



Contribution of rumination and psychological resilience to post-traumatic growth of front-line healthcare workers in mobile cabin hospitals under Normalized epidemic Prevention and Control Requirements

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ABSTRACT

To understand the level of post-traumatic growth (PTG) and influencing factors among front-line healthcare workers (HCWs) working in mobile cabin hospitals treating patients with Coronavirus Disease 2019 (COVID-19) under the Normalized Epidemic Prevention and Control Requirements adopted in China. A random sampling method was used to select 540 HCWs of the Chongqing-aid-Shanghai medical team from April to May 2022 as the study participants. Participants completed a general information questionnaire, the Post-traumatic Growth Inventory-Chinese version (PTGI-C), the Chinese version of the Connor-Davidson Resilience Scale (CD-RISC) and the Chinese Event Related Rumination Inventory (C-ERRI). Among the 540 included HCWs, 83.15 % were nurses and 78.89 % were women. The average scores for PTG (62.25 ± 16.73) and psychological resilience (64.22 ± 15.38) were at moderate levels, and the average score for rumination was low (21.62 ± 10.77). Pearson correlation analysis showed that CD-RISC and C-ERRI scores were positive with the PTGI-C score ($r = 0.528, 0.316, P < 0.001$). Multiple linear regression analysis identified psychological training or intervention during the COVID-19 epidemic ($\beta = 2.353, P = 0.044$), psychological resilience ($\beta = 0.525, P < 0.001$) and deliberate rumination ($\beta = 0.732, P < 0.001$) as factors significantly associated with the PTG of front-line HCWs, which together explained 36.8 % of the total variance in PTG ($F[5,539] = 63.866, P < 0.001$). In general, psychological resilience and deliberate rumination can promote PTG among HCWs and can be improved by strengthening psychological training and interventions for HCWs working under the Normalized Epidemic Prevention and Control Requirements.

1. Introduction

According to the World Health Statistics 2022, by April 20, 2022 the number of confirmed cases of COVID-19 in the world had exceeded 504.4 million and the number of deaths related to COVID-19 had exceeded 6.2 million (WHO, 2022). Due to the outbreak of SARS-CoV-2 Omicron in Shanghai, China, partitioned dynamic closure and control management plans were implemented on March 28, 2022, which created huge emergency pressure on Shanghai's medical and healthcare systems.

With the outbreak of the SARS-CoV-2 Omicron variant, which is highly contagious, mobile cabin hospitals were either newly built or renovated from existing hospitals for the functions of receiving, treating and isolating patients. Most patients treated in mobile cabin hospitals have mild or asymptomatic COVID-19 cases. For these patients, being quarantined means travel restrictions, suspension of original work, and changes in living environment. They face uncertainty about the development of the disease and want to be cured and discharged from hospital quickly. These factors can lead to anxiety, depression, emotional agitation, etc.

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Although medical personnel around the world had been fighting against the epidemic for approximately 3 years, the highly infectious Omicron variant still caused much fear and panic (Singhal, 2022). HCWs faced a constant state of psychological stress and could suffer from anxiety, depression, fatigue, burnout, post-traumatic stress disorder (PTSD), and other psychological problems, due to fear of being infected, the urgency to begin working, the short duration of training, and unfamiliarity with the operating procedures in mobile cabin hospitals, all of which posed serious risks to their physical and mental health (Batra et al., 2020).

However, exposure to traumatic events may also be accompanied by positive psychological changes that allow individuals to achieve a greater adaptation level than they possessed before the traumatic event as well as greater psychological function or life consciousness in adversity, namely PTG (Veronese et al., 2022). Studies have investigated the factors that predict whether individuals can achieve positive changes after trauma, showing that rumination (Ramos et al., 2018;) and resilience (Yun et al., 2020) can act directly or indirectly to promote individual PTG.

The current literature includes studies on PTG related to natural disasters, accidental traumas, cancer, chronic disease, and mental illness (Lai et al., 2021; Ng et al., 2021; Pan et al., 2022; Tanyi et al., 2020). Highly stressful or traumatic events challenge people's assumptions and models of understanding the world. Learning to observe things from multiple perspectives can improve cognition, thereby improving people's ability to cope with complex affairs and achieve PTG (Tedeschi and Calhoun, 2004).

Psychological resilience refers to the process by which an individual can successfully cope or adapt well when faced with trauma, adversity, or major stress (Connor and Davidson, 2003). A previous systematic review provided insight on the strength and direction of the relationships between resilience and other variables including work engagement, social support, PTSD, anxiety, and depression during the COVID-19 pandemic (Baskin and Bartlett, 2021).

Rumination refers to the cognitive process that occurs after an individual experiences a traumatic event or negative change, including intrusive rumination and deliberate rumination (Cann et al., 2011). Intrusive rumination refers to repetitive and uncontrollable thoughts that focus on negative emotions, whereas deliberate rumination refers to voluntary and deliberate thoughts generated by focusing on understanding the meaning of events and the way problems can be solved, which help employees to solve problems and think about the positive side of work to moderate negative effects, thereby enhancing employees' vitality and well-being (Lo et al., 2017). Expressing (rather than suppressing) intrusive ruminative thoughts and transforming this into deliberate rumination may promote PTG (Öcalan and Üzar-Özçetin, 2021).

Understanding the types and timing of PTG processing may be critical to understanding the underlying mechanisms of PTG (Tedeschi and Calhoun, 2004). Cognitive processing, especially the process of rumination, as the central process of PTG and development, plays a crucial role in PTG (Tedeschi and Calhoun, 2004). One study showed that pandemic-related distress and growth are connected in a complex relationship that depends on intra- (e.g., resilience and emotion regulation) and inter-personal (e.g., social support) factors (Fino et al., 2021). This study was conducted in frontline HCWs in Italy, and research is still needed regarding the relationship between rumination, mental resilience, and psychological trauma among staff working specifically in mobile cabins in China during the COVID-19 epidemic, as this type of psychological trauma is influenced by the cultural background environment. Therefore, the present study aimed to explore the influence of rumination and psychological resilience on PTG among front-line HCWs working in mobile cabin hospitals under the Normalized Epidemic Prevention and Control Requirements adopted in China, to identify factors that influenced the level of PTG among HCWs in the post-epidemic period from different perspectives.

2. Materials and methods

2.1. Participants

The random sampling method was used to select HCWs from the Chongqing-aid-Shanghai medical team from April to May 2022 as the study participants. The inclusion criteria were: 1) willingness to voluntarily participate in this research; 2) education of a college degree or above; and 3) experience as a front-line HCW treating COVID-19 patients in mobile cabin hospitals under the Normalized Epidemic Prevention and Control Requirements. A total of 561 questionnaires were collected, and 21 invalid questionnaires were excluded. Finally, 540 questionnaires were included in the data analysis.

2.2. Materials

The questionnaire used in this study consisted of four sections: (a) participants' basic information, e.g., gender, age, prior work experience in a major public health emergency, psychological intervention or training during COVID-19, and the doctor–nurse–patient relationship (this item was measured using a single question, which asked the HCW whether he/she was satisfied with the doctor–nurse–patient relationship, with response choices of yes or no); (b) the Event-Related Rumination Inventory, (c) the Psychological Resilience Scale, and (d) the Posttraumatic Growth Inventory.

2.3. Chinese version of the Event-Related rumination Inventory (C-ERRI)

The C-ERRI was developed by Cann et al (2011) and revised by Dong et al (2013) to assess cognitive processing of highly stressful events. The questionnaire includes two dimensions of intrusive rumination and deliberate rumination, with a total of 20 items. A 4-point Likert scale (0–3 points) is used for answers to each item, with 0 representing “never” and 3 representing “often”. The total score ranges from 0 to 60, and a higher score indicates a higher degree of rumination. In this study, the overall Cronbach's α coefficient for the scale was 0.93, and the Cronbach's α coefficients for the intrusive rumination dimension and the active rumination dimension were 0.91 and 0.89, respectively. The tool has been applied and validated in a number of studies (Li et al., 2022; Feng et al., 2022).

2.4. Chinese version of the Connor-Davidson resilience scale (CD-RISC)

The CD-RISC was published by Connor and Davidson in 2003 (Connor and Davidson, 2003) and translated and revised by Chinese scholar Yu et al. (Yu and Zhang, 2007) It has a total of 25 items and is divided into three dimensions: tenacity, strength, and optimism. Responses are given on a 5-point Likert scale (0–4 points), with 0 representing “never” and 4 representing “always”. The total score ranges from 0 to 100, and a total score ≤ 60 is considered as low-level growth, a total score 61–66 as medium-level growth, and a total score > 66 as high-level growth. The Cronbach's α coefficients for the scale was 0.95, and the Cronbach's α coefficients for the different dimensions were 0.60–0.92. The CD-RISC with 25 items and 3 factors has proven to be a reliable and valid instrument in many studies (Zhong et al., 2022; Xie et al., 2021).

2.5. Post-traumatic growth Inventory-Chinese version (PTGI-C)

The PTGI-C was developed by Tedeschi (Tedeschi and Calhoun, 1996) and revised by Chinese scholars Wang et al. (2011) to assess positive changes experienced by an individual through the processing of traumatic events. The questionnaire includes five dimensions of appreciation of life, personal strength, new possibilities, relating to others, and spiritual change, with a total of 20 items. The Cronbach's α coefficients for the scale and each dimension were 0.94, 0.88, 0.81, 0.79,

Table 1
Participant characteristics and C-ERRI, CD-RISC and PTG scores of healthcare workers among different groups in mobile cabin hospitals, Shanghai, China: 2022 (n = 540).

	n(%)	C-ERRI						CD-RISC						PTGI-C		
		$\bar{x} \pm s$	Overall	P	Intrusive			Deliberate			$\bar{x} \pm s$	t/F	P	$\bar{x} \pm s$	t/F	P
					$\bar{x} \pm s$	t/F	P	$\bar{x} \pm s$	t/F	P						
Total		21.62 ± 10.77			8.62 ± 5.78			13.00 ± 6.11			64.22 ± 15.38			62.25 ± 16.73		
Item equalization		1.08 ± 0.54			0.86 ± 0.58			1.30 ± 0.61			2.57 ± 0.62			3.11 ± 0.84		
Gender			-0.733	0.464												
Male	114 (21.11)	20.96 ± 10.04			8.17 ± 5.35			12.80 ± 5.81			67.05 ± 15.91			64.11 ± 17.15		
Female	426 (78.89)	21.8 ± 10.97			8.74 ± 5.89			13.05 ± 6.20			63.46 ± 15.17			61.75 ± 16.61		
Age (years)			8.308	<0.001												
≤30	207 (38.33)	20.21 ± 10.32			8.01 ± 5.20			12.20 ± 6.20			61.89 ± 15.36			61.76 ± 17.15		
31 ~ 40	279 (51.67)	21.66 ± 10.64			8.58 ± 5.99			13.08 ± 5.83			65 ± 15.09			62.7 ± 16.56		
≥41	54 (10.00)	26.83 ± 11.71			11.20 ± 6.18			15.63 ± 6.54			69.13 ± 15.68			61.83 ± 16.24		
Occupation			1.067	0.345												
Doctor	74 (13.70)	23.19 ± 11.05			9.38 ± 6.02			13.81 ± 6.11			68.88 ± 13.98			61.73 ± 14.33		
Nurse	449 (83.15)	21.32 ± 10.8			8.50 ± 5.75			12.82 ± 6.16			63.24 ± 15.48			62.48 ± 17.17		
Inspector	17(3.15)	22.82 ± 8.41			8.65 ± 5.44			14.18 ± 4.64			69.82 ± 14.48			58.41 ± 15.05		
Working years			0.190	0.827												
0 ~ 5	104 (19.26)	21.25 ± 10.16			7.37 ± 5.00			11.56 ± 6.08			61.23 ± 15.93			63.16 ± 16.11		
6 ~ 10	415 (76.85)	21.77 ± 10.81			8.23 ± 5.31			12.64 ± 6.15			63.43 ± 14.76			62.22 ± 16.77		
≥11	21(3.89)	20.62 ± 13.32			9.21 ± 6.19			13.62 ± 6.04			65.52 ± 15.54			58.33 ± 19.23		
Marital status			1.375	0.170												
Married	405(75)	21.99 ± 10.84			8.87 ± 5.88			13.12 ± 6.13			65.15 ± 15.31			62.45 ± 16.33		
Single	135(25)	20.52 ± 10.52			7.88 ± 5.40			12.64 ± 6.09			61.42 ± 15.3			61.66 ± 17.93		
Parental status			1.991	0.047												
With children	388 (71.85)	22.2 ± 10.88			8.91 ± 5.86			13.29 ± 6.12			65.25 ± 15.39			62.55 ± 16.26		
No children	152 (28.15)	20.15 ± 10.4			7.89 ± 5.51			12.26 ± 6.06			61.59 ± 15.1			61.5 ± 17.93		
Educational level			0.190	0.827												
Junior College	104 (19.26)	21.25 ± 10.16			8.61 ± 5.32			12.64 ± 5.95			60.38 ± 15.58			63.16 ± 16.11		
Undergraduate	415 (76.85)	21.77 ± 10.81			8.65 ± 5.84			13.11 ± 6.11			64.99 ± 15.17			62.22 ± 16.77		
Master's and higher	21(3.89)	20.62 ± 13.32			8.10 ± 6.91			12.52 ± 7.24			68.05 ± 16.14			58.33 ± 19.23		
Department			-0.189	0.850												
Infection/respiratory/ICU/ED	151 (27.96)	21.49 ± 9.7			8.47 ± 5.36			13.02 ± 5.59			63.84 ± 15.86			61.34 ± 17.24		

(continued on next page)

Table 1 (continued)

	n(%)	C-ERRI						CD-RISC						PTGI-C		
		$\bar{x} \pm s$	Overall	P	Intrusive			Deliberate			$\bar{x} \pm s$	t/F	P	$\bar{x} \pm s$	t/F	P
					$\bar{x} \pm s$	t/F	P	$\bar{x} \pm s$	t/F	P						
Other	389 (72.04)	21.67 ± 11.18			8.68 ± 5.94			12.99 ± 6.32			64.37 ± 15.21			62.61 ± 16.54		
Professional title level			4.821	0.008		3.350	0.036		5.190	0.006		4.729	0.009		0.381	0.684
Primary	274 (50.74)	20.48 ± 10.56			8.24 ± 5.53			12.23 ± 6.05			62.67 ± 16.21			62.76 ± 16.79		
Intermediate	226 (41.85)	22.30 ± 10.74			8.70 ± 5.94			13.60 ± 6.05			65.05 ± 14.10			61.51 ± 16.83		
Senior	40(7.41)	25.63 ± 11.41			10.75 ± 6.16			14.88 ± 6.27			70.13 ± 15.03			62.98 ± 16.03		
Prior work experience in a major public health emergency			0.316	0.752		0.438	0.662		0.143	0.887		1.596	0.111		1.495	0.135
Yes	225 (41.67)	21.8 ± 10.67			8.75 ± 5.70			13.04 ± 6.02			65.47 ± 15.54			63.52 ± 17.27		
No	315 (58.33)	21.5 ± 10.86			8.53 ± 5.84			12.97 ± 6.19			63.33 ± 15.23			61.34 ± 16.31		
Psychological intervention or training during COVID-19			3.866	<0.001		3.565	<0.001		3.428	0.001		1.795	0.073		3.575	<0.001
Yes	261 (48.33)	23.45 ± 10.72			9.53 ± 5.92			13.92 ± 5.93			65.44 ± 15.18			64.89 ± 15.59		
No	279 (51.67)	19.91 ± 10.56			7.77 ± 5.52			12.14 ± 6.17			63.07 ± 15.51			59.79 ± 17.41		
Doctor-nurse-patient relationship			-0.581	0.561		-0.978	0.329		-0.101	0.920		-5.850	<0.001		-3.636	<0.001
Dissatisfied	122 (22.59)	21.12 ± 9.78			8.17 ± 5.46			12.95 ± 5.45			57.26 ± 13.4			57.46 ± 16.97		
Satisfied	418 (77.41)	21.77 ± 11.06			8.75 ± 5.87			13.01 ± 6.30			66.25 ± 15.34			63.65 ± 16.42		

0.73, and 0.78, respectively. Each item is ranked using a 6-level scoring method, ranging from 0 points as “completely disagree” to 5 points as “completely agree”. The total score ranges from 0 to 100 points, and a total score ≤ 60 is considered as low-level growth, a total score 61–66 as medium-level growth, and a total score > 66 as high-level growth. The tool has been validated in cancer survivors, stroke survivors, and college students (Quan et al., 2022; Hu et al., 2022).

2.6. Data collection

The survey was conducted for 1 week in June 2022, and participants could only complete it once. This study was approved by the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (No: 2022-162). The respondents were informed by the researchers that their survey contents would be presented in an anonymous form and used only for this study. The survey was conducted via distribution of questionnaires in the form of WeChat questionnaires by researchers who received professional training.

2.7. Data analysis

Statistical analysis was performed using SAS 9.4 software (SAS Institute, Inc., Cary, NC, USA). Normally distributed continuous variables were reported as mean and standard deviation (SD), and Student *t*-test and one-way analysis of variance (ANOVA) were used to identify significant differences among demographic variables. Categorical variables were expressed as numbers and percentages. The total scores represent the average scores of 540 people for each scale (C-ERRI, CD-RISC, and PTGI-C). Item equalization was calculated by dividing the total score for the scale by the number of items. Adjusted *P*-values were obtained by SNK-*q* test in post-hoc analysis. Pearson correlation analysis was conducted to examine the correlations among resilience, rumination, and PTG. Multivariable regression analysis was utilized to identify factors that influenced PTG. $P < 0.05$ was considered significant. In this study, a standardized scoring rate was used to compare scores for each index: Standardized scoring rate = (actual score on each index/full score on each index) $\times 100.00\%$.

Ethical approval

The study was designed and conducted with permission from the hospital. Participants in this study were informed about the purpose and significance of the study in order to obtain their cooperation, and online written consent was provided by those who agreed to participate.

3. Results

3.1. Characteristics of the participating HCWs

The study participants included 426 (78.89 %) women, 449 nurses (83.15 %), and 279 (51.67 %) individuals in the age range of 31–40 years; additional demographic characteristics of the patients are presented in Table 1.

3.2. HCWs' scores for rumination, resilience and PTG

The 540 study participants, the average C-ERRI scores for rumination, intrusive rumination, deliberate rumination, CD-RISC, and PTGI-C were 21.62 ± 10.77 , 8.62 ± 5.78 , 13.00 ± 6.11 , 64.22 ± 15.38 , and 62.25 ± 16.73 , respectively (Table 1). The score rates (percentage relative to total) for intrusive rumination, deliberate rumination, psychological resilience, and PTG were 28.73 %, 43.33 %, 64.22 %, and 62.25 %, respectively.

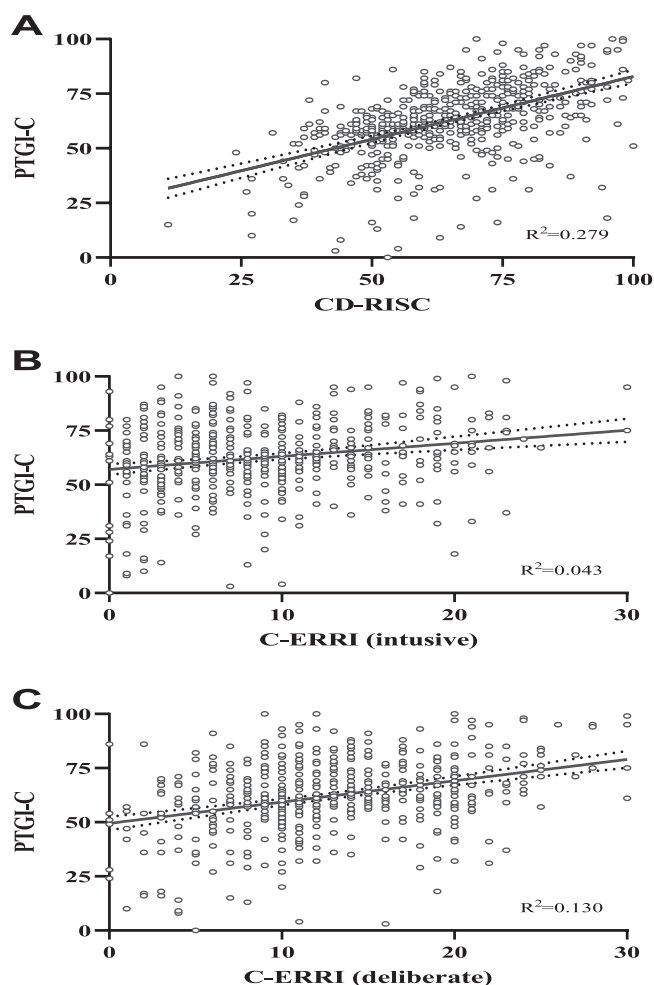


Fig. 1. Scatter plots of relationships between post-traumatic growth (PTGI-C score) and resilience (CD-RISC score), intrusive rumination (C-ERRI intrusive rumination score), and deliberate rumination (C-ERRI deliberate rumination score) of healthcare workers in mobile cabin hospitals, Shanghai, China: 2022 ($n = 540$).

3.3. Correlations of demographic characteristics with rumination, resilience and PTG

Correlation analyses showed that age group, working years, professional title, parental status, and receiving relevant psychological training or intervention during the COVID-19 epidemic were significantly associated with C-ERRI rumination scores. Gender, age, occupation, working years, marital status, parental status, education level, professional title, and satisfaction with doctor–nurse–patient relationship were found to be significantly correlated with the CD-RISC score for psychological resilience. Participation in relevant psychological training or intervention during the COVID-19 epidemic and satisfaction with the doctor–nurse–patient relationship were the only factors found to be significantly associated with the PTGI-C score for PTG. The detail results for other relationships are shown in Table 1.

3.4. Correlations among resilience, rumination and PTG

In each plot, the results from the linear model show that the total scores for psychological resilience, intrusive rumination, and deliberate rumination explained 27.9 %, 4.3 %, and 13.0 % of the variance in the total score of PTG, respectively ($R^2 = 0.279, 0.043, \text{ and } 0.130$; Fig. 1).

Correlation analysis showed that PTG was positively correlated with psychological resilience ($r = 0.528$ and $P < 0.001$), intrusive rumination

Table 2 Correlation analysis of resilience, rumination and PTG scores of healthcare workers in mobile cabin hospitals, Shanghai, China: 2022(n = 540).

Variables	Average ± standard deviation	Post-traumatic growth total score	Insights on life	Personal strength	New possibilities	Relationship with others	Self-transformation	Psychological resilience total score	Intrusive rumination	Deliberate rumination	Relevant ruminant reflection total score
Post-traumatic growth total score	62.25 ± 16.73	1									
Insights on life	21.69 ± 5.30	0.916***	1								
Personal strength	10.02 ± 2.85	0.833***	0.781***	1							
New possibilities	12.22 ± 3.79	0.906***	0.638***	0.590***	1						
Relationship with others	8.25 ± 3.01	0.816***	0.651***	0.615***	0.650***	1					
Self-transformation	10.07 ± 4.26	0.826***	0.517***	0.586***	0.505***	0.629***	1				
Psychological resilience total score	64.22 ± 15.38	0.528***	0.162***	0.149***	0.182***	0.355***	0.339***	1			
Intrusive rumination	8.62 ± 5.78	0.208***	0.310***	0.282***	0.319***	0.153***	0.246***	-0.023	1		
Deliberate rumination	13.00 ± 6.11	0.360***	0.263***	0.240***	0.279***	0.282***	0.357***	0.122**	0.641***	1	
Relevant ruminant reflection total score	21.62 ± 10.77	0.316***	0.263***	0.240***	0.279***	0.242***	0.334***	0.057	0.900***	0.911***	1

Notes: ***p < 0.001; **p < 0.01.

(r = 0.208 and P < 0.001), and deliberate rumination (r = 0.360 and P < 0.001; Table 2). From the traumatic growth sub-scale, the score for psychological resilience was significantly correlated with all PTG sub-scales (r = 0.339–0.586 and P < 0.001; Table 2). Additionally, the score for intrusive rumination was correlated with all PTG sub-scales (r = 0.149–0.246 and P < 0.001), and the score for deliberate rumination was associated with all PTG sub-scales (r = 0.282–0.357 and P < 0.001; Table 2).

3.5. Multivariable linear regression analysis of factors influencing PTG

For multivariable linear regression analysis, psychological training or intervention during the COVID-19 epidemic, satisfaction with the doctor–nurse–patient relationship, psychological resilience, intrusive rumination, and deliberate rumination were set as independent variables to establish a regression equation (Table 3). The results of model 1 showed that psychological training or intervention during COVID-19 epidemic and satisfaction with doctor–nurse–patient relationship were significantly associated with PTG. Model 2 added psychological resilience as a variable in addition to those in Model 1 and found that psychological resilience explained an additional 24.5 % of variance in PTG, which is the main influencing factor of PTG. Psychological resilience was positively correlated with PTG (β = 0.557 and P < 0.001). Model 3 added two additional variables, intrusive rumination and deliberate rumination, to the base Model 1. Deliberate rumination was significantly positively correlated with PTG (β = 1.045 and P < 0.001), whereas intrusive rumination was negatively correlated with PTG (β = -0.171 and P = 0.253). Model 4 added psychological resilience, intrusive rumination, and deliberate rumination to the base Model 1. The results showed that psychological training or intervention during the COVID-19 epidemic (β = 2.353 and P = 0.044), psychological resilience (β = 0.525 and P < 0.001), and deliberate rumination (β = 0.732 and P < 0.001) were positively correlated with PTG.

4. Discussion

First, the psychological resilience of HCWs included in this study was medium level, and the level of mental resilience of nurses was relatively low. This is different from the results of a study from Turkey, which showed that the level of mental resilience of doctors was lower than that of nurses (Bozdağ and Ergün.,2021). A systematic review of studies in the United States showed that the psychological resilience of health professionals depends on dynamic processes of interaction between individual factors, environmental factors, training on coping strategies, and interventions to improve psychological resilience (Huey and Palaganas, 2020). In the present study, higher levels of psychological resilience were observed among HCWs who were male, older, and married as well as those who had children, a higher education level, and a higher professional title, and those who were satisfied with the doctor–nurse–patient relationship (P < 0.05). This is consistent with the results of previous studies (Nourollahi-Darabad et al., 2021).

Therefore, to improve psychological resilience among all HCWs, hospital management staff should devote efforts to supporting medical personnel who are nurses, female, younger, single and childless, who have relatively low education levels and professional titles, and who have poor satisfaction with the doctor–nurse–patient relationship. These HCWs will likely benefit from adequate social support, and from sufficient theoretical and skill training to enhance their abilities and confidence to deal with emergencies.

Second, front-line HCWs exhibited low levels of rumination after working in mobile cabin hospitals, and deliberate rumination of these individuals was positively correlated with psychological resilience, which is consistent with a study of hemodialysis patients (Li et al.,2018). The scores for both intrusive rumination and deliberate rumination did increase with increasing age, more working years, and more advanced professional title (P < 0.05). Also, HCWs who have received

Table 3

Multivariable linear regression analysis of factors influencing PTG of healthcare workers in mobile cabin hospitals, Shanghai, China: 2022 (n = 540).

Variables	β	SE	SD	t	P	Adjust R2	F	P
						(ΔR^2)		
Model 1						0.043	13.180	<0.001
Psychological training or intervention during COVID-19 epidemic	5.053	1.410	0.151	3.584	<0.001			
Satisfaction with doctor–nurse–patient relationship	6.140	1.684	0.154	3.645	<0.001			
Model 2						0.288(0.245)	73.696	<0.001
Psychological training or intervention during COVID-19 epidemic	3.766	1.22	0.113	3.088	0.002			
Satisfaction with doctor–nurse–patient relationship	1.145	1.499	0.029	0.764	0.445			
CD-RISC	0.557	0.041	0.512	13.626	<0.001			
Model 3						0.159(0.116)	26.403	<0.001
Psychological training or intervention during COVID-19 epidemic	3.486	1.34	0.104	2.601	0.010			
Satisfaction with doctor–nurse–patient relationship	6.189	1.582	0.155	3.913	<0.001			
C-ERRI (intrusive)	−0.171	0.150	−0.059	−1.144	0.253			
C-ERRI (deliberate)	1.045	0.141	0.382	7.394	<0.001			
Model 4						0.368(0.325)	63.866	<0.001
Psychological training or intervention during COVID-19 epidemic	2.353	1.164	0.070	2.021	0.044			
Satisfaction with doctor–nurse–patient relationship	1.345	1.418	0.034	0.949	0.343			
CD-RISC	0.525	0.039	0.482	13.366	<0.001			
C-ERRI (intrusive)	0.103	0.131	0.035	0.780	0.435			
C-ERRI (deliberate)	0.732	0.125	0.268	5.876	<0.001			

psychological training or intervention had higher levels of intrusive rumination and deliberate rumination ($P < 0.05$). A study from Shenzhen, China also found that during the COVID-19 epidemic, a greater number of working years was associated with a higher level of intrusive rumination among front-line anti-epidemic HCWs, consistent with the results of the present study (Li et al., 2022). Studies have also shown that positive work reflection is associated with well-being (Labrague and De Los Santos, 2020; Weigelt et al., 2019). Therefore, organizations can take measures to promote deliberate rumination to improve employees' work and life motivation and satisfaction.

Third, intrusive rumination was not significantly associated with psychological resilience and even showed a trend of negative correlation. A study on the psychological state of college students showed that intrusive rumination was significantly negatively related to psychological resilience during the pandemic. However, the relationship between intrusive reflection and resilience may be different in different groups of people and environments.

Fourth, the results of this study confirming that the total score for PTG represented a moderate growth level. This is consistent with findings from a 2020 study in the United States (Feingold et al., 2022). A study in China in the early days of the COVID-19 outbreak revealed high levels of PTG (Cui et al., 2021), and HCWs in Greece also reported moderate to low levels of PTG (Kalaitzaki et al., 2022). The above studies showed that the level of PTG among front-line HCWs working during the epidemic varied greatly, which may be related to factors such as the duration of the epidemic periods and differences in cultural backgrounds.

Studies have shown that effective coping is an important factor in achieving PTG (Tedeschi and Calhoun, 2004). In the present study, HCWs who participated in any form of psychological training or intervention during the fight against COVID-19 and who were satisfied with the doctor–nurse–patient relationship experienced a significantly higher level of PTG ($P < 0.05$) than those who did not participate in related training or were dissatisfied with the doctor–nurse–patient relationship. It may be because psychological training or intervention can improve HCWs' psychological adjustment ability. Our results showed that satisfaction with the doctor–nurse–patient relationship was a factor significantly associated with the PTG score. A previous study of doctor–patient relationships (DPRs) showed a higher DPR score during the COVID-19 pandemic than before the COVID-19 pandemic, which also enhanced the professional identity and sense of achievement of doctors to some extent and promoted their PTG, consistent with our conclusion (Zhou et al., 2021). Therefore, it is necessary to strengthen front-line HCWs' psychological training and intervention to improve satisfaction with the

doctor–nurse–patient relationship.

Fifth, psychological resilience and rumination were positively correlated with PTG among front-line HCWs aiding Shanghai. Studies on victims of earthquakes, second victims, and growth of college students all have shown that both of rumination and psychological resilience are positively correlated with PTG, which is consistent with the results of the current study (Sun et al., 2022; Wu et al., 2015; Xu et al., 2022). When individuals experience trauma, intrusive rumination stimulates deliberate rumination, and deliberate rumination can promote changes or enrich people's existing cognition to help them better understand trauma and achieve PTG (Kim and Bae, 2019). Individuals with higher psychological resilience have richer psychological resources, which can help them effectively relieve negative emotions caused by unfavorable environments, correctly adjust their own psychological state, and promote self-improvement growth and formation of PTG.

In the present study, the factor showing the strongest correlation with PTG level was psychological resilience ($r = 0.528$), and psychological resilience explained an additional 24.5 % of variation in PTG, indicating that for front-line HCWs in Shanghai, psychological resilience was the main factor affecting PTG. Therefore, improving the environmental adaptability and regulation ability of front-line HCWs in Shanghai will help their PTG.

The effect of intrusive rumination on PTG was not statistically significant in this study ($P > 0.05$), which may be different in different people and environments. Therefore, hospital management personnel can improve the psychological resilience and rumination potential of HCWs through precise interventions and guide HCWs to recognize the positive meaning of traumatic events and achieve self-growth.

5. Limitations and future research

The present study has several limitations. 1) The study did not include factors such as social support level, physical condition, working hours per week, workload, sleep quality, the most worrying factors regarding the working environment, the cognitive level of Omicron infection risk, etc., which limited the analysis of influencing factors for PTG. 2) The inclusion of HCWs from within Chongqing in China may have introduced cultural bias. Therefore, a follow-up study should be carried out to increase the representativeness of the sample by cluster sampling of medical professionals in Chinese mobile cabin hospitals. 3) Additionally, its cross-sectional study, this study cannot explain dynamic changes in front-line HCWs' PTG. 4) In this study, differences in satisfaction with the doctor–nurse–patient relationship were not analyzed between doctors, nurses, and genders. 5) In the collection of

participants' basic information, satisfaction with the doctor–nurse–patient relationship was evaluated using a single question rather than a scale.

6. Conclusion

The present study demonstrated that relevant psychological training or intervention during the COVID-19 epidemic, psychological resilience, and deliberate rumination were influencing factors for the PTG of HCWs during the post-epidemic period. Among these factors, psychological resilience was the main influencing factor. Therefore, to improve the physical and mental health of HCWs and promote PTG, it is important to provide psychological training and interventions to improve psychological resilience and promote positive reflection on their time working under the Normalization of Epidemic Prevention and Control Requirements. This study provides a reference for hospital management personnel to plan and provide targeted and scientific normalized training methods, psychological support, and management mechanisms for HCWs.

CRedit authorship contribution statement

Hongmei Yi: Writing – review & editing, Writing – original draft, Supervision, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sha Wei:** Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Mingzhao Xiao:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Data curation, Conceptualization. **Qinghua Zhao:** Writing – review & editing, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Liang Chen:** and **Jian Zhai:** Software, Investigation, Conceptualization. **Jingyan Song:** Investigation, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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Appendix A. Supplementary data

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