

## Posttraumatic Growth and Influencing Factors in Nurses during the COVID-19 Pandemic: A Scoping Review

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### Abstract

**Objective:** This scoping review aimed to systematically clarify the posttraumatic growth (PTG) in nurses and related influencing factors during the COVID-19 pandemic. **Methods:** This scoping review screened, included, sorted, and analyzed relevant studies on the nurses' PTG during the COVID-19 pandemic before 25 December 2022 in databases, including PubMed, Wiley, Web of Science, Elsevier, Embase, and the Cochrane Library. **Results:** A total of 20 studies were included. The results showed that PTG scores varied from  $43.80 \pm 14.65$  (nurses who worked in designated hospitals in South Korea) to  $97.09 \pm 18.47$  (nurses who worked within Hubei Province, China). We analyzed the recurring objective factors and identified that age and marital status were the most common influencing factors, while fertility status, working environment, working time, religion, education, position, gender, and previous training or working experience also affected the PTG. Second, several subjective factors such as social or family support, resilience, deliberation, and several psychological problems were also related to PTG. **Conclusions:** Realizing PTG and related factors in nurses during the COVID-19 pandemic is conducive to formulating intervention measures to help nurses cope with traumatic stress disorder and burnout and improving their mental health too.

Key words: COVID-19; posttraumatic growth; nurse; scoping review

### 1 Introduction

It has been three years since the first COVID-19 pandemic. Scholars and researchers have developed a series of diagnosis and treatment programs to help society control the pandemic during this period (Khamees et al., 2022). There is no doubt that these programs are helpful. Meanwhile, the variant (now Omicron) has shown less patients' hospitalization rate and mortality (Fan et al., 2022), that provided the possibility for the world to return to normal. However, with the gradual opening of the world, the general view that a safe environment has not arrived immediately but has been replaced by multiple infection rates (Singhal, 2022). Whether young children, young people, or elderly people cannot avoid such scale social spreads, the number of patients will increase sharply in the near future. Not surprisingly, social and medical resources are facing enormous challenges and crises as the Omicron variant spreads rapidly, and medical staff undoubtedly played a crucial role in the crisis (Emami et al., 2021).

Alarmingly, most medical staff who were infected with COVID-19 had to continue to work with their feeble bodies. They experienced unprecedented physical, mental, and emotional strain and seemed to take on more responsibilities in their work. As well as long working hours, weak bodies, surrounding medical environment, etc., directly or indirectly caused fatigue and burnout of medical staff. Similarly, it also exposed many problems, such as the increase of psychological barriers of medical staff and the increase of turnover rate (Carmassi et al., 2020). The study (Blanco-Daza et al., 2022) found that the global prevalence of posttraumatic stress disorder (PTSD) during the COVID-19 pandemic increased sharply, especially among ward workers and nurses. Incredibly, nurses' prevalence of psychological disturbances seems to be even higher than doctors' (Kunz et al., 2021).

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According to the survey (Blanco-Daza et al., 2022), the majority PTSD in nursing staff was high, and nearly 50% of nurses experienced PTSD. At the same time, there was also a high job burnout among nurses (Galanis et al., 2021). Although nurses usually experienced high burnout, nurses showed a higher burnout during the COVID-19 pandemic according to the study (Sullivan et al., 2022), and also led to the occurrence of traumatic stress and the growth of turnover rate (Zeihner et al., 2022). So, we hope to focus on the mental health problems of nurses during the COVID-19 pandemic to improve the current situation, and these posttraumatic problems need to be solved. Posttraumatic growth (PTG) is used to test the positive effects of the population after experiencing adverse events, and the ability to recover from trauma (DursunSöylemez, 2020).

For first-line nursing staff who have experienced the COVID-19 epidemic, their PTG is closely associated with their recovery of routine life. Understanding the nursing staff's PTG during the COVID-19 pandemic will be conducive for existing psychological barriers of nurses and making nurses better balance their work and lives, as well as also conducive to providing corresponding support for medical unit leaders and government workers to spend this opening crisis (Clements et al., 2021). Whereas, we rapidly reviewed the studies focused on nurses since the COVID-19 pandemic and conducted a scoping review to clarify nurses' PTG, relevant influencing factors, interview results, etc. We hope that our results can provide a preliminary understanding of the PTG and recovery ability of nurses during the pandemic, then providing a basis for nursing managers to formulate management or incentive measures.

## 2 Methods

### 2.1 Protocol and registration

This study was a scoping review according to the criteria of PRISMA Extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018). Additionally, we pre-registered on the OSF Registries before retrieval. Then, we propose two questions as follows:

- 1- How was the posttraumatic growth in nurses during the COVID-19 pandemic?
- 2- What were the influencing factors of posttraumatic growth for nurses?

### 2.2 Information Sources

We searched databases including PubMed, Wiley, Web of Science, Elsevier, Embase, and the Cochrane Library to obtain relevant literature about the nurses' PTG during the COVID-19 pandemic before 25 December 2022. We used the following strategy in PubMed: ((“posttraumatic growth” OR PTG OR “post traumatic growth” OR “benefit finding” OR “stress related growth” OR “psychological posttraumatic growth” OR “positive psychology” OR “psychological growth” OR “perceived benefit”[Title/Abstract]) OR (Posttraumatic Growth, Psychological[MeSH Terms])) AND (Corona OR “SARS-CoV-2” OR “COVID 19” OR “2019 nCov” OR COVID-19[Title/Abstract]) AND ((“nursing personnel” OR “nursing staff” OR nurs\* OR nurse\*[Title/Abstract]) OR (nurses[MeSH Terms]))

### 2.3 Study selection

We used Endnote 9.1 to screen literature. After removing the same articles, two researchers initially screened according to the title and abstract. Then, two researchers conducted re-screening and cross-checking based on the downloaded full text, and the third researcher made the final decision.

### 2.4 Eligibility Criteria

We screened and included the studies strictly following the principle of PICO, and all included articles were officially published. Additionally, we excluded articles without data, letters to editors, and articles that could not determine the research object to improve the quality of our study.

### 2.5 Data Charting Process

In data collation, we mainly rely on Excel (Microsoft Corporation), including the study's first author, study setting, recruitment, study time, country, study population, sample size, age, working experience, PTG, and PTG evaluating indicator. At the same time, we sorted out the statistical methods of all articles and extracted influencing factors based on them (e.g., univariable analyses, correlation/bivariate analyses, multivariable analyses, and mediating structural equation models).

### 2.6 Summarize and Organize the Results

According to the two questions raised, we respectively summarized tables for the nurses' PTG during the COVID-19 pandemic and its influencing factors to clarify this scoping review's subject.

### 3 Results

#### 3.1 Sources of Evidence

The article screening flow chart is shown in Figure 1. We retrieved 145 relevant articles and finally included 20 articles for this study, and the study enrolled 12 596 nurses.

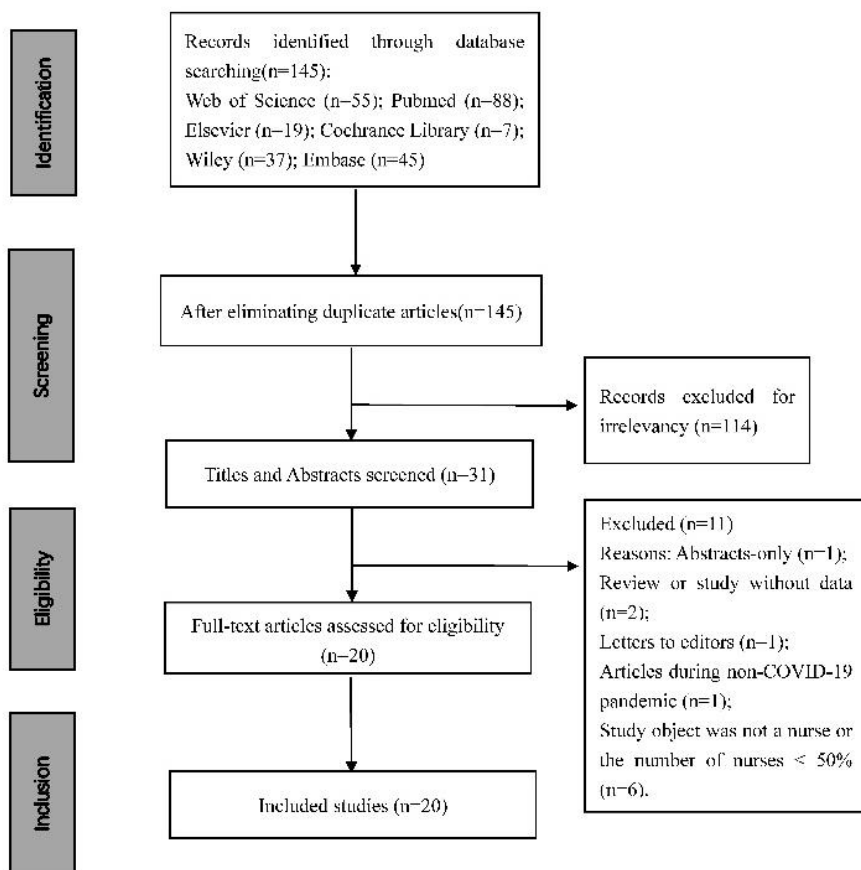


Figure 1 The article screening flow chart

#### 3.2 Study Characteristics

The study methods and main outcome indicators were described in detail in the 20 studies included, and the primary characteristics are shown in Table 1. There were 14 cross-sectional surveys (Aggar et al., 2022; Atay et al., 2022; Chen et al., 2021; Cui et al., 2021; Dahan et al., 2022; Jiang et al., 2022; Li et al., 2022; Liu et al., 2021; Mo et al., 2021; Peng et al., 2021; Prekazi et al., 2021; Saralioğlu et al., 2022; Yeung et al., 2022; YimKim, 2022), three qualitative studies (AydinBulut, 2022; Foli et al., 2021; Jiang et al., 2022), one prospective cohort study (Zhang et al., 2022), one program evaluation (Pfeiffer et al., 2023), and one narrative investigation (KimLee, 2021). There were 13 studies (Aggar et al., 2022; Atay et al., 2022; Chen et al., 2021; Cui et al., 2021; Dahan et al., 2022; Foli et al., 2021; Jiang et al., 2022; KimLee, 2021; Li et al., 2022; Liu et al., 2021; Mo et al., 2021; Peng et al., 2021; Yeung et al., 2022) during the early stage of the pandemic in 2020, five studies (AydinBulut, 2022; Pfeiffer et al., 2023; Prekazi et al., 2021; Saralioğlu et al., 2022; YimKim, 2022) in 2021, and 2 studies (Jiang et al., 2022; Zhang et al., 2022) in 2022. Half of the study data came from China, and other studies were from Korea (KimLee, 2021; Yeung et al., 2022), the United States (Foli et al., 2021; Pfeiffer et al., 2023), Israel (Dahan et al., 2022), Australia (Aggar et al., 2022), Turkey (Atay et al., 2022; AydinBulut, 2022; Saralioğlu et al., 2022), and Kosovo (Prekazi et al., 2021).

Most studies analyzed nurses as the independent samples, and only two studies (Prekazi et al., 2021; Zhang et al., 2022) mixed with other groups. Recruitment is as follows: most studies (Chen et al., 2021; Cui et al., 2021; Foli et al., 2021; Li et al., 2022; Mo et al., 2021; Pfeiffer et al., 2023) were recruited via online platforms (WeChat, a questionnaire website platform, online marketing, etc.), three study data (KimLee, 2021; Peng et al., 2021; YimKim, 2022) were from designated hospitals, one study (Jiang et al., 2022) used purposeful sampling, four studies (Aggar et al., 2022; Jiang et al., 2022; Liu et al., 2021; Zhang et al., 2022) used convenience sampling, two studies (AydinBulut, 2022; Saralioğlu et al., 2022) used snowball sampling, three studies (Atay et al., 2022; Dahan

et al., 2022; Yeung et al., 2022) used cluster sampling, and one study (Prekazi et al., 2021) via public health facilities.

### 3.3 Posttraumatic Growth in Nurses during the COVID-19 Pandemic

Most studies reported specific PTG scores. Three studies (AydinBulut, 2022; Foli et al., 2021; Jiang et al., 2022) were qualitative and had no particular PTG scores, and one study (Pfeiffer et al., 2023) involved data with pre/post-intervention. We only involved data before the intervention to reduce bias. Additionally, although two studies (Liu et al., 2021; Zhang et al., 2022) reported the PTG scores, we preferred them to be the single-item scores, so they were not involved in the final analysis.

The results had several heterogeneities due to the different measurement tools. For the PTG, we mainly discussed the study data using the Post-Traumatic Growth Inventory (PTGI), and nine studies (Atay et al., 2022; Cui et al., 2021; Jiang et al., 2022; KimLee, 2021; Li et al., 2022; Mo et al., 2021; Peng et al., 2021; Prekazi et al., 2021; YimKim, 2022) used this scale. We identified that PTG scores varied from  $43.80 \pm 14.65$  (nurses who worked in designated hospitals in South Korea) to  $97.09 \pm 18.47$  (nurses who worked within Hubei Province, China), and the median of PTG in 9 studies was 69.95. Moreover, nurses who worked in China showed a higher PTG ranging from  $63.28 \pm 23.41$  to  $97.09 \pm 18.47$ . Other countries showed lower PTG. For example, nurses who worked in South Korea scored  $43.80 \pm 14.65$ , and Kosovo scored 47.13.

### 3.4 Influencing Factors of Posttraumatic Growth in Nurses during the COVID-19 Pandemic

We summarized and charted the factors associated with nurses' PTG during the COVID-19 pandemic according to the statistical methods of each study. Three qualitative studies (AydinBulut, 2022; Foli et al., 2021; Jiang et al., 2022) did not have statistical tests on the factors related to nurses' PTG. The remaining 17 studies carried out statistical analysis on the factors associated with it, and 8 (Atay et al., 2022; Chen et al., 2021; Cui et al., 2021; Jiang et al., 2022; KimLee, 2021; Mo et al., 2021; Peng et al., 2021; Saralioğlu et al., 2022) of them described the results of univariable analyses, ten studies (Aggar et al., 2022; Atay et al., 2022; Cui et al., 2021; Dahan et al., 2022; KimLee, 2021; Li et al., 2022; Liu et al., 2021; Saralioğlu et al., 2022; Yeung et al., 2022; YimKim, 2022) undertook correlation/bivariate analyses, twelve studies (Chen et al., 2021; Cui et al., 2021; Dahan et al., 2022; Jiang et al., 2022; KimLee, 2021; Li et al., 2022; Mo et al., 2021; Peng et al., 2021; Pfeiffer et al., 2023; Prekazi et al., 2021; Saralioğlu et al., 2022; Yeung et al., 2022) undertook multivariable analyses, and three studies (Liu et al., 2021; Prekazi et al., 2021; Zhang et al., 2022) undertook mesmeric effect/model. At the same time, we distinguished subjective factors and objective factors to better understand the determinants of PTG. The bold materials are objective factors, while the rest are subjective factors (Table 2).

We analyzed the recurring objective factors and identified that age and marital status were the most common influencing factors that appeared in 5 studies respectively. Kim's study (KimLee, 2021) mentioned that nurses aged under 25 and over 31 years old had higher PTG, and other studies (Cui et al., 2021; Yeung et al., 2022; Zhang et al., 2022) only mentioned that older nurses had higher PTG. Among the 5 studies (Cui et al., 2021; KimLee, 2021; Li et al., 2022; Mo et al., 2021; Yeung et al., 2022) on marital status, three studies (Cui et al., 2021; KimLee, 2021; Yeung et al., 2022) believed that married nurses had higher PTG ability. Similarly, fertility status (Li et al., 2022; Mo et al., 2021; Peng et al., 2021; Yeung et al., 2022) was also a common influencing factor, nurses with children (Peng et al., 2021; Yeung et al., 2022) showed stronger PTG. Second, the working environment and working time also seriously affected nurses' PTG, the PTG of nurses working in critical care units (Chen et al., 2021), severely affected areas (Atay et al., 2022; Mo et al., 2021), and hospitals directly contacting COVID-19 patients (Chen et al., 2021; Pfeiffer et al., 2023) was higher. Meanwhile, Kim (KimLee, 2021) referred to that the PTG of nurses who worked for less than one year or more than ten years was higher, and other studies (Chen et al., 2021; Cui et al., 2021; Dahan et al., 2022) only mentioned that the PTG of nurses who worked for longer was high. Similarly, daily working hours and the number of visits (Mo et al., 2021; Yeung et al., 2022) also affected PTG, and part-time nurses might have stronger recovery ability (Atay et al., 2022). In addition, religion (Dahan et al., 2022; KimLee, 2021; Yeung et al., 2022), education (Cui et al., 2021; Mo et al., 2021; Zhang et al., 2022), position (Cui et al., 2021; KimLee, 2021; Li et al., 2022), gender (Li et al., 2022; Saralioğlu et al., 2022), and previous training or working experience (Chen et al., 2021; Cui et al., 2021) were also the decisive factors of PTG. Yan's results (Zhang et al., 2022) showed that nurses with high education had more capable of coping with trauma; Saralioğlu's results (Saralioğlu et al., 2022) showed that female was better than male; as well as nurses who had previous experience in public health emergencies, psychological intervention, or training during COVID-19 showed the stronger growth ability (Cui et al., 2021).

The subjective factors were not significantly centralized compared with the objective factors, but we still sorted out the repeated subjective factors (Table 2). The most frequent influencing factor in included studies was social or family support. Five studies (Atay et al., 2022; KimLee, 2021; Mo et al., 2021; Peng et al., 2021; YimKim, 2022) mentioned that nurses with any support would have higher PTG. Similarly, several nurses worried that their family members would be infected affecting the PTG results (Yeung et al., 2022).

Then, resilience (Atay et al., 2022; Dahan et al., 2022; Liu et al., 2021; Zhang et al., 2022) also played an essential role in the influencing factors of nurses' PTG; equally important was the degree of deliberation (Cui et al., 2021; KimLee, 2021; YimKim, 2022). The nurses' calling (KimLee, 2021; Mo et al., 2021; Yeung et al., 2022) and professional benefits (Liu et al., 2021) were also associated with PTG. Cui's study (Cui et al., 2021) mentioned that several nurses had confidence in the frontline work, while others worried about the high risk of the frontline making the PTG fluctuate. In addition, nurses' psychological problems were needed more attention. Eight studies (Aggar et al., 2022; Jiang et al., 2022; Li et al., 2022; Liu et al., 2021; Prekazi et al., 2021; Saralioğlu et al., 2022; Yeung et al., 2022; YimKim, 2022) showed the impact of multiple psychological problems on PTG. PTSD was positively correlated with PTG (Jiang et al., 2022; YimKim, 2022), and emotional issues (e.g., anxiety, depression, subjective well-being) (Aggar et al., 2022; Li et al., 2022; Yeung et al., 2022) and coping ability (Aggar et al., 2022; Li et al., 2022; Prekazi et al., 2021; Saralioğlu et al., 2022) were also the main related factors of PTG. Then, the subjective factors shown by Saralioğlu's results (Saralioğlu et al., 2022) showed that some nurses needed psychiatric or psychological help after the pandemic, while several nurses who volunteered to participate in the COVID-19 treatment also had higher PTG (KimLee, 2021).

Finally, we found similar results in the summary of qualitative research data. As mentioned in the descriptive results of Aydin (AydinBulut, 2022), nurses' PTG during the epidemic period was associated with the spiritual transformation of self and changes in relationships with others. Jiang (Jiang et al., 2022) summarized relevant themes as team resilience and social support, and Foli (Foli et al., 2021) also mentioned the positive influence of others. They were similar to the psychological problems and social support mentioned above in statistical results.

Table 1 Studies primary characteristics

First Author	Study Setting	Recruitment	Study Time	Country	Study Population	Sample Size	Age ( year )	PTG	Evaluating Indicator
Ruey Chen	A cross-sectional survey	via specialized groups in the WeChat app and hospitals through paper surveys	April 2020	Beijing, Taipei China	nurses	12596	33.1±7.5	28.0±11.5	Post-traumatic Growth Inventory-Short Form (PTGI-SF)
Yoojung Kim	A narrative investigation	designated hospital	November 2020	Korea	nurses	194	31.0±8.5	46.54±14.19	Korea-Post Traumatic Growth Inventory(K-PTGI)
Pan pan Cui	A cross-sectional survey	via WeChat	February 2020	China	frontline nurses	167	30(median age)	70.53±17.26	Post-Traumatic Growth Inventory (PTGI)
Xin Peng	A cross-sectional survey	designated hospital	April 2020	China	frontline nurses	116	34.07	65.65±11.50	Post-Traumatic Growth Inventory (PTGI)
Yuanyuan Mo	A cross-sectional descriptive study	online survey (via a questionnaire website platform)	February to April 2020	China	nurses	266	32.34±6.01	96.26±21.57	Post-Traumatic Growth Inventory (PTGI)
Xiaoxin Liu	A cross-sectional survey	convenience sampling	May 2020	China	frontline nurses	200	32.28±6.21	3.18 ± 1.06	Posttraumatic growth inventory(PTGI)
Karen J. Foli	A qualitative study	via the research webpage and	from June to September 2020	the United States	registered nurses	105	34±10	-	-

		an alumni list							
Hu Jiang	A cross-sectional survey	convenience sampling via WeChat	February 2020	China	nurses	3419	30.39±5.95(working outside Hubei Province) 30.32±5.52(working within Hubei Province)	95.27±18.07(working outside Hubei Province) 97.09±18.47(working within Hubei Province)	Post-traumatic growth inventory (PTGI)
Nelson Chun-Yiu Yeung	A cross-sectional survey	cluster sampling via email	from August to September 2020	Hong Kong, China	nurses working in hospitals and community settings	1510	36.8% of them were 30 to 39	-	Posttraumatic Growth Inventory-Short Form (PTGI-SF)
Lin Li	A cross-sectional survey	via mobile phone app	March 2020	China	nurses	455	33.51±5.94	63.28±23.41	Posttraumatic growth inventory questionnaire (PTGI)
Sagit Dahan	A cross-sectional study	text message to 800 registered members	April 2020	Israel	mental health nurses	183	47.00±10.71	3.01±0.81	Questionnaire PTG-Inventory
Christina Aggar	A cross-sectional study	convenience sample via email	from September to November 2020	Australia	emergency nurses	767	45.93±11.95	21.60±11.72	Posttraumatic Growth Inventory-short form
Nuvit Atay	A cross-sectional study	cluster sampling	from June to September 2020	Turkey	nurses working at the pandemic clinics	263	32.14±8.21	69.95±15.73	Posttraumatic Growth Inventory (PTGI)
Arzu Saralioğlu	A cross-sectional study	snowball sampling	from April to August 2021	Turkey	nurses who tested first positive	175	47.4% of the nurses were between the ages of 19-29	50.98 ± 25.30	Post-Traumatic Growth Scale

					inCOVID-19 PCR				
Ruveyde Aydin	A descriptive qualitative study	snowball sampling	January 2021	Turkey	nurses diagnosed with and treated for COVID-19	18	-	-	-
Katherine Pfeiffer	A program called "Compassion & Growth Workshops" evaluation	via online marketing	from January to March 2021	the United States	registered and advanced practice nurses	163	-	pre: 2.4 (1.2-2.5)	Posttraumatic Growth Inventory-Expanded Version (PTGI-X)
LulejetePrekazi	A cross-sectional and correlational survey	via public health facilities	January 2021	Kosovo	physicians, nurses and other healthcare providers	691	41.6±10.79	47.13	Posttraumatic growth inventory(PTGI)
Ju Young Yim	A cross-sectional survey	designated hospital	from April to May 2021	South Korea	nurses	229	30.28 ± 4.57	43.80±14.65	Post-traumaticgrowth inventory (PTGI)
Jinxia Jiang	A phenomenological qualitative study and individual semistructured interviews	purposeful sampling	June 2022	China	first-line emergency nurses	13	26.33±3.75	-	-
Zhang Yan	A prospective cohort study	convenience sampling	from March 2022 to March 2022	China	doctors or nurses	565	31.07±6.58(older) 28.74±4.13(younger)	2.89±1.14(T1) 3.04 0.92(T2) 3.40±0.80(T3)	Post-traumatic growth inventory (PTGI)



Table 2 Influencing factors

First Author	Influencing Factors	Statistical Methods
Ruey Chen	<b>1-worked in critical care units; 2-cared for patients with COVID-19; 3-worked in a COVID-19-designated hospital</b>	univariable analyses
	<b>1-cared for patients with COVID-19; 2-maslach Burnout Inventory; 3-trauma Screening Questionnaire; 4-tenure</b>	multivariable analyses
Yoojung Kim	<b>1-under 25 and over 31 years old; 2-clinical experience under 1 year and over 10 years; 3-married; 4-religious beliefs; 5-position; 6-willing to participate in the nursing of new infectious diseases</b>	univariable analyses
	1-family support; 2-peer support; 3-calling; 4-deliberate rumination	correlation/bivariate analyses
	<b>1-religion; 2-calling; 3-deliberate rumination</b>	multivariable analyses
Pan pan Cui	<b>1-older; 2-married; 3-had a higher level of education; 4-had a higher professional title; 5-had more working years; 6-participated in previous major public health emergencies; 7-received psychological intervention or training during COVID-19; 8-had confidence about performing frontline work; 9-were aware of the high risk of frontline work</b>	univariable analyses
	1-rumination; 2-deliberate rumination; <b>3-age; 4-education; 5-working years; 6-professional title; 7-previous experience in public health emergencies; 8-psychological intervention or training during COVID-19; 9-felt well prepared for frontline work; 10-confidence about frontline work; 11-awareness of the risk of frontline work</b>	correlation/bivariate analyses
	<b>1-working years; 2-psychological intervention or training during COVID-19; 3-confidence about frontline work; 4-awareness of the risk of frontline work; 5-deliberate rumination</b>	multivariable analyses
Xin Peng	<b>1-had child/children; 2-reported physical discomfort; 3-got support from family and friends during the epidemic</b>	univariable analyses
	<b>1-had children; 2-any physical discomfort; 3-get support from family and friends during the epidemic</b>	multivariable analyses
Yuanyuan Mo	<b>1-different education profiles; 2-marital statuses; 3-fertility statuses; 4-whether nurses were from other provinces to support Hubei Province; 5-working hours per day</b>	univariable analyses

	<b>1-whether nurses moved from other provinces to support Hubei Province;</b> 2-professional self-identity; 3-social support	multivariable analyses
Xiaoxin Liu	1-intent to stay; 2-resilience; 3-perceived professional benefits	correlation/bivariate analyses
	posttraumatic growth and perceived professional benefits mediated the effects of resilience on intent to stay	mesmeric effect /model
Karen J. Foli	experience and exposure to positive significant others (e.g. parents, peers and friends)	content analysis
Hu Jiang	posttraumatic stress disorder	univariable analyses
	posttraumatic stress disorder	multivariable analyses
Nelson Chun-Yiu Yeung	<b>1-older; 2-married; 3-had children; 4-had a religious affiliation; 5-worked non-full-time;</b> 6-higher levels of worries about contracting COVID-19 from work; 7-worried about family members becoming infected with COVID-19; 8-psychological distress; 9-work satisfaction	correlation/bivariate analyses
	<b>1-had a religious affiliation;</b> 2-higher levels of worries about contracting COVID-19 from work; 3-worried about family members contracting COVID-19 due to their work; 4-psychological distress; 5-work satisfaction; 6-distress×satisfaction with workplace pandemic control guidelines	multivariable analyses
Lin Li	<b>1-sex; 2-marriage status; 3-professional titles;</b> 4-fertility; 5-anxiety; 6-ways to cope with stress	correlation/bivariate analyses
	<b>1-marriage status;</b> 2-ways to cope with stress	multivariable analyses
Sagit Dahan	1-personal resilience; <b>2-national resilience</b>	correlation/bivariate analyses
	<b>1-higher religiosity levels; 2-higher professional seniority</b>	multivariable analyses
Christina Aggar	1-pandemic-related stress; 2-low depression; 3-low anxiety; 4-psychological adjustment outcomes; 5-subjective well-being	correlation/bivariate analyses
Nuvit Atay	<b>1-worked for the hospital in Istanbul; 2-stayed at hotels; 3-had no communication problems with the healthcare team; 4-weekly working hour(s); 5-the number of visits to patients</b>	univariable analyses

	<b>1-weekly working hours; 2-number of visits; 3-psychological resilience</b>	correlation/bivariate analysis
Arzu Sarialioğlu	<b>1-gender(female)</b>	univariable analyses
	1-transformative power of pain	correlation/bivariate analysis
	<b>1-age; 2-gender;</b> 3-need for psychiatric or psychological help after the pandemic; 4-transformative power of pain	multivariable analyses
Ruveyde Aydin	1-spiritual change; 2-changes in relationships with others; 3-changes in priorities; 4-appreciation of life	thematic analysis
Katherine Pfeiffer	<b>1-direct patient care×microretreat attendance</b>	multivariable analyses
LulejetePrekazi	<b>1-period of attending to COVID-19 patients</b>	multivariable analyses
	1-coping skills on the relationship between mental health and post-traumatic growth; 2-coping skills	mesmeric effect /model
Ju Young Yim	1-deliberate rumination; 2-posttraumatic stress disorder; 3-social support	correlation/bivariate analysis
	1-deliberate rumination; 2-posttraumatic stress disorder; 3-social support	mesmeric effect /model
Jinxia Jiang	1-mobilization of psychological capital; 2-stimulation of team resilience; 3-perceived social support	Colaizzi’s phenomenological seven-step method
Zhang Yan	<b>1-older age; 2-higher education;</b> 3-greater resilience	mesmeric effect /model

#### 4. Discussion

This scoping review summarized the PTG and its influencing factors in nurses during the COVID-19 pandemic for the first time. The PTG scales were different, so the final results had significant heterogeneity that we could only get partial results from the 20 studies. We identified that the median PTG score was 69.95 under the results of the same scale. The nurses' PTG in this study is lower than the survey data ( $PTGI=78.1\pm 23.5$ ) of general nurses before the pandemic (Okoli et al., 2021). It is not difficult to see the impact of the COVID-19 pandemic on nurses, both physical and psychological injuries may exist for a long time. At the same time, we also considered the PTG of patients with COVID-19. The results showed that although the nurses' PTG during the pandemic was lower, it was also better than that of patients in the same period ( $PTGI=45.10\pm 18.87$ ) (özgüç et al., 2022). These showed that although nurses' growth during the COVID-19 pandemic was not as good as before, they were still stronger than patients. It may be because nurses have more vital recovery abilities due to various sudden traumatic events they have been facing for a long time. Moreover, we also compared the PTG of other high-risk occupations, and the PTG score of firefighters before the epidemic was  $65.39\pm 23.80$  (Sun et al., 2020). There is not much difference between the two sides. It may be associated with the similar working environment and work content of both parties. Whereas, we should fully consider the change in nurses' environment, grasp the negative factors in the work and life, and prepare for improving PTG.

Clarifying the factors associated with PTG is the key to improving nurses' PTG. The 20 studies included all described subjective or objective factors related to PTG, which may provide a reference for nursing leaders and government departments to develop incentive measures.

Among the most mentioned objective factors, personal conditions such as age, marital status, and fertility status were more common. This is similar to the results of many studies (García et al., 2022; Zhang et al., 2022) about PTG. The older and more experienced nurses tend to be accompanied by stronger coping ability, and higher recovery after trauma. The results also proved this point again that the senior nurses with more clinical experience also had higher PTG scores, it may be because they experienced similar work environments (such as large influenza (Hyun et al., 2021)). This type of nurses knew better how to adjust work and lives. So, managers should give more care and spiritual support to young and single nurses to help them cope with the sudden pandemic. Second, nurses with previous experience in public health emergencies, psychological intervention, or training during COVID-19 showed high PTG scores. This also indicates the necessity of psychological support. Nurses who experienced training better understand how to deal with sudden problems, which was conducive to self-regulation. Therefore, medical institutions could redeploy relevant training to help nurses better adapt to the pandemic environment (Schulz-Quach et al., 2022). Moreover, nurses' PTG with long working hours, low education, and no religion were not ideal. Nursing managers should focus on the future and provide reasonable material welfare or spiritual support for these nurses to balance their cumbersome work tasks. Sarılioğlu's results (Sarılioğlu et al., 2022) also marked that female was better than male. Though the nurse as a career with a large number of females, we cannot ignore the needs of males. Regular male nurse communication and activities may be meaningful.

On the other hand, the subjective factors provided by nurses should also be emphasized. Support from all aspects of society and various psychological problems had the most impact on PTG. Of course, this was also the result of most studies (Ning et al., 2023). Support such as social support, family support, and peer support can improve nurses' abilities to cope with stress to a certain extent and enhance their ability to grow after trauma (Zhang et al., 2022). So, healthcare professionals should strengthen their sensitivity to multiple support in nurses' lives, mobilizing nurses' families and colleagues to promote each other and overcome difficulties together. For psychological problems, psychological support and counseling are essential. If conditions permit, nurses may participate in psychological counseling or courses regularly or hold on peer communications to relieve their psychological pressure. Then, our results showed that resilience was a significant influence factor, and deliberation also appeared frequently. This may be because the nurses have a complete understanding after deliberation, and they are more explicit about how to deal with the current pressure to improve PTG. Meanwhile, a 10-year cohort study (Chen et al., 2022) as well as showed that people's PTG was closely associated with resilience, and different resilience trajectories showed different PTG. So, we can classify nurses by distinguishing different degrees of resilience, and take more personalized measures to provide support.

## 5. Limitations

Whereas, we summarized and sorted out 20 published studies, including qualitative or quantitative data, but that was not enough. First, although we reported global data, there was only one article in Korean and the rest in English, which may lead to data loss from other countries. Next, most studies remained at the early stage of the pandemic, and the data summarized may not be consistent with the current situation. Meanwhile, most studies were cross-sectional surveys without follow-up, which may affect the final results. Therefore, nurses' PTG will continue to change with the continuous development of the COVID-19 pandemic. Future research can continue to explore the deep factors or interactions that affect nurses' PTG based on our study to precisely formulate incentive and promotion plans.

## 6. Conclusions

The above contents have preliminarily sorted out the nurses' PTG during the COVID-19 pandemic, and the results showed that the nurses' PTG was lower than before the pandemic. Relevant factors of PTG mainly involved personal situations, working environments, psychological problems encountered, etc. Therefore, medical units and managers should fully consider nurses' personal problems, such as marriage, fertility status, social support status, etc. and form effective incentives as soon as possible to improve the PTG of follow-up nurses.

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