



ORIGINAL ARTICLE

Association between resilience and burnout of front-line nurses at the peak of the COVID-19 pandemic: Positive and negative affect as mediators in Wuhan

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ABSTRACT: *The outbreak of coronavirus disease 2019 (COVID-19) is having a dramatic effect on the mental health of healthcare workers (HCWs). Upon the emergence of the COVID-19 pandemic, the Chinese government dispatched about 42 000 HCWs to Wuhan City and Hubei Province to fight this pandemic. This study briefly examines front-line nurses who experienced burnout, with the main objective of investigating the mediating roles of positive and negative affect in the relationship between resilience and burnout in Wuhan hospitals at the peak of the COVID-19 pandemic. A total of 180 front-line nurses voluntarily participated via a social media group. They completed the online questionnaires, including the Maslach Burnout Inventory-General Survey (MBI-GS), the Positive and Negative Affect Schedule (PANAS), the Connor–Davidson Resilience Scale (CD-RISC), demographics, and work-related characteristics. Structural equation modelling (SEM) analysis was used to examine the mediating effect of positive and negative affect on the relationship between resilience and burnout. The total prevalence of burnout was 51.7%, of which 15.0% were severe burnout. These preliminary results revealed that positive and negative affect fully mediated the effects of resilience on burnout, emotional exhaustion, depersonalization, and reduced personal accomplishment of front-line nurses. It is necessary to know the impact of resilience on HCWs with burnout through the positive and negative*

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affect of individual backgrounds and situations, and how policymakers can deploy resilience interventions to support front-line HCWs.

KEY WORDS: *burnout, COVID-19 pandemic, front-line nurses, positive and negative affect, resilience.*

INTRODUCTION

The coronavirus disease 2019 (COVID-19) outbreak continues to be a public health emergency of international concern (PHEIC), which is having a dramatic effect on the mental health of healthcare workers (HCWs). Following the COVID-19 outbreak in Wuhan, the Chinese government dispatched about 42 000 HCWs to Wuhan City and Hubei Province from other parts of the country to fight the COVID-19 outbreak, representing the largest deployment of HCWs and medical resources in the world. The everyday use of personal protective equipment (PPE), including gloves, gowns, clothing, masks, respirators, goggles, and face shields, is mandatory for HCWs at all working times to protect patients and themselves, when providing care, and off-work contact with others is discouraged (Smereka & Szarpak, 2020). Front-line HCWs are under high stress, experiencing physical exhaustion, stigmatization, and increased symptoms of anxiety and depression (Mokhtari *et al.*, 2020), they are at increased risk of COVID-19 infection and may be quarantined, which is related to severe mental health problems (Anmella *et al.*, 2020). Front-line HCWs dealing with traumatic events, making life and death decisions, are exposed to unprecedented emotionally distress situations, such as the high risk of infection, longer shifts and excessive workload, and increased vulnerability; thus, they are at a greater risk of negative mental health outcomes (Rivas *et al.*, 2020). More than 70% of the nurses in the task force of front-line HCWs dispatched to Wuhan and Hubei Province originated from secondary and tertiary hospitals in China. They were closely exposed to COVID-19 patients and thus may suffer from vicarious traumatization (Li *et al.*, 2020), as well as experience severe burnout (Murat *et al.*, 2020). To evaluate immediate mental health impact on front-line nurses working in the wake of the COVID-19 pandemic (Su Hong & Xiaoming, 2020), the optimal structure of a mentally healthy life for each front-line nurse needs to be mapped out, which differs as a function of each individual's background and situation.

Understanding the effects of the COVID-19 pandemic on burnout in front-line HCWs is an urgent necessity to provide resilience interventions aimed at improving their well-being (Digby *et al.*, 2020). The severe acute respiratory syndrome (SARS) epidemic of 2003 had significant psychosocial effects on HCWs, 29% of them reported emotional exhaustion as measured by the General Health Questionnaire (GHQ-12), and being a nurse was found to have the highest significant association with emotional exhaustion (adjusted OR 2.8, 95% CI 1.5–5.5) (Nickell *et al.*, 2004). HCWs exposed to the emotional distress and negative affect of COVID-19 patients and their families had a high risk of long-term psychological problems (Barello *et al.*, 2020), and reported significant pressure and somatic symptoms, as well as higher levels and rate of emotional exhaustion than those observed during the SARS outbreak (Maunder *et al.*, 2006). In a national COVID-19 study among physicians in the USA, 21.8% reported burnout, 47.9 and 60.2% had symptoms of anxiety and distress, and 10.6% showed depression symptoms (Civantos *et al.*, 2020). A survey of 12 596 nurses in April 2020 found moderate emotional exhaustion during the COVID-19 pandemic and indicated that front-line nurses had higher burnout scores (Chen *et al.*, 2020). Front-line nurses in Istanbul had high levels of stress and burnout, as well as moderate depression (Murat *et al.*, 2020). These effects of the COVID-19 pandemic on HCWs differed with respect to occupation and risk perception, in particular. Part-time employment status was found to be significantly associated with emotional exhaustion (adjusted OR 2.6, 95% CI 1.2–5.4) (Nickell *et al.*, 2004). Lifestyle changing conditions in the workplace affected by the SARS outbreak were significantly associated with emotional exhaustion (adjusted OR 2.2, 95% CI 1.4–3.5) (Nickell *et al.*, 2004).

It should be emphasized that emotion-related affects are normal reactions to the unpredictable and threatening COVID-19 pandemic, which has particularly directly affected HCWs (Vinkers *et al.*, 2020). HCWs are vulnerable to emotional issues, especially nurses who screened positive for acute stress, depression, and

anxiety, 75% reported at least moderate insomnia symptoms (Shechter *et al.*, 2020). Additionally, collected evidence suggests that HCWs have an increased risk for developing negative affect, as well as an increased likelihood of experiencing transient stress-related symptoms (de Burgos-Berdud *et al.*, 2020; Lai *et al.*, 2020; Shanafelt *et al.*, 2020). The negative affect of hostility and distress caused by the COVID-19 threat and quarantine increased the association with situational fears (Brooks *et al.*, 2020). Negative affect was linked to nervousness and irritation during the COVID-19 pandemic, and positive and negative affect may serve as mediators (Perez-Fuentes *et al.*, 2020). A recent systematic review and meta-analysis showed that HCWs had a high prevalence of negative affect, such as depression (22.8%), anxiety (23.2%), and insomnia (34.3%) during the COVID-19 pandemic (Pappa *et al.*, 2020). This pandemic was also reported to increase social isolation and loneliness (Sciences, 2020), which are markers of poor functioning across negative affect (Matthews *et al.*, 2019). The stress resulting from social disruptions and health-related threats during the COVID-19 pandemic, such as isolation and loneliness, may cause mental health issues, and trigger or exacerbate mental illnesses (Vahia *et al.*, 2020). Front-line HCWs experienced psychological issues (Mauder *et al.*, 2006), a particular case reported fearing the psychological impact of quarantine after two weeks of the COVID-19 lockdown (Barello *et al.*, 2020).

There has been limited research on the mental health issues of HCWs associated with the current COVID-19 pandemic (Pappa *et al.*, 2020). However, the prospect of front-line HCWs becoming psychologically unwell was reported to be lower than that related to the psychological response to the pandemic (Holmes *et al.*, 2020). Front-line HCWs are exposed to increases in workplace pressure and are the most severely hit by patients' overload, and thus struggle to cope with the psychological challenges and threats (Barello *et al.*, 2020). The psychological and social impact of the COVID-19 pandemic on HCWs is related to significant negative mental health outcomes (Du *et al.*, 2020). After exposure to a highly challenging pandemic, HCWs have to face and combat the burnout with psychological resilience (Greenberg *et al.*, 2020). Resilience can be used to lessen the negative effects of burnout in health facility settings and to prevent poor psychosocial outcomes in nurses (Kim & Windsor, 2015). Social isolation makes the COVID-19 pandemic different from other PHEIC, and resilience may be a more effective response to control this situation, which

is vital to cope with stress and stay in balance; thus, there is a need for HCWs with burnout to explore the importance of resilience support (Goh *et al.*, 2020). Accordingly, it is urgently needed to explore the importance of resilience in HCWs during the current COVID-19 pandemic and the implications for HCWs with burnout.

In this COVID-19 pandemic time, all HCWs are extremely important worldwide, and the public also needs them for the future, they make decisions on how to allocate limited medical resources and balance their own physical and mental illnesses (Holmes *et al.*, 2020). China is a good example of how to conduct a successful emergency response to the pandemic, research should be conducted collaboratively and rapidly to deal with the growing mental health threats to HCWs. Policymakers must acknowledge the challenges HCWs face and minimize the psychological harms inherent in dealing with burnout, and ensure that the work ahead does not affect long-term risks. What is the association between burnout and resilience interventions for front-line HCWs, and how can such consequences be mitigated using positive and negative affect? The answer to these questions is that more research is needed, particularly on the association between resilience and burnout and the mediating effect of positive and negative affect or mitigation of the changes on burnout. The aim of this study was to determine the mediating role of positive and negative affect in the relationship between resilience and burnout in front-line nurses. The conceptual framework and hypothesis (Fig. 1) were according to a previous report (Stewart *et al.*, 2019) as follows: (i) There are positive links between resilience and burnout, resilience is correlated with positive and negative affect and burnout; and (ii) positive affect and negative affect play a mediating role in the relationship between resilience and burnout, and could be used in predicting burnout.

METHODOLOGY

Participants and procedures

The potential participants were front-line nurses who were assigned to the task force in Wuhan City. Therefore, purposive sampling was used to recruit participants between March and April 2020. All participants were informed of voluntary participation (Merlo *et al.*, 2017). Anonymously collected sociodemographic data included lifestyle habits, work-related characteristics

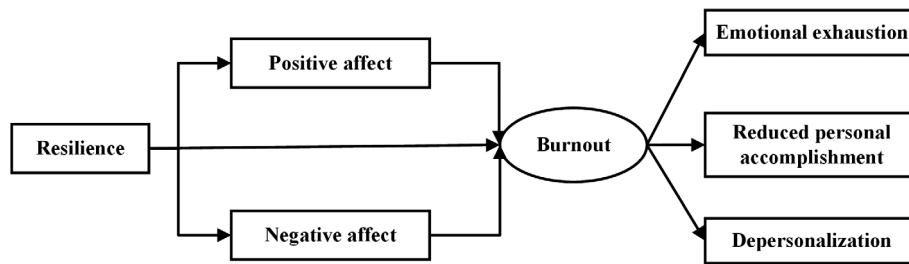


FIG. 1 Conceptual framework and hypotheses

(years of work, weekly working hours, type of employment contract, *etc.*), and psychological status (burnout, resilience, and positive and negative affect).

Measures

Sociodemographic and work-related characteristics

Sociodemographic characteristics included age, sex (male, female), marital status (married, single), number of children (none, 1, 2), and the level of education (associate degree, bachelor's degree, and master's degree). Lifestyle habits included sleeping time (4-5 hours, 6-7 hours, >8 hours) and weight change (stable, weight loss, and weight gain). Work-related characteristics included years of working (0-1 years, 2-4 years, 5-9 years, >10 years), level of hospital (tertiary A hospital, tertiary B hospital, secondary hospital), type of hospital (public, private), type of employment contract (permanent, indefinite), head nurse (yes, no), weekly working hours (16-23 hours, 24-31 hours, 32-40 hours), patient-to-nurse ratio (1-5, 6-10, 11-15), part-time job (yes, no), and amount of time spent with patients daily (50-75%, 30-49%, <29%).

Burnout

Burnout was assessed using the Maslach Burnout Inventory-General Survey (MBI-GS), a validated version for measuring burnout in HCWs (Suttle *et al.*, 2020; Wu *et al.*, 2020). This instrument encompasses emotional exhaustion (tiredness, somatic symptoms, and decreased emotional resources), depersonalization (developing negative, cynical attitudes, and impersonal feelings), and reduced personal accomplishment (feelings of incompetence, inefficiency, and inadequacy) (Kumar, 2007). The MBI-GS comprises 16 items scored on a seven-point Likert scale ranging from 0 (never) to 6 (everyday); choosing 'once a week' or more frequently to either item is considered as a positive response and indicates burnout (Portero de la Cruz *et al.*, 2020). Scores are categorized as mild, moderate,

or severe using established cut-offs (Guo *et al.*, 2018). High scores for emotional exhaustion and depersonalization and low ones for personal accomplishment indicate the incidence of burnout (Li *et al.*, 2020a; Portero de la Cruz *et al.*, 2020). The Chinese version of the MBI-GS shows satisfactory validity and reliability, the Cronbach alpha coefficient for the whole scale was 0.86 and for three dimensions was 0.896, 0.747, and 0.825, respectively (Li *et al.*, 2014; Li & Shi, 2003).

Resilience

The resilience was measured by the Connor–Davidson Resilience Scale (CD-RISC), a 25-item scale consisting of three subdomains (strength, tenacity, and optimism) that assesses resilience to cope with adversity (Connor & Davidson, 2003). Each item is rated on a five-point Likert scale from 0 (not true at all) to 4 (true nearly all the time); total scores range from 0 to 100, with higher scores indicate greater resilience (Hou *et al.*, 2020; Ramirez-Granizo *et al.*, 2020). The participants responded to each item based on life events during the past month (Ramirez-Granizo *et al.*, 2020). The Cronbach alpha coefficient of the Chinese version was 0.91 for the total score, indicating satisfactory reliability and validity, and the scale shows sound psychometric properties (Yu & Zhang, 2007).

Positive and negative affect

The positive affect and negative affect were measured using the Positive and Negative Affect Schedule (PANAS) (Watson *et al.*, 1988), a self-report instrument comprised of 10-item subscales: negative affects (fear, nervousness, irritability, hostility, and shame) and positive affects (enthusiasm, attentiveness, pride, hopefulness, and contentment) (Ravyts *et al.*, 2019). Participants are required to rate the degree to which they feel a particular emotion using a five-point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely) (Watson *et al.*, 1988). Higher scores indicate a higher level of either positive or negative affect.

The PANAS showed satisfactory reliability and validity among Chinese in an US context (Deng *et al.*, 2020); the Cronbach alpha coefficient for the whole scale was 0.76 and for the subscales of positive and negative affect was 0.93 and 0.90, respectively.

Statistical analyses

Data were analysed using the Stata 15 software (Stata Corporation, College Station, TX, USA) for Windows and AMOS 23 (IBM Corporation, Armonk, NY, USA). Descriptive analysis was conducted to summarize the frequencies and percentages of the categorical variables or the mean and standard deviation (SD) of the quantitative variables. The relationships between sociodemographic, work-related, and psychological characteristics were compared using the chi-square test for categorical variables. Pearson's correlation analysis was performed to preliminarily test the correlations among resilience, positive and negative affect, and burnout.

Structural equation modelling (SEM) was performed in four models by the maximum-likelihood method implemented in the SPSS Amos v23.0 software (IBM Corp) to examine the mediating role of positive and negative affect in the association between resilience and burnout (Bollen, 1989). In this study, resilience is the predictor, and model 1 included positive and negative affect as mediators in the relationship between resilience and burnout. In models 2, 3, and 4, the dependent variable was emotional exhaustion, reduced personal accomplishment, and depersonalization, respectively. The bootstrapping method was used to confirm the statistical significance of the mediating effect (Efron & Tibshirani, 1985), which determines whether an independent variable is related to a dependent variable through a third variable—the mediator. In this study, resilience is the predictor, burnout is the dependent variable, and the positive affect and negative affect are used as the mediator. This method determined the bias-corrected 95% confidence interval from 2000 samples; if the interval excludes zero, it represents the significance of the effects (Preacher & Hayes, 2008). A P -value < 0.05 for the results indicated statistical significance. The internal consistency was examined by Cronbach's alpha (>0.60 was considered acceptable) (Frankel *et al.*, 2015).

Patient and public involvement

Due to limited access to front-line nurses, all of them were isolated off-work, to improve the questionnaires,

the distribution of measures was constrained to a subsample of front-line nurses mainly through communication with others by social media apps, who received and completed the questionnaires *via* WeChat social media groups. If participants did not answer the current question, the WeChat applet could not jump to the next question. The IP addresses identified and eliminated duplicate participants. Response bias was examined before analysing the data (*e.g.* clicking the same answer and moving rapidly to the next question). A pilot study for the questionnaires was conducted on eight nurses to improve clarity, consistency, and validity, and those three questionnaires were not changed after the pilot study, the data of the pilot study were combined with the final sample.

The first page of the electronic questionnaire provided guidance, and informed consent was asked after the study guidance, all participants signed their names on informed consent forms before completing the questionnaires, which included an electronic study summary of the research purpose, expected outcomes, procedures, benefits, risks, and option not to take part. Participants were required to tick a box indicating their informed consent to participate before taking the online survey, they had the option to withdraw from the study at any time, and the survey data were only accessible to study personnel. The project was approved for research ethics by the Xuzhou Medical University Research Ethics Committee (ID number: XZ20200225) and was conducted in accordance with the Helsinki Declaration.

RESULTS

Characteristics of participants and the distribution of burnout

The sociodemographic and work-related characteristics of the participants are shown in Table 1. Among the 200 participants who were approached, 20 declined and 180 responded and completed all three questionnaires (response rate 90.0%). The mean age of the 180 participants was 28 ($SD = 4.5$), 78.3% were female, 68.3% were married, 90.0% held a bachelor's degree, and 81.7% were permanent employees. The marital status, type of employment contract, years of work, and patient-to-nurse ratio were significantly different between participants with and without burnout ($P < 0.05$). Most of the participants (98.9%) had a full-time nursing job, 76.6% reported having more than 5 years of work experience.

Descriptive analysis of burnout, resilience, and positive and negative affect

The total prevalence of burnout was 51.7%, of which 15.0% were severe burnout in Table 1. As shown in

Table 2, the mean scores for emotional exhaustion, depersonalization, and reduced personal accomplishment were 5.30 ($SD = 3.13$), 2.91 ($SD = 2.68$), and 2.33 ($SD = 2.62$), respectively. The mean scores for resilience tenacity, strength, and optimism were 34.23

TABLE 1 Sociodemographic and work-related characteristics of the participants and the distributions of dimensions of burnout (N = 180)

Variables	Burnout		N (%)	χ^2 value	P-value
	No (n = 87)	Yes (n = 93)			
Age					
<27 years	19 (55.9)	15 (44.1)	34 (18.9)	4.136	0.247
28–30 years	37 (54.4)	31 (45.6)	68 (37.8)		
31–35 years	19 (38.8)	30 (61.2)	49 (27.2)		
>36 years	12 (41.4)	17 (58.6)	29 (16.1)		
Gender					
Male	15 (38.5)	24 (61.5)	39 (21.7)	1.943	0.163
Female	72 (51.1)	69 (48.9)	141 (78.3)		
Marital status					
Single	21 (36.8)	36 (63.2)	57 (31.7)	4.411	0.036
Married	66 (53.7)	57 (46.3)	123 (68.3)		
Number of children					
0	33 (47.8)	36 (52.2)	69 (38.3)	1.960	0.375
1	29 (43.3)	38 (56.7)	67 (37.2)		
2	25 (56.8)	19 (43.2)	44 (24.4)		
Level of education					
Associate degree	6 (46.2)	7 (53.8)	13 (7.2)	0.400	0.927
Bachelor's degree	78 (48.1)	84 (51.9)	162 (90.0)		
Master's degree	3 (60.0)	2 (40.0)	5 (2.8)		
Type of employment contract					
Permanent	77 (52.4)	70 (47.6)	147 (81.7)	5.260	0.022
Indefinite	10 (30.3)	23 (69.7)	33 (18.3)		
Type of hospital					
Public	79 (49.1)	82 (50.9)	161 (89.4)	0.330	0.566
Private	8 (42.1)	11 (57.9)	19 (10.6)		
Amount of time spent with patients daily					
50–75%	28 (47.5)	31 (52.5)	59 (32.8)	0.889	0.641
30–49%	40 (51.9)	37 (48.1)	77 (42.8)		
< 29%	19 (43.2)	25 (56.8)	44 (24.4)		
Full-time job					
No	2 (100.0)	0 (0.0)	2 (1.1)	0.232	0.232
Yes	85 (47.8)	93 (52.2)	178 (98.9)		
Level of hospital					
Tertiary A hospital	62 (53.9)	53 (46.1)	115 (63.9)	4.232	0.120
Tertiary B hospital	6 (33.3)	12 (66.7)	18 (10.0)		
Secondary hospital	19 (40.4)	28 (59.6)	47 (26.1)		
Head nurse					
Yes	25 (59.5)	17 (40.5)	42 (23.3)	2.747	0.097
No	62 (44.9)	76 (55.1)	138 (76.7)		
Years of working					
0–1 years	0 (0.0)	8 (100.0)	8 (4.4)	12.244	0.005
2–4 years	22 (64.7)	12 (35.3)	34 (18.9)		
5–9 years	43 (49.4)	44 (50.6)	87 (48.3)		
>10 years	22 (43.1)	29 (56.9)	51 (28.3)		

(Continued)

TABLE 1 (Continued)

Variables	Burnout		N (%)	χ^2 value	P-value
	No (n = 87)	Yes (n = 93)			
Sleeping time					
4–5 hours	16 (66.7)	8 (33.3)	24 (13.3)	3.812	0.149
6–7 hours	68 (45.3)	82 (54.7)	150 (83.3)		
>8 hours	3 (50.0)	3 (50.0)	6 (3.3)		
Weekly working hours				0.287	0.901
16–23 hours	4 (44.4)	5 (55.6)	9 (5.0)		
24–31 hours	26 (51.0)	25 (49.0)	51 (28.3)		
32–40 hours	57 (47.5)	63 (52.5)	120 (66.7)		
Patient-to-nurse ratio				26.737	<0.001
1–5	57 (45.2)	69 (54.8)	126 (70.0)		
6–10	10 (29.4)	24 (70.6)	34 (18.9)		
11–15	20 (100.0)	0 (0.0)	20 (11.1)		
Weight change				0.671	0.715
Stable	28 (44.4)	35 (55.6)	63 (35.0)		
Weight loss	27 (51.9)	25 (48.1)	52 (28.9)		
Weight gain	32 (49.2)	33 (50.8)	65 (36.1)		
Burnout	Prevalence 93 (51.7)	Level Mild 41 (44.1)	Moderate 38 (40.9)		Severe 14 (15.0)

TABLE 2 Mean and standard deviations of dimensions of burnout, resilience, and PANAS^a (N = 180)

Variables	Mean	SD	Min.	Max.	Skewness	Kurtosis
Burnout						
Emotional exhaustion	5.30	3.13	0.00	12.00	0.11	−0.84
Depersonalization	2.91	2.68	0.00	11.00	0.76	0.11
Reduced personal accomplishment	2.33	2.62	0.00	12.00	1.48	2.35
Resilience						
Tenacity	34.23	7.61	9.00	49.00	−0.25	0.89
Strength	21.86	4.40	6.00	32.00	−0.47	1.42
Optimism	11.57	2.59	3.00	16.00	−0.44	0.64
PANAS						
Positive affect	30.74	6.24	13.86	44.00	−0.30	−0.44
Negative affect	21.44	5.08	12.00	41.14	0.98	2.29

^aPositive and Negative Affect Scale.

($SD = 7.61$), 21.86 ($SD = 4.40$), and 11.57 ($SD = 2.59$), respectively. The mean scores for positive affect and negative affect were 30.74 ($SD = 6.24$) and 21.44 ($SD = .24$), respectively.

Pearson's correlation analyses

The analysis of the Pearson correlation coefficients is shown in Table 3. Resilience showed significant negative correlations with burnout ($r = -0.387$, $P < 0.01$), emotional exhaustion ($r = -0.283$, $P < 0.01$), depersonalization ($r = -0.400$, $P < 0.01$), reduced personal accomplishment ($r = -0.388$,

$P < 0.01$), and negative affect ($r = -0.609$, $P < 0.01$); and showed significant positive correlation with positive affect ($r = 0.224$, $P < 0.01$). Negative affect had a significant positive correlation with burnout ($r = 0.268$, $P < 0.01$), emotional exhaustion ($r = 0.151$, $P < 0.05$), depersonalization ($r = 0.297$, $P < 0.01$), and reduced personal accomplishment ($r = 0.302$, $P < 0.01$). Positive affect had a significant negative correlation with burnout ($r = -0.465$, $P < 0.01$), emotional exhaustion ($r = -0.486$, $P < 0.01$), depersonalization ($r = -0.387$, $P < 0.01$), and reduced personal accomplishment ($r = -0.389$, $P < 0.01$).

TABLE 3 Correlations among resilience, emotional exhaustion, depersonalization, reduced personal accomplishment, and negative and positive affect (N = 180)

Variables	Emotional exhaustion	Depersonalization	Reduced personal accomplishment	Negative affect	Positive affect	Resilience	Burnout
Emotional exhaustion	1.000						
Depersonalization	0.698**	1.000					
Reduced personal accomplishment	0.707**	0.853**	1.000				
Negative affect	0.151*	0.297**	0.302**	1.000			
Positive affect	-0.486**	-0.387**	-0.389**	0.231**	1.000		
Resilience	-0.283**	-0.400**	-0.388**	-0.609**	0.224**	1.000	
Burnout	0.891**	0.923**	0.926**	0.268**	-0.465**	-0.387**	1.000

* $P < 0.05$, ** $P < 0.01$

TABLE 4 Total, direct, and indirect effects of resilience on burnout (N = 180)

Effects	Paths	Effect	SE	P	BC 95% CI
Indirect effects	Resilience → Positive affect → Burnout	-0.113	0.047	0.013	-0.209 to -0.019
	Resilience → Negative affect → Burnout	-0.209	0.061	0.001	-0.353 to -0.108
Direct effects	Resilience → Burnout	-0.039	0.080	0.584	-0.205 to 0.108
	Resilience → Positive affect	0.224	0.091	0.013	0.038 to 0.403
	Resilience → Negative affect	-0.609	0.065	0.001	-0.723 to -0.470
	Positive affect → Burnout	-0.505	0.040	0.002	-0.580 to -0.418
Total effect	Negative affect → Burnout	0.343	0.085	0.001	0.177 to 0.515
	Resilience → Burnout	-0.361	0.051	0.001	-0.458 to -0.259

SE, standard error; BC 95% CI, bias-corrected 95% confidence intervals.

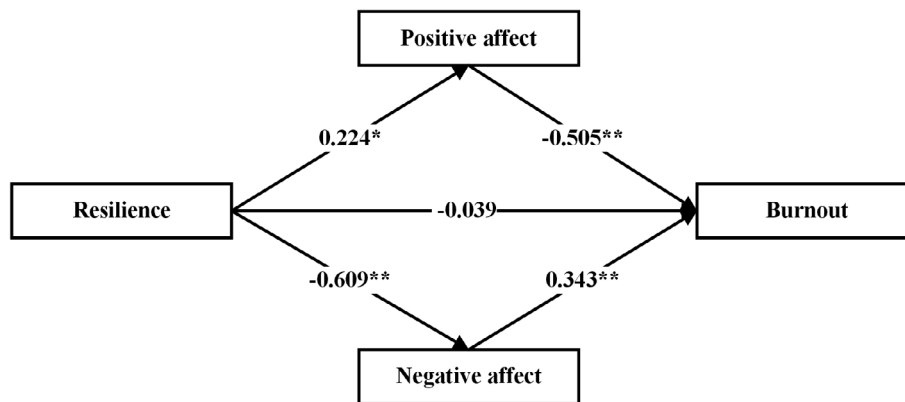


FIG. 2 Mediating roles of positive and negative affect between resilience and burnout in Model 1. * $P < 0.05$, ** $P < 0.01$

Structural equation modelling (SEM)

The mediating role of positive and negative affect in the relationship between resilience and burnout

The standardized direct, indirect, and total effect estimates of resilience on burnout in model 1 are presented in Table 4, and the path diagrams labelled on

each path of the relationship between resilience and burnout are shown in Fig. 2. In model 1, resilience had a significant indirect effect ($\beta = -0.322$, $P < 0.05$) and total effect ($\beta = -0.361$, $P < 0.05$) on burnout, and the path coefficient of the direct effect was -0.039 (BC 95% CI: -0.205 , 0.108). The path coefficient of the indirect effect of resilience on burnout

through positive and negative affect was -0.113 (*BC* 95% CI: $-0.209, -0.019$) and -0.209 (*BC* 95% CI: $-0.353, -0.108$), respectively. Burnout was directly and negatively associated with positive affect ($\beta = -0.505, P < 0.01$), but had a direct and positive association with negative affect ($\beta = 0.343, P < 0.01$). Since the direct effect of resilience to burnout included zero, which was insignificant, the positive and negative affect fully mediated the effects of resilience on burnout.

The mediating role of positive and negative affect in the relationship between resilience and burnout constructs

The standardized direct, indirect, and total effect estimates of resilience on emotional exhaustion in model 2 are presented in Table 5, and the path diagrams labelled on each path of the relationship between resilience and emotional exhaustion are shown in Fig. 3. In model 2, resilience had a significant indirect effect ($\beta = -0.286, P < 0.05$) and total effect ($\beta = -0.268, P < 0.05$) on emotional exhaustion and the path coefficient of the direct effect was 0.018 (*BC* 95% CI:

$-0.169, 0.189$). The path coefficient of the indirect effect of resilience on emotional exhaustion through positive and negative affect was -0.118 (*BC* 95% CI: $-0.228, -0.021$) and -0.168 (*BC* 95% CI: $-0.300, -0.060$), respectively. Emotional exhaustion was directly and negatively associated with positive affect ($\beta = -0.527, P < 0.01$), but had a direct and positive association with negative affect ($\beta = 0.276, P < 0.01$). Since the direct effect of resilience to emotional exhaustion included zero, which was insignificant, the positive and negative affect fully mediated the effects of resilience on emotional exhaustion.

The standardized direct, indirect, and total effect estimates of resilience on reduced personal accomplishment in model 3 are presented in Table 6, and the path diagrams labelled on each path of the relationship between resilience and reduced personal accomplishment are shown in Fig. 4. In model 3, resilience had a significant indirect effect ($\beta = -0.314, P < 0.05$), and total effect ($\beta = -0.365, P < 0.05$) on reduced personal accomplishment and the path coefficient of the direct effect was -0.051 (*BC* 95% CI: $-0.214, 0.096$). The

TABLE 5 Total, direct, and indirect effects of resilience on emotional exhaustion (N = 180)

Effects	Paths	Effect	SE	P	BC 95% CI
Indirect effects	Resilience → Positive affect → Emotional exhaustion	-0.118	0.052	0.012	-0.228 to -0.021
	Resilience → Negative affect → Emotional exhaustion	-0.168	0.061	0.004	-0.300 to -0.060
Direct effects	Resilience → Emotional exhaustion	0.018	0.090	0.870	-0.169 to 0.189
	Resilience → Positive affect	0.224	0.091	0.013	0.038 to 0.403
	Resilience → Negative affect	-0.609	0.065	0.001	-0.723 to -0.470
	Positive affect → Emotional exhaustion	-0.527	0.057	0.001	-0.627 to -0.405
	Negative affect → Emotional exhaustion	0.276	0.094	0.007	0.081 to 0.451
Total effects	Resilience → Emotional exhaustion	-0.268	0.061	0.001	-0.387 to -0.150

SE, standard error; BC 95% CI, bias-corrected 95% confidence intervals.

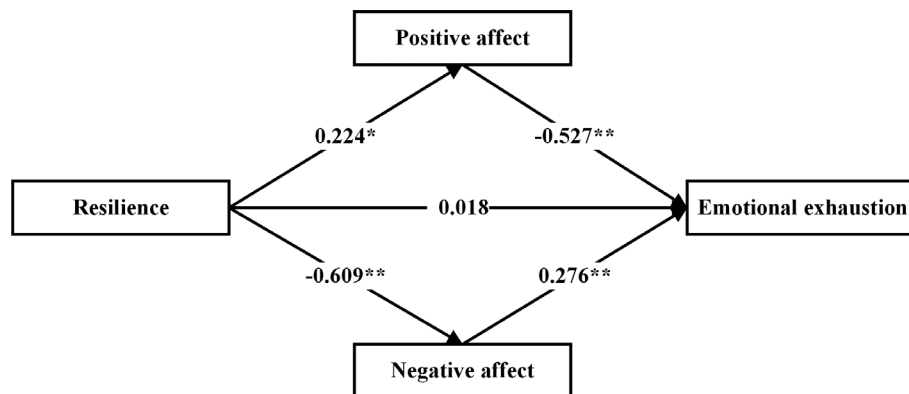
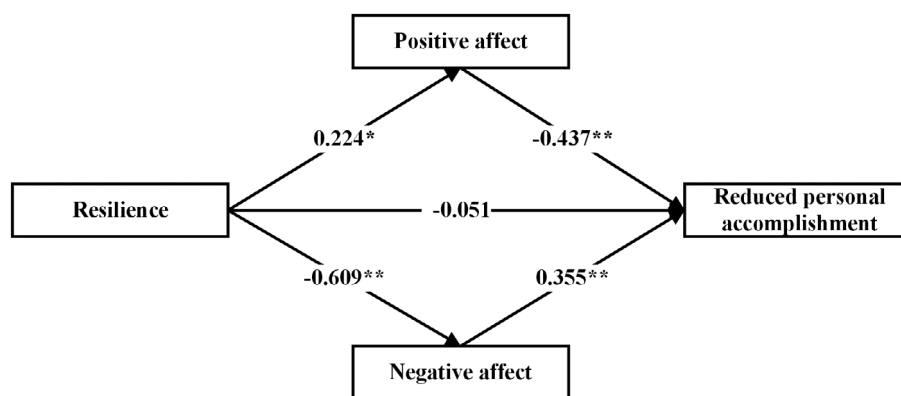


FIG. 3 Mediating roles of positive and negative affect between resilience and emotional exhaustion in Model 2. *P < 0.05, **P < 0.01

TABLE 6 Total, direct, and indirect effects of resilience on reduced personal accomplishment (N = 180)

Effects	Paths	Effect	SE	P	BC 95% CI
Indirect effects	Resilience → Positive affect → Reduced personal accomplishment	-0.098	0.041	0.012	-0.182 to -0.017
	Resilience → Negative affect → Reduced personal accomplishment	-0.216	0.066	0.001	-0.366 to -0.103
Direct effects	Resilience → Reduced personal accomplishment	-0.051	0.078	0.502	-0.214 to 0.096
	Resilience → Positive affect	0.224	0.091	0.013	0.038 to 0.403
	Resilience → Negative affect	-0.609	0.065	0.001	-0.723 to -0.470
	Positive affect → Reduced personal accomplishment	-0.437	0.041	0.001	-0.515 to -0.358
	Negative affect → Reduced personal accomplishment	0.355	0.090	0.001	0.176–0.530
Total effects	Resilience → Reduced personal accomplishment	-0.365	0.046	0.001	-0.446 to -0.267

SE, standard error; BC 95% CI, bias-corrected 95% confidence intervals.

**FIG. 4** Mediating roles of positive and negative affect between resilience and reduced personal accomplishment in Model 3. *P < 0.05, **P < 0.01**TABLE 7** Total, direct, and indirect effects of resilience on depersonalization (N = 180)

Effects	Paths	Effect	SE	P	BC 95% CI
Indirect effects	Resilience → Positive affect → Depersonalization	-0.095	0.039	0.009	-0.176 to -0.019
	Resilience → Negative affect → Depersonalization	-0.200	0.062	<0.001	-0.351 to -0.097
Direct effects	Resilience → Depersonalization	-0.085	0.084	0.349	-0.249 to 0.085
	Resilience → Positive affect	0.224	0.091	0.013	0.038 to 0.403
	Resilience → Negative affect	-0.609	0.065	0.001	-0.723 to -0.470
	Positive affect → Depersonalization	-0.424	0.051	0.001	-0.519 to -0.321
	Negative affect → Depersonalization	0.328	0.089	0.001	0.159 to 0.513
Total effects	Resilience → Depersonalization	-0.379	0.049	0.001	-0.474 to -0.278

SE, standard error; BC 95% CI, bias-corrected 95% confidence intervals.

path coefficient of the indirect effect of resilience on reduced personal accomplishment through positive and negative affect was -0.098 (BC 95% CI: -0.182 , -0.017) and -0.216 (BC 95%CI: -0.366 , -0.103), respectively. Reduced personal accomplishment was directly and negatively associated with positive affect ($\beta = -0.437$, $P < 0.01$), but had direct and positive association with negative affect ($\beta = 0.355$, $P < 0.01$). Since the direct effect of resilience to reduced personal accomplishment included zero, which was insignificant,

the positive and negative affect fully mediated the effects of resilience on reduced personal accomplishment.

The standardized direct, indirect, and total effect estimates of resilience on depersonalization in model 4 are presented in Table 7, and the path diagrams labelled on each path of the relationship between resilience and depersonalization are shown in Fig. 5. In model 4, resilience had a significant indirect effect ($\beta = -0.294$, $P < 0.05$) and total effect ($\beta = -0.379$,

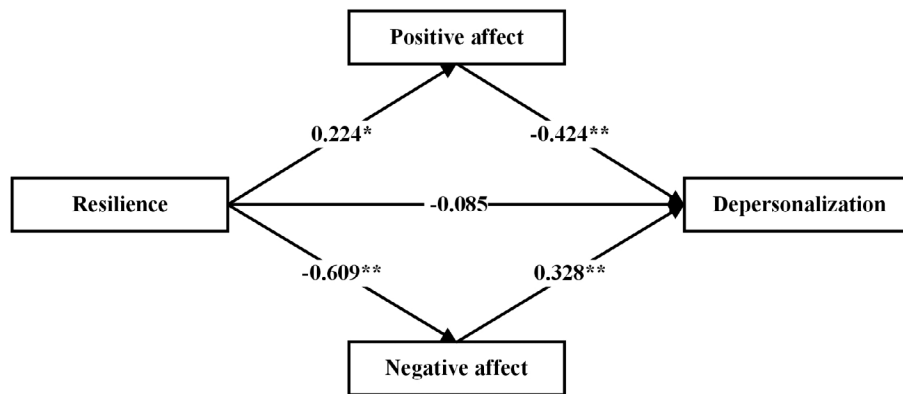


FIG. 5 Mediating roles of positive and negative affect between resilience and depersonalization in Model 4. * $P < 0.05$, ** $P < 0.01$

$P < 0.05$) on depersonalization and the path coefficient of the direct effect was -0.085 (BC 95%CI: -0.249 , 0.085). The path coefficient of the indirect effect of resilience on depersonalization through positive and negative affect was -0.095 (BC 95%CI: -0.176 , -0.019) and -0.200 (BC 95%CI: -0.351 , -0.097), respectively. Depersonalization was directly and negatively associated with positive affect ($\beta = -0.424$, $P < 0.01$), but had a direct and positive association with negative affect ($\beta = 0.328$, $P < 0.01$). Since the direct effect of resilience to reduced personal accomplishment included zero, which was insignificant, the positive and negative affect fully mediated the effects of resilience on depersonalization.

DISCUSSION

HCWs across the world, working under extreme pressure, are subjected to unprecedented stressful situations during the COVID-19 pandemic (Holmes *et al.*, 2020). There is growing evidence regarding the effect of burnout among front-line nurses during the COVID-19 pandemic (Chen *et al.*, 2020; Sarbooji Hoseinabadi *et al.*, 2020). The excellent resilience preparation of front-line nurses and the associated positive affect can reduce the risk of burnout. This study proposes the prioritization and coordination of policy-relevant research on burnout and positive and negative affect, to ensure that resilience interventions are efficiently targeted for the optimal mental health of front-line HCWs as the COVID-19 pandemic unfolds. To the best of our knowledge, this is the first study to explore the mediating role of positive and negative affect in the relationship between resilience and burnout among front-line nurses at the peak of the COVID-19 pandemic.

Quarantine is associated with social and psychological risks for mental health (Brooks *et al.*, 2020), and is a predictor of post-traumatic stress in HCWs even 3 years later (Wu *et al.*, 2009). HCWs exposed to SARS were immediately quarantined, which was a severe predictor of acute stress disorder (Bai *et al.*, 2004). Quarantined HCWs were significantly more likely to report emotion exhaustion, and detachment from family when caring for COVID-19 patients, and may have a deteriorating work performance, show reluctance to work, and suffer negative affect, such as irritability (Brooks *et al.*, 2020). Individuals who experienced living with COVID-19 patients were concerned about social isolation and increased negative affect (Holmes *et al.*, 2020). The effects of social isolation on the well-being of HCWs should be widespread concerned with increased negative affect and the practical implications of pandemic resilience interventions (Perez-Fuentes *et al.*, 2020). A sense of losing direct social contacts (Usher *et al.*, 2020) is reported, as these front-line nurses living in a single room off-work communicate with their families or friends *via* video or audio calls. Deploying mental health researchers to the pandemic area may help the formation of emotional change initiatives aimed at reducing the spread of the burnout among front-line nurses. Quarantine management during the COVID-19 pandemic is crucial to understand the burnout through positive and negative affect of front-line HCWs to conduct resilience interventions earlier.

Positive and negative affect can be influenced by uncertainty, which requires making highly challenging decisions to mitigate the risk of mental health issues (Brooks *et al.*, 2020). Increased negative affect in response to the pandemic should be highlighted, and front-line HCWs are exposed to traumatic events, such

as a large number of deaths and severe cases (Li *et al.*, 2020). Acute or long-term mental impacts of the COVID-19 pandemic on HCWs, worries, and uncertainties about this pandemic are common, and cause undue emotional distress and impairment to social and occupational functioning (Brooks *et al.*, 2020). HCWs reported they were exposed to difficulty solving problems in emergency care and situations for which they felt unprepared, and which may be similar to the unprecedented COVID-19 pandemic challenges HCWs are currently facing (Brooks *et al.*, 2020). The COVID-19 pandemic may cause HCWs to experience moral injury (Greenberg *et al.*, 2020), which is defined as the emotional distress that violates the moral or ethical rule (Litz *et al.*, 2009). HCWs are likely to experience negative affect, feeling intensely afraid, ashamed, irritable, or hostile, which can contribute to the development of burnout (Williamson *et al.*, 2018). These front-line nurses reported fear being compulsorily required to use PPE during work time, using elastomeric respirator, and rated the respirator less favourably with respect to comfort, and preferred to use them only in certain higher risk situations (Hines *et al.*, 2019), although they can accept less convenience, but more protective PPE to provide care for COVID-19 patients (Hines *et al.*, 2020). HCWs were affected and hurt by experiencing the pandemic, no one is invulnerable, they need to be resilient and prepared, and policies need to provide resilience support for burnout through negative affect.

There is a risk that the prevalence of burnout will increase, and coping emergency responses to burnout are expected during this extraordinary pandemic (Gunnell *et al.*, 2020). Burnout may be caused by organizational and individual attributes, and organizational attributes or health facility settings of front-line nurses contribute to psychological distress (Cusack *et al.*, 2016). Individual attributes act as internal factors, such as optimism and hope, spirituality, and a positive identity (Rees *et al.*, 2015). Structuring effective, individualized resilience interventions for coping in this pandemic is critical (Folkman & Moskowitz, 2004). The organizational attributes are mostly characterized by social support, a supportive workplace environment, and interventions (Delgado *et al.*, 2017). Individual attributes and organizational resources of front-line nurses should be used by policymakers to manage workplace adversity, including self-reliance, passion and interest, positive thinking, and emotional intelligence as self-efficacy mechanisms (Holmes *et al.*, 2020). Most HCWs found that support from colleagues

and leaders may protect their mental health, and managers should reach out to HCWs who avoid attending peer discussions (Holmes *et al.*, 2020). Monitoring the incidence of real negative affect is necessary, as burnout might be hidden, managers should keep a resilient eye on burnout through negative affect. If negative affect of front-line nurses is persistent or severe, the awareness of its mediating roles in the relationship between resilience and burnout individually is required. As the situation progresses, managers should help front-line nurses make sense of the burnout challenges through positive affect to safely provide discussions on resilience.

The resilience interventions may be overwhelmed by the pandemic, and this has personal relevance; HCWs experience genuine feelings of negative affect and burnout may affect their mental health. Front-line HCWs need both managerial and psychological support to balance mental issues and resilience in order to deal with the COVID-19 pandemic (Digby *et al.*, 2020). This study advocates for an increased attention to burnout in HCWs and highlights positive affect strategies associated with resilience to be applied during the COVID-19 pandemic (Vinkers *et al.*, 2020). Several potential resilience interventions can help mitigate the burnout through positive and negative affect, by reliably and iteratively delivering mental health, such as with digital resources to efficiently manage the mental health of HCWs in an adaptive and resilience manner (Wind *et al.*, 2020), which requires a range of international collaborative research (Holmes *et al.*, 2018). Front-line nurses who provided care for COVID-19 patients, developed burnout, and associated mental health problems should be aware of the consequences of the avoidance of speaking about negative affect (Salkovskis *et al.*, 1999). The government bodies, scientific organizations, and mental health providers, besides providing funds for longer-term resilience interventions, are important to protect the mental well-being of HCWs, which may include eliciting community (Dawson *et al.*, 2015), peer support (Zhao *et al.*, 2019), and assertiveness training (Solomonov *et al.*, 2019). Due to quarantine policy, digital resilience interventions, such as social media apps, are mechanistically buffering effects of burnout through positive affect to alleviate burnout. HCWs who persistently avoid meetings or experience negative affect may require sensitive and positive discussion, and support from suitably experienced or trained peers. HCWs have greater difficulty in accessing mental health services during the pandemic, this study combined with those in the literature

informs the development of research priorities. The positive affect can be leveraged by resilience interventions to mitigate and minimize the burnout, to boost the well-being across the whole task force of HCWs during the pandemic.

Monitoring the level of burnout through the positive and negative affect of front-line HCWs is beneficial to understand mediating mechanisms. It is needed to understand how front-line HCWs can be supported to optimize resilience strategies to mitigate burnout through positive affect, and facilitate the resilience interventions (Duan & Zhu, 2020). Research is needed to deploy available resilience resources to HCWs, which can be important for mitigating burnout through positive affect on HCWs (Sehmi *et al.*, 2019). It is critical that front-line HCWs are resilience and positively supported, and personalized resilience interventions are likely to be a key component to mitigate burnout (Usher *et al.*, 2020). The optimal resilience interventions should be tailored to multiple front-line HCW groups, deployed appropriate mental health resource, and multidimensional perspectives. Once the COVID-19 pandemic is over, policymakers should ensure that they reflect on and learn from the difficult healthcare experiences (Usher *et al.*, 2020), rapidly learning from existing successful resilience strategies to integrate the proper medical and resilience resources and promoting optimal mental health among HCWs, moving forward to any future periods of the pandemic.

Resilience interventions and mental health support initiatives aimed at reducing the burnout, which recommend active screening for burnout in front-line HCWs during this pandemic (de Burgos-Berdud *et al.*, 2020). This study provides a mediating strategy, which can be integrated with research efforts worldwide, targeting mediators between resilience interventions and burnout. This pandemic fosters the connection of global researchers to support an international response to the challenges and mental health of HCWs and should be harnessed to benefit both society and the public in the long term. Rising to this challenge, the social and psychological effects of this pandemic should be coordinated at a national and international level. International research funding is needed to establish a high-level national and international group, mental health of HCWs can be effectively leveraged by the world leading global infrastructures, and that firm evidence can be translated into effective resilience interventions. The creation of high-quality database of the psychological effects of current and future pandemics on the whole task force of front-line HCWs, detailing how to

implement a coordinated emergency response regarding resilience interventions, should be brought together under a national or international open data portal.

Limitations

This study has some limitations worth noting. Data were obtained from self-reported questionnaires, all front-line nurses were isolated off-work, and social media is their main ways of communication with the outside world, potential selection bias and the political sway of social media should be considered. The results of this study are preliminary and only represent a snapshot of the current mental status of front-line nurses, and their validity needs to be further confirmed. The sample of this study is not representative of all the front-line nurses, and generalization of the results is limited. Burnout may have been greater and sustained among front-line HCWs during and after the COVID-19 pandemic, longitudinal studies should be conducted to examine long-term effects of burnout through positive and negative affect, by performing prolonged follow-up of HCWs with a short-lived burnout to avoid relapse from mental health problems (Rivas *et al.*, 2020). A small-size and localized research does not benefit the need to guide policymakers, we must build and harness longitudinal and international data sets with new research strategies for recording detailed psychological information (Holmes *et al.*, 2018).

Conclusion

This study revealed the association between resilience and burnout in front-line nurses, with positive and negative affect acting as mediators at the peak of the COVID-19 pandemic. This study proposes to set out immediate and longer-term resilience strategies for front-line HCWs, and provides early insight into the urgent need to support HCWs who are at higher risk of negative affect to avoid burnout, through positive affect to alleviate burnout. Immediate insights provide evidence-based guidance for resilience interventions responding to burnout through positive and negative affect in HCWs to improve well-being during pandemics. The evidence is valuable for preventing burnout and guiding studies to creating resilience interventions for front-line HCWs in future pandemics. This study strongly recommends providing timely resilience interventions to mitigate the massive mental health impact of this pandemic on the current and future well-being of HCWs.

RELEVANCE FOR CLINICAL PRACTICE

- Association between resilience and burnout of front-line nurses, and positive and negative affect act as mediators at the peak of the COVID-19 pandemic in Wuhan.
- This study reveals immediate insights to provide evidence on resilience interventions to support front-line nurses with burnout through positive and negative affect.
- Further research is needed to confirm findings on resilience interventions for burnout nurses during the pandemic mediated by positive and negative affect. HCWs can learn from previous pandemics on how to become more resilient to cope with burnout.

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ETHICS STATEMENT

Human participation was approved by the Xuzhou Medical University Research Ethics Committee (ID number: XZ20200225).

INFORMED CONSENT

Participants provided signed consent online.

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CONSENT FOR PUBLICATION

Not applicable.

Data Availability Statement

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

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