ORIGINAL ARTICLE

The mediating role of regulatory emotional self-efficacy on negative emotions during the COVID-19 pandemic: A cross-sectional study

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ABSTRACT: *Nurses exposed to coronavirus disease 2019 (COVID-19) are psychologically stressed. This study examines the characteristics and distribution of negative emotions among Chinese nurses during the COVID-19 pandemic and explores regulatory emotional self-efficacy (RESE) as the underlying mechanism in the relationship between nurses' personalities and negative emotions. A cross-sectional design with convenience sampling was utilized. Three comprehensive tertiary hospitals located in China were selected. Nurses (n = 339) who cared for COVID-19 patients were enrolled. Recruitment was conducted between 14 February 2020 and 1 March 2020. Self-reported questionnaires about personality, RESE, and epidemic-related negative emotions were completed online. A correlation analysis, structural equation modelling, and the bootstrapping method were used to analyse the data. This study identified a 24.9% incidence of negative emotions in nurses. RESE was a significant mediator explaining the effect of personality on epidemic-related negative emotions. RESE mediated the effect of introversion–extroversion on depression (β = −0.151, P = 0.015), neuroticism (β = −0.182, P = 0.007), fear (β = −0.142, P = 0.006), anxiety (β = −0.189, P = 0.015), and hypochondria (β = −0.118, P = 0.010); it also mediated the effect of neuroticism on depression (β = 0.313, P = 0.002), neuroticism (β = 0.394, P = 0.003), fear (β = 0.345, P = 0.005), anxiety (β = 0.384, P = 0.003), and hypochondria (β = 0.259, P = 0.004). Nurses caring for COVID-19 patients displayed negative emotions, particularly emotionally unstable and introverted nurses with a low RESE level. RESE is often essential for interventions because it significantly influences the relationship between personality and negative emotions. In the event of a major outbreak, tailored psychological well-being education, which includes emotional self-efficacy strategies, should be provided by organizations to help nurses manage stress related to the outbreak.*

KEY WORDS: *COVID-19, mediating effect, negative emotion, personality, regulatory emotional self-efficacy.*

INTRODUCTION

Viral diseases have become a significant threat to public health. The World Health Organization (WHO) reports that there have been several outbreaks of infectious diseases worldwide during the past 20 years, such as severe acute respiratory syndrome (SARS) in 2003, influenza caused by the virus subtype H1N1 in 2009, Middle East respiratory syndrome in 2012, and the Ebola virus in 2014. In December 2019, Wuhan reported a novel pneumonia named coronavirus disease 2019 (COVID-19), which is spreading worldwide. COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Zhu *et al.* 2020). On 30 January 2020, the WHO held an emergency meeting and declared that the global COVID-19 outbreak was a public health emergency of international concern (World Health Organization 2020); the WHO later declared it a pandemic. The COVID-19 pandemic situation is currently dire throughout the world.

There is a wide consensus that the outbreak of an infectious disease is often linked with adverse psychological outcomes (Brooks *et al.* 2020), such as the occurrence of fear, panic, and discrimination (Usher *et al.* 2020). Compared with the general public, healthcare workers are more likely to experience a wide range of negative psychological impacts following an emergency or disaster, particularly those who are directly involved in the diagnosis, treatment, and care of patients with COVID-19 (Brooks *et al.* 2020). The increasing number of confirmed and suspected cases, work overload, the exhaustion of personal protective equipment (PPE) early in the outbreak, the high risk of being infected with the virus, the widespread coverage in the public media, the lack of specific medicines, and feelings of being inadequately supported may all contribute to the mental burden of healthcare providers (Jiang *et al.* 2020). In a study of 863 medical care workers from seven provinces in China during the COVID-19 outbreak, the participants displayed mild to extremely severe symptoms of depression (13.6%), anxiety (13.9%), and stress (8.6%) (Si *et al.* 2020). Post-traumatic stress (PTS) was also prevalent, and 40.2% of the population has exhibited significant PTS disorder symptoms (Si *et al.* 2020).

Similar concerns about the mental health of nurses are still arising. Among medical care workers, nurses are more likely to fall into negativity and moral distress (Liu *et al.* 2020; Pappa *et al.* 2020; Si *et al.* 2020). They spend more time exposing themselves to a contagious environment, feel powerless to handle patients'

conditions, and are challenged by working in a stressful context (Liu *et al.* 2020). Nurses fear infection and fear spreading that infection to family, friends, and colleagues. They feel uncertain about whether they are ill, have a fear of clinical work, or even consider resignation (Liu *et al.* 2020). High levels of stress may have a long-term psychological influence on individuals. Consequently, nurses tend to experience some adverse psychiatric symptoms, such as suspected illness, fear, compulsive behaviour, or neurasthenia (Yifan *et al.* 2020a). In response to the outbreak, local and national medical institutions in China have widely launched psychological assistance services such as telephone and Internet services. However, evidence-based assessments and targeted mental health interventions for nurses are relatively rare.

Personality, an essential factor affecting mental health, has been generally recognized by the psychology community. Personality refers to the unique and stable way of thinking and behaviours of an individual that are distinguishable from those of others (Eysenck 1996). Personality theory has undergone long-term development, including common theories such as Eysenck's three-factor theory (Eysenck 1996), Cartel's sixteen-factor theory (Cattell *et al.* 2002), McCrae and Costa's 'Big Five' structure (McCrae 1991), and Tellegen and Waller's seven-factor personality model (Waller *et al.* 1991). These theories imply that emotion is a critical component of personality and its core content. A growing number of studies have also indicated that personality widely explains and predicts emotions (Segerstrom & Smith 2019). Some core or underlying personality traits are a significant concomitant of negative emotions. Introversion (i.e. low extroversion) is particularly promising in its relationship with the symptoms and outcomes of depression and may represent an underlying heritable trait of aetiological significance (Janowsky 2001; Markaki *et al.* 2019). Extraversion and neuroticism also contribute mediating effects towards the development of depression and anxiety. Specifically, neuroticism has been suggested to be a strong mediator of anxiety (Grav *et al.* 2012; Murray & O'Neill 2019). Moreover, the presence of psychoticism predicted motivational–somatic symptoms of depression (García-Torres & Alós 2014). Psychoticism also has substantial effects on several negative emotions, such as perceived daily hassles, depression, and hostility (Compton *et al.* 2008).

Although many personality characteristics have been recognized as influencing factors for negative emotions, few studies have explored how to protect individuals

with such characteristics from negativity. Therefore, testing the mediating role of regulatory emotional self-efficacy (RESE) in the pathway from personality to negativity is important. Based on the self-efficacy theory developed by Bandura *et al.* (2003), Caprara *et al.* (2008) postulated the concept of RESE. RESE refers to the belief in one's ability to improve negative emotions and experience positive emotions (Caprara *et al.* 2008). However, RESE is specific and refers to particular domains and given times. Individuals may feel that they are efficient in regulating certain emotions but less efficient in controlling others, which could affect or modify their subsequent behaviour. Recently, the correlation between RESE and negative emotions was partially confirmed. Emotional instability (characterized by the experience of negative emotions such as anger, anxiety, and depression) could be associated with lower levels of RESE (Mesurado *et al.* 2018).

While the above studies have consistently agreed that personality and RESE are crucial in influencing negative emotions, few studies have investigated the specific effects that personality and RESE have on negative emotions. The previous series of evidence has provided a foundation for conjecture regarding the roles of RESE as a mediator in the relationship between personality and negative emotions. In this study, we proposed RESE as an essential mediator; this role of RESE may provide new insights to serve as crucial evidence for directing the promotion of mental well-being among healthcare personnel. Our specific research questions were as follows: (i) What is the status of negative emotions related to COVID-19 and personality traits among Chinese nurses? (ii) Is there a mediation effect of RESE on the relationship between personality and epidemic-related negative emotions? Figure 1 presents the tested hypothesis: the impact of personality on negative emotions is mediated by RESE (total mediation effect: a_1*b_1).

METHODS

Design and participants

This study was a cross-sectional survey conducted via convenience sampling from 14 February 2020 to 1 March 2020. During this period, the total number of confirmed COVID-19 cases in China exceeded 80 000. For the convenience of this study, three hospitals equipped with fever clinics or wards for COVID-19 were selected, including two hospitals in Wuhan and Jiaxing that were designated by the local government to treat COVID-19 and one non-designated hospital in Hangzhou. The inclusion criteria for the participants were as follows: (i) held a registered nurse certificate of the People's Republic of China; (ii) engaged in the care of patients with confirmed or highly suspected COVID-19 in the fever clinic or ward; and (iii) were willing to participate in this study and signed the informed consent form. The exclusion criteria for the participants were as follows: (i) were not working in the hospital during the investigation period, including sick leave, personal leave, or maternity leave and (ii) were administrative nurses. Approximately 364 nurses (Hangzhou, 159; Wuhan, 119; Jiaxing, 86) were approached. All questionnaires were distributed through the online platform 'WenJuanXing', and the guidelines were added to the platform's homepage. The completeness of the questionnaires was checked by two researchers. We considered questionnaires with missing items for 80% or more of the total number of entries to be invalid, and we eliminated these questionnaires ($n = 25$). Eventually, a total of 339 nurses (Hangzhou, 154; Wuhan, 108; Jiaxing, 77) from the three hospitals were enrolled. The data were reviewed by two researchers and then entered into the statistical software.
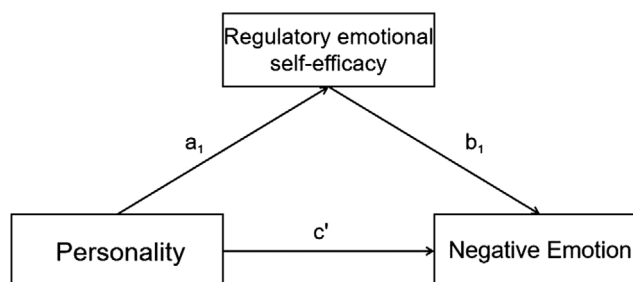

FIG. 1 Represents the tested hypothesis: Among Chinese nurses, the impact of personality on negative emotions is mediated by regulatory emotional self-efficacy (total mediation effect: a1*b1).

Samples

Structural equation modelling (SEM) analysis is based on the covariance matrix; therefore, the chi-square test of parameter estimation and fitness is sensitive to the sample size. However, determining the sample size required for SEM is very complicated. There is no absolute standard or rule of thumb applicable to all situations in SEM. Rigdon (2005) believed that SEM analysis requires a sample of 200 or more; otherwise, the model estimate may be unstable. Some researchers (Schumacker & Lomax 1996) believe that SEM requires a larger sample size, such as 200–500, and the number of samples can fit well with the overall model. In this study, we eventually obtained 339 valid completed questionnaires.

Measurement

Demographic data

Data were self-reported by the participants, including sex, age (18–25, 26–30, 31–40, or >40 years), marital status (married, unmarried or divorced), educational level (junior college, undergraduate, or postgraduate), professional title (junior, intermediate/supervisor nurse, or senior), and geographic location of the hospital (Wuhan, Jiaxing, or Hangzhou).

Eysenck Personality Questionnaire-Revised Short Scale (EPQ-RSS)

This scale was developed by Eysenck et al. (Eysenck 1996) to measure personality type. The scale is now widely used in many fields. This study adopted the Chinese version of the EPQ-RSS (EPQ-RSC) (Mingyi et al. 2000). It has four subscales (E, N, P, and L), each with 12 items, for a total of 48 items. The E dimension represents introversion–extroversion and measures inward or outward tendencies. The N dimension represents neuroticism and measures emotional stability. The P dimension represents psychoticism and measures the level of stubbornness or indifference. The L dimension is a validity scale and measures the participant's honesty. The discrimination index of each item and its subscale is greater than 0.30, which meets the acceptance criteria for items required by psychometric projects (Mingyi et al. 2000). The split-half reliability and internal consistency reliability of each subscale are greater than 0.70, and the retest reliability is greater than 0.70 (Huang et al. 2018; Mingyi et al. 2000). The reliability and validity of the EPQ-RSC are good, and the psychometric quality is stable and reliable.

The revised Scale of Regulatory Emotional Self-Efficacy (SRESE) – Chinese version

The SRESE is from the second-order two-factor structure questionnaire on RESE compiled and revised by Caprara et al. (2008) in a cross-cultural study. The Chinese version of the SRESE was used in this study (Yujie et al. 2013). The SRESE adopts a 5-point Likert scoring method and includes 17 items; higher scores indicate that an individual has higher confidence in their ability to effectively regulate their own emotional state. Cronbach's α for the total scale is 0.864, the split-half reliability is 0.740, Cronbach's α of the subscale ranges between 0.653 and 0.772, the split-half reliability ranges between 0.602 and 0.753, and the construction reliability is greater than 0.7 (Yujie et al. 2013). Therefore, the SRESE is suitable for this study.

The psychological questionnaire related to public health emergencies

By referring to the classification and diagnostic criteria of the Chinese Classification and the Diagnose Criterion of Mental Disorder (CCMD-3) and combining the psychological reactions that may occur during public health emergencies, Yan et al. (2004) developed this questionnaire and then tested its reliability and validity during the SARS epidemic. It is used to assess the psychological response of people over the age of 16 to public health event outbreaks. The questionnaire contains 25 items assessing five dimensions: depression, neuroticism, fear, anxiety, and hypochondria. According to the degree of emotional reaction (none, mild, moderate, severe) and frequency (occasionally, sometimes, often, always), participants were given scores of 0, 1, 2, or 3 points, respectively. The correlations between the above five dimensions and the similar dimensions in the SCL-90 range between 0.16 and 0.60 (Yan et al. 2004). The test–retest reliability coefficients of the questionnaire range between 0.40 and 0.92 (Yan et al. 2004). Cronbach's α of the entire questionnaire is 0.69, and Cronbach's α of the five dimensions ranges between 0.76 and 0.81 (Yan et al. 2004; Zhiping et al. 2020). The questionnaire has good reliability and validity. It has been widely used in the measurement of negative emotions during the COVID-19 pandemic (Zhiping et al. 2020).

Ethical considerations

Before initiating this study, it was approved by the clinical research ethics committee of the Sir Run Shaw

Hospital School of Medicine Affiliated with Zhejiang University (20200316-22). The participants received a notification before the study that their participation was entirely voluntary. The participants could also terminate the survey at any time. All survey participants provided verbal informed consent before registration. All data were processed strictly to remove identity information.

Statistical analysis

The data analysis was performed using SPSS statistical software version 25.0 (IBM Corp.) and AMOS statistical software version 24.0 (IBM Corp.). The significance level was set at $\alpha = 0.05$, and all tests were 2-tailed. The normality of these critical variables was determined using skewness, kurtosis, and Q-Q plots. Demographic and descriptive characteristics are summarized as the frequency and percentage for categorical variables and as the mean and standard deviation (SD) for continuous variables. Discrete trends are presented as medians with interquartile ranges (IQRs). After satisfying the conditions of the intermediary effect analysis (Baron & Kenny 1986), a structural equation model was constructed to obtain the fitting index and path coefficient. In the mediation analysis, the indirect effect was defined as the product of path a_1 and path b_1 (a_1*b_1) for RESE (Fig. 1). Finally, the total effect consisted of the direct effect, depicted as path c', and the indirect effects. All the effects mentioned above were tested using the bootstrapping procedure with 95% confidence intervals (CIs) (Preacher & Hayes 2008).

RESULTS

Demographic data

The demographic characteristics of the participants are shown in Table 1. Most of the participants were female (90.6%), young (<40 years, accounting for 90.9%), had an intermediate professional title (supervisor nurse) (82.3%), and were well educated (bachelor's degree or above, accounting for 92.1%). More than half of the participants (56.3%) were married.

The negative emotions of nurses during the COVID-19 pandemic

According to Yan *et al.* (2004), a score on a particular dimension of negative emotions higher than the

TABLE 1 *Demographic characteristics of nurses during the COVID-19 pandemic* (n = 339)

Variables	N	%
Sex		
Male	32	9.4
Female	307	90.6
Age		
22~25	56	16.5
26~30	125	37.5
31~40	127	37.5
40~	31	9.1
Geographic location		
Hangzhou	154	45.4
Wuhan	108	31.9
Jiaxing	77	22.7
Education		
College degree	17	5.0
Bachelor's degree	303	89.4
Master's degree or above	9	2.7
Marital status		
Married	191	56.3
Unmarried	143	42.2
Divorced	5	1.5
Professional title		
Junior	53	15.6
Intermediate (Supervisor nurse)	279	82.3
Senior	7	2.1

mean + 1 SD indicates 'emotional deviation'; a score higher than the mean + 2 SDs indicates 'emotional disorder'. The descriptive statistics of negative emotions related to public health emergencies are shown in Table 2. The highest incidence of emotional deviation was reported for hypochondria (11.8%), followed by fear (11.5%), anxiety (9.2%), neuroticism (8.3%), and depression (7.7%). The highest incidence of emotional disorder was reported for depression (6.5%), followed by neuroticism (5.3%), anxiety (5.0%), fear (4.1%), and hypochondria (4.0%).

Personality traits of frontline nurses in the COVID-19 pandemic

After the raw score of each subscale of the EPQ-RSC is calculated, it must be converted into the standard score according to the formula $T = 50 + 10 \times$ (raw score-the mean score of the dimension)/(SD of the dimension). If the standard score is higher than 56.7 or less than 43.3, the subject is considered to have high or low tendency characteristics on the dimension, respectively. If the standard score is higher than 61.5 or less than 38.5, the subject is thought to have high or low typical characteristics, respectively. The descriptive

TABLE 2 *The negative emotions of nurses during the COVID-19 pandemic* (n = 339)

Statistics	Depression	Neuroticism	Fear	Anxiety	Hypochondria
Mean	0.49	0.63	1.24	.34	.11
SD	0.57	0.60	0.68	0.46	0.16
Percentile					
25th	0.00	0.20	0.67	0.00	0.00
50th	0.33	0.40	1.17	0.17	0.00
75th	0.67	1.00	1.67	0.50	0.17
Normal n (%)	291 (85.8)	293 (86.4)	286 (84.4)	291 (85.8)	282 (83.2)
Emotional deviation n (%)	26 (7.7)	28 (8.3)	39 (11.5)	31 (9.2)	40 (11.8)
Emotional disorder n (%)	22 (6.5)	18 (5.3)	14 (4.1)	17 (5.0)	17 (4.0)

TABLE 3 *Personality traits of nurses during the COVID-19 pandemic* (n = 339)

Statistics	E Dimension	N Dimension	P Dimension
Mean	50.01	49.99	50.01
SD	9.99	9.98	9.99
Percentile			
25th	41.34	42.42	46.93
50th	53.48	48.63	51.96
75th	57.53	57.95	56.98
High typical (>61.5) n (%)	62 (18.3)	50 (14.7)	4 (1.2)
High tendency (56.7~61.5) n (%)	59 (17.4)	46 (13.6)	122 (36.0)
Intermediate (43.3~56.7) n (%)	131 (38.6)	128 (37.8)	169 (49.9)
Low tendency (38.5~43.3) n (%)	29 (8.6)	83 (24.5)	10 (2.9)
Low typical (<38.5) n (%)	58 (17.1)	32 (9.4)	34 (10.0)

statistics of personality traits are shown in Table 3. The mean score on the E dimension was 50.01 (SD = 9.99). The mean score on the N dimension was 49.99 (SD = 9.98). The mean score on the P dimension was 50.01 (SD = 9.99). According to each personality dimension, the sample tended to have a slightly high score on the E dimension and a relatively low score on the N and P dimensions. Based on the distribution of the EPQ-RSC scores, nurses in this study tended to be outgoing, gentle, emotionally stable, and friendly.

Correlation analysis for personality, RESE, depression, neuroticism, fear, anxiety, and hypochondria

The correlation analysis (Table 4) showed that depression was positively correlated with the N dimension of personality. Neuroticism was negatively correlated with the E dimension and positively correlated with the N dimension. Fear was positively related to the N dimension of personality. Anxiety was positively associated with the N dimension of personality. Hypochondria was positively correlated with the N dimension. RESE was negatively associated with depression, neuroticism, fear, anxiety, and hypochondria, positively associated with the E dimension of personality, and negatively associated with the N and P dimensions. All the above correlations were statistically significant (*, $P < 0.05$, **, $P < 0.01$).

The mediating effect of RESE on depression, neuroticism, fear, anxiety, and hypochondria

In this study, SEM was performed to analyse the relationship between personality or RESE and depression, neuroticism, fear, anxiety, or hypochondria. The correction index was used to test and modify the structural equation model. Finally, structural equation models with personality as an independent variable and RESE as an intermediary variable, acting together in all dimensions of negative emotions related to public health emergencies, were constructed (Table 5).

According to the results shown in Table 5, introversion–extroversion could predict depression directly and negatively ($\beta = -0.110$, $P = 0.009$). Neuroticism could predict depression directly and positively ($\beta = 0.108$, $P = 0.046$). RESE could directly predict depression ($\beta = -0.653$, $P = 0.005$), neuroticism ($\beta = -0.808$, $P = 0.006$), fear ($\beta = -0.694$, $P = 0.005$), anxiety ($\beta = -0.808$, $P = 0.006$), and hypochondria ($\beta = -0.528$, $P = 0.008$). RESE mediated the effect of introversion–extroversion on depression ($\beta = -0.151$,

TABLE 4 *Correlation matrix of personality, RESE and negative emotions* (n = 339)

	The E dimension	The N dimension	The P dimension	RESE	Depression	Neuroticism	Fear	Anxiety	Hypochondria
The E dimension	1.000	−.187**	.031	.281**	−.348**	−.275**	−.194**	−.184**	−.148**
The N dimension	−0.187**	1.000	0.097	−0.518**	0.454**	0.501**	0.459**	0.520**	0.322**
The P dimension	0.031	0.097	1.000	−0.063	0.016	0.051	0.060	0.010	0.012
RESE	0.281**	−0.518**	−0.063	1.000	−0.614**	−0.768**	−0.655**	−0.679**	−0.443**
Depression	−0.348**	0.454**	0.016	−0.614**	1.000	0.628**	0.479**	0.639**	0.388**
Neuroticism	−0.275**	0.501**	0.051	−0.768**	0.628**	1.000	0.632**	0.708**	0.413**
Fear	−0.194**	0.459**	0.060	−0.655**	0.479**	0.632**	1.000	0.687**	0.526**
Anxiety	−0.184**	0.520**	0.010	−0.679**	0.639**	0.708**	0.687**	1.000	0.513**
Hypochondria	−0.148**	0.322**	0.012	−0.443**	0.388**	0.413**	0.526**	0.513**	1.000

**Significantly correlated at the 0.01 (bilateral) level.

$P = 0.015$), neuroticism ($\beta = -0.182$, $P = 0.007$), fear ($\beta = -0.142$, $P = 0.006$), anxiety ($\beta = -0.189$, $P = 0.015$), and hypochondria ($\beta = -0.118$, $P = 0.010$). RESE also mediated the effect of neuroticism on depression ($\beta = 0.313$, $P = 0.002$), neuroticism ($\beta = 0.394$, $P = 0.003$), fear ($\beta = 0.345$, $P = 0.005$), anxiety ($\beta = 0.384$, $P = 0.003$), and hypochondria ($\beta = 0.259$, $P = 0.004$).

DISCUSSION

The emotional status of frontline nurses in the COVID-19 pandemic

As a significant novel infectious agent since 2019, SARS-CoV-2 is highly contagious, with a primary reproductive number (RO) of 2.2–5.7 (Sanche *et al.* 2020). The clinical symptoms of COVID-19 are hidden and diversified and can cause a variety of severe consequences. The current understanding of COVID-19 is lacking, and there is no specific treatment or prevention. The public has experienced varying degrees of psychological and behavioural problems, manifesting as depression, suspicion, fear, anxiety, or compulsive behaviour (Chua *et al.* 2004; Gao *et al.* 2013; Tang *et al.* 2017). Faced with the COVID-19 pandemic, nurses are on the front line of prevention and control. The emotional reaction of nurses to an infectious disease pandemic is more complicated than that of the general public.

This study showed that nurses in the COVID-19 pandemic generally have an enormous psychological burden and exhibit high rates of affective symptoms, which is consistent with previous studies (Pappa *et al.* 2020). The sources of these affective symptoms may include feelings of vulnerability or a loss of control and concerns about the health of oneself, the spread of the virus, the health of family and others, changes in work, and being isolated (Wong *et al.* 2005). Additionally, anticipated shortages of PPE and an increasing influx of suspected and actual cases of COVID-19 contribute to the pressures and concerns of nurses (Tan *et al.* 2020a,b). The inequality experienced by nurses can cause negative emotions during the process of caring for COVID-19 patients, mainly because of unequal exposure to the infectious environment and role ambiguity between doctors and nurses (Jia *et al.* 2020). Specifically, nurses mentioned that some doctors expected nurses to assume some of the doctors' responsibilities, such as checking on patients' conditions by pulmonary auscultation and bedside blood gas analysis, causing nurses mental and moral distress (Jia *et al.* 2020; Tan *et al.* 2020a,b).

Among the study sample, 4.0%–11.8% of nurses had an emotional deviation or even a psychological disorder, and depression was the most prevalent emotional disorder. It is speculated that depression is caused by the lack of knowledge about the aetiology, diagnostic standards and methods, and treatment measures of COVID-19. Because of this lack of knowledge and faced with this moral dilemma, which can be summarized as emerging and/or accentuated occupational psychosocial risk factors during the health crisis produced by COVID-19, nurses are more likely to be depressed

TABLE 5 *The effect of personality and RESE on negative emotions* (n = 339)

Pathway	Effect	B	95% CI	P
			Model	
RESE → Negative Emotions	Effect on depression ($b_{1, 2}$)	−0.653	(−0.762, −0.548)	0.005
	Effect on neuroticism ($b_{1, 2}$)	−0.808	(−0.871, −0.728)	0.012
	Effect on fear ($b_{1, 2}$)	−0.694	(−0.570, −0.407)	0.005
	Effect on anxiety ($b_{1, 2}$)	−0.808	(−0.912, −0.721)	0.006
	Effect on hypochondria ($b_{1, 2}$)	−0.528	(−0.661, −0.388)	0.008
E dimension of personality→ (RESE)→Depression	Effect on RESE (a_1)	0.231	(0.137, 0.335)	0.012
	Indirect effect via RESE (a_1*_{b1})	−0.151	(−0.215, 0.086)	0.015
	Direct effect (c_1')	−0.110	(−0.204, 0.026)	0.009
	Total effect ($c_1'+a_1*_{b1}$)	−0.261	(−0.363, 0.175)	0.009
E dimension of personality→ (RESE) →Neuroticism	Effect on RESE (a_1)	0.226	(0.137, 0.326)	0.011
	Direct effect (c_1')	−0.013	(−0.075, 0.070)	0.882
	Indirect effect via RESE (a_1*_{b1})	−0.182	(−0.271, −0.116)	0.007
	Total effect ($c_1'+a_1*_{b1}$)	−0.196	(−0.278, −0.079)	0.010
E dimension of personality→ (RESE) →Fear	Effect on RESE (a_1)	0.205	(0.117, 0.310)	0.008
	Direct effect (c_1')	−0.020	(−0.067, 0.117)	0.630
	Indirect effect via RESE (a_1*_{b1})	−0.142	(−0.234, −0.084)	0.006
	Total effect on fear ($c_1'+a_1*_{b1}$)	−0.122	(−0.225, −0.019)	0.015
E dimension of personality→ (RESE) →Anxiety	Effect on RESE (a_1)	0.234	(0.140, 0.335)	0.012
	Direct effect (c_1')	0.058	(−0.019, 0.135)	0.125
	Indirect effect via RESE (a_1*_{b1})	−0.189	(−0.278, −0.108)	0.015
	Total effect ($c_1'+a_1*_{b1}$)	−0.123	(−0.219, −0.031)	0.027
E dimension of personality→ (RESE) →Hypochondria	Effect on RESE (a_1)	0.224	(0.136, 0.331)	0.009
	Direct effect (c_1')	0.028	(−0.074, 0.146)	0.629
	Indirect effect via RESE (a_1*_{b1})	−0.118	(−0.202, 0.063)	0.010
	Total effect ($c_1'+a_1*_{b1}$)	−0.090	(−0.202, 0.016)	0.102
N dimension of personality→ (RESE) →Depression	Effect on RESE (a_2)	−0.480	(−0.561. −0.380)	0.005
	Indirect effect via RESE (a_2*_{b2})	0.313	(0.247, 0.417)	0.002
	Direct effect (c_2')	0.108	(0.002, 0.201)	0.046
	Total effect ($c_2'+a_2*_{b2}$)	0.422	(0.327,0 .510)	0.010
N dimension of personality→ (RESE) →Neuroticism	Effect on RESE (a_2)	−0.488	(−0.561. −0.397)	0.005
	Indirect effect via RESE (a_2*_{b2})	0.394	(0.316, 0.468)	0.003
	Direct effect (c_2')	0.063	(−0.020, 0.154)	0.101
	Total effect ($c_2'+a_2*_{b2}$)	0.457	(0.365, 0.545)	0.043
N dimension of personality→ (RESE) →Fear	Effect on RESE in fear pathway (a_2)	−0.497	(−0.561, −0.397)	0.005
	Indirect effect via RESE (a_2*_{b2})	0.345	(0.274, 0.416)	0.005
	Direct effect (c_2')	0.075	(−0.037, 0.071)	0.234
	Total effect on fear ($c_2'+a_2*_{b2}$)	0.421	(0.316, 0.506)	0.014
N dimension of personality→ (RESE) →Anxiety	Effect on RESE (a_2)	−0.475	(−0.554, −0.387)	0.005
	Indirect effect via RESE (a_2*_{b2})	0.384	(−0.039, 0.163)	0.003
	Direct effect (c_2')	0.072	(0.305, 0.485)	0.215
	Total effect ($c_2'+a_2*_{b2}$)	0.456	(0.374, 0.559)	0.005
N dimension of personality→ (RESE) →Hypochondria	Effect on RESE (a_2)	−0.490	(−0.563, 0.386)	0.006
	Indirect effect via RESE (a_2*_{b2})	0.259	(0.184, 0.355)	0.004
	Direct effect (c_2')	0.067	(−0.042, 0.173)	0.259
	Total effect ($c_2'+a_2*_{b2}$)	0.326	(0.233, 0.426)	0.005

(Gold 2020; Si *et al.* 2020). The first research studies in this area, which are being conducted in China, the epicentre of the crisis, seem to point in this direction. The higher proportion of hypochondria among emotional deviations may be due to the nonspecific symptoms of early COVID-19, such as low fever, dry cough, and muscle aches, similar to symptoms of the common cold or flu (Chan *et al.* 2020). Frontline nurses have a close contact history with viruses. Some nurses are very uneasy during the COVID-19 pandemic and pay too much attention to their own health status. This overfocus on the self can include compulsive measuring of

body temperature, unreasonable overconcern, and a suspicion of being infected, but the focus is inconsistent with the nurse's actual health (Yifan *et al.* 2020b). During the SARS epidemic, some nurses were always worried that they would be infected with the SARS virus. They compulsively washed their hands frequently and measured their body temperature dozens of times a day, which is also a type of anxiety (Yan *et al.* 2004). Fear, as a self-defensive response to stimuli, is an emotional experience in which an individual tries to escape or eliminate an unfavourable situation but is unable to do so. The facts that COVID-19 is transmissible between humans (Chan *et al.* 2020), associated with high morbidity and potentially fatal (Wang *et al.* 2020), may intensify the perception of personal danger. Nurses may have unusually intense fear and nervousness about COVID-19 (Jia *et al.* 2020). When an infectious disease epidemic occurs, people often have other symptoms and reactions, such as dizziness, body aches, memory loss, and sleep disturbances (Rossi *et al.* 2020), which are related to neurasthenia. Particular attention is warranted regarding the mental health of nurses caring for patients with COVID-19.

The personality traits of Chinese frontline nurses in the COVID-19 pandemic

The survey of nurses' personality traits in this study showed that frontline nurses scored slightly higher on the *E* dimensions and relatively low on the *N* and *P* dimensions. The results indicated that the proportion of nurses with extroversion, low neuroticism, and low psychoticism was higher than the opposite tendency, indicating that the nurses are outgoing, cheerful, selfless, compassionate, gentle, and interact well with others, which agrees with previous studies (Wan *et al.* 2019; Wang *et al.* 2010; Xia *et al.* 2013). Based on the Big Five personality model, a recent study showed that the strongest tendency in nurses was towards the dimension of agreeableness, followed by conscientiousness, openness and extroversion, and neuroticism (Wan *et al.* 2019), also validating our findings. Our findings indicate a relatively high tendency towards extroversion, which could indicate that nurses have rich imagination and feelings, as noted by Namikawa *et al.* (2012). This finding could help explain the fact that nurses are better than doctors at perceiving the emotions of others and generating empathy in clinical practice (André *et al.* 2017). Many previous studies have analysed personality traits in nursing personnel and noted that a neurotic personality tendency indicates anxiety, depression, hostility, impulsivity, and other similar character traits (Chen *et al.* 2018; Herman *et al.* 2013; Takase *et al.* 2018). Nurses in this study showed a low neurotic personality tendency, which is helpful for harmony among nurses, patients, and doctors and the construction of a cooperative relationship.

The mediating role of RESE on nurses' negative emotions related to the COVID-19 pandemic

This study primarily aimed to disentangle RESE and the underlying mechanisms operating between personality and negative emotions during public health emergencies. First, abundant evidence links personality with negative emotions. Relationships between personality and negative emotions can theoretically be organized in several ways (Akiskal *et al.* 1983; Murray & O'Neill 2019; Segerstrom & Smith 2019). Our study also found that introversion–extroversion and neuroticism can predict depression directly. The path analysis showed that more extroversion was associated with a lower level of depression. A previous study (Janowsky 2001) reflected similar findings. The reason may be that extroverted people tend to be more cheerful, optimistic, and good at releasing stress through emotional venting and have a high tolerance for stimulation. Conversely, introverted people are rich in introspection (Eysenck 1996). In the face of frequent pressure and with the stimuli due to the occurrence of sudden infectious diseases, introverted nurses are more prone to depression (Janowsky 2001). Depression is also correlated with neuroticism. The path analysis shows that neuroticism has a positive effect on depression. It shows that medical staff with high scores in neuroticism are more likely to experience depression and anxiety (Murray & O'Neill 2019). Neuroticism seemed to be linked with an impaired ability to cope with stress and is an important risk factor for stress-related disorders (Mohiyeddini *et al.* 2015). The reason may be that individuals with high neuroticism have a low limbic system activation threshold and a robust sympathetic response (Eysenck 1996). Unhealthy neuroticism may tend to result in potentially maladaptive coping strategies, such as self-accusation and reflection; it may also tend to over-reinforce threat-related stimuli and more often interpret neutral situations as threatening (Barlow *et al.* 2014; Eysenck 1996; Friedman 2019). After negative emotions are activated, it is difficult for individuals to regulate or cope with them in an appropriate manner (Sauer-Zavala *et al.* 2017). Therefore, education to

support all nurses' well-being during pandemics could include emotional self-efficacy strategies to help them manage their emotions and promote their mental health.

RESE is described as an individual's confidence level and perceived ability to regulate their emotions (Bandura *et al.* 2003). According to Bandura's (1997) self-efficacy theory, individuals have incentives to undertake activities only if they believe that they will be able to attain desired results. Thus, RESE may play a vital role in individuals' selection of and actual engagement in adaptive and effective emotion regulation behaviours (Liu *et al.* 2020). However, whether personality and negative emotions operate in isolation from one another or whether RESE acts as a mediator between personality and negative emotions, at least to some degree, is still being explored across some activities and situations. Based on this, we assume that there is a mediation effect of RESE on the relationship between personality and negative emotions. Our study suggests that there is a significant negative correlation between the RESE in nurses and negativity (depression, neuroticism, fear, anxiety, hypochondria) during public health emergencies. The path analysis shows that RESE can affect negative emotions directly and negatively. The indication is that people with a high RESE level have strong self-confidence in adapting to and changing frustrating situations or sudden situations; they can also effectively regulate their emotional state to reduce the generation of negative emotions (Caprara *et al.* 2008). Hence, nurses who have a lower RESE tend to be negative, particularly during public health outbreaks (Zeng *et al.* 2018).

A primary finding of our study is that RESE plays an important mediating role in the relationship between personality and negative emotions. In our study, five structural equation models were tested and indicated a good fit between the proposed model and the empirical data. We demonstrated that RESE is the mediating variable of introversion–extroversion and neuroticism affecting negative emotions related to public health emergencies. Specifically, high RESE weakened the relationship of personality traits to negative emotions related to COVID-19, which demonstrates that RESE could be viewed as a barrier or a buffer variable for negativity (Liu *et al.* 2020; Zeng *et al.* 2018). This result aligns with previous research revealing that RESE moderated the relationship between personality and maladaptive emotions (Caprara *et al.* 2008; Mesurado *et al.* 2018). In the light of the social cognitive theory (Bandura *et al.* 2003), individuals first evaluate the situation and

their abilities when facing emotional stimuli and then decide on their responses, that is, to take adaptive or maladaptive emotional regulation strategies (e.g. behaviours associated with depression, neuroticism, anxiety, fear, hypochondria), based on their perceived emotional regulation ability. RESE can be divided into three aspects: self-efficacy in expressing positive emotions, in managing despondency, and in managing anger (Caprara *et al.* 2008). First, if self-efficacy in managing despondency is high, individuals are inclined to think in an enabling manner and apply positive coping strategies; thus, they are less likely to experience negativity (Caprara *et al.* 2010; Muris *et al.* 2016). Second, if self-efficacy in managing anger is high, individuals may prefer to try adjustment strategies to defuse anger, such as cognitive reappraisal. Third, if self-efficacy in expressing positive emotions is high, individuals tend to have positive thinking and experience feelings of self-acceptance and self-worth (Caprara & Steca 2005). Such a positive thinking style is conducive to positive expectations about the future and may lower the likelihood of negative emotions (Liu *et al.* 2020). All three aspects of RESE may act as protectors against negativity related to COVID-19, but these hypotheses could not be tested in the present study and must be clarified in future studies.

Therefore, improving RESE can be effective for emotionally unstable and introverted nurses. In terms of concrete measures, mental health staff can assist nurses via an Internet platform through mindfulness training, meditation, and applied art therapy (Botha *et al.* 2015). Solution-focused self-help, solution-focused brief therapy (SFBT) (Grant, 2015), and self-reflection were adopted. All of the above can improve the RESE level and assist with appropriate communication skills, positive coping style, and problem-solving strategies to achieve a better psychological intervention effect. Because the psychological problems of frontline nurses can affect their attention, understanding, and decision-making abilities, these actions can not only prevent nurses from developing more severe psychological trauma but can also be more conducive to medical safety (Gold 2020). Additionally, improved control of the COVID-19 outbreak may improve the mental health status of these frontline nurses.

LIMITATIONS AND FUTURE RESEARCH

The results obtained in this study are promising in terms of theory and practice, although it is necessary to point out certain limitations.

First, causality cannot be drawn from correlational data. The mediation analysis may suggest a causal hypothesis, but it cannot prove causality. The second limitation refers to the sampling technique. Convenience sampling increases the probability of selecting individuals who feel strongly about the research topic, which can result in a bias in the answers. Additionally, this type of sampling prevents drawing conclusions about the population (statistical generalization) (Polit & Beck 2010). The third limitation refers to social desirability, which is considered one of the most influential biases in responses when a cross-sectional design involves questionnaires (Song *et al.* 2015). Finally, this study found that there was no apparent intermediary effect on RESE for the *P* dimension of personality, suggesting that there may be other mediating variables that have not been included in our research hypothesis that require further exploration.

CONCLUSION

In the light of a sudden public health crisis, Chinese frontline nurses have demonstrated excellent professionalism, but their mental health status deserves continuous attention. This study described the personality traits, epidemiological characteristics, and negative emotions of frontline nurses in the pandemic through a cross-sectional survey. It screened out relevant factors affecting negative emotions through a correlation analysis. By constructing a structural equation model, the mediating effect of RESE in the process of personality traits affecting negative emotions related to public health emergencies was validated, which is a concern for nursing managers. In the event of a major outbreak, tailored psychological well-being education that includes emotional self-efficacy strategies should be provided by organizations to help nurses to manage stress related to the outbreak.

RELEVANCE FOR CLINICAL PRACTICE

This study has strong theoretical and practical application value. Some interventions, such as improving RESE to reduce the negative emotions in frontline nurses exposed to COVID-19, can be considered. In any case, protecting the mental health of healthcare personnel is an essential component of public health measures that address the COVID-19 pandemic.

ETHICS APPROVAL

This study's approval from the clinical research ethics committee of Sir Run Run Shaw Hospital School of Medicine Affiliated with Zhejiang University was received before the initiation of this study (20200316-22).

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