.125	***	0.064	0.186
Abbreviations: PTSD, posttraumatic stress disorder; QOL, quality of life; IES-R, the Impact of Event Scale-Revised; MSPSS, Multidimensional Scale of Perceived Stress; SF-36, the MOS 36-Item Short-Form Health Survey; MCS, Mental Component Summary; PPP, the posterior predictive p-value; RMSEA, the root mean square error of approximation; CFI, the confirmatory fit index; 95% CI, 95% confidence interval; SD, Standard Deviation.														
* $p < .05$ ; ** $p < .01$ ; *** $p < .001$ .														
<sup>a</sup> Subscales in Brief COPE: Active coping, Behavioral disengagement, Venting, and Positive reframing.														
$\beta$ s are not standardized.														
Covariates adjusted for age, length of employment, and education.														
Model fit values of four mediation models were as follows: Active coping: PPP = .266, RMSEA = 0.075, CFI = 0.986, TLI = 0.938; Behavioral disengagement: PPP = .285, RMSEA = 0.068, CFI = 0.988, TLI = 0.947; Positive reframing: PPP = .219, RMSEA = 0.081, CFI = 0.984, TLI = 0.930.														



Table 5  
Specific indirect effects, total indirect effect, and total effect in mediation analysis

	Active coping					Behavioral disengagement					Venting			
	$\beta$	p	95% CI		Posterior	$\beta$	p	95% CI		Posterior	$\beta$	p	95% CI	
S.D.	S.D.	S.D.	S.D.											
Brief COPE <sup>a</sup> → CD-RISC	0.007	**	0.002	0.018	0.004	-0.012	**	-0.026	-0.002	0.006	0.004	*	0.000	0.012
MSPSS	-0.044	**	-0.082	-0.016	0.017	-0.044	**	-0.082	-0.016	0.017	-0.044	**	-0.083	-0.016
MSPSS → CD-RISC	-0.006	**	-0.016	-0.001	0.004	-0.005	*	-0.013	0.000	0.003	-0.005	*	-0.014	-0.001
Total indirect effect	-0.043	**	-0.084	-0.010	0.019	-0.062	***	-0.104	-0.029	0.019	-0.046	**	-0.088	-0.014
Total effect	-0.218	***	-0.305	-0.130	0.044	-0.237	***	-0.324	-0.151	0.044	-0.221	***	-0.308	-0.135
Abbreviations: PTSD, posttraumatic stress disorder; QOL, quality of life; IES-R, the Impact of Event Scale-Revised; MSPSS, Multidimensional Scale of Perceive SF-36, the MOS 36-Item Short-Form Health Survey; MCS, Mental Component Summary; PPP, the posterior predictive p-value; RMSEA, the root mean square error Tucker-Lewis index; 95% CI 95% confidence interval; SD, Standard Deviation..														
*p < .05; **p < .01; ***p < .001.														
<sup>a</sup> Subscales in Brief COPE: Active coping, Behavioral disengagement, Venting, and Positive reframing.														
$\beta$ s are not standardized.														
Covariates adjusted for age, length of employment, and education.														
Model fit values of four mediation models were as follows: Active coping: PPP = .266, RMSEA = 0.075, CFI = 0.986, TLI = 0.938; Behavioral disengagement: PP = .285, RMSEA = 0.068, CFI = 0.988, TLI = 0.947; Positive reframing: PPP = .219, RMSEA = 0.081, CFI = 0.984, TLI = 0.930.														

Supplementary Table 2 shows sensitivity analysis using data with a list-wise deletion method. Model fits for the three subscale scores in the Brief COPE comparing the FIML method and the list-wise deletion method had similar values, and sensitivity analysis revealed acceptable model fit (Active coping: PPP = .209, RMSEA = 0.086, CFI = 0.982, TLI = 0.919; Behavioral disengagement: PPP = .280, RMSEA = 0.073, CFI = 0.987, TLI = 0.945; Venting: PPP = .236, RMSEA = 0.083, CFI = 0.982, TLI = 0.923). Therefore, the assumption of not missing at random (NMAR) was rejected. However, the model fit for Positive reframing on the subscale scores in the Brief COPE indicated that a good model fit was not retained (PPP = .141, RMSEA = 0.100, CFI = 0.976, TLI = 0.894). For the above reason, the missing data in Positive reframing might reflect NMAR. For  $\beta$  coefficient values, the three subscale scores in the Brief COPE (Active coping, Behavioral disengagement, and Positive reframing) using the list-wise deletion method exhibited similar values to the results of the FIML method. However, the 95% CIs of the  $\beta$  coefficient values between IES-R scores and Venting on scores in the Brief COPE included zero, and were not significant. It is possible that the assumption of NMAR for Venting score data was valid for the present analysis.

## Discussion

The present study aimed to identify mediators in a third potential model to determine whether stress-coping, social support, and resilience mediate the association between probable PTSD and QOL among firefighters and emergency medical technicians working in emergency services. In addition, to analyze the associations between measures mentioned above, we sought to determine how behavior in stress-coping influences components of QOL. The results supported our initial hypothesis, revealing that probable PTSD directly and indirectly predicted mental health state and QOL in models through three mediators.

### Effects of independent variables

A linear regression analysis of the univariate showed associations between probable PTSD, QOL, stress-coping, social support, and resilience. Greater probable PTSD directly predicted lower mental health and role/social functioning in QOL. A previous study indicated that war veterans with PTSD exhibited impaired social functioning in QOL [59], potentially developing impairments in their social lives. Such cases typically involve a cost to society, associated with healthcare utilization [60]. This contributes to the importance of identifying effective methods for protecting individuals from developing PTSD and improving QOL.

The current results revealed that the association between PTSD and QOL involved many confounding factors and independent variables, such as stress-coping and social support. The identified factors were consistent with the findings of previous studies of firefighters and war veterans with PTSD, which indicated that greater stress-coping is predicted by PTSD [61, 62], and Active coping, Positive reframing, and Venting in the Brief COPE can effectively indicate improvement of PTSD symptoms [61, 63, 64]. Most of the stress-coping strategies in the present study directly predicted mental health state in QOL, and more maladaptive coping strategies, including Self-distraction, Self-blame, and Behavioral disengagement, indicated worse mental health and QOL. Holubova et al.

reported that participants with mental disorders tend to engage in negative rather than positive coping (adaptive) strategies, and that negative coping (maladaptive) strategies are likely to be associated with lower QOL [65]. Maladaptive coping, which negatively affects QOL, involves Self-distraction, Substance use, Behavioral disengagement, Denial, Self-blame, and Venting. In contrast, adaptive coping, which improves QOL, involves Acceptance, Active coping, Planning, Positive reframing, Humor, Religion, the Use of emotional support, and the Use of instrumental support [65–67]. It is possible that Japanese emergency service workers tend to engage in maladaptive coping, and stress-coping might worsen QOL in rescue workers with PTSD.

In the present study, lower social support was predicted by greater PTSD. Therefore, social support is likely to protect against worsening PTSD [33]. Previous studies indicated that, among war veterans with PTSD, lower family support was associated with PTSD [68], and poorer social functioning was exhibited compared with war veterans without PTSD [33]. Importantly, social support might promote improvements in QOL among rescue workers.

Greater resilience in the present study was predicted to occur when more adaptive coping strategies were employed, including Active coping, Venting, and Positive reframing, and when avoidance strategies were employed less, including Behavioral disengagement and Denial in stress-coping, in accord with previous studies [35, 69]. In addition, greater resilience exhibited an association with better mental health state and QOL but not probable PTSD. In the current study, we did not find the association between PTSD and resilience reported in a previous study of patients in the Emergency Department, which found that lower resilience predicted the impact of PTSD [35]. Based on the discrepancy between this previous finding and the current results, we propose that probable PTSD may indirectly predict mental health on QOL-mediated stress-coping and social functioning via resilience.

#### The main findings of the multiple mediation analysis

The results of the mediation analysis without covariates indicated that four stress-coping strategies (Active coping, Behavioral disengagement, Venting, and Positive reframing), social support, and resilience partially mediated the association between probable PTSD and mental health in QOL. The p-values for the association between probable PTSD and resilience in the linear regression model and mediator model analysis were not significant. These findings suggest that resilience was not directly associated with probable PTSD. In contrast, the association between probable PTSD and QOL in the multiple mediation model, as a partial model, was significant.

In a mediator model with covariates, all of the mediator variables predicted QOL, except for stress-coping. Mediator models using two coping strategies (Active coping and Positive reframing) supported our research hypothesis. The findings of the present multiple mediation analysis in the two mediator models revealed that probable PTSD directly predicted stress-coping and social support, which were indirectly associated with QOL when mediated by resilience. In the present study, resilience, as a third mediator, was indicated to have an association with stress-coping and social support. Previous studies indicated a positive association between stress-coping and resilience [35], revealing that firefighters reported that receiving social support from a boss influenced workers' resilience [70]. In the current study, we found a significant positive association between resilience and QOL among emergency service workers. Therefore, both stress-coping and social support through resilience appear to help prevent PTSD and maintain good QOL. Thus, Active coping and social support strengthen resilience and improve mental health and QOL among emergency service workers with PTSD.

However, it is possible that Positive reframing in coping strategies skewed the results of the FIML method. Specifically, Positive reframing might lead to type I errors. Therefore, the main findings of the current study suggested that only the mediation model using Active coping exerted protective effects against PTSD and improved mental health in QOL. Active coping to confront difficulties was found to be a particularly important behavior, revealing that this behavior requires practice with social support for the behavior to maintain mental health and QOL among emergency service workers. One method of Active coping is talking about the feelings associated with anxiety, and to receive acceptance from another person as a form of social support.

In addition, mental health screening in emergency service workers at risk from PTSD should include an examination of resilience. If, as indicated in the current study, stress-coping is sometimes negatively associated with QOL, failure to take resilience into account could produce an inaccurate assessment of mental health, as resilience might improve QOL. Although the present findings are suggestive, because this was a cross-sectional study, the causal relationships between PTSD and QOL (mediated by stress-coping, social support, and resilience) could not be confirmed.

This study involved several limitations that should be considered. First, the study sample was composed of only male participants. It is possible that the observed association between PTSD symptoms and QOL would have differed if sex had been included as a confounding factor. Previous studies have also failed to examine the effect of sex; for example, a study by Schnurr et al. on PTSD and QOL included only male veterans [25]. Second, because the current study used a cross-sectional design, we could not confirm a causal relationship between QOL and probable PTSD, or the direction of such a relationship. Third, the use of retrospective data about events that occurred in the past may have led to recall bias, distorting the results. Fourth, statistical analysis using FIML can involve bias when data are not missing at random, because it is based on the assumption of missing at random or missing completely at random [71]. Comparing values between the FIML method and the list-wise deletion method revealed that model fit indices for Positive reframing indicated not to retain good model fit, and the  $\beta$  coefficient on Venting in Brief COPE scores included zero in 95% CIs. The use of these two coping strategies might have confounded the results.

Despite these limitations, the current study had several strengths. To the best of our knowledge, this is the first study to assess the association between PTSD and QOL mediated by stress-coping, social support and resilience among emergency service workers. The mediation analysis indicated associations between stress-coping, social support, and resilience. The current results suggested that stress-coping and social support may strengthen resilience, and resilience may prevent a decline in QOL. The next stage of our research will be to conduct an in-depth longitudinal study to determine whether stress-coping, social support, and resilience influence mental health.

## Conclusions

The current study revealed that only coping strategies involving active coping protected against probable PTSD and improved mental health in QOL. Active coping to confront difficulties was found to be a particularly important behavior, such as talking about feelings associated with anxiety to receive acceptance from another person as a form of social support. Developing this behavior requires practicing Active coping with social support to maintain good mental health and QOL among emergency service workers. However, because the present study had a cross-sectional design, no conclusions could be drawn regarding the causality of the relationship between PTSD and QOL, mediated by stress-coping, social support, and resilience. Therefore, a longitudinal study will be required to clarify the relationships by which stress-coping, social support, and resilience mediate the association between PTSD and QOL.

## Abbreviations

CFI  
Comparative fit index  
CI  
Confidence interval  
CD-RISC  
Connor-Davidson Resilience Scale  
EMT  
Emergency medical technicians  
FIML  
Full information maximum likelihood  
IES-R  
Impact of Event Scale-Revised  
MCS  
Mental Component Summary  
SF-36  
MOS 36-Item Short-Form Health Survey  
MSPSS  
Multidimensional Scale of Perceived Social Support  
PCS  
Physical Component Summary  
PTSD  
Posttraumatic stress disorder  
PPP  
Posterior predictive p-value  
QOL  
Quality of life  
RMSEA  
Root mean square error  
RCS  
Role/social Component Summary  
TLI  
Tucker-Lewis index

## Declarations

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. Ethical approval was granted by the Clinical Research Ethics Committee of Chiba University (approval number 1731).

Consent for publication: Not applicable

Availability of data and materials: Not applicable

Competing interests: The authors declare that they have no conflicts of interest.

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Author contributions:

Conceptualization: [Eiji Shimizu]; Methodology: [Yoshikazu Noda, Kenichi Asano, and Yoshiyuki Hirano]; Formal analysis and investigation: [Yoshikazu Noda]; Writing - original draft preparation: [Yoshikazu Noda]; Funding acquisition: [Eiji Shimizu]; Resources: [Yoshikazu Noda]; Supervision: [Kenichi Asano and Yoshiyuki Hirano].

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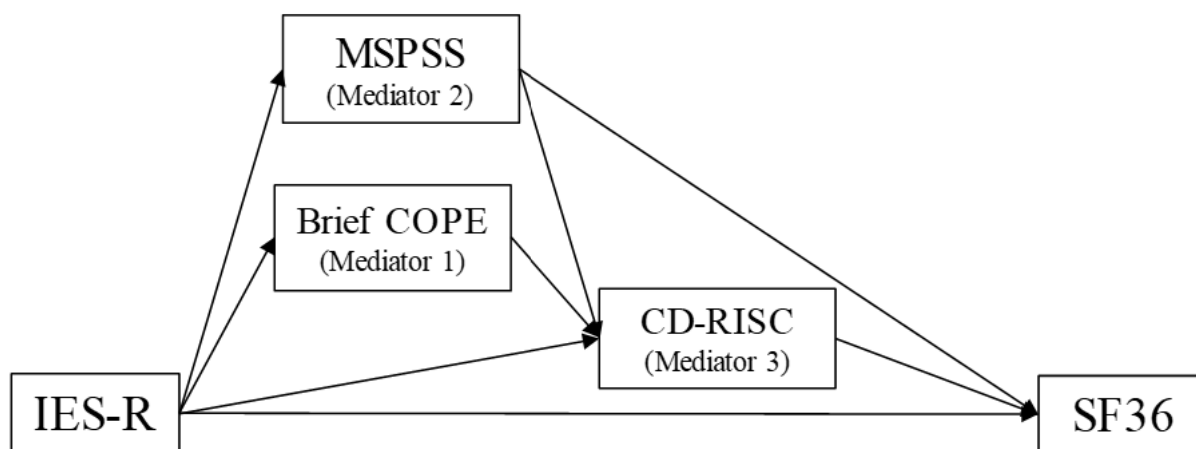
## References

1. Berninger A, Webber MP, Niles JK, Gustave J, Lee R, Cohen HW, et al. Longitudinal study of probable post-traumatic stress disorder in firefighters exposed to the World Trade Center disaster. *Am J Ind Med*. 2010;53:1177–85.
2. Sakuma A, Takahashi Y, Ueda I, Sato H, Katsura M, Abe M, et al. Post-traumatic stress disorder and depression prevalence and associated risk factors among local disaster relief and reconstruction workers fourteen months after the Great East Japan Earthquake: a cross-sectional study. *BMC Psychiatry*. 2015;15:58.
3. Stellman JM, Smith RP, Katz CL, Sharma V, Charney DS, Herbert R, et al. Enduring mental health morbidity and social function impairment in world trade center rescue, recovery, and cleanup workers: the psychological dimension of an environmental health disaster. *Environ Health Perspect*. 2008;116:1248–53.
4. Slottje P, Witteveen AB, Twisk JWR, Smidt N, Huizink AC, van Mechelen W, et al. Post-disaster physical symptoms of firefighters and police officers: role of types of exposure and post-traumatic stress symptoms. *Br J Health Psychol*. 2008;13:327–42.
5. Brackbill RM, Hadler JL, DiGrande L, Ekenga CC, Farfel MR, Friedman S, et al. Asthma and posttraumatic stress symptoms 5 to 6 years following exposure to the World Trade Center terrorist attack. *JAMA*. 2009;302:502–16.
6. McFarlane AC. Epidemiological evidence about the relationship between PTSD and alcohol abuse: the nature of the association. *Addict Behav*. 1998;23:813–25.
7. Chiu S, Niles JK, Webber MP, Zeig-Owens R, Gustave J, Lee R, et al. Evaluating risk factors and possible mediation effects in posttraumatic depression and posttraumatic stress disorder comorbidity. *Public Health Rep*. 2011;126:201–9.
8. Guo Y-J, Chen C-H, Lu M-L, Tan HK-L, Lee H-W, Wang T-N. Posttraumatic stress disorder among professional and non-professional rescuers involved in an earthquake in Taiwan. *Psychiatry Res*. 2004;127:35–41.
9. McFarlane AC. Relationship between psychiatric impairment and a natural disaster: the role of distress. *Psychol Med*. 1988;18:129–39.
10. Chang C-M, Connor KM, Lai T-J, Lee L-C, Davidson JRT. Predictors of posttraumatic outcomes following the 1999 Taiwan earthquake. *J Nerv Ment Dis*. 2005;193:40–6.
11. Leykin D, Lahad M, Bonne N. Posttraumatic Symptoms and Posttraumatic Growth of Israeli Firefighters, at One Month following the Carmel Fire Disaster. *Psychiatry J*. 2013;2013:274121.
12. Katsavouni F, Bebetos E, Malliou P, Beneka A. The relationship between burnout, PTSD symptoms and injuries in firefighters. *Occup Med*. 2016;66:32–7.
13. Duckworth DH. Psychological problems arising from disaster work. *Stress Med*. 1986;2:315–23.
14. Sifaki-Pistolla D, Chatzea V-E, Vlachaki S-A, Melidoniotis E, Pistolla G. Who is going to rescue the rescuers? Post-traumatic stress disorder among rescue workers operating in Greece during the European refugee crisis. *Soc Psychiatry Psychiatr Epidemiol*. 2016;
15. Perrin MA, DiGrande L, Wheeler K, Thorpe L, Farfel M, Brackbill R. Differences in PTSD prevalence and associated risk factors among World Trade Center disaster rescue and recovery workers. *Am J Psychiatry*. 2007;164:1385–94.
16. Pietrzak RH, Feder A, Singh R, Schechter CB, Bromet EJ, Katz CL, et al. Trajectories of PTSD risk and resilience in World Trade Center responders: an 8-year prospective cohort study. *Psychol Med*. 2014;44:205–19.
17. Chiu S, Niles JK, Webber MP, Zeig-Owens R, Gustave J, Lee R, et al. Evaluating risk factors and possible mediation effects in posttraumatic depression and posttraumatic stress disorder comorbidity. *Public Health Rep*. 2011;126:201–9.
18. Wisco BE, Marx BP, Wolf EJ, Miller MW, Southwick SM, Pietrzak RH. Posttraumatic stress disorder in the US veteran population: results from the National Health and Resilience in Veterans Study. *J Clin Psychiatry*. 2014;75:1338–46.
19. Haynes PL, Kelly M, Warner L, Quan SF, Krakow B, Bootzin RR. Cognitive Behavioral Social Rhythm Group Therapy for Veterans with posttraumatic stress disorder, depression, and sleep disturbance: Results from an open trial. *J Affect Disord*. 2016;192:234–43.
20. Brown J, Mulhern G, Joseph S. Incident-related stressors, locus of control, coping, and psychological distress among firefighters in Northern Ireland. *J Trauma Stress*. 2002;15:161–8.
21. Regehr C, Hill J, Knott T, Sault B. Social support, self-efficacy and trauma in new recruits and experienced firefighters. *Stress Health*. 2003;19:189–93.
22. Chen Y-S, Chen M-C, Chou FH-C, Sun F-C, Chen P-C, Tsai K-Y, et al. The relationship between quality of life and posttraumatic stress disorder or major depression for firefighters in Kaohsiung, Taiwan. *Qual Life Res*. 2007;16:1289–97.
23. Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. *Psychol Med*. 1998;28:551–8.
24. Johansen VA, Wahl AK, Eilertsen DE, Weisaeth L, Hanestad BR. The predictive value of post-traumatic stress disorder symptoms for quality of life: a longitudinal study of physically injured victims of non-domestic violence. *Health Qual Life Outcomes*. 2007;5:26.
25. Schnurr PP, Lunney CA, Bovin MJ, Marx BP. Posttraumatic stress disorder and quality of life: extension of findings to veterans of the wars in Iraq and Afghanistan. *Clin Psychol Rev*. 2009;29:727–35.
26. Bracken-Scally M, McGilloway S, Gallagher S, Mitchell JT. Life after the emergency services: an exploratory study of well being and quality of life in emergency service retirees. *Int J Emerg Ment Health*. 2014;16:223–31.
27. Bartlett BA, Smith LJ, Tran JK, Vujanovic AA. Understanding mental health among military veterans in the fire service. *Psychiatry Res*. 2018;267:394–9.

28. Nachar N, Guay S, Beaulieu-Prévost D, Marchand A. Assessment of the Psychosocial Predictors of Health-Related Quality of Life in a PTSD Clinical Sample. *Traumatology*. 2013;19:20–7.
29. Connor KM, Davidson JRT. Development of a new resilience scale: the Connor-Davidson Resilience Scale (CD-RISC). *Depress Anxiety*. 2003;18:76–82.
30. Post F, Pardeller S, Frajo-Apor B, Kemmler G, Sondermann C, Hausmann A, et al. Quality of life in stabilized outpatients with bipolar I disorder: Associations with resilience, internalized stigma, and residual symptoms. *J Affect Disord*. 2018;238:399–404.
31. Mizuno Y, Hofer A, Suzuki T, Frajo-Apor B, Wartelsteiner F, Kemmler G, et al. Clinical and biological correlates of resilience in patients with schizophrenia and bipolar disorder: A cross-sectional study. *Schizophr Res*. 2016;175:148–53.
32. Nakazawa K, Noda T, Ichikura K, Okamoto T, Takahashi Y, Yamamura T, et al. Resilience and depression/anxiety symptoms in multiple sclerosis and neuromyelitis optica spectrum disorder. *Mult Scler Relat Disord*. 2018;25:309–15.
33. Tsai J, Harpaz-Rotem I, Pietrzak RH, Southwick SM. The role of coping, resilience, and social support in mediating the relation between PTSD and social functioning in veterans returning from Iraq and Afghanistan. *Psychiatry*. 2012;75:135–49.
34. Crestani Calegaro V, Canova Mosele PH, Lorenzi Negretto B, Zatti C, Miralha da Cunha AB, Machado Freitas LH. The role of personality in posttraumatic stress disorder, trait resilience, and quality of life in people exposed to the Kiss nightclub fire. *PLoS ONE [Internet]*. 2019 [cited 2020 Feb 5];14. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6663027/>
35. Thompson NJ, Fiorillo D, Rothbaum BO, Ressler KJ, Michopoulos V. Coping strategies as mediators in relation to resilience and posttraumatic stress disorder. *J Affect Disord*. 2018;225:153–9.
36. Xu J, Ou L. Resilience and quality of life among Wenchuan earthquake survivors: the mediating role of social support. *Public Health*. 2014;128:430–7.
37. Noda Y, Asano K, Shimizu E, Hirano Y. Assessing Subgroup Differences in Posttraumatic Stress Disorder Among Rescue Workers in Japan With the Impact of Event Scale-Revised. *Disaster Med Public Health Prep*. 2018;1–10.
38. Asukai N, Kato H, Kawamura N, Kim Y, Yamamoto K, Kishimoto J, et al. Reliability and validity of the Japanese-language version of the impact of event scale-revised (IES-R-J): four studies of different traumatic events. *J Nerv Ment Dis*. 2002;190:175–82.
39. Matsuoka Y, Nishi D, Nakaya N, Sone T, Noguchi H, Hamazaki K, et al. Concern over radiation exposure and psychological distress among rescue workers following the Great East Japan Earthquake. *BMC Public Health*. 2012;12:249.
40. Chung I-S, Lee M-Y, Jung S-W, Nam C-W. Minnesota multiphasic personality inventory as related factor for post traumatic stress disorder symptoms according to job stress level in experienced firefighters: 5-year study. *Ann Occup Environ Med*. 2015;27:16.
41. Daniel S. Weiss. The Impact of Event Scales-Revised. John P Wilson Teren M KeaneEd Assess Psychol Trauma PTSD Second Ed. New York: The Guilford Press; 2004. p. 168–89.
42. Cetin M, Kose S, Ebrinc S, Yigit S, Elhai JD, Basoglu C. Identification and posttraumatic stress disorder symptoms in rescue workers in the Marmara, Turkey, earthquake. *J Trauma Stress*. 2005;18:485–9.
43. Beck JG, Grant DM, Read JP, Clapp JD, Coffey SF, Miller LM, et al. The impact of event scale-revised: psychometric properties in a sample of motor vehicle accident survivors. *J Anxiety Disord*. 2008;22:187–98.
44. Carver CS. You want to measure coping but your protocol's too long: consider the brief COPE. *Int J Behav Med*. 1997;4:92–100.
45. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The Multidimensional Scale of Perceived Social Support. *J Pers Assess*. 1988;52:30–41.
46. Hays RD, Sherbourne CD, Mazel RM. The RAND 36-Item Health Survey 1.0. *Health Econ*. 1993;2:217–27.
47. Hinkle DE, Wiersma W, Jurs SG. *Applied Statistics for the Behavioral Sciences, International Edition*. 5th ed. Belmont, CA: Wadsworth Publishing Co Inc; 2009.
48. Fairchild AJ, MacKinnon DP. A general model for testing mediation and moderation effects. *Prev Sci Off J Soc Prev Res*. 2009;10:87–99.
49. Preacher KJ, Rucker DD, Hayes AF. Addressing Moderated Mediation Hypotheses: Theory, Methods, and Prescriptions. *Multivar Behav Res*. 2007;42:185–227.
50. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*. 1986;51:1173–82.
51. Roux P, Passerieux C, Fleury M-J. Mediation analysis of severity of needs, service performance and outcomes for patients with mental disorders. *Br J Psychiatry*. 2016;209:511–6.
52. Muthen B. Bayesian Analysis In Mplus: A Brief Introduction. 2010;23.
53. Muthén B, Asparouhov T. Bayesian structural equation modeling: a more flexible representation of substantive theory. *Psychol Methods*. 2012;17:313–35.
54. Fong TCT, Ho RTH. Dimensionality of the 9-item Utrecht Work Engagement Scale revisited: A Bayesian structural equation modeling approach. *J Occup Health*. 2015;57:353–8.
55. Cain MK, Zhang Z. Fit for a Bayesian: An Evaluation of PPP and DIC for Structural Equation Modeling. *Struct Equ Model Multidiscip J*. 2019;26:39–50.
56. Tucker LR, Lewis C. A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*. 1973;38:1–10.
57. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Model Multidiscip J*. 1999;6:1–55.
58. Nakagami Y, Sugihara G, Takei N, Fujii T, Hashimoto M, Murakami K, et al. Effect of physical state on pain mediated through emotional health in rheumatoid arthritis. *Arthritis Care Res*. 2018;
59. Zatzick DF, Marmar CR, Weiss DS, Browner WS, Metzler TJ, Golding JM, et al. Posttraumatic stress disorder and functioning and quality of life outcomes in a nationally representative sample of male Vietnam veterans. *Am J Psychiatry*. 1997;154:1690–5.

60. Tuerk PW, Wangelin B, Rauch SAM, Dismuke CE, Yoder M, Myrick H, et al. Health service utilization before and after evidence-based treatment for PTSD. *Psychol Serv.* 2013;10:401–9.
61. Chamberlin MJA, Green HJ. Stress and Coping Strategies Among Firefighters and Recruits. *J Loss Trauma.* 2010;15:548–60.
62. Beaton R, Murphy S, Johnson C, Pike K, Corneil W. Coping responses and posttraumatic stress symptomatology in urban fire service personnel. *J Trauma Stress.* 1999;12:293–308.
63. Brooks SK, Dunn R, Amlôt R, Greenberg N, Rubin GJ. Social and occupational factors associated with psychological distress and disorder among disaster responders: a systematic review. *BMC Psychol* [Internet]. 2016 [cited 2016 May 24];4. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4845476/>
64. Saxon L, Makhashvili N, Chikovani I, Seguin M, McKee M, Patel V, et al. Coping strategies and mental health outcomes of conflict-affected persons in the Republic of Georgia. *Epidemiol Psychiatr Sci.* 2017;26:276–86.
65. Holubova M, Prasko J, Ociskova M, Grambal A, Slepecky M, Marackova M, et al. Quality of life and coping strategies of outpatients with a depressive disorder in maintenance therapy - a cross-sectional study. *Neuropsychiatr Dis Treat.* 2018;14:73–82.
66. Skeffington PM, Rees CS, Mazzucchelli TG, Kane RT. The Primary Prevention of PTSD in Firefighters: Preliminary Results of an RCT with 12-Month Follow-Up. *PloS One.* 2016;11:e0155873.
67. Braun-Lewensohn O, Bar R. Coping and quality of life of soldiers' wives following military operation. *Psychiatry Res.* 2017;254:90–5.
68. Wright BK, Kelsall HL, Sim MR, Clarke DM, Creamer MC. Support mechanisms and vulnerabilities in relation to PTSD in veterans of the Gulf War, Iraq War, and Afghanistan deployments: a systematic review. *J Trauma Stress.* 2013;26:310–8.
69. Fino E, Mema D, Russo PM. War trauma exposed refugees and posttraumatic stress disorder: The moderating role of trait resilience. *J Psychosom Res.* 2020;129:109905.
70. Bernabé M, Botia JM. Resilience as a mediator in emotional social support's relationship with occupational psychology health in firefighters. *J Health Psychol.* 2016;21:1778–86.
71. Blozis SA, Ge X, Xu S, Natsuaki MN, Shaw DS, Neiderhiser J, et al. Sensitivity Analysis of Multiple Informant Models When Data are Not Missing at Random. *Struct Equ Model Multidiscip J.* 2013;20:283–98.

## Figures



**Figure 1**

Mediation model as a path model for the effect of PTSD (IES-R) on QOL (SF-36) mediated by coping (Brief COPE), support (MSPSS), and resilience (CD-RISC). Abbreviations: PTSD, posttraumatic stress disorder; QOL, quality of life; IES-R, the Impact of Event Scale-Revised; MSPSS, Multidimensional Scale of Perceived Social Support; CD-RISC, Connor-Davidson Resilience Scale; SF-36, the MOS 36-Item Short-Form Health Survey; MCS, Mental Component Summary; PCS, Physical Component Summary; RCS, Role/social Component Summary. The Brief COPE used 14 subscales: Self-distraction, Active coping, Denial, Substance use, Emotional support, Instrumental support, Behavioral disengagement, Venting, Positive reframing, Planning, Humor, Acceptance, Religion, and Self-blame. The SF-36 used three subscales: MCS, PCS, and RCS.

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