



## Relationship between rumination and post-traumatic growth in mobile cabin hospital nurses: The mediating role of psychological resilience

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### ABSTRACT

Psychological resilience helps individuals to actively respond to various emergencies, but its mediating role between the rumination and post-traumatic growth (PTG) of nurses remains unknown. Our study aimed to explore the extent to which psychological resilience mediates the association between rumination and PTG among nurses working in mobile cabin hospitals. This cross-sectional survey was conducted on 449 medical team members working in mobile cabin hospitals to support the prevention and control of coronavirus disease 2019 in Shanghai, China in 2022. Pearson correlation analysis was applied to assess the correlation between rumination, psychological resilience, and PTG. Structural equation models were used to examine the mediating role of psychological resilience between rumination and PTG. Our study results showed that deliberate rumination directly promoted psychological resilience and PTG and had positive effects on PTG through the mediating effect of psychological resilience. Invasive rumination had no direct effect on PTG. However, it had a negative effect on PTG through the mediating effect of psychological resilience. Together the results of this study indicate that the mediating effect of psychological resilience was significant in the association of rumination and PTG among mobile cabin hospital nurses, with a higher individual psychological resilience level helping nurses to achieve PTG. Therefore, targeted interventions should be implemented to improve nurses' psychological resilience and guide their rapid growth.

### 1. Introduction

As of 16 December 2022, 647 million confirmed cases of coronavirus disease 2019 (COVID-19) had been reported worldwide along with 6,642,832 deaths, representing a major disaster for global health and healthcare systems (World Health Organization, 2019). To actively manage this highly infectious and widespread epidemic disease, the Chinese government established mobile cabin hospitals with the concept of "life first" to reduce spreading from virus-infected patients to their families and communities (Shi et al., 2022). Staff in mobile cabin hospitals are faced with unprecedented challenges due to their strange working environment, unfamiliar working partners, urgent on-duty time, high risk of infection, rapidly changing work dynamics, and

heavy workload (Liu et al., 2020; Ashley et al., 2021; Bennett et al., 2020; Fernández-Castillo et al., 2021). Recent studies have shown that up to 40% of nursing staff working during the COVID-19 pandemic suffer from negative emotions like fear, anxiety, depression, and so on (Eftekhar et al., 2021; Chew et al., 2020; Danet, 2021), which has caused severe psychological trauma. In mobile cabin hospitals, most nurses are female (Zhou et al., 2020; Xie et al., 2021). Compared with men, female workers face more serious mental health challenges (Chen et al., 2021; Aggar et al., 2022). An analysis of the existing literature showed that although most recent studies have focused on the relationship between nurses' mental health and post-traumatic growth (PTG), analysis of mediating effects between psychological resilience, rumination, and PTG of nurses in mobile cabin hospitals is lacking. Such an analysis is

Abbreviations: PTG, post-traumatic growth; COVID-19, coronavirus disease 2019.

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needed to gain a full understanding of the psychological development process of front-line nurses in the process of fighting the epidemic. Therefore, the purpose of this study was to investigate the status of PTG among mobile cabin hospital nurses and analyze the mediating effect of psychological resilience between rumination and PTG.

The term PTG refers to a positive psychological perspective that emphasizes an individual's efforts or growth after experiencing a traumatic event or adversity. Although the term has been extensively explored in the existing literature, which reveals the complexity of the definition, no unified conclusion has been reached (Tehrani-neshat and Torabizadeh, 2021; Casellas-Grau et al., 2017; Joseph et al., 2012). In addition, some scholars have proposed the measurement defects of self-reported PTG but have not provided standard psychometric methods for PTG to avoid cognitive bias. Therefore, this study continues to use the currently widely used definition of Tedeschi and Calhoun and its related measurement tools (Tedeschi and Calhoun, 2004). PTG is mainly reflected in the positive changes in self-understanding, relationships with others, and philosophical views of life. This concept focuses more on the individual's transcendence in psychological function or life consciousness than the pre-traumatic adjustment level. In recent years, with the outbreak of COVID-19, research on PTG among front-line nursing staff has gradually increased, analyzing their PTG experience, factors that influence their PTG, intermediary effects of PTG, and other aspects (Yim and Kim, 2022; Feingold et al., 2022; Cui et al., 2021; Atay et al., 2022; Lyu et al., 2021). Psychological resilience is a positive adaptation process in which individuals respond to adversity, trauma, threat, or other major stresses (American Psychology Association, 2022). In the context of COVID-19, nurses' psychological resilience was shown to remain at a moderate level (Atay et al., 2022; Labrague, 2021) and to be influenced by various topics such as individual factors, environmental and organizational factors, individual actions in occupational activities, and effective educational interventions (Huey and Palaganas, 2020). Research has shown that a high level of psychological resilience is a fundamental variable in reducing and preventing negative psychological development among nurses during the pandemic, contributing to personal PTG (Atay et al., 2022). Over time, psychological resilience and PTG influence each other, forming a reciprocal circular relationship (Lyu et al., 2021). Nevertheless, the mechanism by which psychological resilience influences PTG among mobile cabin hospital nurses has not been established.

Rumination refers to the cognitive processing process through which individuals achieve growth after a traumatic event via purposeful and active meditation on the event, and invasive rumination involves negative and repeated passive recall of the traumatic event itself (Cann et al., 2011). At present, most studies of the effects of rumination have focused on patient groups, and few studies have examined rumination among nurses. A structural equation model for psychiatric nurses in Korea demonstrated that deliberate rumination has a direct impact on PTG, and prediction is the most important role among the analyzed factors (Yeo and Park, 2020). A Chinese survey of frontline nurses fighting the epidemic found that invasive rumination is negatively associated with PTG, and deliberate rumination is positively correlated with PTG, playing a protective role in the PTG of frontline nurses (Cui et al., 2021).

Although these recent studies separately investigated the relationship between psychological resilience and rumination or psychological resilience and PTG, the mediating effect of psychological resilience between rumination and PTG in nurse groups has not been effectively explored. To address this gap in knowledge, the present study recruited nurses working in mobile cabin hospitals to treat COVID-19 patients in Shanghai as the research participants to explore the intermediary relationship between psychological resilience, rumination, and PTG, in order to provide guidance for a more complete understanding of the predictors of nurses' PTG and strategies to increase their PTG level.

## 2. Methods

### 2.1. Study design and participants

The random sampling method was used to select nurses 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 level of a college degree or above; and 3) experience as a front-line nurse treating COVID-19 patients in a mobile cabin hospital under the Normalized Epidemic Prevention and Control Requirements. Nurses were excluded if their data were incomplete or an obvious inconsistency in their data was detected.

### 2.2. Measurements

#### 2.2.1. General demographic information

The questionnaire for collecting the general demographic information of the participants was designed by the investigator according to the study objectives and included questions regarding gender, age, working years, marriage status, number of children, educational level, professional title, previously responded to a major public health emergency, and received psychological interventions or training during the COVID-19 pandemic.

#### 2.2.2. Chinese version of the Event-related rumination Inventory

The Chinese version of the Event-related Rumination Inventory (Dong et al., 2013) was used to assess participants' rumination levels. The scale includes two dimensions of invasive rumination and deliberate rumination with 10 items for each. The response to each item is scored from 0 (never) to 3 (often), for a total score range of 0–60. A higher score reflects a stronger rumination level. In this study, the Cronbach's alpha coefficient of the overall scale was 0.892, and those for the invasive rumination and deliberate rumination dimensions were 0.92 and 0.929, respectively.

#### 2.2.3. Chinese version of the Connor-Davidson resilience scale

The Chinese version of the Connor-Davidson Mental Resilience Scale (Yu and Zhang, 2007) was used to assess the level of psychological resilience of the participants in this study. The scale includes 25 items covering three dimensions: tenacity, strength, and optimism. The response to each item is scored from 0 (never) to 4 (always), for a total score range of 0–100. A higher score indicates a better level of resilience. In this study, the Cronbach's  $\alpha$  coefficient for the scale was 0.951, and the Cronbach's  $\alpha$  coefficients for the three dimensions of resilience, strength, and optimism were 0.924, 0.889, and 0.704, respectively.

#### 2.2.4. Chinese version of the posttraumatic growth inventory

The Chinese version of the Post-traumatic Growth Scale, compiled by American scholars Tedeschi and Calhoun (2004) and revised by Chinese scholars Wang et al. (2011), was used to assess the positive changes achieved following the traumatic events. This scale contains 20 items covering five dimensions of life perception, personal strength, new possibilities, relationships with others, and self-transformation. The response to each item is scored from 0 (completely disagree) to 5 (fully agree), for a total score range of 0–100. A higher score reflects a higher level of PTG. In this study, the Cronbach's  $\alpha$  coefficient for this scale was 0.938.

### 2.3. Data collection and analysis

Data collection was conducted by professionally trained researchers via online questionnaires. Participants received a thank you letter sent with the questionnaire, instead of payment, as appreciation for their participation in the study. The participants were guaranteed confidentiality of the study data to ensure their privacy and improve the

authenticity of the reported data. In this study, 449 questionnaires were distributed, and 418 valid questionnaires were selected, with an effective recovery rate of 93.10%. SAS 9.4 software (SAS Institute, Inc.) was used to perform the statistical analyses. Structural equation models were used to investigate the mediating role of psychological resilience between rumination and PTG. To determine whether the normalization coefficient ( $\beta$ ) was statistically significant, we used a two-way bootstrapping 95% confidence interval (95% CI) based on a  $\beta$  of 5,000 bootstrapped samples. With this method, if the 95% CI for  $\beta$  does not contain zero, the mediating or direct effect is considered significant ( $P < 0.05$ ).

**Ethical approval**

This study was approved by the ethics committee of our hospital (approval number: 2022-162). 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. Basic characteristics of nurses associated with PTG**

Overall, 418 nurses completed the survey, of which 78.23% were female ( $n = 327$ ); 52.87% were aged 30–40 years ( $n = 221$ ). The results of univariate analysis indicated that receiving psychological intervention or training during the COVID-19 pandemic was significantly associated with PTG scores ( $P < 0.001$ ). The general demographic characteristics of the participants and the corresponding PTG scores of participants with those characteristics are presented in **Table 1** with the results from univariate analysis of associations between these characteristics and nurses' PTG.

**3.2. Correlation analysis among psychological resilience, rumination, and PTG**

Analysis of the correlation between rumination, psychological resilience, and PTG showed that invasive rumination was negatively correlated with PTG ( $r = -0.171, P < 0.01$ ) and psychological resilience ( $r = -0.226, P < 0.01$ ) separately, whereas deliberate rumination was positively correlated with PTG ( $r = 0.283, P < 0.01$ ) and psychological resilience ( $r = 0.247, P < 0.01$ ) separately. Psychological resilience was positively correlated with PTG ( $r = 0.579, P < 0.01$ ). The detailed results of the correlation analysis are presented in **Table 2**.

**3.3. Analysis of mediating effects of psychological resilience on rumination and PTG based on a structural equation model**

A structural equation model was constructed to explore the mediating effects of psychological resilience on PTG and rumination. The fit degree of the constructed structural model was  $\chi^2/df = 3.765$ , with a goodness of fit index = 0.996, normed fit index = 0.985, incremental fit index = 0.989, Tucker–Lewis index = 0.931, comparative fit index = 0.988, standardized root mean square residual = 0.033, and root mean square error of approximation = 0.081. The statistical excellence of the fit of the model confirmed that the theoretical model was in good agreement with the data. The standardized path coefficient for the structural equation model is shown in **Fig. 1**, and the path test results are presented in **Table 3**.

In this study, the AMOS bootstrap method was used to test the mediating effect of psychological resilience, and the results showed that invasive rumination could not directly affect PTG ( $\beta = -0.067, 95\%CI: -0.155, 0.021$ ), but could negatively affect PTG through psychological resilience ( $\beta = -0.131, 95\%CI: -0.195, -0.075$ ). Additionally,

**Table 1**  
Demographic characteristics of the participants and differences of PTG scores according to different sample characteristics.

Variable	Number	Percentage	Average PTG score	F/t	P
Gender				-0.690	0.491
Male	91	21.77%	61.44 ± 17.04		
Female	327	78.23%	63.60 ± 15.53		
Age (years)				0.040	0.961
≤30	189	45.22%	62.67 ± 16.40		
31–40	221	52.87%	62.31 ± 15.65		
≥41	18	4.31%	61.83 ± 12.96		
Working years				0.488	0.614
0–5	63	15.07%	62.62 ± 18.07		
6–10	157	37.56%	63.36 ± 15.89		
≥11	198	47.37%	61.69 ± 15.11		
Marriage status				-0.363	0.717
Married	296	70.81%	62.27 ± 15.45		
Unmarried	122	29.19%	62.89 ± 16.86		
Number of children				-0.342	0.732
≥1	280	66.99%	62.27 ± 15.46		
0	138	33.01%	62.83 ± 16.69		
Education level				0.262	0.770
High school degree	92	22.01%	61.64 ± 15.36		
Bachelor's degree	324	77.51%	62.72 ± 16.05		
Master's degree or above	2	0.48%	57.50 ± 3.54		
Professional title				0.355	0.701
Primary	248	59.33%	62.04 ± 16.11		
Intermediate	159	38.04%	62.89 ± 15.67		
Advanced	11	2.63%	65.55 ± 13.46		
Previously responded to a major public health emergency				0.840	0.401
Yes	175	41.87%	63.22 ± 16.96		
No	243	58.13%	61.90 ± 14.11		
Received psychological interventions or training during the COVID-19 pandemic				3.660	<0.001
Yes	200	47.85%	65.38 ± 15.02		
No	218	52.15%	59.78 ± 16.17		

deliberate rumination directly and positively affected PTG ( $\beta = 0.159, 95\%CI: 0.058, 0.254$ ) and also indirectly affected PTG through psychological resilience ( $\beta = 0.141, 95\%CI: 0.092, 0.200$ ). Psychological resilience had a significant mediating effect between deliberate rumination and PTG, accounting for 46.84% of the total effect. The detailed results for direct effects, indirect effects, and 95% CIs from the structural equation models are presented in **Table 4**.

Using the same data analysis method, we investigated the mediating effects of resilience on rumination and PTG. The results showed that

**Table 2**  
Pearson correlation analysis of correlations among psychological resilience, types of rumination, and PTG by participants.

Variable	Score	PTG	Life perception	Personal strength	New possibilities	Relationships with others	Self-transformation	Psychological resilience	Invasive rumination	Deliberate rumination
PTG	62.45 ± 15.858	1								
Life perception	10.32 ± 3.994	0.813**	1							
Personal strength	8.28 ± 2.808	0.799**	0.626**	1						
New possibilities	12.20 ± 3.633	0.905**	0.667**	0.756**	1					
Relationships with others	10.04 ± 2.668	0.863**	0.602**	0.561**	0.745**	1				
Self-transformation	21.61 ± 5.357	0.892**	0.581**	0.580**	0.736**	0.810**	1			
Psychological resilience	63.28 ± 15.707	0.579**	0.386**	0.355**	0.523**	0.626**	0.574**	1		
Invasive rumination	8.59 ± 5.639	-0.171**	-0.107*	-0.105*	-0.155**	-0.194**	-0.169**	-0.226**	1	
Deliberate rumination	12.64 ± 6.393	0.283**	0.271**	0.224**	0.244**	0.233**	0.238**	0.247**	0.095	1

\*\*P < 0.01.

invasive rumination had negative effects on life perception, personal strength, new possibilities, relationship with others and self-transformation through the mediating effect of resilience, and no direct effect was produced, indicating that it acts only as a mediator. In addition to personal strength, deliberate rumination not only exerted a direct positive influence on life perception, new possibilities, relationship with others, self-transformation and other variables but also exerted an indirect influence on various dimension factors through the mediating effect of psychological resilience. The indirect effect accounted for 56.47%, 49.62%, 35.17% and 31.10% of the total effect, respectively. Resilience had a positive effect on the relationship between purposive rumination and personal strength, acting only as a mediator. Tables 5–9 list the direct and indirect effects of mental toughness on various dimensional factors and the detailed results with 95% CIs.

#### 4. Discussion

In the present study, we explored the mediating effect of psychological resilience on the relationship between rumination, both invasive and deliberate, and PTG. The structural equation model fitted in this study showed that psychological resilience partially mediated the association between deliberate rumination and PTG, accounting for 46.84% of the total effect. Our results also showed that deliberate rumination can directly promote psychological resilience and PTG as well as influence the PTG through the mediating effect of psychological resilience. In contrast, invasive rumination had no direct effect on PTG but did show a negative effect on PTG through the mediating influence of psychological resilience.

The PTG score of the front-line nurses included in this study was medium, which was lower than that of Zhang et al. (2021) and Peng et al. (2021) in China, but higher than that of nurses in relevant studies in South Korea (Hyun et al., 2021) and Israel (Dahan et al., 2022). Potential reasons for these differences include: the nurses who supported the Shanghai epidemic learned from the experience of the Wuhan epidemic prevention and control, and the nurses showed less negative emotions such as anxiety and fear. In addition, the successful experience in fighting the epidemic in Wuhan had strengthened nurses' confidence in China's anti-epidemic measures. Therefore, the PTG of nurses in this study was relatively weak. Another potential explanation may be that compared with the participants of studies in other countries, the respondents in the present study consisted of team members who voluntarily registered to work in mobile cabin hospitals on the frontline of the COVID-19 pandemic and underwent a strict qualification examination administered by the National Health Administration Department. Therefore, the research participants in our study had strong learning and emergency response abilities, and therefore, were able to achieve a strong level of PTG. In this study, univariate analysis of socio-demographic data revealed a significant correlation between PTG scores and nurses who had received psychological intervention or training during the fight against COVID-19. Nurses who had received psychological intervention had higher PTG scores and thus showed higher psychological resilience and less poor mental health (Brooks et al., 2020), similar to previous findings (Zhang et al. 2021; Peng et al. 2021). Together the evidence suggests that during emergency situations, psychological training or intervention provided by medical institutions can help to reduce negative emotions such as fear and anxiety among medical staff and thereby improve the work efficiency of nurses and their PTG after trauma. However, different from the results of Rzeszutek et al. (Rzeszutek et al., 2016) and Vishnevsky et al. (Vishnevsky et al., 2010), gender factors in our study did not show statistically significant effects on participants' PTG scores. The reasons may be related to the large difference in the proportions of male and female nurses included in this study. To further explore the effect of gender differences on PTG scores of nurses, future large-sample studies on gender balance need to be carried out.

Pearson correlation analysis showed that invasive rumination was

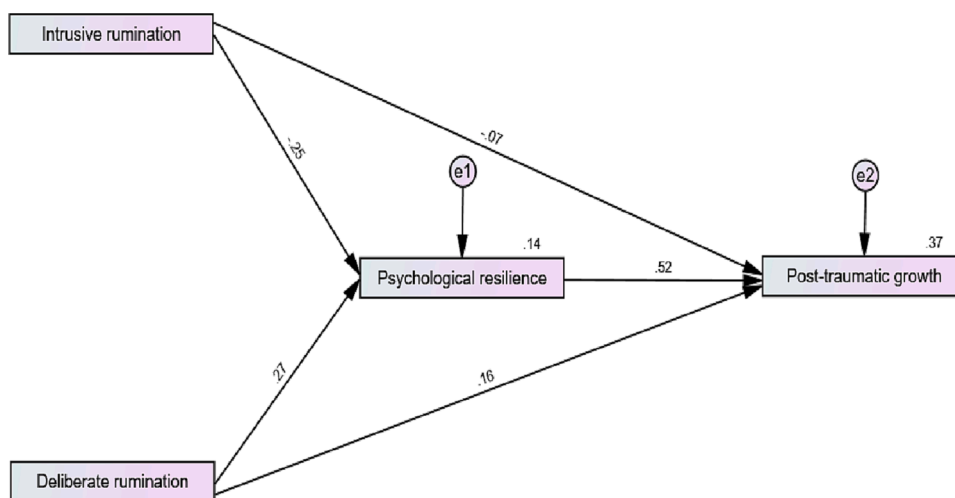


Fig. 1. Normalized pathway coefficient diagram.

**Table 3**  
Results of the standardized pathway coefficient tests for participants.

Exogenous variable	Path	Endogenous variable	Non-standardized regression coefficient	Standardized regression coefficient	S.E.	C.R.	P
Invasive rumination	→	Psychological resilience	-0.701	-0.250	0.128	-5.488	<0.001
Deliberate rumination	→	Psychological resilience	0.667	0.270	0.113	5.919	<0.001
Psychological resilience	→	PTG	0.529	0.525	0.042	12.528	<0.001
Invasive rumination	→	PTG	-0.190	-0.067	0.114	-1.669	0.095
Deliberate rumination	→	PTG	0.397	0.159	0.101	3.926	<0.001

SE: Standard Error; C.R: T-values.

**Table 4**  
Direct effects, indirect effects, and 95% confidence intervals for the mediating effect of psychological resilience on PTG for participants.

Effect type	Path	Effect value	LLCI	ULCI	P
Direct effect	Invasive rumination → PTG	-0.067	-0.155	0.021	0.140
Indirect effect	Invasive rumination → Psychological resilience → PTG	-0.131	-0.195	-0.075	<0.001
Total effect	Invasive rumination → PTG	-0.198	-0.289	-0.105	<0.001
Direct effect	Deliberate rumination → PTG	0.159	0.058	0.254	0.002
Indirect effect	Deliberate rumination → Psychological resilience → PTG	0.141	0.092	0.200	<0.001
Total effect	Deliberate rumination → PTG	0.301	0.190	0.396	<0.001

LLCI: lower level of confidence interval; ULCI: upper level of confidence interval.

significantly negatively correlated with psychological resilience and PTG among the nurses in the present study, whereas deliberate rumination showed a significant positive correlation with psychological resilience and PTG. These results are consistent with the factors found to influence the PTG of frontline nurses in the study by Cui et al (2021). The results of a pathway analysis of the PTG of nurses in South Korea showed that deliberate rumination was the variable with the largest and most direct effect on nurses' PTG, while uncontrolled invasive rumination caused emotional pain among nurses (Yim and Kim, 2022). Invasive rumination immediately after a traumatic event and real-time deliberate rumination are the active and effective responses aiming to explore and address the problem, while real-time invasive rumination is more likely to bring uncontrollable negative emotions and subsequently negative

**Table 5**  
Mediating effects of resilience on rumination and life perception by participants.

Effect type	Path	Effect value	LLCI	ULCI	P
Direct effect	Invasive rumination → Life perception	-0.059	-0.162	0.042	0.265
Indirect effect	Invasive rumination → Psychological resilience → Life perception	-0.133	-0.200	-0.076	0.000
Total effect	Invasive rumination → Life perception	-0.193	-0.293	-0.093	0.001
Direct effect	Deliberate rumination → Life perception	0.111	0.022	0.194	0.014
Indirect effect	Deliberate rumination → Psychological resilience → Life perception	0.144	0.092	0.206	0.000
Total effect	Deliberate rumination → Life perception	0.255	0.162	0.338	0.000

physiological experiences, with outcomes such as lower efficiency and poor work quality (Kurebayashi, 2020; Williams and Moulds, 2010; Newby and Moulds, 2012). A US psychoeducational group study reported significant differences in the levels of psychological resilience and PTG before and after the experimental intervention (Sawyer et al., 2022). Therefore, after an emergency, leaders should seek to prevent the occurrence of invasive rumination among nurses to the maximum extent through purposeful intervention measures and to actively promote conversion to achieve deliberate rumination, which will help nurses to adopt helpful ways to deal with difficult events, cultivate a more positive attitude, and improve their ability to cope with future work challenges and setbacks.

This study found that psychological resilience had a significant mediating effect on the relationship between rumination and PTG. Similar to this conclusion, Finstad et al. (2021) found that a high level of

**Table 6**  
Mediating effects of resilience on rumination and personal strength by participants.

Effect type	Path	Effect value	LLCI	ULCI	P
Direct effect	Invasive rumination → Personal strength	-0.070	-0.154	0.012	0.102
Indirect effect	Invasive rumination → Psychological resilience → Personal strength	-0.147	-0.215	-0.082	0.000
Total effect	Invasive rumination → Personal strength	-0.217	-0.304	-0.125	0.000
Direct effect	Deliberate rumination → Personal strength	0.094	-0.002	0.184	0.056
Indirect effect	Deliberate rumination → Psychological resilience → Personal strength	0.158	0.104	0.221	0.000
Total effect	Deliberate rumination → Personal strength	0.252	0.147	0.340	0.001

**Table 7**  
Mediating effects of resilience on rumination and new possibilities by participants.

Effect type	Path	Effect value	LLCI	ULCI	P
Direct effect	Invasive rumination → New possibilities	-0.060	-0.151	0.029	0.195
Indirect effect	Invasive rumination → Psychological resilience → New possibilities	-0.119	-0.177	-0.067	0.000
Total effect	Invasive rumination → New possibilities	-0.179	-0.274	-0.079	0.001
Direct effect	Deliberate rumination → New possibilities	0.131	0.027	0.231	0.016
Indirect effect	Deliberate rumination → Psychological resilience → New possibilities	0.129	0.083	0.182	0.000
Total effect	Deliberate rumination → New possibilities	0.260	0.147	0.359	0.000

**Table 8**  
Mediating effects of resilience on rumination and relationship with others by participants.

Effect type	Path	Effect value	LLCI	ULCI	P
Direct effect	Invasive rumination → Relationship with others	-0.051	-0.143	0.041	0.268
Indirect effect	Invasive rumination → Psychological resilience → Relationship with others	-0.077	-0.125	-0.041	0.000
Total effect	Invasive rumination → Relationship with others	-0.127	-0.218	-0.030	0.010
Direct effect	Deliberate rumination → Relationship with others	0.153	0.041	0.253	0.007
Indirect effect	Deliberate rumination → Psychological resilience → Relationship with others	0.083	0.050	0.130	0.000
Total effect	Deliberate rumination → Relationship with others	0.236	0.126	0.333	0.000

psychological resilience and positive coping strategies are positive factors that promote individual growth, and psychological resilience is the only important predictor of PTG. Individuals with greater psychological resilience show higher levels of tolerance in response to traumatic events; a lower incidence of negative emotions such as anxiety, depression, and burnout; and more actively cope with difficulty and self-recovery, thus showing higher levels of PTG. A longitudinal study of

**Table 9**  
Mediating effects of resilience on rumination and self-transformation by participants.

Effect type	Path	Effect value	LLCI	ULCI	P
Direct effect	Invasive rumination → Self-transformation	-0.052	-0.138	0.035	0.241
Indirect effect	Invasive rumination → Psychological resilience → Self-transformation	-0.082	-0.133	-0.043	0.000
Total effect	Invasive rumination → Self-transformation	-0.133	-0.219	-0.044	0.004
Direct effect	Deliberate rumination → Self-transformation	0.195	0.084	0.296	0.000
Indirect effect	Deliberate rumination → Psychological resilience → Self-transformation	0.088	0.054	0.134	0.000
Total effect	Deliberate rumination → Self-transformation	0.283	0.171	0.381	0.000

psychological resilience and PTG among frontline healthcare workers in China revealed a reinforcing cycle of psychological resilience and PTG over time, and the relationship between the two gradually increased as the intensity of traumatic events increased (Lyu et al., 2021). Another study with a sample of Chinese college students explored the internal mechanism of PTG on resilience and found that students with higher PTG scores tended to report more positive coping strategies, which improved their own resilience (Li and Hu, 2022). Based on the above mediating relationship, we conducted an in-depth analysis of the relationship between resilience and the dimensions of PTG and found that invasive rumination could not directly affect PTG and its dimensions, but had a negative effect on PTG and its dimensions through the mediating effect of psychological resilience. This is consistent with the results of Chinese scholars Sun et al. (2022). This result suggests that traumatized individuals should be alert to the occurrence of invasive rumination after traumatic events and its possible adverse consequences and actively seek social help and adjust their self-status to reduce the occurrence of a series of negative hazards such as invasive rumination. Fortunately, we also found a positive promoting effect of resilience in the relationship between deliberate rumination and PTG. The indirect effect of life perception (56.47%) and new possibilities (49.62%) accounted for the highest proportion of the total effect, and the relationship with others (35.70%) and self-transformation dimension (31.17%) accounted for the lowest proportion of the total effect, indicating that the psychological growth process of individuals after experiencing traumatic events, such as consciousness awakening, is more obvious than the actual behavioral changes of individuals themselves, which provides a way for researchers to take measures to improve the level of individual PTG.

### 5. Strengths and limitations

This study promotes the relevant research in this field in the following aspects. First, our findings provide clear evidence for the effect of resilience on PTG among medical personnel responding to COVID-19 in China. Second, our study reveals resilience as a mechanism that can explain the relationship between rumination and PTG, which helps us understand how rumination influences PTG. The present study also has several limitations. First, the online survey was conducted using a structured questionnaire for a period of time after the end of the Shanghai support measures for the COVID-19 outbreak which may not have allowed for a timely and in-depth understanding of various elements of the survey. Second, this study is a cross-sectional survey, so it cannot provide a longitudinal understanding of the three relationships over a longer period of time. Accordingly, Future research should include a broader group of nurses, through long-term cohort studies, to explore in depth the interplay between rumination, psychological

resilience, and PTG.

## 6. Conclusion

In this study, structural equation modeling was used to analyze the mediating effect of psychological resilience on the relationship between rumination and PTG among nurses working in mobile cabin hospitals. The results showed a significant mediating effect of psychological resilience on both factors and indicate that targeted training, education, and other interventions can improve the psychological resilience of nurses in distressing conditions, which will help promote deliberate rumination among the nurses, leading to improvements in their PTG.

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## Author contribution

The conception and design of the study protocol were completed by HY and SW. HY conducted the data collection. JL, HY and SW jointly sorted out and analyzed the data. JL was responsible for drafting the first draft of this paper. JL and HY participated in the revision of the article. DW, GQ, LN, XG, and XW participated in the data collection and the design and revision of the article.

## 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

Data will be made available on request.

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