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Resilience and Mindfulness as Factors of Posttraumatic Stress and Growth Among Chinese Healthcare Workers During the COVID-19 Pandemic: Mediation via Adaptive Coping and Stigmatisation

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ABSTRACT

Experiences during the COVID-19 pandemic may be traumatic to healthcare workers (HCWs). This study investigated the associations of resilience and mindfulness with posttraumatic stress symptoms (PTSS) and posttraumatic growth (PTG), and the mediation role of adaptive coping and stigmatisation related to HCWs' role in these associations from the perspective of trauma and positive psychology research. An anonymous online survey was conducted among 1449 doctors and nurses (85.4% females; mean age 34.1 years) from five hospitals in different regions of China between October and November 2020, which was about six months after the COVID-19 outbreak was almost 'put under control' in China. PTSS and PTG were assessed using the 17-item PTSS Scale-Self-Report and Posttraumatic Growth Inventory, respectively. The prevalence of PTSS and PTG was 42% and 65%, respectively. Results of structural equation modelling suggested that the association between resilience and PTSS was partially mediated by adaptive coping, self-stigma, and the serial path via adaptive coping and self-stigma, which accounted for 66% of the total association. The association between mindfulness and PTSS was partially mediated by adaptive coping and serially mediated by adaptive coping and self-stigma. In contrast, only adaptive coping was a significant mediator in the associations between resilience/mindfulness and PTG. The findings first unravelled the mechanisms between resilience, mindfulness, and posttraumatic outcomes of COVID-19 among a large sample of HCWs. Health promotion may consider alleviating PTSS and promoting PTG for HCWs experiencing traumatic stressful events via strengthening resilience and mindfulness, fostering adaptive coping, and reducing stigmatisation.

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1 | Introduction

The coronavirus disease (COVID-19) pandemic has globally increased significant mental health burdens. Healthcare workers (HCWs) are particularly vulnerable due to exposure to various work-related stressors, including shortage of medical resources, overwhelming workload, high risks of infection, fatigue, and perceived inability to treat their patients, which posit them at considerable risk for developing psychopathologies (d'Ettorre et al. 2021). Posttraumatic stress symptoms (PTSS), characterised by recurrent memories, avoidance, and heightened arousal regarding a traumatic event that last long after its occurrence, are commonly reported among HCWs during the pandemics of severe acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS) (Finstad et al. 2021; Maunder et al. 2006). Similarly, a systematic review reported pooled prevalence of PTSS of 21.5% among HCWs worldwide during the COVID-19 pandemic (Li et al. 2021). PTSS could last many years and lead to severe psychiatric comorbidities such as major depression and substance use disorders (Ehlers and Clark 2000).

On the other hand, traumatic experiences (e.g., natural disasters and pandemics) could potentially lead to constructive mental health outcomes, such as posttraumatic growth (PTG) (R. Chen et al. 2021; Finstad et al. 2021). PTG refers to positive psychological changes arising from highly challenging situations and could be conceptualised as an outcome or a process of struggle with the traumatic event (Tedeschi and Calhoun 2004). Cognitive theories of posttraumatic reactions suggest that traumatic experiences are both highly salient and incompatible with individuals' preexisting beliefs, thus generating cognitive disequilibrium. If individuals can undergo cognitive processing and reconstruction that lead to successful adaption to a new reality, this promotes personal strength and PTG (manifested as newfound appreciation of life, identification of new possibilities, and endorsement of spirituality) (Tedeschi and Calhoun 2004; Zhou and Zhen 2024). Conversely, unsuccessful incorporation leads to negative posttraumatic reactions. In addition, personality characteristics, support, and emotional regulation are also highlighted as crucial factors in the development of PTG (Shakespeare-Finch and Lurie-Beck 2014). PTG is common as a systematic review of 26 studies found that 53% of people who endured traumas experienced PTG (Wu et al. 2019). Relatedly, 39% of Chinese HCWs developed moderate-to-high levels of PTG during the COVID-19 pandemic (R. Chen et al. 2021). PTG has long-term positive impacts on individuals' mental health and subjective physical health, which would contribute to recovery from trauma and gaining strength (R. Chen et al. 2021).

Conceptually, PTSS and PTG can coexist within an individual, as a traumatic event may simultaneously be detrimental and a catalyst for transitioning to a new phase of life (An et al. 2018). The Chinese word for 'crisis', which could turn into trauma if unsolved, is composed of two Chinese characters signifying 'danger' (wei) and 'opportunity' (ji). Empirical studies have reported mixed linear relationships between PTSS and PTG, with some indicating a positive association, while others found negative or non-significant associations (Shakespeare-Finch and Lurie-Beck 2014; An et al. 2018; H.-M. Chen et al. 2019). To explain these discrepancies, some researchers have proposed

curvilinear associations between PTG and PTSS (Butler et al. 2005; Yilmaz-Karaman et al. 2023). For instance, a study among terrorist attack survivors found that PTG had a curvilinear association with the level of trauma symptoms, such that those with intermediate trauma symptoms reported the highest levels of growth (Butler et al. 2005). This suggests that there may be a range of challenging experiences that is sufficient to impel growth, but not overwhelm or inhibit the growth-promoting processes. To understand the complexity between PTG and PTSS, it is thus warranted to study PTSS and PTG simultaneously and interventions should address both ends, as investigating only one of them might present an incomplete or even biased picture of the consequences of traumatic events. Several studies have examined PTSS and PTG during the COVID-19 pandemic among the general populations of Spain (Vazquez et al. 2021) and Greece (Koliouli and Canellopoulos 2021), the U.S. veterans (Pietrzak et al. 2021), and Chinese adolescents (Zhen and Zhou 2021). Examples of factors of PTG included openness to the future, dispositional optimism, and positive refocusing; those of PTSS included intolerance of uncertainty, anxiety, rumination, and catastrophising (Vazquez et al. 2021; Zhen and Zhou 2021). It is crucial to understand more shared and unique factors of PTG and PTSS and the potential mechanisms of these associations in order to inform relevant health promotion programs.

1.1 | Associations of Resilience and Mindfulness With Posttraumatic Outcomes

While many studies focused on the risk factors of psychopathology in past decades, positive psychology that explores human flourishing and positive adaptation has received increasing attention. Resilience and mindfulness are two key constructs of positive psychology. Schaefer and Moos (1992) addressed how resilience and mindfulness are associated with posttraumatic outcomes. They proposed the life crises and personal growth model to elucidate the determinants associated with posttraumatic outcomes. This model posits that crisis experience and its subsequent consequences are influenced by personal system factors (e.g., resilience, mindfulness, and self-confidence), environmental factors (e.g., personal relationships, social support, and financial resources), and event-related factors (e.g., severity, duration, and timing of the life crisis). These factors influence cognitive appraisal processes and coping responses, which subsequently affect the outcome of the trauma (Zoellner and Maercker 2006). Accordingly, resilience and mindfulness might be linked to posttraumatic outcomes.

Resilience describes individuals' abilities to adapt to, bounce back, or recover from adverse events (Carver 1998). It has commonly been identified as a positive personality trait or adaptive cognitive process that could promote PTG by facilitating flexibility, adaptive coping, and buffering the negative impacts of stress (She et al. 2020). COVID-19 research showed that resilience was associated with personal growth and less PTSS among HCWs (Finstad et al. 2021; Kalaitzaki and Rovithis 2021). Mindfulness, which emphasises the ability to pay attention to the present moment with a curious and non-judgemental attitude (Brown and Ryan 2003), may also

influence PTSS and PTG. Mindfulness was negatively associated with PTSS while positively associated with PTG among aid workers involved in humanitarian relief work (Wen et al. 2021). A systematic review reported that mindfulness intervention moderately reduced stress and mental exhaustion among HCWs (Chiappetta et al. 2018). If such associations are confirmed in the context of COVID-19 pandemic, interventions instilling such positive psychology attributes and cognitive processes may reduce PTSS and enhance PTG among HCWs who were traumatically influenced.

1.2 | Potential Mediators in the Associations Between Resilience and Mindfulness With Posttraumatic Outcomes

The mechanisms underlying the associations between mindfulness/resilience and PTG/PTSS have not been well-studied and tested in the context of COVID-19 pandemic. As reviewed above, personal system factors potentially influence an individual's cognitive appraisal processes and coping responses to traumatic events, which subsequently determine posttraumatic outcomes (Schaefer and Moos 1992). For example, resilient individuals were more able to cope with trauma and even grow out of it (Parker et al. 2015). Additionally, the stress-coping theory posits that coping response to stressors is a central determinant of mental health outcomes (Lazarus and Folkman 1984); adaptive coping strategies (e.g., cognitive restructuring) were negatively associated with mental distress, and are regarded as a significant pathway between resilience and PTG (Ogińska-Bulik and Kobylarczyk 2015). Similarly, cross-sectional and intervention studies have suggested that mindfulness promoted the use of adaptive coping strategies (e.g., acceptance and cognitive reinterpretation) (Keng et al. 2018), as mindfulness may enhance awareness of one's internal states and the need to cope with situational stressors, and hence engagement in adaptive regulation (Teper et al. 2013). Empirically, adaptive coping mediated the association of resilience with PTG or PTSS among cancer patients (Gori et al. 2021) and paramedics (Ogińska-Bulik and Kobylarczyk 2015). Adaptive coping was also a significant mediator in the association between mindfulness and psychological health (Keng et al. 2018).

In addition to the higher risk of exposure to COVID-19, HCWs are subjected to stigmatisation because of their close relationship with patients and heightened risk of disease transmission, which is similar to the cases of previous pandemics (Lyu et al. 2021). For instance, stigma was felt by 20% of Taiwan HCWs because of their hospital work during the SARS outbreak (Bai et al. 2004). HCWs widely encountered stigmatisation during the COVID-19 pandemic, resulting in elevated prevalence of stress and burnout (Ramaci et al. 2020). Self-stigma occurs when individuals internalise these public or social attitudes, leading to numerous negative consequences (Mak and Cheung 2010). Such stigmatised cognitive processing of pandemic was a common risk factor of mental disorders, including PTSS, among HCWs during SARS and MERS outbreaks (Kisely et al. 2020). Similarly, perceived stigma related to COVID-19 was associated with PTSS among HCWs in Taiwan (M.-Y. Lu et al. 2021). Stigma may also hinder the development

of PTG by hampering individuals' capacity to properly express emotions, develop a better understanding of the trauma, and initiate the process of meaning-making (Drewes et al. 2021). Therefore, the present study tested whether self-stigma related to one's HCW role amid the pandemic (self-stigma related to COVID-19) would mediate the associations between resilience/mindfulness and PTG/PTSS, as both resilience and mindfulness were negatively associated with self-stigma among patients with mental illness and HCWs (Post et al. 2021). Experimental investigations have shown that mindfulness training can assist stigmatised individuals in mitigating the psychological toll of stigma (Chan et al. 2018). Relatedly, self-stigma mediated the association between mindfulness and life satisfaction among individuals with psychiatric disorders (Chan et al. 2018).

Furthermore, the serial mediation paths between mindfulness/resilience and PTSS/PTG via adaptive coping and self-stigma are plausible, as adaptive coping may reduce self-stigma (Link et al. 1989; Moses 2015). A longitudinal study reported that adaptive coping predicted less self-stigma among people with mental illness (Moses 2015). The Modified Labelling Theory postulates that an individual's coping strategies can determine the perception of his/her stigmatised identity and longer-term adjustment (Link et al. 1989). Higher perceived efficacy in coping with COVID-19 was also associated with low stigmatisation among Asians in the U.S. (Cho et al. 2021). In contrast, avoidance coping was positively associated with perceived stigma among HCWs during the COVID-19 pandemic (Chew et al. 2020). The serial mediation model was thus tested in the present study.

1.3 | Purpose of the Present Study

The present study was conducted among HCWs in mainland China during October–November 2021, approximately six months since the COVID-19 outbreak was 'put under control' in China. While most of existing studies assessing HCWs' PTSS/PTG were conducted during or shortly after the COVID-19 outbreak when the traumatic conditions were still ongoing (e.g., during February–March 2021 in China (Song et al. 2020) and during March–April 2021 in Italy (d'Ettorre et al. 2021)), the present study monitored the longer-term impact of COVID-19 under the unique context of 'post-outbreak period' in China when very few national cases were reported. Therefore, the assessment of PTSS and PTG at this time point is particularly relevant. This study aimed to test the associations and underlying mechanisms of resilience and mindfulness with post-traumatic outcomes (see Figure 1A for conceptual model). It was hypothesised that (1) resilience would be positively associated with PTG through three mediation paths: (a) adaptive coping, (b) self-stigma, and (c) a serial path of adaptive coping and self-stigma, in addition to its direct effect on PTG (Hypotheses 1a–1c); (2) mindfulness would be positively associated with PTG via the mediation of (a) adaptive coping, (b) self-stigma, and (c) a serial path of adaptive coping and self-stigma (Hypotheses 2a–2c); (3) resilience would be negatively associated with PTSS directly and indirectly via (a) adaptive coping, (b) self-stigma, and (c) a serial path of adaptive coping and self-stigma (Hypotheses 3a–3c); and (4) mindfulness would be negatively associated with PTSS directly and indirectly via (a)

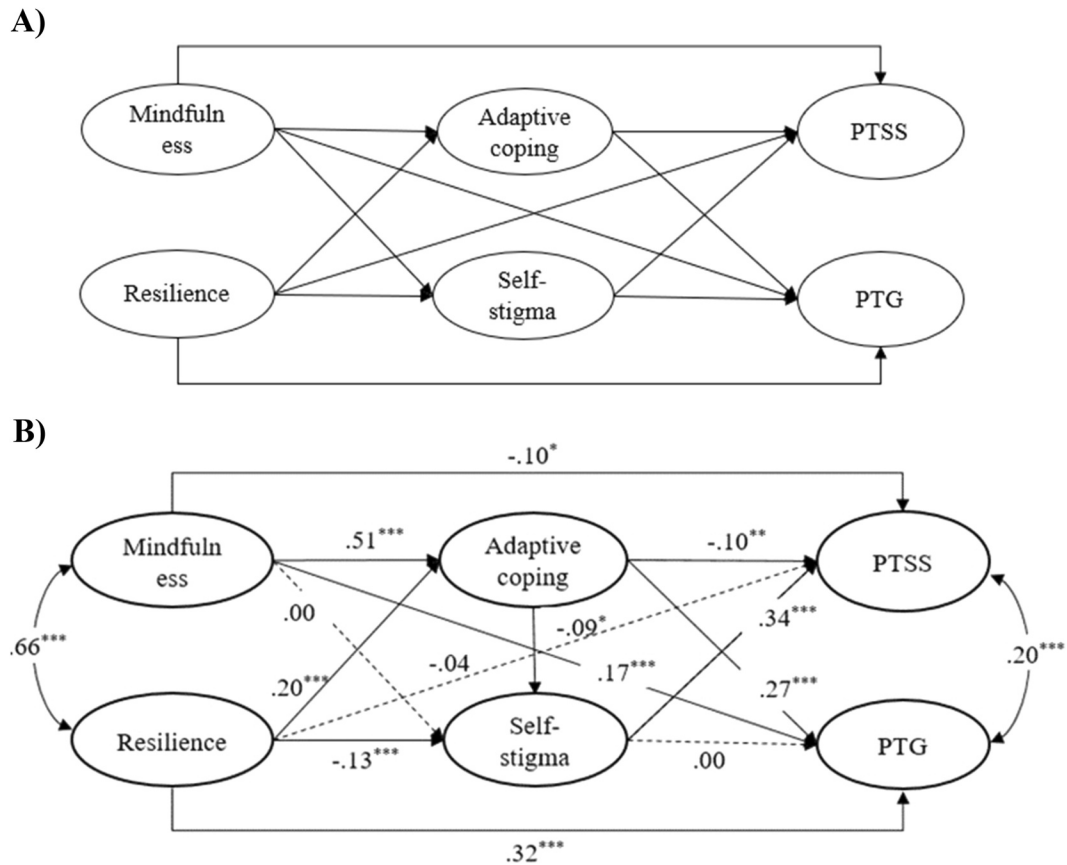


FIGURE 1 | Conceptual (A) and statistical (B) forms of structural equation modelling examining the relationships among mindfulness, resilience, PTSS, and PTG via adaptive coping and self-stigma. Latent variables are shown in ovals. Solid lines represent the significance of the structural path ($p < 0.05$) while dash lines represent non-significant paths. Standardised coefficients were shown. For simplicity, the significant background covariates (i.e., marital status, job seniority rank, profession, and hospital) of outcomes and error covariance are not presented. PTG, posttraumatic growth; PTSS, posttraumatic trauma symptoms. *** $p < 0.001$; ** $p < 0.01$. * $p < 0.05$.

adaptive coping, (b) self-stigma, and (c) a serial path of adaptive coping and self-stigma (Hypotheses 4a–4c).

2 | Method

2.1 | Participants & Procedure

An anonymous cross-sectional survey was conducted from October to November 2020. Five hospitals of four provinces (Zhejiang, Ningxia, Guangxi, and Yunnan) in mainland China were conveniently selected. The four provinces were geographically (east, north central, south, and southwest) and socioeconomically (levels of gross domestic product: top, about average, below average, and low) representative of mainland China to some extent. The inclusion criteria of the participants were: (a) full-time doctors or nurses, (b) employment in the current hospital since January 2020, and (c) access to mobile phones. All eligible doctors/nurses ($n = 2419$) working in the major departments of internal medicine, surgery, gynaecology and obstetrics, paediatrics, emergency, infectious diseases, and intensive care were invited to complete an anonymous online survey. The online survey link was distributed to the prospective participants by the hospital administrators through the participating departments' regular WeChat/QQ platforms, which were

the most commonly used social media applications in China. All participants were briefed properly about the study. They were explained that the participation was voluntary and anonymous, and rejection would not cause any negative consequences. They were also guaranteed that only the research team can access their data. No incentives were given to the participants. The study was approved by the Survey and Behavioural Research Ethics Committee of the corresponding author's affiliation. A total of 1449 completed questionnaires were returned to the research team; the response rate was 60.0% (1449/2419).

2.2 | Measures

2.2.1 | Background Variables

Data on socio-demographics (i.e., sex, age, marital status, and education level) and work-related variables (i.e., department, job seniority rank, profession, and hospital) were collected.

2.2.2 | Posttraumatic Stress Symptoms

The 17-item PTSD Symptom Scale-Self-Report (PSS-SR) was used to assess the level of PTSS related to COVID-19 during the

past month, which was designed according to the DSM-IV criteria (Foa et al. 1997). The Chinese version of PSS-SR has been validated among Chinese cancer patients (Q. Lu et al. 2017) and PSS-SR has been used to assess HCWs' PTSS during the COVID-19 pandemic (Sarapaltseva et al. 2021). It comprises three subscales: avoidance, arousal, and re-experiencing. Sample items include 'trying to avoid activities, people, or places that remind you of the illness' (avoidance) and 'having trouble falling asleep or staying asleep' (arousal). Responses were rated on a four-point scale (0 = not at all to 3 = almost always). Higher sum scores indicated higher levels of PTSS and the cutoff of 13 was used to define the likelihood of PTSS (Zang et al. 2019). The Cronbach's alpha of PSS-SR was 0.96 in the present study.

2.2.3 | Posttraumatic Growth

The Posttraumatic Growth Inventory (PTGI) was used to measure perceived benefits from traumatic events. The Chinese version of the PTGI has been validated among Chinese HCWs (X. Xu et al. 2016) and has been applied to Chinese nurses during the COVID-19 pandemic (X. Peng et al. 2021). The PTGI contains 21 items within five categories: relating to others, new possibilities, personal strength, spiritual change, and appreciation of life. Response options range from 0 (no change) to 5 (high degree of change). Higher scores reflect greater perceived benefit and the prevalence of moderate-to-high PTG was defined by a mean score ≥ 3 (total score ≥ 63) (Jansen et al. 2011). The Cronbach's alpha was 0.93 in the current study.

2.2.4 | Resilience

Resilience was assessed by the 10-item Connor-Davidson Resilience Scale (Campbell-Sills and Stein 2007), which has shown good validity and reliability in the Chinese populations with the Cronbach's alpha of 0.88 (She et al. 2020). Items were rated on a five-point Likert Scale ranging from 0 (not true at all) to 4 (true nearly all the time). Higher total scores denote higher levels of resilience (Cronbach's alpha = 0.95).

2.2.5 | Mindfulness

Mindfulness was assessed using the mindfulness subscale of the Self-Compassion Scale. The Chinese version has demonstrated good reliability and validity (J. Chen et al. 2011). Sample statements include 'When I'm feeling down I try to approach my feelings with curiosity and openness'. Responses are given on a five-point scale from Almost Never to Almost Always. In the present study, Cronbach's alpha was 0.95.

2.2.6 | Adaptive Coping

Two adaptive coping styles (i.e., positive reframing and acceptance) were assessed by using two corresponding subscales of the Brief COPE (Carver 1997). These scales have been applied in

a previous Chinese COVID-19 study (She et al. 2021). Each subscale includes two questions (1 [*almost never*] to 5 [*almost always*]). Sample statements include 'I think of something nice instead of what has happened'. In the present study, Cronbach's alpha was 0.81 for acceptance and 0.82 for positive reframing subscale, respectively.

2.2.7 | Perceived Self-Stigma

Perceived self-stigma during the COVID-19 pandemic was assessed by the three-item behavioural dimension of the Stigma Scale-Short (SSS-S) form (Mak and Cheung 2010). The Chinese version has been validated among patients with mental illness and other minorities (Mak and Cheung 2010; L. Peng et al. 2020). The scale has also been applied to Taiwanese HCWs to assess self-stigma related to COVID-19, which showed satisfactory internal reliability and validity (M.-Y. Lu et al. 2021). Sample item includes 'I estrange myself from others because I am an HCW during the COVID-19 pandemic', with a four-point Likert response scale ranging from 1 (Strongly disagree) to 4 (Strongly agree). The Cronbach's alpha was 0.87 in the present study.

2.3 | Data Analysis

Descriptive statistics were presented. Pearson's correlation analyses were performed on major variables. Structural equation modelling (SEM) analysis was used to test the hypothesised mediation model conducted to evaluate the fitness of the hypothesised mediation model, using latent variables and full-information maximum likelihood estimation method. Indicators of resilience, mindfulness, adaptive coping, and self-stigma were created by the item parcelling method based on the original items, while PTG and PTSS were based on the subscales (Matsunaga 2008). Background variables (i.e., marital status, hospital, job seniority rank, and profession) significantly associated with PTSS and/or PTG were controlled for. Multiple model fit indices were used to assess the adequacy of model fit: (1) chi-square/degrees of freedom (χ^2/df) ratio ≤ 3 , (2) comparative fit index (CFI) ≥ 0.90 , (3) incremental fit index (IFI) ≥ 0.90 , (4) root mean square error of approximation (RMSEA) ≤ 0.08 , and (5) standardised root mean square residual (SRMR) ≤ 0.08 (Hooper et al. 2008; Kline 2015). It should be noted that χ^2 was sensitive to large sample size; therefore, the model's goodness-of-fit was evaluated based on an overall interpretation of all indices rather than relying on a single indicator (West et al. 2012).

The direct and indirect effects and their significance were estimated using bootstrapping, which is a non-parametric resampling procedure that involves repeated sampling of the dataset ($n = 2000$). Standardised coefficients (β) and the proportion of mediation (PM) were reported. The SPSS 23.0 Statistics for Windows (IBM Corp. Released 2015; Armonk, NY: IBM Corp) and AMOS 23.0 were used for all statistical analyses.

3 | Results

3.1 | Descriptive Statistics

The description of the participants is summarised in Table 1. The mean age of the participants was 34 years (standard deviation = 9.0 years). The majority were females (85.4%), nurses (70.8%), being married (73.1%), and had obtained a bachelor's degree or above (72.5%). Of all the participants, 42% presented probable PTSS (doctors vs. nurses: 44.7% vs. 40.9%; $p = 0.189$) and 65% reported moderate-to-high levels of PTG (doctors vs. nurses: 61.7% vs. 66.4%; $p = 0.090$). The average total score of PTSS and PTG was 12.0 (range: 0–51) and 66.5 (range: 0–105), respectively; the nurses reported a significantly higher average PTG score than the doctors (63.9 vs. 67.6; $p < 0.001$) but the difference in PTSS between the two groups were statistically non-significant (Table 1).

3.2 | Correlation Analysis

The bivariate correlation analyses showed that resilience and mindfulness were positively correlated with adaptive coping and PTG (r ranging from 0.49 to 0.59; all $p < 0.01$) while negatively associated with self-stigma and PTSS (r ranging from -0.11 to -0.22 ; all $p < 0.01$). In addition, adaptive coping was positively correlated with PTG ($r = 0.49$; $p < 0.01$) while negatively correlated with self-stigma ($r = -0.11$; $p < 0.01$) and PTSS ($r = -0.20$; $p < 0.01$). Furthermore, self-stigma was significantly and moderately correlated with PTSS ($r = 0.35$; $p < 0.01$) and mildly with PTG ($r = -0.09$; $p < 0.01$). PTSS showed a non-significant correlation with PTG (Table 2).

3.3 | SEM Analysis

The structural model fitted the data well: $\chi^2/df = 4.51$, CFI = 0.94, IFI = 0.94, RMSEA = 0.049 (90% CI 0.047–0.051), SRMR = 0.04. All the parcel indicators were significantly loaded on the latent variables, with standardised factor loadings ranging from 0.75 to 0.97 (all $p < 0.001$).

All except three of the hypothesised paths (i.e., the direct path from resilience to PTSS and the indirect paths between mindfulness and PTG via self-stigma) were statistically significant. The significant paths included those indicating that resilience was positively associated with adaptive coping ($\beta = 0.20$; $p < 0.001$) and negatively associated with self-stigma ($\beta = -0.13$; $p < 0.001$); mindfulness was positively associated with adaptive coping ($\beta = 0.51$; $p < 0.001$); adaptive coping was positively associated with PTG ($\beta = 0.27$; $p < 0.001$) while negatively associated with self-stigma ($\beta = -0.09$; $p = 0.017$) and PTSS ($\beta = -0.10$; $p = 0.008$); self-stigma was also positively associated with PTSS ($\beta = 0.34$; $p < 0.001$).

The findings of the SEM and effect estimation are presented in Figure 1 and Table 3. First, the association between resilience and PTSS was significantly mediated via three indirect paths: (a) resilience $\rightarrow$ adaptive coping $\rightarrow$ PTSS ($\beta = -0.02$; PM = 18.3%; $p = 0.01$), (b) resilience $\rightarrow$ self-stigma $\rightarrow$ PTSS ($\beta = -0.04$;

PM = 41.7%; $p = 0.001$), (c) resilience $\rightarrow$ adaptive coping $\rightarrow$ self-stigma $\rightarrow$ PTSS ($\beta = -0.01$; PM = 6.0%; $p = 0.014$). Second, the association between mindfulness and PTSS were significantly mediated via mindfulness $\rightarrow$ adaptive coping $\rightarrow$ PTSS ($\beta = -0.05$; PM = 30.0%; $p = 0.013$) and via mindfulness $\rightarrow$ adaptive coping $\rightarrow$ self-stigma $\rightarrow$ PTSS ($\beta = -0.02$; PM = 9.9%; $p = 0.018$); the path via self-stigma alone was non-significant. Third, the association between resilience and PTG was significantly mediated only via adaptive coping (i.e., resilience $\rightarrow$ adaptive coping $\rightarrow$ PTG; $\beta = 0.05$; PM = 14.1%; $p = 0.001$). Fourth, the association between mindfulness and PTG was significantly mediated only via adaptive coping (i.e., mindfulness $\rightarrow$ adaptive coping $\rightarrow$ PTG; $\beta = 0.14$; PM = 44.7%; $p = 0.001$). All the indirect effects between resilience/mindfulness and PTG via self-stigma were statistically non-significant.

After taking the mediation effects into account, the two direct effects from mindfulness to PTSS ($\beta = -0.10$; $p = 0.015$) and PTG ($\beta = 0.17$; $p < 0.001$) and the direct effect from resilience to PTG ($\beta = 0.32$; $p < 0.001$) but not that from resilience to PTSS remained significant. The overall model explained 43% of the variance in PTG and 19% of the variance in PTSS (Figure 1B).

4 | Discussion

To summarise, the present study found high prevalence of PTSS (42%) and moderate-to-high levels of PTG (65%) among Chinese HCWs during a period when COVID-19 was mostly 'put under control' in China. These findings are both worrisome and encouraging, highlighting the importance of interventions to reduce PTSS and enhance PTG jointly. Second, with a few exceptions, resilience and mindfulness were positively associated with PTG while negatively associated with PTSS related to COVID-19. Third, adaptive coping significantly mediated all four paths between resilience/mindfulness and PTSS/PTG, supporting Hypotheses 1a, 2a, 3a, and 4a. Self-stigma, however, only significantly mediated the association between resilience and PTSS (Hypothesis 3b supported) but neither between mindfulness and PTSS nor between resilience/mindfulness and PTG (Hypothesis 1b, 2b, and 4b not supported). Fourth, the two serial paths between mindfulness/resilience and PTSS via adaptive coping and self-stigma were statistically significant, supporting Hypothesis 3c and 4c. In general, the mediation hypotheses were supported by the present study, especially the role of adaptive coping. The novel findings of the mediation model provide an advanced understanding of how resilience and mindfulness impacted HCWs' mental health from both the traumatic and positive psychology perspectives during the pandemic.

A systematic review reported a wide range of prevalence of PTSS of 2.9%–49.5% among HCWs during the COVID-19 pandemic (Li et al. 2021); another review reported prevalence of PTG of 10%–77% among people experiencing traumatic events (Wu et al. 2019). Thus, the present study's prevalence of PTSS/PTG tended to be high but within the range. As PTSS are highly predictive of chronic depression, attention is warranted and screening may be considered. Unexpectedly, the prevalence of PTSS between doctors and nurses was non-significant, despite

TABLE 1 | Description of the study participants' characteristics ($n = 1449$).

	Total (n = 1449)	Doctors (n = 423)	Nurses (n = 1026)	p-value
Background variables				
Sex				
Male	211 (14.6%)	157 (37.1%)	54 (5.3%)	< 0.001
Female	1238 (85.4%)	266 (62.9%)	972 (94.7%)	
Age, mean (SD)	34.1 (9.0)	37.8 (9.1)	32.7 (8.6)	< 0.001
Department				
Internal medicine	337 (23.3%)	117 (27.7%)	220 (21.6%)	0.004
Surgery	230 (15.9%)	57 (13.5%)	173 (17.0%)	
Gynaecology and obstetrics	80 (5.5%)	21 (5.0%)	59 (5.8%)	
Pediatrics	80 (5.5%)	23 (5.5%)	57 (5.6%)	
Infectious diseases	100 (6.9%)	23 (5.5%)	77 (7.6%)	
Emergency	50 (3.5%)	24 (5.7%)	26 (2.6%)	
Intensive care unit	83 (5.7%)	17 (4.0%)	66 (6.5%)	
Others	481 (33.2%)	140 (33.2%)	341 (33.5%)	
Job seniority rank				
Junior	828 (57.1%)	159 (37.6%)	669 (65.2%)	< 0.001
Middle	426 (29.4%)	140 (33.1%)	286 (27.9%)	
Vice-senior	129 (8.9%)	78 (18.4%)	51 (5.0%)	
Senior	38 (2.6%)	36 (8.5%)	2 (0.2%)	
Others (e.g., uncertain)	28 (1.9%)	10 (2.4%)	18 (1.8%)	
Marital status				
Single	342 (23.6%)	68 (16.1%)	274 (26.7%)	< 0.001
Married/Cohabited	1059 (73.1%)	340 (80.4%)	719 (70.1%)	
Others	48 (3.3%)	15 (3.5%)	33 (3.2%)	
Education level				
Junior college or below	398 (27.5%)	34 (8.0%)	364 (35.5%)	< 0.001
Bachelor's degree	990 (68.3%)	333 (78.7%)	657 (64.0%)	
Postgraduate degree	61 (4.2%)	56 (13.2%)	5 (0.5%)	
Psychosocial variables, mean (SD)				
Resilience	27.4 (6.3)	27.3 (6.4)	27.5 (6.2)	0.569
Mindfulness	15.1 (2.9)	15.0 (2.7)	15.1 (2.9)	0.372
Self-stigma	6.0 (2.0)	6.2 (1.9)	6.0 (2.0)	0.108
Adaptive coping	14.7 (3.0)	14.7 (2.9)	14.7 (3.1)	0.935
Posttraumatic stress symptoms				
Total mean score (SD) (range 0–51)	12.0 (9.9)	12.5 (10.0)	11.8 (9.8)	0.217
Prevalence, <i>n</i> (%) (≥ 13)	609 (42.0%)	189 (44.7%)	420 (40.9%)	0.189
Posttraumatic growth				
Total mean score (SD) (range 0–105)	66.5 (18.3)	63.9 (19.3)	67.6 (17.8)	< 0.001
Prevalence, <i>n</i> (%) (≥ 63)	942 (65.0%)	261 (61.7%)	681 (66.4%)	0.090

Note: Data are presented as n (%) unless specified.
Abbreviation: SD, standard deviation.

nurses' potentially stronger work stress due to frequent physical contact with patients. It is plausible that nurses might have more opportunities to share and communicate about their work-related stress with other nurses as they tend to have more peer

colleagues than doctors (Duffy et al. 2015). Corroborating previous studies, nurses showed higher levels of PTG than doctors (Hamama-Raz et al. 2020) but the small observed difference in prevalence of only 5% may not have strong practical

TABLE 2 | Correlations between studied variables.

Measures	1	2	3	4	5	6
1. Resilience	—					
2. Mindfulness	0.630**	—				
3. Self-stigma	−0.149**	−0.114**	—			
4. Adaptive coping	0.486**	0.586**	−0.112**	—		
5. Posttraumatic trauma symptoms	−0.204**	−0.223**	0.349**	−0.204**	—	
6. Posttraumatic growth	0.537**	0.521**	−0.090**	0.493**	−0.022	—

** $p < 0.01$.**TABLE 3** | Summary of total, direct, and indirect effects of the mediation model.

	DV1: PTSS		DV2: PTG	
	Standardised effect	Proportion mediated	Standardised effect	Proportion mediated
Direct effect				
Resilience → DV	−0.04	—	0.32***	—
Mindfulness → DV	−0.10*	—	0.17***	—
Indirect effect				
Resilience → adaptive coping → DV	−0.02**	18.3%	0.05***	14.1%
Resilience → self-stigma → DV	−0.04***	41.7%	0.00	0%
Resilience → adaptive coping → self-stigma → DV	0.01*	6.0%	0.00	0%
Mindfulness → adaptive coping → DV	−0.05*	30.0%	0.14***	44.7%
Mindfulness → self-stigma → DV	0.00	0%	0.00	0%
Mindfulness → adaptive coping → self-stigma → DV	−0.02*	9.9%	0.00	0%
Total effect				
Resilience → DV	−0.10*	—	0.37***	—
Mindfulness → DV	−0.16***	—	0.30***	—

Abbreviations: DV, dependent variable; PTG, posttraumatic growth; PTSS, posttraumatic trauma symptoms.

* $p < 0.001$.** $p < 0.01$.*** $p < 0.05$.

implications. More contextual research is needed to understand differences in PTSS/PTG between these occupational groups. Interventions are warranted for both groups.

Consistent with prior studies, resilience and mindfulness were associated with increased PTG and reduced PTSS (Finstad et al. 2021; Kalaitzaki and Rovithis 2021; W. Xu et al. 2018). More importantly, adaptive coping significantly mediated all four associations between resilience/mindfulness and PTG/PTSS, highlighting its pivotal role in shaping the experience and consequence of traumatic events. Similar mediations have been found among cancer patients and HCWs having traumatic experiences (Gori et al. 2021; Ogińska-Bulik and Kobylarczyk 2015). This study hence extends knowledge about the vital role of adaptive coping in understanding posttraumatic reactions in the context of COVID-19 research. Previous studies showed that cognitive and coping processes mediated the associations between mindfulness interventions and their beneficial psychological outcomes (Keng et al. 2011; Tomlinson

et al. 2018). In addition, the mediation between resilience and PTG was supported by the outcome theory of PTG, which claims that PTG reflects human strength and resilience and is a result of coping (Westphal and Bonanno 2007). These findings also corroborate cognitive theories of posttraumatic outcomes positing adaptive cognitive appraisal and coping as critical mechanisms underlying the development of PTG (Tedeschi and Calhoun 2004; Zhou and Zhen 2024).

The study also explored the role of self-stigma in explaining the associations between mindfulness/resilience and PTG/PTSS. An interesting finding is that self-stigma mediated the association between resilience and PTSS but not PTG, as it was not associated with PTG after considering other variables in the model. The findings implied that self-stigma might have a stronger effect on PTSS than on PTG. The mediations involving PTSS are understandable, as resilience was negatively associated with stigma while self-stigma was a strong predictor of mental distress, including PTSS (Kisely et al. 2020). The findings

suggested that despite a significant correlation found between PTSS and PTG, the mechanisms between positive psychology attributes and PTSS/PTG might be specific; factors that have stronger associations with mental distress might be significant mediators of the association between resilience and PTSS but not for similar associations involving PTG. In addition, self-stigma was not a significant mediator in the associations between mindfulness and PTG/PTSS. This suggested that adaptive coping, rather than self-stigma, was the primary mechanism of change through which mindfulness impacted traumatic psychological health. It also reinforces the current understanding that, although resilience and mindfulness impact psychological health through similar pathways (e.g., adaptive coping), there are distinct constructs that warrant individual assessment.

There are a few other interesting findings. First, the two serial mediations between mindfulness/resilience and PTSS (via adaptive coping and self-stigma) were significant. It quests understanding why adaptive coping might affect PTSS. One plausible mechanism is that it might reduce self-stigma related to COVID-19, which is a risk factor of PTSS. Second, the direct effects of mindfulness and resilience on PTG were statistically significant, indicating the partial mediation role of adaptive coping and stigma. Thus, other potential mechanisms between resilience/mindfulness and PTSS/PTG might exist and warrant further investigation. Resilience and mindfulness may enhance posttraumatic adjustments by enhancing adaptive emotional regulation and psychological flexibility. Through mindfulness, individuals may engender a broadened state of present-moment awareness that facilitates empowering interpretations of stressful life events, thereby reducing emotional reactivity and distress (Garland et al. 2011). Relatedly, empirical evidence suggested that emotional regulation and maladaptive coping strategies, such as rumination and avoidant coping, mediated the association between mindfulness and psychological health (Tomlinson et al. 2018). Additionally, perceived social support has been identified as a potential mechanism mediating the relationship between resilience and PTSS/PTG, as demonstrated in studies involving Chinese adolescents experiencing a tornado (Yuan et al. 2018). Third, PTG and PTSS were significantly and positively correlated in the SEM analysis. The findings supported previous arguments that PTSS might lead to PTG, but the causal relationship could not be proved in this cross-sectional study. The relationship between such positive and negative consequences of trauma requires further investigation.

The findings have practical implications for interventions. Universal programs should be provided to all HCWs to raise awareness of their vulnerability to PTSS, its potential harms, and the possibilities for prevention and remission. To promote workplace mental health, regular education and seminars should be integrated into hospital routines. Engaging key stakeholders, such as hospital administrators and health policymakers, is crucial to highlight the mental health challenges faced by HCWs, especially during pandemics. Furthermore, health promotion campaigns on social media could also enhance public awareness of the mental distress faced by HCWs, thereby helping to reduce social stigma and discrimination against HCWs during the pandemic. Updated knowledge on the mental health challenges of HCWs could be incorporated into the curricula of relevant disciplines, such as occupational

therapy and psychiatry. Moreover, secondary prevention of early and continuous detection of high-distress individuals (e.g., self-screening questionnaires) followed by timely online/offline counselling, support groups, and treatment should be implemented in the workplace. Intervention strategies could prioritise the promotion of resilience and mindfulness as well as adaptive coping mechanisms to help HCWs recover from traumatic events and foster PTG. A recent meta-analysis reviewing 268 studies suggested that resilience-promoting interventions, such as cognitive-behavioural therapy, physical activity, psychoeducation, or building support networking, were effective and showed a moderate effect size (Liu et al. 2020). Specific evidence-based interventions were also able to improve mindfulness (Chiappetta et al. 2018). Last but not least, the prominent role of adaptive coping (positive reframing and acceptance in particular) underlying PTSS/PTG necessitates interventions to empower HCWs to develop effective coping mechanisms. Training programs that emphasise skill training for stress management, cognitive-behavioural techniques, problem-solving, and help-seeking may be effective in increasing HCWs' coping abilities. Additionally, the provision of coping resources such as peer support, a supportive workplace culture, and organisational backing that encourage open communication and the sharing of experiences can reduce feelings of isolation and enhance collective resilience.

5 | Limitations

This study has several limitations. First, reporting bias about perceived stigma and PTSS due to social desirability may exist among HCWs. Second, the cross-sectional study design cannot allow for causal inferences. It is plausible that, in contrast, individuals at risk of PTSS used adaptive coping less and perceived higher levels of stigma, while those with PTG might be more inclined to use adaptive coping and be stigma-resistant. Longitudinal studies are thus warranted to ascertain the causal relationships between these variables. Third, despite an acceptable response rate, only five hospitals from four provinces in China were involved; generalisation to hospitals of other provinces needs caution. The context and culture of the study may also make generalisations to other countries infeasible. Comparative research taking into account such differences is warranted. Fourth, we only examined a few adaptive coping styles and future studies may include different adaptive coping strategies in response to COVID-19 stressors. Lastly, we did not include other types of HCWs as we would like to keep the sample homogeneous.

6 | Conclusions

It is alarming that PTSS might affect almost half of the indispensable workforce of HCWs in China when COVID-19 was mostly 'put under control', highlighting the need to provide mental health support for HCWs. However, it is very encouraging that a high percentage of them might have acquired PTG. Alleviating the adverse posttraumatic impacts of the COVID-19 pandemic on HCWs is essential to resume regular work and life after the pandemic. This research further contributes to our

understanding of the potential impacts of positive psychology attributes (mindfulness and resilience) on PTSS and PTG, which might be interrelated. Future longitudinal studies should confirm the associations between studied variables. As suggested by the findings, randomised controlled studies testing interventions for improving resilience and mindfulness to enhance PTG and reduce PTSS among HCWs are greatly warranted. Such interventions may consider promoting adaptive coping and reducing stigmatisation related to COVID-19. The present study sheds insights on this new and potentially important research direction to alleviate the negative traumatic consequence of COVID-19 and boost personal growth among HCWs.

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Ethics Statement

The study was approved by the Survey and Behavioural Research Ethics Committee of the Chinese University of Hong Kong (Reference No. SBRE-19-644).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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