

ORIGINAL RESEARCH:  
EMPIRICAL RESEARCH - QUANTITATIVE

# Associations between demographic characteristics, perceived threat, perceived stress, coping responses and adherence to COVID-19 prevention measures among Chinese healthcare students

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**Abstract**

**Aim:** To investigate the associations between demographic characteristics, perceived threat, perceived stress, coping responses and adherence to COVID-19 prevention measures in Chinese Healthcare students.

**Design:** A cross-sectional survey collecting data in Hong Kong and Fujian Province of China in April 2020.

**Methods:** A convenience and snowball sample of 2706 students aged 18 years or older and studying a healthcare programme were recruited in tertiary education institutions/universities in Hong Kong and Putian. The participants completed the questionnaire with six scales: Social Distancing Scale; Personal Hygiene Scale; Empathic Responding Scale; Wishful Thinking Scale; Perceived Stress Scale and Perceived Threat Scale. Path analysis was performed to identify factors associated with the preventive measures outcomes. *p* value < .05 was considered as statistical significance.

**Results:** The participants reported high compliances to both social distancing (SoD) and personal hygiene measures (PHM). Confidence to manage the current situation, wishful thinking and empathetic responding directly predicted compliance with SoD and PHM. The final model constructed demonstrated a very good fit to the data.

**Conclusion:** The findings suggest that students who are male, habituate in Hong Kong, have more clinical experience and weak confidence to manage the threat tend to have lower compliance with the COVID-19 preventive measures.

**Impact:** The predictive model constructed is the first one to explore factors associating with the compliance with infection control measures in healthcare students amid the COVID-19 outbreak. As the infection control behaviours of healthcare students, whom are still under training and are the high-risk group of being infected and infecting others in the community, are rarely reported in literature, this study has provided empirical evidence to nurses and other healthcare professionals to identify students susceptible to poor compliance and provide early monitoring and education to suppress the COVID-19 transmission.

## KEYWORDS

Chinese healthcare students, coping responses, COVID-19, infection control measures, nursing, online survey, path analysis, perceived stress, perceived threat

## 1 | INTRODUCTION

Since China first identified and reported a pneumonia case in Wuhan to the World Health Organization (WHO) Country Office on 31 December 2019, COVID-19 has infected over 10 million people in more than 46 countries, resulting in 499,913 deaths as of 30 June 2020 (WHO, 2020a). The extent of community spread of COVID-19 is significantly greater than that for previous viral outbreaks such as severe acute respiratory syndrome (SARS) in 2003, H1N1 influenza in 2009, and Middle East respiratory syndrome in 2012 and 2015. The highly contagious nature of COVID-19, even during the incubation period, favours the insidious and rapid transmission of severe acute respiratory syndrome coronavirus 2 (the virus responsible for the COVID-19 outbreak) from person to person via respiratory droplets and contact, as asymptomatic people are unaware of being infected (Centers for Disease Control & Prevention [CDC], 2020; Special Expert Group for Control of the Epidemic of Novel Coronavirus Pneumonia of the Chinese Preventive Medicine, 2020; WHO, 2020b). In efforts to swiftly control the continuous spread of the virus, many countries have been launching a series of stringent infection prevention and control measures (ICPs), such as mandatory quarantine, massive lockdowns, border control, and suspending schooling to seal off transmission. However, these aggressive ICPs have unprecedentedly restricted daily living and hampered global economic activities. Reports warn that the COVID-19 pandemic will shrink global GDP by almost 1% in 2020 (United Nation, 2020), hitting people's livelihoods hard due to the resulting depression of the employment market (France-Presse, 2020; Hugh Rise, 2020). To mitigate the socioeconomic impact of the pandemic, governments have been gradually resuming normal social and economic activities along with less restrictive but essential ICPs to control the spread of the virus (Wilder-Smith et al., 2020).

## 2 | BACKGROUND

At present, implementing essential ICPs is the sole approach to mitigate virus spread in the community. WHO and national health agencies have compiled a recommended list of COVID-19 ICPs for the general public to follow, including social distancing (SoD), avoiding crowds, wearing face coverings, handwashing with soap and water or using hand sanitizer with at least 60% alcohol, and regular cleaning and disinfection of touched surfaces (CDC, 2020; Centre for Health Protection, 2020; WHO, 2020b). Reports related to numerous community cluster infections have indicated the importance of strict compliance with the recommended ICPs to minimise viral transmission. For instance, the nightclub cluster in South Korea, which was

initiated by a man visiting several nightclubs without wearing a mask, led to a resurgence of new infections in South Korea (Wilder-Smith et al., 2020). Understanding the underlying factors that determine people's compliance with ICPs in a community setting is therefore a pressing need (Bish & Michie, 2010). Evidence regarding compliance with ICPs in the context of the COVID-19 pandemic is currently underreported. With reference to previous studies concerning factors related to ICP adherence during the earlier SARS and H1N1 outbreaks, notable regional and demographic differences were observed in the adherence to the ICPs by the general public (Bish & Michie, 2010; Bults et al., 2015; Eastwood et al., 2009; Leung et al., 2004; Marshall et al., 2012; Tooher et al., 2013). Older, more educated females are generally reported as having higher compliance with the ICPs (Bish & Michie, 2010; Eastwood et al., 2009; Leung et al., 2004; Tooher et al., 2013). Moreover, higher ICP compliance is also associated with those who have a higher anxiety level, higher perceived risk of infection, better knowledge about the infection, and belief in the effectiveness of the recommended ICPs (Bish & Michie, 2010; Bults et al., 2015; Eastwood et al., 2009; Leung et al., 2004; Tooher et al., 2013). Greater trust in authorities has also been found to favour engaging in ICPs (Bults et al., 2015). This study targeted healthcare students, a group that is currently underinvestigated regarding their compliance with ICPs. Relevant studies have often targeted healthcare workers during virus outbreaks (Brooks et al., 2020; Chor et al., 2012; Moore et al., 2005; Powell-Jackson et al., 2020; Sigayeva et al., 2007). According to the scanty evidence available, healthcare students were not as knowledgeable and competent as their seniors regarding ICPs. Even medical students' significant improvement in hand hygiene practice after experiencing SARS was still considered insufficient (Pittet et al., 2004). In contrast, nursing students were found to exercise moderate compliance with universal precautionary measures when they possessed sufficient knowledge about infection control precautions (Darawad & Al-Hussami, 2013). When healthcare students participate in internship/practicum in hospitals/clinics, insufficient compliance with ICPs on their part may facilitate viral spread from community to hospital, or vice versa. Therefore, the present study aims to investigate the determining factors associated with compliance with COVID-19 ICPs by healthcare students to fill in gaps in the existing body of knowledge and help stakeholders devise effective public health interventions to enhance healthcare students' compliance with ICPs. The study findings could implicate the characteristics of healthcare students prone to have poor compliance with ICPs. Stakeholders such as nurse educators and clinical partners could early identify high-risk students and so to devise health-promoting interventions focusing on the identified modifiable factors to enhance compliance to the recommended ICPs to suppress the potential virus transmission through this group of students.

## 2.1 | Hypothesised model

For the purpose of understanding adherence to COVID-19 ICPs, a hypothesised health behaviour model was formulated based on the health belief model (Janz & Becker, 1984) and transactional model of stress and coping (Folkman, 2013) to explain the associations among potential contributing factors and compliance with ICPs during the COVID-19 pandemic (Figure 1). Engaging in behaviours that promote health (i.e. COVID-19 ICP behaviour) is influenced by the perceived threat (PT) of COVID-19, such as the chance of becoming infected, the prognosis, and the perceived stress (PS) level, which is affected by the degree of PT. An increase in the stress level will bring about an evaluation of coping responses to overcome the stress, which will eventually provoke a series of health behaviours to cope with stress. For the general public, specifically, WHO and national health agencies have recommended SoD and personal hygiene measures (PHM) to prevent COVID-19 transmission in the community. Examples of SoD are avoiding crowded places and refraining from shaking hands, while measures related to PHM include wearing a mask and hand-washing with hand sanitizer. For the coping response in this study, we chose wishful thinking (WT) and empathetic responding (ER), which were found to be commonly adopted by individuals during outbreaks of SARS and West Nile virus (Lee-Baggley et al., 2004; Putermna et al., 2009). WT is a type of emotion-focused coping response that refers to an individual's effort to cognitively escape from or avoid a situation by simply fantasising or hoping the situation will go away or will somehow be over. Evidence has shown that WT is often associated with negative health outcomes such as poor adjustment to illness (Penley et al., 2002). ER is a relationship-focused coping response in which the individual attempts to understand what others are experiencing and makes an effort to offer support and assistance. Lee-Baggley et al. (2004) found WT was positively associated with avoidant health behaviours such as eschewing public areas and people during a SARS outbreak. Conversely, ER was associated with proactive prevention behaviours such as mask wearing and exerting caution in personal hygiene (Lee-Baggley et al., 2004; Putermna et al., 2009). The previous literature has suggested that demographic characteristics play a significant role in people's health behaviours. Consequently, demographic characteristics were

included in the hypothesised model as they were believed to indirectly influence engagement in ICPs through PT, PS, and coping responses.

## 3 | THE STUDY

### 3.1 | Aim

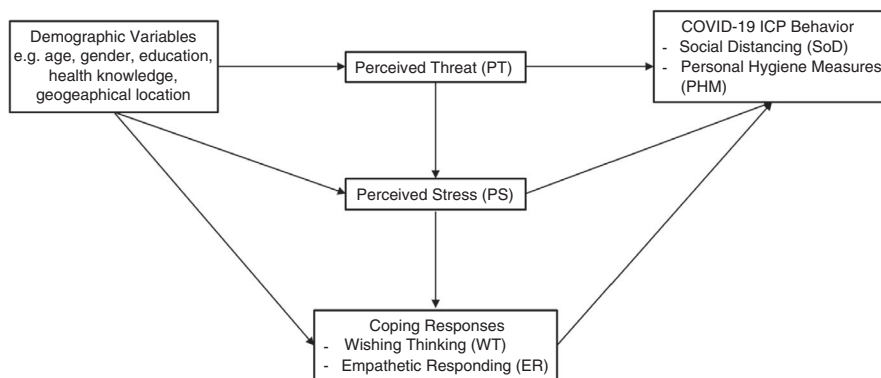
The aim of this study was to investigate the associations between demographic characteristics, PT, PS, coping responses, and adherence to COVID-19 ICPs in Chinese healthcare students using path analysis. The main hypothesis was that demographic characteristics, PT, PS, and coping responses associate with SoD and PHM.

### 3.2 | Design

We conducted a cross-sectional study, collecting data in Hong Kong and Fujian in China. In Hong Kong, the samples included students from two universities and one tertiary education institution. Students from three tertiary education institutions in Putian, a prefecture-level city in eastern Fujian Province, were also a part of the study. The manuscript was written according to the STROBE guideline for observational studies (Vandenbroucke et al., 2007).

### 3.3 | Participants

Eligibility criteria included fulltime students aged 18 years or older and engaged in one of the healthcare programmes offered in the participating universities or tertiary education institutions for this study. Such programmes included general/obstetric nursing, medical laboratory science, Chinese medicine, radiation therapy, pharmacy, occupational therapy, and physiotherapy. Students were ineligible if they were studying in a programme other than those listed. Mass emails were sent to the students via school emails to invite them and



**FIGURE 1** Hypothesized model of the associations among the study variables

their friends to complete the online questionnaire. Total participants numbered 2706, and the number of parameters to be estimated in the predictive model was 38. This sample size was adequate for modelling, in which the ratio of sample size to estimated parameters should be 5:1 (Kline, 2011).

### 3.4 | Data collection

Participants completed self-administered online questionnaires that collected data on demographic characteristics, PT, PS level, use of WT, and ER and adherence to SoD and PHM in response to COVID-19 in April 2020. Completing the entire questionnaire required about 15 min. The participants were informed of the objectives and procedures of the study and their rights of participation before beginning the survey. Returning the completed questionnaire implied consent to participate in the study.

### 3.5 | Outcome measures

#### 3.5.1 | Compliance with SoD and PHM

Our main outcome of interest was adherence to COVID-19 ICPs, comprising SoD and PHM. The scales for measuring SoD and PHM were developed based on the WHO's and Centers for Disease Control and Prevention's guidelines for preventing and controlling the spread of COVID-19 for the public and individuals (CDC, 2020; WHO, 2020b), along with questionnaires developed by the SARS Collaborative Research Group in 2004 (Lee-Baggley et al., 2004). SoD was measured using ten items while PHM was measured by five items. Participants rated their likelihood of performing the actions described in the items to prevent COVID-19 on a 5-point Likert scale, where 1 was "very unlikely," and 5 was "very likely." The total SoD score and PHM score were the aggregation of the corresponding item scores. The higher the score was, the more likely the respondent was to engage in the corresponding measures.

#### 3.5.2 | Perceived threat

Perceived threat was measured by four items extracted from the PT scale originally used to measure an individual's PT due to SARS (Putermna et al., 2009). The participants were asked to rate the extent to which four statements were true for them at the current moment on a 4-point Likert scale, ranging from "not at all" (1) to "a great extent" (4). A summation of the items' scores formed the total PT score. The higher the score, the greater was the PT to the individual.

#### 3.5.3 | Perceived stress

Perceived stress was measured by the Perceived Stress Scale (PSS-10) developed by Cohen and Williamson (1988). The PSS-10 is a 10-item self-reported questionnaire that asks respondents to rate the frequency of their feelings and thoughts about life events and situations over the previous month using a 5-point scale ranging from 0 ("never") to 4 ("very often"). According to our results after confirmatory factor analysis (Table 1), the PSS-10 was divided into two subscales that measured stress level (PS1) and confidence about managing the current situation (PS2). PS1 was measured by six items. A higher score indicated greater stress. PS2 was measured by four items which the rating was reversely scored.

#### 3.5.4 | Coping responses

Wishful thinking and ER were measured by two items taken from the WT subscale of the ways of coping questionnaire (Folkman & Lazarus, 1988) and six items taken from the relationship-focused coping scale (O'Brien & DeLongis, 1996), respectively. Participants rated the items from the two scales on a 4-point Likert scale, ranging from "not at all" (1) to "a great deal" (4) to indicate the extent to which they had managed their concerns or fears about COVID-19 through wishing or helping others. Higher total scores for the scales indicated a greater likelihood of using wishing and helping others to manage stress.

TABLE 1 Psychometric analyses of the scales used in the present study

Scales	Variables	Item numbers on variable	Factor loadings	Cronbach's alpha in the testing sample	Possible range
Social Distancing Scale	Social distancing (SoD)	10	0.58–0.84	.93	5–50
Personal Hygiene Scale	Personal hygiene measures (PHM)	5	0.50–0.96	.83	5–25
Wishing thinking Scale	Wishing thinking (WT)	2	0.73–0.77	.70	2–8
Empathetic Responding Scale	Empathetic responding (ER)	6	0.61–0.92	.92	6–24
Perceived Stress Scale	Perceived stress (PS)	Domain 1 (PS1): 6	0.58–0.89	.90	0–24
		Domain 2 (PS2): 4	0.62–0.85	.79	0–16
Perceived Threat Scale	Perceived threat (PT)	4	0.51–0.72	.70	4–16

### 3.5.5 | Demographic variables

Demographic variables described characteristics of the students and their programme of study. Age, gender, year of study, and clinical experience were variables collected for student characteristics. Programme characteristics included geographical location of the institution, academic level of the programme, and professions. Age was measured on a continuous scale, while the other variables were measured via categories.

### 3.6 | Ethical considerations

The study protocol, questionnaires and procedures were approved by the corresponding institutional review boards in Hong Kong (REC2020056) and Fujian (2020-42). All participants gave implied consent to enrol in the study. The questionnaires were anonymised.

### 3.7 | Data analysis

Data were managed and analysed by the statistical package SPSS 23 for Windows. Missing values, normality, and outliers were first checked prior to the main analysis. Descriptive statistics were used to summarise the demographic variables and outcomes: frequency and percentage for categorical variables, means and standard deviations for continuous variables. Chi-squared test and independent t-test were performed to examine the differences in all variables between Hong Kong and Fujian. Subgroup analyses were conducted to investigate the differences of outcomes in demographic variables using independent t-test or one-way ANOVA with Tukey post-hoc test.

For the main analysis, AMOS 23 was used to conduct the path analysis, which is a multivariate statistical technique modelling direct or indirect relationships among variables, to explore the associations between covariates and outcomes. Maximum likelihood was used to estimate the regression coefficient of each path presented in the model. The model was trimmed until all insignificant paths were eliminated. Path coefficients were computed, including standardised and unstandardised regression coefficients with a 95% confidence interval. The model fit was determined by fit indices that included goodness-of-fit index (GFI) >0.9, comparative fit index (CFI) and Tucker-Lewis index (TLI)  $\geq$ 0.9, root mean square error of approximation (RMSEA) <0.05, and relative chi-square ( $\chi^2/df$ ) <5.  $p$  value <.05 was considered as statistical significance.

### 3.8 | Validity, reliability and rigour

All scales and demographic information were translated into Chinese for collecting the data in Putian by forward-backward translation. The Chinese scales were then validated by five experts

in nursing education, psychology, infection control, epidemiology, and public health nursing. The content validity of all scales ranged from very good to satisfactory (CVI =0.7-1). Table 1 provides a summary of the scales included together with their psychometric properties.

## 4 | RESULTS

### 4.1 | Demographic characteristics

Responses from a total of 2706 students from healthcare professions were analysed. Most participants were from Fujian. The average age was 20.7 (SD 1.72). Out of the total number, 90.5% were female. About half were pursuing an associate degree, and 46.2% were studying for a bachelor's degree, with around 90% studying nursing. About 70% of the participants were year 1 or year 2 students. More than 60% did not have clinical experience.

### 4.2 | Study variables and subgroup analyses to COVID-19 ICPs

The mean scores for PT ( $M = 9.7$ ), PS1 ( $M = 12.3$ ), and PS2 ( $M = 7.2$ ) were around the midpoint of the corresponding score ranges, indicating that the participants felt moderate threat and stress regarding COVID-19 and had moderate confidence about their ability to manage the situation. The mean scores for both WT (6.8) and ER ( $M = 18.4$ ) were on the high side of the corresponding score ranges, indicating that the respondents often used WT and ER to manage their stress. The participants reported high compliance with SoD and PHM, as reflected by the high mean SoD and PHM scores ( $M = 43.4, 23.1$  respectively). Table 2 outlines the descriptive findings of the study.

The Fujian students exhibited a significantly higher compliance with SoD ( $p < .001$ ) and PHM ( $p < .01$ ) than the Hong Kong students (Table 2). As shown in Table 3, female students had a higher SoD and PHM scores in comparison to male students. Students without clinical experience were found to practise higher compliance with SoD as compared to the other two groups ( $p < .001$ ).

### 4.3 | Path analyses

The hypothesised model with all paths (Figure 1) were tested first. Gradually, all non-significant paths were dropped until only significant paths remained. Figure 2 depicts the final predictive model with significant pathways and correlations. The trimmed path model shows good fit indexes, with chi-square  $\chi^2 = 27.27, df = 17, p = .044$ ;  $\chi^2/df = 1.61$ ; GFI = 0.998, CFI = 0.997, TLI = 0.992, RMSEA = 0.015. Table 4 presents path coefficients with their standard errors and their significant levels for the model. The variables, which had significant direct and/or indirect effects on SoD and PHM, included

TABLE 2 Sample characteristics and study variables by geographical location

	Hong Kong	Fujian	Total	p-value
	(N = 462)	(N = 2244)	(N = 2706)	
	N (%) / M (SD)	N (%) / M (SD)	N (%) / M (SD)	
Age	21.1 (2.79)	20.6 (1.38)	20.7 (1.72)	<.001 <sup>a,***</sup>
Gender				.032 <sup>b,*</sup>
Female	344 (74.5)	2105 (93.8)	2449 (90.5)	
Male	118 (25.5)	139 (6.2)	257 (9.5)	
Academic level of the studying programme				<.001 <sup>b,***</sup>
Diploma	1 (0.2)	0 (0.0)	1 (0.0)	
Higher diploma	80 (17.3)	0 (0.0)	80 (3.0)	
Associate degree	2 (0.4)	1372 (61.1)	1374 (50.8)	
Bachelor degree	379 (82.0)	872 (38.9)	1251 (46.2)	
Professions				<.001 <sup>b,***</sup>
Nursing	397 (85.9)	2099 (93.5)	2496 (92.2)	
Medical laboratory science	22 (4.8)	48 (2.1)	70 (2.6)	
Chinese medicine	0 (0.0)	48 (2.1)	48 (1.8)	
Radiation therapy	11 (2.4)	21 (0.9)	32 (1.2)	
Pharmacy	0 (0.0)	28 (1.2)	28 (1.0)	
Occupational therapy	18 (3.9)	0 (0.0)	18 (0.7)	
Physiotherapy	14 (3.0)	0 (0.0)	14 (0.5)	
Year of study				<.001 <sup>b,***</sup>
Year 1	147 (31.9)	963 (42.9)	1110 (41.0)	
Year 2	102 (22.1)	759 (33.8)	861 (31.8)	
Year 3	110 (23.9)	485 (21.6)	595 (22.0)	
Year 4	61 (13.2)	37 (1.6)	98 (3.6)	
Year 5	41 (8.9)	0 (0.0)	41 (1.5)	
Clinical experience				<.001 <sup>b,***</sup>
No clinical experience	189 (40.9)	1512 (67.4)	1701 (62.9)	
Less than 12 weeks	127 (27.5)	254 (11.3)	381 (14.1)	
More than 12 weeks	146 (31.6)	478 (21.3)	624 (23.1)	
Study variables				
Perceived threat	13.1 (2.59)	9.0 (2.18)	9.7 (2.72)	<.001 <sup>a,***</sup>
Perceived stress				
Domain 1	14.4 (4.64)	11.9 (4.57)	12.3 (4.68)	<.001 <sup>a,***</sup>
Domain 2	7.0 (2.84)	7.3 (2.75)	7.2 (2.72)	.031 <sup>a,*</sup>
Coping responses				
Wishful thinking	6.8 (1.40)	6.9 (1.10)	6.8 (1.16)	.348 <sup>a</sup>
Empathetic responding	17.9 (3.68)	18.6 (2.64)	18.4 (2.85)	<.001 <sup>a,***</sup>
COVID-19 ICP behaviour				
Social distancing	41.6 (6.37)	43.6 (8.47)	43.3 (8.18)	<.001 <sup>a,***</sup>
Personal hygiene measures	22.6 (2.51)	23.1 (2.92)	23.1 (2.86)	<.01 <sup>a,**</sup>

<sup>a</sup>Independent t test.<sup>b</sup>Chi-squared test.\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

TABLE 3 Study variables by gender and clinical experience

	Male		Female		Total		p-value <sup>a</sup>		
	(N = 257)		(N = 2499)		(N = 2706)				
	M (SD)		M (SD)		M (SD)				
Perceived threat	10.5 (3.50)		9.6 (2.61)		9.7 (2.72)		<.001 <sup>***</sup>		
Perceived stress									
Domain 1	12.6 (5.39)		12.3 (4.60)		12.3 (4.68)		.485		
Domain 2	6.8 (3.21)		7.3 (2.71)		7.2 (2.77)		.019 <sup>*</sup>		
Coping responses									
Wishful thinking	6.6 (1.45)		6.9 (1.12)		6.8 (1.16)		.013 <sup>*</sup>		
Empathetic responding	18.3 (3.68)		18.5 (2.75)		18.4 (2.85)		.598		
COVID-19 ICP behaviour									
Social distancing	41.6 (8.72)		43.5 (8.11)		43.3 (8.18)		.001 <sup>**</sup>		
Personal hygiene measures	22.4 (3.64)		23.1 (2.76)		23.1 (2.86)		.004 <sup>**</sup>		
	No clinical experience		Less than 12 weeks		More than 12 weeks		Total		p-value <sup>b</sup>
	(N = 1701)		(N = 381)		(N = 624)		(N = 2706)		
	M (SD)		M (SD)		M (SD)		M (SD)		
Perceived threat	9.3 (2.59)		10.6 (2.87)		10.2 (2.76)		9.7 (2.72)		<.001 <sup>***</sup>
Perceived stress									
Domain 1	12.1 (4.61)		12.8 (4.94)		12.8 (4.65)		12.3 (4.68)		.001 <sup>**</sup>
Domain 2	7.3 (2.7)		7.0 (2.88)		7.2 (2.87)		7.2 (2.77)		.084
Coping responses									
Wishful thinking	6.8 (1.14)		6.8 (1.21)		6.8 (1.16)		6.8 (1.16)		.928
Empathetic responding	18.5 (2.77)		18.4 (2.99)		18.4 (2.98)		18.4 (2.85)		.874
COVID-19 ICP behaviour									
Social distancing	43.7 (7.91)		42.6 (8.68)		42.5 (8.53)		43.3 (8.18)		.001 <sup>**</sup>
Personal hygiene measures	23.0 (2.92)		23.1 (2.69)		23.1 (2.81)		23.1 (2.86)		.448

<sup>a</sup>Independent t-test.

<sup>b</sup>F-test.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

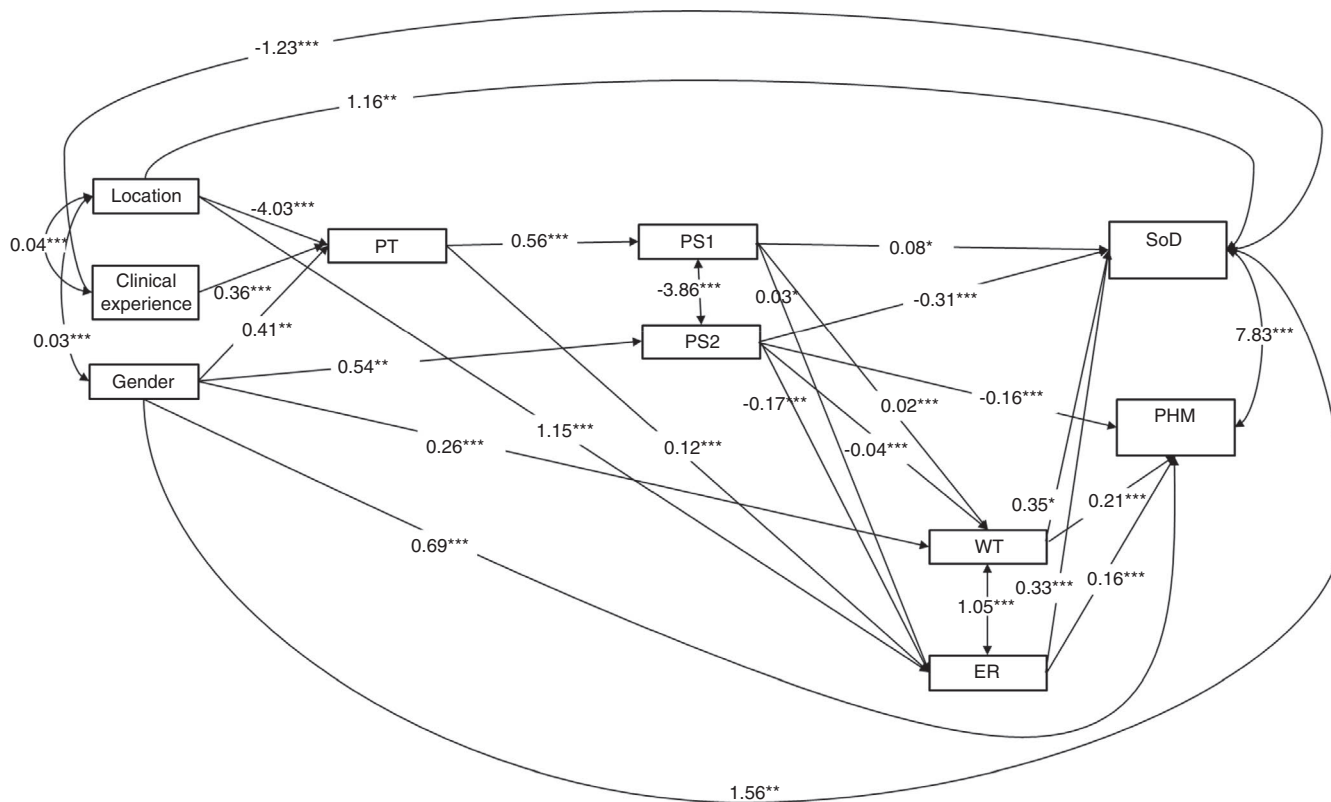
gender, geographical location, clinical experience, PT, PS, and coping responses.

#### 4.3.1 | Variables with direct effects on COVID-19 ICPs

PS1, PS2, WT, and ER were significantly associated with SoD. Among them, PS2, WT, and ER displayed the greatest contributions to SoD, with unstandardised regression coefficients ( $\beta$ ) of  $-0.31$  ( $p < .001$ ),  $0.35$  ( $p = .015$ ), and  $0.33$  ( $p < .001$ ), respectively. Fujian students had a higher mean SoD score than those in Hong Kong by 1.16 scores ( $p < .01$ ). This result indicates that compared to Hong Kong students, Fujian students were more willing to engage in SoD. Female students showed higher compliance with SoD than their male counterparts, with  $\beta$  of 1.56 ( $p = .004$ ). Those having clinical experience had

a lower mean SoD score than those without ( $\beta = -1.23$ ,  $p < .001$ ). These results imply that students with clinical experience are less likely to avoid going to public places than students without such experience.

Similar to SoD, PS2 ( $\beta = -0.156$ ,  $p < .001$ ), WT ( $\beta = 0.21$ ,  $p < .001$ ), and ER ( $\beta = 0.16$ ,  $p < .001$ ) were the three variables with the greatest contributions towards PHM, though they exhibited lesser effects as compared with those on SoD. PS1 exerted an indirect impact on PHM through WT and ER. Gender was the only significant demographic variable that had a direct impact on PHM ( $\beta = 0.69$ ,  $p < .001$ ), in that female students were more likely to comply with PHM than male students. The negative associations of PS2 with SoD and PHM indicate that a high level of confidence about managing the current situation increased compliance with SoD and PHM. Unlike the hypothesised model, PT did not have a direct impact on both SoD and PHM but infiltrated its impact into the two outcomes by way of PS1 and ER.



**FIGURE 2** The final predictive model. Location = geographical location. ER, empathetic responding; PHM, personal hygiene measures; PS1, perceived stress domain 1; PS2, perceived stress domain 2; PT, perceived threat; SoD, social distancing; WT, wishful thinking. Single arrow = unstandardized regression coefficient; doubled arrow = correlation coefficient. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

### 4.3.2 | Variables with indirect effects on COVID-19 ICPs

The three demographic variables and PS2 exhibited their indirect influences on SoD and PHM through other variables in addition to their direct effects. Geographical location was positively associated with PT and ER, with  $\beta$  of  $-4.03$  ( $p < .001$ ) and  $1.15$  ( $p < .001$ ), respectively. This result means that Fujian students perceived less threat and adopted more ER than Hong Kong students. Gender positively associated with PT ( $\beta = 0.41$ ,  $p = .008$ ), PS2 ( $\beta = 0.54$ ,  $p = .002$ ), and WT ( $\beta = 0.26$ ,  $p < .001$ ). Students having clinical experience had a higher PT score than those without ( $\beta = -1.23$ ,  $p < .001$ ), indicating that students with clinical experience tended to feel more threat than those without. Students with higher confidence towards managing the current situation drew on WT and ER to cope with the situation as reflected in the significant negative association between PS2 and WT ( $\beta = -0.04$ ,  $p < .001$ ), and between PS2 and ER ( $\beta = -0.17$ ,  $p < .001$ ).

## 5 | DISCUSSION

In this study, the use of path analysis to construct the predictive model revealed the possible direct and indirect contributions of demographic and independent variables to compliance with SoD and

PHM. The final predictive model for COVID-19 ICPs demonstrates that gender, geographical location, clinical experience and stress level do not merely associate with SoD and PHM directly but also impose indirect association on them through other variables in the model. PT, as expected, does not have a direct association with COVID-19 ICPs. WT and ER directly and positively associate with the two COVID-19 ICPs.

### 5.1 | Demographic characteristics

The significant associations of gender and geographical location with infection control measures reported in this study were similar to those in previous studies in which females showed greater compliance with infection control measures such as handwashing than males among college students and healthcare workers (Anderson et al., 2008; Brooks et al., 2020; Powell-Jackson et al., 2020; White et al., 2005). Healthcare workers in different countries were reported to have varying adherence to personal protection measures (Chor et al., 2012; Koh et al., 2009; Wong et al., 2005). The contributions of the present study are twofold. First, the negative association between clinical experience and compliance with SoD suggests that healthcare students with clinical experience comply less with SoD. Second, geographical location and clinical experience directly



TABLE 4 Regression coefficients of the significant paths in the final predictive model<sup>a</sup>

Paths	B	$\beta$	SE	95% CI	p-value
Gender → PT	0.044	0.405	0.152	[0.244, 0.703]	.008
Location → PT	-0.558	-4.029	0.121	[-4.157, -3.792]	<.001
Experience → PT	0.064	0.358	0.091	[0.180, 0.454]	<.001
PT → PS1	0.326	0.559	0.03	[0.527, 0.618]	<.001
Gender → PS2	0.057	0.537	0.172	[0.355, 0.874]	.002
Gender → WT	0.067	0.264	0.071	[0.189, 0.403]	<.001
PS1 → WT	0.095	0.023	0.005	[0.018, 0.033]	<.001
PS2 → WT	-0.088	-0.037	0.008	[-0.045, -0.021]	<.001
Location → ER	0.151	1.146	0.162	[0.974, 1.464]	<.001
PT → ER	0.111	0.117	0.023	[0.093, 0.162]	<.001
PS2 → ER	-0.162	-0.166	0.02	[-0.187, -0.127]	<.001
PS1 → ER	0.044	0.027	0.013	[0.013, 0.052]	.033
Gender → SoD	0.056	1.559	0.54	[0.987, 2.617]	.004
Location → SoD	0.053	1.164	0.41	[0.729, 1.968]	.005
Experience → SoD	-0.073	-1.233	0.303	[-1.827, -0.912]	<.001
PS1 → SoD	0.044	0.078	0.033	[0.043, 0.143]	.018
PS2 → SoD	-0.104	-0.308	0.059	[-0.371, -0.192]	<.001
WT → SoD	0.049	0.346	0.142	[0.195, 0.624]	.015
ER → SoD	0.113	0.326	0.058	[0.265, 0.440]	<.001
Gender → PHM	0.071	0.69	0.18	[0.499, 1.043]	<.001
PS2 → PHM	-0.151	-0.156	0.019	[-0.176, -0.119]	<.001
WT → PHM	0.086	0.212	0.049	[0.160, 0.308]	<.001
ER → PHM	0.161	0.161	0.02	[0.140, 0.200]	<.001

Note: Experience = clinical experience; Location = geographical location.

Abbreviations: B, standardized regression estimates; CI, confidence interval; ER, empathetic responding; PHM, personal hygiene measures; PS1, perceived stress domain 1; PS2, perceived stress domain 2; PT, perceived threat; SE, standard error; SoD, social distancing; WT, wishful thinking;  $\beta$ , unstandardized regression estimates.

<sup>a</sup>Model fit indices:  $\chi^2 = 27.270$ ;  $df = 17$ ;  $p = .044$ ;  $\chi^2/df = 1.604$ ; goodness-of-fit index = 0.998; comparative fit index = 0.997; Tucker-Lewis index = 0.992; root mean square error of approximation = 0.015.

and positively associate with compliance with SoD only. The higher compliance with SoD found in Fujian students might be the result of a difference in regulations regarding SoD between Hong Kong and Fujian. Restrictive measures were launched at an early stage of the COVID-19 outbreak in Fujian. The Fujian government imposed the strictest measures to control social contact among people, such as banning social gatherings and suspending public transportation. In contrast to Fujian, the regulations affecting SoD in Hong Kong have been less restrictive at that time. For instance, in Hong Kong, people could have gatherings, though these were limited to four attendees at most. Public transport was still in operation, but passengers were required to put on facemasks. In addition, students and workers in Mainland China are used to travelling across cities and provinces seeking better study and job opportunities. Residents of Fujian may thus be more vigilant about the potential for infection caused by contact in public areas with strangers from high-risk cities. Regarding the negative association of clinical experience and compliance with SoD, we should interpret it with caution, as students with clinical

experience were mainly clustered in the Hong Kong samples. The results might be biased by the skewed samples. Further studies shall be launched to confirm it.

## 5.2 | Perceived stress

PSS-10 is a widely used scale to assess the perception of stress in response to life events in an adult population. Unlike previous studies that commonly used the total scale score for analysis, we split the scale into two domains—stress level (PS1) and confidence about managing the present situation (PS2)—when performing the path analysis. The present model suggests that confidence about managing the situation has a stronger association than one's stress level for both SoD and PHM. Confidence about managing an encountered difficulty relates to one's sense of self-efficacy (Bandura, 1982). Self-efficacy is a major behaviour-specific cognitive factor contributing to engagement in health-promoting behaviour. A high level of

self-efficacy can reduce the perception of barriers and improve the likelihood of engaging in healthful practices (Janz & Becker, 1984).

### 5.3 | Coping responses

WT and ER were both found to positively associate with SoD and PHM, results that are incongruent with those from previous studies regarding SARS and other epidemics (Lee-Baggley et al., 2004; Putermna et al., 2009). In this study, WT and ER both directly and positively associated with adherence to SoD and PHM. Conversely, Lee-Baggley et al. (2004) reported that WT did not relate to PHM in SARS samples. The distinctive nature of COVID-19 may explain the incongruent findings between previous studies and ours. The transmissibility of COVID-19 is much higher than that for viruses encountered in previous incidents. The progress of the current virus is fluctuating, and no medications are available at this time to cure the infection. People are in fact facing many unknowns and uncertainties that exert a significant impact on their psychological wellbeing. Recent studies have reported that COVID-19 has compromised the psychological wellbeing of healthcare workers and the general public (Kuang et al., 2020; Lai et al., 2020; Ma et al., 2020). People suffering from despair may turn to WT to relieve their psychological burdens to preserve their mental health. Although the literature often associates WT with higher stress level and poorer health outcomes (Onieva-Zafra et al., 2020; Penley et al., 2002; Quynh et al., 2020), the use of WT in the face of the COVID-19 pandemic may have a protective effect on people's mental wellbeing (Karaca et al., 2019). The positive correlation between WT and ER may support the protective effect of WT on the participants' mental health in that greater employment of WT would simultaneously increase the use of a proactive stress-coping strategy—ER to manage the stress.

The present study showed that ER had a greater influence on SoD than on PHM. Conversely, previous studies found that ER had a higher association with PHM in SARS and West Nile virus samples (Lee-Baggley et al., 2004; Putermna et al., 2009). The different findings among studies may be explained by the differences in the key strategies to control viral spread in different outbreaks. In COVID-19, SoD is a key strategy to mitigate community spread of the infection, along with PHM. However, in the case of SARS, PHM were emphasised to quell the outbreak. Another possible explanation for the incongruence may involve the sample characteristics in the present study. In our samples, over 80% of the participants were from Fujian. This number is significant because the Fujian group was found to have a significantly higher mean ER score than the Hong Kong group in subgroup analysis. The greater use of ER observed in the Fujian group may be attributable to the social norm to maintain close relationships within neighbourhoods and support each other in Mainland China. Although public health measures to control COVID-19 have forced the participants to isolate themselves from others with whom they used to be in close contact, they may continue to interact as usual through other means such as communication apps or social media to share their stress and difficulties.

Further, some students were forced to stay in hostels during the outbreak because of the lockdown and suspension of transportation, they may exhibit empathetic behaviours to support each other to transcend a difficult situation.

### 5.4 | Recommendations

This study is the first to use path analysis to explore factors associated with compliance with infection control measures for the control of COVID-19 among healthcare students. Both direct and indirect associations of potential factors with the COVID-19 ICPs were revealed. This approach is more advantageous than regression analysis in the sense that any indirect effects of the factors would not be masked in path analysis. The statistically significant paths and the good fit of the model provide empirical support for the study hypotheses.

Stakeholders may refer to the present model to provide interventions targeted not only at factors directly associated with SoD and PHM but also factors associated with confidence in managing the situation and coping responses that can improve compliance. It is recommended that nurse educators and clinical parties shall work together to enhance students' self-efficacy through appropriate strategies as recommended by some relevant theories such as Bandura's Self-efficacy Theory (Bandura, 1997). For instance, successful cases about the effective control of virus spread through concerted effort shall be shared with the students to provide models for learning. Positive reinforcement shall be provided to those who can adhere to the practice well through giving appropriate compliment. Besides, students' emotional reactions to the pandemic is one of the major factors for self-efficacy development (Bandura, 1997). Nurse educators and school counsellors shall understand that WT could be a temporary strategy to cope with the pandemic as it helps to preserve students' mental wellbeing. ER shall be promoted among students as it could help in creating an emotionally supportive environment. Counselling services that may not be regularly provided to students in general may also be an additional support to students to their emotion during the outbreak through understanding students' feelings and worries towards the pandemic.

### 5.5 | Limitations

Although this study contributes to the knowledge of factors associated with compliance with COVID-19 ICPs, several limitations may limit the validity of the findings. First, the convenience and snowball samples may not reflect the full characteristics of the entire population. The participants were mainly from junior years, and only a few senior students who would have more clinical experience were included. Thus, the negative association found between clinical experience and compliance with SoD may be biased because the samples were dominated by junior students. Fujian samples are much more than that of Hong Kong, the unbalanced

sample sizes between two geographical locations may be the between-group comparison. Second, since the data collection was conducted in China, the predictive model may not apply to other countries with different socio-cultural backgrounds and dissimilar implementation policies for COVID-19 ICPs. Third, a self-reported survey was used to collect students' perceptions and likelihood to comply with COVID-19 ICPs. Thus, the data may be subject to social response bias. Fourth, the present model was established based on cross-sectional data, making it difficult to draw causal inferences about the relationships between variables. A world-wide study should be designed to collect subjects from more countries to enhance study validity. The use of random sampling and inclusion of more objective data collection methods should be considered to minimise biases caused by unbalanced sample characteristics and subjective responses. Further research should additionally examine the causal relationships using longitudinal methodologies.

## 6 | CONCLUSION

The predictive model developed in this study is the first to explore factors associated with compliance with infection control measures by healthcare students amid the COVID-19 outbreak. The findings help stakeholders to identify students at risk for poor compliance. The findings suggest that students who are male, reside in Hong Kong, have more clinical experience, and exhibit weak confidence about managing the threat tend to display lower compliance in terms of SoD and PHM. WT, which has been generally connected to negative health outcomes (Penley et al., 2002), was found to be a positive factor in complying with infection control measures for COVID-19. Public health interventions should target groups susceptible to poor compliance to strengthen the control of COVID-19 spread.

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### CONFLICT OF INTEREST

No conflict of interest has been declared by the author(s).

### AUTHOR CONTRIBUTION

All authors have agreed on the final version and meet at least one of the following criteria: 1) substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content.

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### DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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