

Original Article

Factors associated with behavioral intention of free and self-paid severe acute respiratory coronavirus virus 2 (SARS-CoV-2) vaccination based on the social cognitive theory among nurses and doctors in China

Rui She PhD¹, Xi Chen PhD², Liping Li PhD³, Lijuan Li MPA⁴, Zepeng Huang MPH⁵ and Joseph T.F. Lau PhD¹ 

¹Centre for Health Behaviours Research, School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, China, ²Hunan Provincial Center for Disease Control and Prevention, Changsha, China, ³Shantou University Medical College, Shantou, China, ⁴School of Public Health, Dali University, Dali, Yunnan, China and ⁵The Second Affiliated Hospital of Shantou University Medical College, Shantou, China

Abstract

Objective: To examine the associations between factors based on the social cognitive theory (SCT) and behavioral intention among doctors and nurses in China toward free and self-paid (600 RMB or US\$91) severe acute respiratory coronavirus virus 2 (SARS-CoV-2) vaccination given 80% effectiveness and rare mild side effects.

Design: Cross-sectional study.

Setting: Public hospitals.

Participants: The study included 362 doctors and 1,702 nurses in major departments of 5 hospitals of 3 Chinese provinces.

Methods: An anonymous online survey was conducted from October to November 2020, facilitated by hospital administrators through online WeChat/QQ working groups. Data on outcome expectations, self-efficacy, norms, and COVID-19-related work experiences were collected. Multivariate logistic regression models were used for data analyses.

Results: The logistic regression analysis showed that physical (eg, protective effect of vaccination) and self-evaluative outcome expectations (eg, anticipated regret), self-efficacy, norms (eg, descriptive norm, subjective norm, professional norm, and moral norm), and job satisfaction were significantly and positively associated with the free and self-paid SARS-CoV-2 vaccination intention outcomes among doctors and nurses, adjusted for background variables. Doctors who had engaged in COVID-19-related work reported higher self-paid vaccination intention.

Conclusions: Health promotion is needed to improve the uptake of SARS-CoV-2 vaccination among healthcare workers. Such interventions may consider modifying the identified factors of vaccination intention, including strengthening perceived efficacy, positive feelings about vaccination, the need to avoid future regret, self-efficacy, and social norms. Future studies should examine the actual behavior patterns of SARS-CoV-2 vaccination, and the efficacy of promotion intervention should be tested in randomized controlled studies.

(Received 27 December 2020; accepted 16 April 2021)

Severe acute respiratory coronavirus virus 2 (SARS-CoV-2) vaccination is a promising approach to achieve herd immunity and contain the pandemic, in addition to public health preventive measures. Healthcare workers (HCWs) are vulnerable to coronavirus disease 2019 (COVID-19),¹ but vaccination hesitancy could be a concern (eg, influenza vaccination rates among HCWs range from as low as 2.1% to 62%).² The prevalence of SARS-CoV-2 vaccination intention was only 27.7% among HCWs in Congo³ and 40% among nurses in Hong Kong.⁴ The few previous studies reported significant factors of acceptability of SARS-CoV-2

vaccination among HCWs: being male, being a doctor, positive attitude toward SARS-CoV-2 vaccines, perceived susceptibility to COVID-19, and engagement in COVID-19 care.^{3–5}

The commonly applied social cognitive theory (SCT) was used as the study's conceptual framework.^{6,7} SCT emphasizes that human behavior is the product of the dynamic interplay of personal, behavioral, and environmental influences.⁸ It is highly applicable because the working environment, norms, and professional identity of HCWs affect their SARS-CoV-2 vaccination beliefs and behaviors.⁹ Three other key constructs of SCT that we investigated were (1) outcome expectation, which encompassed physical outcomes and self-evaluative outcomes (eg, pride, self-worth, and anticipated regret if not taking up vaccination),¹⁰ (2) observational learning (eg, peer modeling),¹¹ and (3) self-efficacy (ie, beliefs about personal ability/confidence to perform behaviors).⁸

Author for correspondence: Prof Joseph Tak Fai Lau, E-mail: jlau@cuhk.edu.hk

Cite this article: She R, et al. (2021). Factors associated with behavioral intention of free and self-paid severe acute respiratory coronavirus virus 2 (SARS-CoV-2) vaccination based on the social cognitive theory among nurses and doctors in China. *Infection Control & Hospital Epidemiology*, <https://doi.org/10.1017/ice.2021.201>

We investigated the prevalence of and factors related to the behavioral intention of Chinese HCWs to take SARS-CoV-2 vaccination. The 4 SCT factors related to SARS-CoV-2 vaccination investigated in this study were (1) environmental factors (norms, experiences related to COVID-19, and job satisfaction), (2) outcome expectations, (3) self-efficacy of COVID-19 vaccination, and (4) observational learning (ie, colleagues' SARS-CoV-2 vaccination). The norms related to SARS-CoV-2 vaccination that we studied were the descriptive norm (what others would do), the subjective norm (what others would think one should do), the moral norm (feelings of obligation and responsibility toward adopting the behavior),¹² and the professional norm (evaluations of the behavior based on professional convictions).¹³

Method

Sampling

An anonymous cross-sectional survey was conducted (October–November 2020) in 5 tier-1 tertiary-care hospitals in 3 provinces (Guangdong, Hunan, and Yunnan) of mainland China. The 3 provinces included were geographically (southeast, central, and southwest) and socioeconomically (levels of gross domestic product: top, about average, and below average) representative of mainland China. The inclusion criteria were (1) full-time doctors or nurses, (2) employed in the current hospital since at least January 2020, and (3) access to mobile phones. The exclusion criteria were (1) unable to give informed consent and (2) had taken SARS-CoV-2 vaccination or had made an appointment for SARS-CoV-2 vaccination. During the study period, vaccines were not marketed in China. Instead, a limited number of vaccinations took place in experimental trials or for emergency use.¹⁴ In our sample, only 17 HCWs (0.7%) had taken SARS-CoV-2 vaccination under those circumstances, and they were excluded. All eligible doctors and nurses working in the major departments of internal medicine, surgery, gynecology and obstetrics, pediatrics, emergency, and infectious diseases were invited to complete an anonymous online survey ($n = 3,104$). The online survey link was distributed to prospective participants by the hospital administrators through the participating departments' WeChat/QQ platforms (the most commonly used social media applications in China). With informed consent, all participants were briefed properly about the study. Ethics approval was obtained from the corresponding author's affiliated institution (reference no. SBRE-20-094). In total, 2,287 completed questionnaires were returned (response rate, 73.7%), of which 2,254 (99.1%) were valid and were used in the data analysis.

Measurements

Background variables

Sociodemographics (ie, gender, age, marital status, and education level) and work-related variables (ie, department, job rank, and hospital) were measured as background variables.

Behavioral intention of SARS-CoV-2 vaccination

SARS-CoV-2 vaccination intention was measured under 2 scenarios within the first 6 months since its availability: free cost or self-paid at a cost of RMB 600 (US\$91), given an effectiveness of 80% and rare mild side effects of the vaccine. The responses were rated on a 5-point Likert scale (1 = extremely unlikely; 5 = extremely likely) and were dichotomized into binary outcomes (extremely likely/likely versus else).

Self-efficacy of taking SARS-CoV-2 vaccination

The scale included 2 items about perceived self-efficacy in obtaining quota and scheduling time for SARS-CoV-2 vaccination (1 = totally disagree; 5 = totally agree). Higher total scores indicated higher levels of self-efficacy.

Outcome expectations

We measured 2 physical outcome expectations: (1) protective effect of SARS-CoV-2 vaccination for oneself and family or friends and (2) perceived likelihood of severe side effects of the SARS-CoV-2 vaccination.

We also investigated 2 self-evaluative outcomes. (1) We used 2 items to address participants' anticipated regret and self-disappointment if not taking the SARS-CoV-2 vaccination. This measure was used in a previous influenza vaccination study among Chinese HCWs.¹² (2) We measured anticipated positive feelings regarding SARS-CoV-2 vaccination by including 3 items to assess the degree of participants' feelings of safety, wisdom, and morality if they take SARS-CoV-2 the vaccination.

Observational learning

A single item was used to record whether the participant was acquainted with other HCWs who had taken or intended to take the SARS-CoV-2 vaccination.

Environmental factors

For descriptive norms, we included 3 items. We assessed perceived percentages (in increments of 10%) of acquainted non-HCWs, acquainted HCWs, and HCWs in China that would take the SARS-CoV-2 vaccination during the 6 months of its availability. For subjective norms, we included 5 items. We assessed perceptions regarding how much the general public, HCW colleagues, significant others, social media, and the government would expect HCWs to take SARS-CoV-2 vaccination. For the moral norm, we used a single item from a previous study to assess the extent that SARS-CoV-2 vaccination was seen as a personal responsibility.¹² For the professional norm, we constructed 2 items: "All HCWs should uptake SARS-CoV-2 vaccination" and "Hospital should require all HCWs to uptake SARS-CoV-2 vaccination." All items of subjective, moral, and professional norms were rated on a 5-point Likert scale: 1 (strongly disagree) to 5 (strongly agree). The average score of all items was used, with higher scores denoting higher levels of agreement with SARS-CoV-2 vaccination.

Work environment was assessed using 3 items regarding (1) engagement in COVID-19–related work, (2) COVID-19 diagnosis history, and (3) colleagues' COVID-19 infection. Job satisfaction was assessed using a single item from previous studies (ie, "Overall, I am satisfied with my job").¹⁵ A detailed description of these measurements is available in Appendix 1 (online). The reliability of the measurements was satisfactory.

Statistical analysis

Descriptive data were presented separately for doctors and nurses and compared using an independent t test or the χ^2 test. Adjusted for the background variables, the associations between the individual SCT-related constructs and the 2 binary behavioral intention variables were analyzed by multivariate logistic regression analysis. Adjusted odds ratios (AORs) and respective 95% confidence intervals (CIs) are reported. SPSS version 21.0 software (IBM, Armonk, NY) was used for data analyses. The statistically significant level was $P < .05$ (2-tailed).

The study was approved by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong (No. SBRE-20-094).

Results

Prevalence of behavioral intention of SARS-CoV-2 vaccination

The prevalence of intention of free SARS-CoV-2 vaccination was 75.1% among doctors and 68.0% among nurses, which dropped to 64.6% for doctors and 56.5% for nurses regarding self-paid vaccination intention at a cost of 600 RMB (US\$91) (Table 1). Both situations specified 80% effectiveness and rare mild side effects. Doctors had significantly higher SARS-CoV-2 vaccination intentions relative to nurses (all $P < .05$).

Background characteristics and description of the independent variables

The background information for and comparisons between doctors and nurses are summarized in Table 1. Moreover, 72.7% of the participants had engaged in COVID-19-related work; 5% and 1.4% had had COVID-19 infection and infected colleagues, respectively. The participants perceived that on average ~60% of the acquainted non-HCWs, acquainted HCWs, and HCWs in China would take a SARS-CoV-2 vaccination within the first 6 months of its availability. Nurses showed higher levels of perceived side effects, anticipated regret, descriptive norm, and professional norms related to SARS-CoV-2 vaccination than doctors. Doctors demonstrated higher self-efficacy of SARS-CoV-2 vaccination and were more likely to engage in COVID-19 treatment or control work.

SCT factors of SARS-CoV-2 vaccination intention

Separate logistic regression analyses adjusted for the background variables were conducted for the 4 vaccination intention scenarios (ie, free and self-paid vaccination intention among doctors and nurses) (Table 2).

Outcome expectations

Except for perceived severe side effects, the other outcome expectation variables were significantly and positively associated with both intention of free and self-paid SARS-CoV-2 vaccination among doctors and nurses (all $P < .001$), including perceived vaccine protectiveness for self (AORs, 1.84–2.58), protectiveness for family and friends (AORs, 1.84–2.75), anticipated positive feelings if taking a SARS-CoV-2 vaccination (AORs, 1.32–1.47), and anticipated regret if not taking a SARS-CoV-2 vaccination (AORs, 1.35–1.36).

Self-efficacy

Self-efficacy was positively associated with all the 4 vaccination intention scenarios (AORs, 1.44–2.20; all $P < .001$).

Observational learning

No significant association was found between knowing acquainted HCWs that having taken up SARS-CoV-2 vaccination and vaccination intention (AORs, 0.61–1.02; $P > .05$).

Norms

All 4 norm variables were significantly and positively associated with all the four vaccination intention scenarios at the level of $P < .001$: the descriptive norm (AORs, 1.36–1.54), the subjective

norm (AORs, 2.76–4.85), the moral norm (AORs, 2.23–2.98), and the professional norm (AORs, 1.98–2.47).

Work-related experience and environment

Engagement in COVID-19 treatment and control work was only positively associated with intention of self-paid SARS-CoV-2 vaccination among doctors (AOR, 1.80; $P < .05$) but not for the other vaccination intention variables. In addition, job satisfaction was positively associated with all the 4 vaccination intention variables (AORs, 1.20–1.31; all $P < .001$).

Discussion

In the present study, we investigated the intention of free or self-paid SARS-CoV-2 vaccination and the associated factors based on the SCT among HCWs in China. Overall, 68% of the doctors and 75% of the nurses intended to take up free SARS-CoV-2 vaccination. However, the prevalence dropped to 57% and 65% at a fee of 600 RMB (US\$91), corroborating previous studies among Chinese university students and general population in Hong Kong.^{16,17} Cost is an expected barrier, and the concerns about downturns in economy due to the pandemic may have further reduced the willingness to pay. Free and prioritized SARS-CoV-2 vaccination should be provided to these vulnerable occupational groups to avoid nosocomial infections during the pandemic. Although a prior study suggested that a coverage rate of $\geq 75\%$ would be required to achieve herd immunity with a 80% vaccine effectiveness,¹⁸ the intention-behavior gap signifies the necessity of continuous efforts to promote vaccination uptake. Corroborating a previous Israel study,⁵ doctors indicated higher SARS-CoV-2 vaccination intention than nurses. Future studies should investigate the reasons behind the discrepancy in motivation for SARS-CoV-2 vaccination between these 2 groups. Additional efforts and incentives should be given to promote SARS-CoV-2 vaccination among HCWs, especially for nurses.

The SCT is applicable to understanding the intention to take a SARS-CoV-2 vaccination among HCWs. Most of the SCT factors (outcome expectations, self-efficacy, norms, and COVID-19-related work experience) were significantly and consistently associated with both free and self-paid vaccination intentions among the 2 groups. Observational learning was an exception and was not associated with vaccination intentions. This finding is understandable because SARS-CoV-2 vaccination had not been implemented, although a very small number of HCWs might have taken up experimental vaccinations.¹⁹ Thus, observational learning, which involves information processing and responses,⁸ might not have occurred among most participants. The significance of this potential factor of SARS-CoV-2 vaccination would evolve over time.

Supporting the SCT, outcome expectations were significant factors of SARS-CoV-2 vaccination intention among HCWs. Corroborating a previous study,⁸ perceived protectiveness of COVID-19 vaccination (oneself and family or friends) was significantly associated with all vaccination intention variables. Thus, SARS-CoV-2 vaccination health promotion may highlight both egoistic and altruistic benefits. Unexpectedly, perceived side effect of vaccines was not associated with vaccination intention in the present study. It was, however, negatively associated with various types of vaccination-related behaviors or intentions (eg, influenza) in previous studies.^{20,21} It is plausible that side effects were rarely reported during the experimental use of the Chinese SARS-CoV-2 vaccines. In addition, the item about free or self-paid COVID-19 intention specifically referred to vaccines with rare mild side

Table 1. Description of the Study Participants' Characteristics

Variable	All (n=2,254)	Doctors (n=362)	Nurses (n=1,902)	P Value ^a
	No. (%)	No. (%)	No. (%)	
Background characteristics				
<i>Sex</i>				
				<.001
Female	2,015 (89.0)	175 (48.3)	1,840 (96.7)	
Male	249 (11.0)	187 (51.7)	62 (3.3)	
Age, mean y (SD) ^b	32.7 (7.4)	37.6 (8.7)	31.8 (6.8)	<.001
<i>Department</i>				
				<.001
Internal medicine	706 (31.2)	146 (40.3)	560 (29.4)	
Surgery	561 (24.8)	46 (12.7)	515 (27.1)	
Gynecology and obstetrics	85 (3.8)	30 (8.3)	55 (2.9)	
Pediatrics	272 (12.0)	62 (17.1)	210 (11.0)	
Infectious diseases	106 (4.7)	13 (3.6)	93 (4.9)	
Emergency	166 (7.3)	12 (3.3)	154 (8.1)	
Others	322 (14.2)	53 (14.6)	315 (16.6)	
<i>Job seniority rank</i>				
				<.001
Junior	1,125 (49.7)	80 (22.1)	1,045 (54.9)	
Middle	878 (38.8)	152 (42.0)	726 (38.2)	
Vice-senior	180 (8.0)	94 (26.0)	86 (4.5)	
Senior	36 (1.6)	31 (8.6)	5 (0.3)	
Others (eg, uncertain)	45 (2.0)	5 (1.4)	40 (2.1)	
<i>Marital status</i>				
				<.001
Single	616 (27.2)	54 (14.9)	562 (29.5)	
Married/cohabited	1,591 (70.3)	299 (82.6)	1,292 (67.9)	
Others (eg, separated/divorced, widowed)	57 (2.5)	9 (2.5)	48 (2.5)	
<i>Education level</i>				
				<.001
Junior college or below	365 (16.1)	3 (0.8)	362 (19.0)	
Bachelor's degree	1563 (69.0)	71 (19.6)	1492 (78.4)	
Postgraduate degree	336 (14.8)	288 (79.6)	48 (2.5)	
SCT-related constructs				
<i>Outcomes expectations</i>				
<i>Physical outcomes</i>				
Likelihood of protecting oneself	3.8 (0.8)	3.8 (0.9)	3.8 (0.8)	.690
Likelihood of protecting family/friends	3.8 (0.8)	3.8 (0.9)	3.8 (0.8)	.418
Likelihood of severe side effects	3.2 (1.0)	3.0 (1.0)	3.2 (1.0)	<.001
<i>Self-evaluative outcomes^b</i>				
Anticipated positive feelings if taking up COVID-19 vaccination	10.4 (2.2)	10.3 (2.2)	10.5 (2.2)	.147
Anticipated regret if not taking up COVID-19 vaccination	6.9 (1.6)	6.6 (1.7)	6.9 (1.7)	<.001
<i>Self-efficacy of COVID-19 vaccination^b</i>	6.8 (1.4)	7.0 (1.4)	6.7 (1.4)	.003
<i>Observational learning</i>				
Acquainted HCWs having taken up vaccination	121 (5.3)	18 (5.0)	103 (5.4)	.731
<i>Environmental factors</i>				
<i>Norms^b</i>				
Descriptive norm	62.5% (0.2)	58.6% (0.2)	63.3% (0.2)	<.001
Subjective norm	3.7 (0.7)	3.7 (0.7)	3.7 (0.7)	.568
Moral norm	3.6 (0.8)	3.6 (0.9)	3.6 (0.8)	.406

(Continued)

Table 1. (Continued)

Variable	All (n=2,254)	Doctors (n=362)	Nurses (n=1,902)	P Value ^a
	No. (%)	No. (%)	No. (%)	
Professional norm	3.5 (0.8)	3.3 (0.9)	3.5 (0.8)	<.001
<i>Job-related experience and environment</i>				
Involvement in COVID-19 related work	1,647 (72.7)	282 (77.9)	1,365 (71.8)	.016
Infected with COVID-19	113 (5.0)	14 (3.9)	99 (5.2)	.284
Having colleagues infected with COVID-19	32 (1.4)	5 (1.4)	27 (1.4)	.955
Job satisfaction ^b	8.0 (1.9)	7.9 (2.0)	8.0 (1.9)	.508
<i>Behavioral intention of free COVID-19 vaccination</i>				
Extremely unlikely/Unlikely/Neutral	698 (30.8)	90 (24.9)	608 (32.0)	.007
Extremely likely/Likely	1,566 (69.2)	272 (75.1)	1,294 (68.0)	
<i>Behavioral intention of self-paid COVID-19 vaccination</i>				
Extremely unlikely/Unlikely/Neutral	956 (42.2)	128 (35.4)	828 (43.5)	.004
Extremely likely/Likely	1,308 (57.8)	234 (64.6)	1,074 (56.5)	

Note: Data are tabulated as no. (%) if not specified.

^aP-value footnote here.

^bContinuous variables are presented with mean (SD).

effects. Thus, participants' responses to such questions did not involve consideration of perceived side effects of SARS-CoV-2 vaccines. Future studies need to confirm and explain this unexpected finding. Furthermore, self-evaluative outcome expectations of positive feelings and anticipated regret about SARS-CoV-2 vaccination were also significantly associated with vaccination intentions. These findings suggest that psychological outcomes such as peace of mind by avoiding regret and positive feelings resulted from SARS-CoV-2 vaccination are potential themes for related health promotion.

As expected, self-efficacy was associated with SARS-CoV-2 vaccination intentions. It is a key construct of a number of behavioral theories (eg, the Health Belief Model and Theory of Planned Behaviors) and has been shown to be a significant determinant of multiple types of behaviors and intentions regarding vaccination, including influenza and COVID-19 vaccination.^{12,13,20} Evidence based on workplace vaccination programs suggest that vaccines may be offered on-site and provided free, at multiple locations, on multiple shifts or days, with health education and mobile units for information dissemination to reduce logistics barriers and increase availability and self-efficacy of vaccination for HCWs.²² Doctors showed higher self-efficacy of SARS-CoV-2 vaccination (eg, confidence in getting the quota and time) than nurses, which might partially explain the higher vaccination intention among doctors than nurses. Our data also supported this speculation (not shown). In general, doctors are more likely than nurses to possess higher positions in the hierarchy of power and decision making.²³ Nurses should be assured about their priority to take up SARS-CoV-2 vaccination as a means to increase self-efficacy.

A novel feature of this study is that following the SCT, it has considered various types of descriptive, subjective, moral, and professional norms and work experiences as part of the environmental and contextual factors. All 4 types of norms were consistently and positively associated with vaccination intentions among doctors and nurses, corroborating prior studies about influenza vaccination behaviors of HCWs.^{12,13} In general, literature shows that social norms can be fostered to result in behavioral changes,²⁴ and such

findings could be considered in relevant health promotion campaigns for SARS-CoV-2 vaccination. First, future intervention should consider peer sharing sessions, newsletters, declarations of professional societies through existing online platforms used by HCWs to build up professional and descriptive norms regarding SARS-CoV-2 vaccination among HCWs. Second, our findings indicate that SARS-CoV-2 vaccination might be seen as a moral and prosocial behavior related to others' health. Such positive framing of SARS-CoV-2 vaccination as a prosocial behavior could be a feasible marketing approach to promote SARS-CoV-2 vaccination.²⁵ Third, the present study showed that subjective norms perceived from peers, general public, hospital, government, and social media were significantly associated with SARS-CoV-2 vaccination intentions. Thus, health planners should regard SARS-CoV-2 vaccination both as an individual and social behaviors, and social media might be a feasible approach for health promotion.

As another dimension of environmental influence, engagement in the COVID-19 treatment and care was positively correlated with self-paid vaccination intention among doctors, corroborating a previous study.⁵ Such experiences may be associated with perceived susceptibility, which was usually associated with vaccination behaviors.²⁶ With regard to free vaccination, it is possible that HCWs who were not involved in COVID-19 work also showed relatively high willingness for SARS-CoV-2 vaccination due to no cost, which might explain the nonsignificant association. Furthermore, no significant associations between COVID-19-related work and vaccination intentions among nurses were observed. A previous study among nurses suggested that COVID-19-related work was positively associated with SARS-CoV-2 vaccination intention via increased work stress.²⁷ It is plausible that nurses in mainland China who had not been involved in COVID-19 work were also experiencing greater work stress during the pandemic. Empirical data are needed to substantiate these propositions. Interestingly and importantly, job satisfaction was positively associated with vaccination intentions, corroborating previous studies for influenza vaccination.²⁸ Job satisfaction has been associated with lower

Table 2. Adjusted Associations Between SCT-Related Independent Variables and Behavioral Intention of COVID-19 Vaccination

Independent Variables	Behavioral Intention of COVID-19 Vaccination (Free)		Behavioral Intention of COVID-19 Vaccination (Self-paid)	
	Doctors	Nurses	Doctors	Nurses
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Outcomes expectations				
<i>Physical outcomes</i>				
Likelihood of protecting self	2.58 (1.84–3.61)***	2.20 (1.93–2.51)***	2.30 (1.70–3.12)***	1.84 (1.63–2.08)***
Likelihood of protecting family/friends	2.75 (1.95–3.88)***	2.16 (1.90–2.46)***	2.21 (1.63–2.99)***	1.84 (1.63–2.08)***
Likelihood of severe side effect	0.97 (0.76–1.25)	1.02 (0.92–1.14)	0.98 (0.79–1.23)	1.05 (0.96–1.16)
<i>Self-evaluative outcomes</i>				
Anticipated positives feeling if taking up COVID-19 vaccination	1.43 (1.24–1.64)***	1.36 (1.29–1.43)***	1.47 (1.29–1.68)***	1.32 (1.25–1.38)***
Anticipated regret if not taking up COVID-19 vaccination	1.36 (1.15–1.60)***	1.36 (1.27–1.46)***	1.36 (1.17–1.59)***	1.35 (1.27–1.44)***
Self-efficacy	2.02 (1.59–2.58)***	1.50 (1.38–1.63)***	1.51 (1.25–1.81)***	1.44 (1.33–1.55)***
Observational learning				
Acquainted HCW get vaccinated	0.61 (0.21–1.84)	0.96 (0.63–1.48)	0.86 (0.30–2.45)	1.02 (0.68–1.54)
Environmental factors				
<i>Social norms</i>				
Descriptive norm	1.54 (1.33–1.79)***	1.41 (1.34–1.50)***	1.44 (1.26–1.64)***	1.36 (1.29–1.43)***
Subjective norm	4.85 (3.04–7.74)***	3.46 (2.91–4.11)***	4.02 (2.68–6.01)***	2.76 (2.37–3.22)***
Moral norm	2.51 (1.81–3.49)***	2.65 (2.30–3.06)***	2.98 (2.16–4.13)***	2.23 (1.96–2.54)***
Professional norm	2.10 (1.51–2.90)***	2.47 (2.14–2.86)***	2.29 (1.68–3.12)***	1.98 (1.75–2.25)***
<i>Job-related experience and environment</i>				
Involvement in COVID-19-related work	1.55 (0.84–2.89)	1.14 (0.92–1.42)	1.80 (1.03–3.15)*	1.12 (0.91–1.38)
Infected with COVID-19	0.49 (0.15–1.66)	1.15 (0.73–1.79)	0.44 (0.14–1.40)	1.13 (0.75–1.72)
Having colleagues infected with COVID-19	NA	1.41 (0.68–2.93)	NA	1.19 (0.62–2.28)
Job satisfaction	1.31 (1.14–1.49)***	1.21 (1.15–1.28)***	1.23 (1.09–1.39)**	1.20 (1.14–1.26)***

Note: NA, not applicable; AOR, adjusted odds ratio; CI, confidence interval.

^aAdjusted for age, sex, marital status, education level, department, job seniority rank, and hospital.

^bBecause only 5 doctors (1.4%) reported having colleagues infected with COVID-19, the odds ratio was not computed.

†.05 < P < .10; *P < .05; **P < .01; ***P < .001.

turnover intention and higher organizational commitment among HCWs²⁹; therefore, HCWs with higher levels of job satisfaction may be more likely to conform to expected behaviors for HCWs (eg, vaccination). This finding reinforces the importance of environmental interactions with preventive behaviors, as highlighted by the concept of reciprocal determinism of the SCT. This is particularly crucial because many HCWs are fighting against COVID-19 in risky, stressful, and less rewarding working environments.³⁰ The finding sends a reminder to policy makers that HCW vaccination compliance may be based on their job satisfaction and environment.

This study has several limitations. Reporting bias may have occurred due to social desirability associated with SARS-CoV-2 vaccination. The cross-sectional study design cannot allow for making causal inferences; longitudinal studies are warranted. Despite a high response rate, only 5 tertiary-care hospitals in 3 provinces of China were involved. The generalization of these results to hospitals of other levels or provinces should be done with caution. The gender distribution was comparable to the census data for doctors (male: 54.9% vs 51.7%) and nurses in 2018 (male: 2.2% vs 3.3%).³¹ However, the sample was overrepresented by HCWs with higher educational levels because we focused on HCWs in tertiary-care hospitals. The prevalence of SARS-CoV-2

vaccination might be overestimated; education was positively associated with vaccination behavior among HCWs.³² The sample sizes of the 2 groups were uneven and implied lower statistical power in the doctor group, making comparisons of the significance of factors difficult. In the absence of existing tools in the context of SARS-CoV-2 vaccination, some measurements were constructed for this study and referred to previous studies (eg, positive feelings associated with SARS-CoV-2 vaccination). In the present study, we considered the intention to be vaccinated because actual SARS-CoV-2 vaccination had not yet become available, and there is always a discrepancy between intention and action. Future studies are required to compare such differences and validate the present findings. Last, we did not include other types of HCWs because we wanted to keep the sample as homogeneous as possible.

In summary, in the present study, ~70% of HCWs had behavioral intention to take a free SARS-CoV-2 vaccination with 80% effectiveness and rare mild side effect. This rate dropped to 60% a fee of 600 RMB (US\$91) was applied. A number of SCT constructs were associated with SARS-CoV-2 vaccination intention. Prompt theory-driven social marketing is warranted to improve the coverage of SARS-CoV-2 vaccination among HCWs. Future longitudinal studies and randomized controlled trials should be

implemented to test the applicability of SCT and whether outcome expectations, norms, self-efficacy, and work environment would increase vaccination uptake. Other evidence-based interventions, such as facilitating vaccination behavior through reminders and prompts and reducing barriers through logistics and healthy defaults (eg, no cost, worksite vaccination, and availability), could also be considered in vaccination health campaigns.³³

Acknowledgments. We thank Lihui Zhu of Hunan Children's Hospital, Huifang Tan of the First Affiliated Hospital of Nanhua University, Xiaojun Chen of the First Affiliated Hospital of Shantou University Medical College, Ling Guo of Yunnan Kungang Hospital, Lijun Zhu of Dali Bai Autonomous Prefecture People's Hospital, and Huixia Lu of the First Affiliated Hospital of Dali University for their assistance in data collection.

Financial support. The study was supported by the internal research funding of the Centre for Health Behaviour Research, the Chinese University of Hong Kong.

Conflicts of interest. The authors declare no conflicts of interest.

References

- Karlsson U, Fraenkel C-J. COVID-19: risks to healthcare workers and their families. *BMJ* 2020;371:m3944.
- Riphagen-Dalhuisen J, Gefenaite G, Hak E. Predictors of seasonal influenza vaccination among healthcare workers in hospitals: a descriptive meta-analysis. *Occupat Environ Med* 2012;69:230–235.
- Nzaji MK, Ngombe LK, Mwamba GN, *et al.* Acceptability of vaccination against COVID-19 among healthcare workers in the Democratic Republic of the Congo. *Pragmat Observ Res* 2020;11:103.
- Wang K, Wong ELY, Ho KF, *et al.* Intention of nurses to accept coronavirus disease 2019 vaccination and change of intention to accept seasonal influenza vaccination during the coronavirus disease 2019 pandemic: a cross-sectional survey. *Vaccine* 2020;38:7049–7056.
- Dror A, Eisenbach N, Taiber S, *et al.* Vaccine hesitancy: the next challenge in the fight against COVID-19. *Eur J Epidemiol* 2020;35.
- Plotnikoff RC, Costigan SA, Karunamuni N, Lubans DR. Social cognitive theories used to explain physical activity behavior in adolescents: a systematic review and meta-analysis. *Prevent Med* 2013;56:245–253.
- Glanz K, Bishop DB. The role of behavioral science theory in development and implementation of public health interventions. *Ann Rev Public Health* 2010;31:399–418.
- Bandura A. Human agency in social cognitive theory. *Am Psychol* 1989;44:1175.
- Godin G, Bélanger-Gravel A, Eccles M, Grimshaw J. Healthcare professionals' intentions and behaviours: a systematic review of studies based on social cognitive theories. *Implement Sci* 2008;3:36.
- Dijkstra A, Vries HD, Kok G, Rouackers J. Self-evaluation and motivation to change: social cognitive constructs in smoking cessation. *Psychol Health* 1999;14:747–759.
- Glanz K, Rimer BK, Viswanath K. *Health Behavior and Health Education: Theory, Research, and Practice*. New York: John Wiley & Sons; 2008.
- Ng TWY, Cowling BJ, So HC, Ip DKM, Liao Q. Testing an integrative theory of health behavioural change for predicting seasonal influenza vaccination uptake among healthcare workers. *Vaccine* 2020;38:690–698.
- Godin G, Vézina-Im L-A, Naccache H. Determinants of influenza vaccination among healthcare workers. *Infect Control Hosp Epidemiol* 2010;31:689–693.
- China focus: emergency use of COVID-19 vaccines expands to larger scale. Xinhuanet website. http://www.xinhuanet.com/english/2020-12/30/c_139630438.htm. Published 2021. Accessed March 1, 2021.
- Dolbier CL, Webster JA, McCalister KT, Mallon MW, Steinhart MA. Reliability and validity of a single-item measure of job satisfaction. *Am J Health Promo* 2005;19:194–198.
- Mo PK-h, Luo S, Wang S, *et al.* Intention to receive the COVID-19 vaccination in China: application of the diffusion of innovations theory and the moderating role of openness to experience. *Vaccines* 2021;9:129.
- Yu Y, Lau JTF, Lau MMC, Wong MCS, Chan PKS. Understanding the prevalence and associated factors of behavioral intention of COVID-19 vaccination under specific scenarios combining effectiveness, safety, and cost in the Hong Kong Chinese general population. *Int J Health Policy Manag* 2021. doi: 10.34172/IJHPM.2021.02.
- Bartsch SM, O'Shea KJ, Ferguson MC, *et al.* Vaccine efficacy needed for a COVID-19 coronavirus vaccine to prevent or stop an epidemic as the sole intervention. *Am J Prev Med* 2020;59:493–503.
- Zhu F-C, Guan X-H, Li Y-H, *et al.* Immunogenicity and safety of a recombinant adenovirus type-5-vectored COVID-19 vaccine in healthy adults aged 18 years or older: a randomised, double-blind, placebo-controlled, phase 2 trial. *Lancet* 2020;396:479–488.
- Sherman SM, Smith LE, Sim J, *et al.* COVID-19 vaccination intention in the UK: results from the COVID-19 Vaccination Acceptability Study (CoVAccS), a nationally representative cross-sectional survey. *Hum Vaccin Immunother* 2020. doi: 10.1080/21645515.2020.1846397.
- Bish A, Yardley L, Nicoll A, Michie S. Factors associated with uptake of vaccination against pandemic influenza: a systematic review. *Vaccine* 2011;29:6472–6484.
- Worksite health: seasonal influenza vaccinations using interventions with on-site, free, actively promoted vaccinations—healthcare workers. The Community Guide website. <https://www.thecommunityguide.org/findings/worksite-health-seasonal-influenza-vaccinations-healthcare-on-site>. Published 2008. Accessed March 11, 2021.
- Elsous A, Radwan M, Mohsen S. Nurses and physicians attitudes toward nurse-physician collaboration: a survey from Gaza Strip, Palestine. *Nurs Res Pract* 2017;7406278.
- Miller DT, Prentice DA. Changing norms to change behavior. *Ann Rev Psychol* 2016;67:339–361.
- French J, Blair-Stevens C, McVey D, Merritt R. *Social Marketing and Public Health: Theory and Practice*. New York: Oxford University Press; 2010.
- Wong LP, Alias H, Wong P-F, Lee HY, AbuBakar S. The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay. *Human Vacc Immunother* 2020;16:2204–2214.
- Kwok KO, Li K-K, Wei WI, Tang A, Wong SYS, Lee SS. Influenza vaccine uptake, COVID-19 vaccination intention and vaccine hesitancy among nurses: a survey. *Int J Nurs Studies* 2021;114:103854.
- Naleway AL, Henkle EM, Ball S, *et al.* Barriers and facilitators to influenza vaccination and vaccine coverage in a cohort of health care personnel. *Am J Infect Control* 2014;42:371–375.
- Delobelle P, Rawlinson JL, Ntuli S, Malatsi I, Decock R, Depoorter AM. Job satisfaction and turnover intent of primary healthcare nurses in rural South Africa: a questionnaire survey. *J Adv Nurs* 2011;67:371–383.
- Liu Q, Luo D, Haase JE, *et al.* The experiences of healthcare providers during the COVID-19 crisis in China: a qualitative study. *Lancet Global Health* 2020;8:e790–e798.
- National Bureau of Statistics of China. *China Health Statistical Yearbook 2019*. China Statistics Press; 2019.
- Maltezou HC, Theodoridou K, Ledda C, Rapisarda V, Theodoridou M. Vaccination of healthcare workers: is mandatory vaccination needed? *Expert Rev Vaccines* 2019;18:5–13.
- Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing vaccination: putting psychological science into action. *Psychol Sci Public Interest* 2017;18:149–207.