RESEARCH ARTICLE

Acceptance of COVID-19 booster vaccination based on the protection motivation theory: A cross-sectional study in China

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Abstract

The promotion of the booster shots against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection is an open issue to be discussed. Little is known about the public intention and the influencing factors regarding the booster vaccine. A cross-sectional survey in Chinese adults was conducted using an online questionnaire, which designed on the basis of protection motivation theory (PMT) scale and vaccine hesitancy scale (VHS). Hierarchical multiple regression was used to compare the fitness of the PMT scale and VHS for predicting booster vaccination intention. Multivariable logistic regression was used to analyze the factors associated with the acceptance. Six thousand three hundred twenty-one (76.8%) of participants were willing to take the booster shot. However, the rest of the participants (23.2%) were still hesitant to take the booster vaccine. The PMT scale was more powerful than the VHS in explaining the vaccination intention. Participants with high perceived severity (adjusted odds ratio [aOR] = 0.69) and response cost (aOR = 0.47) were less willing to take the booster shots, but participants with high perceived susceptibility (aOR = 1.19), response efficacy (aOR = 2.13), and self-efficacy (aOR = 3.33) were more willing to take the booster shots. In summary, interventions based on PMT can provide guidance to ensure the acceptance of the booster vaccine.

KEYWORDS
booster vaccine, COVID-19, protection motivation theory, vaccine hesitancy

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Fan Wu and Yue Yuan contributed equally to this study.

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1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), remains a severe challenge worldwide. As of April 7, 2022, there were over 494 million confirmed COVID-19 cases and over 6.17 million deaths.[1] Mass vaccination is one of the potential measures to stop the COVID-19 pandemic by establishing the herd immunity against SARS-CoV-2 infection.[2] Increasing evidence has showed that the COVID-19 vaccines were safe and efficacious against SARS-CoV-2 infections.[3] But the infected cases were frequently reported even after receiving two doses of COVID-19 vaccines, which termed as "breakthrough infections" and have raised a critical issue. Thus, current vaccination strategy might be not sufficient to establish a strong barrier against SARS-CoV-2 infections.[4,5]

The reasons for the emergence of breakthrough infections are still under investigation. One of the explanations is the rapid decline in antibody titers overtime after vaccination.[6] Moreover, the numerous variants of SARS-CoV-2, including B.1.1.7 strain in the UK, P.1 in Brazil, B.1.617 strain in India, and mostly recent B.1.1.529 strain in South Africa, further exacerbates the risk of breakthrough infections.[5,7] Recent clinical studies have demonstrated that the third and fourth doses of inactivated vaccine or mRNA vaccine significantly reduced the rates of confirmed COVID-19 and severe illness.[8] In addition, other studies showed that the booster vaccination effectively increased the titers of neutralization antibodies against SARS-CoV-2 variants.[9,10] Consequently, the administration of another additional shot (thereby termed as the booster vaccination) is proposed to maintain and improve the effectiveness of COVID-19 vaccines.[11] The acceptability of routine doses of COVID-19 vaccination had been extensively investigated in different countries and population.[12–15] However, little is known about the public intention regarding the additional booster vaccination and the factors that influence this willingness.

Protection motivation theory (PMT) is often used to explain how individuals adopt protective measures against different diseases.[16] PMT is a type of social cognition theory that includes the following constructs: perceived severity, perceived susceptibility, response efficacy, self-efficacy, and response cost.[17] The PMT is usually used to predict the motivation of individuals towards self-protective. In addition, the vaccine hesitancy scale (VHS) developed by the World Health Organization Strategic Advisory Group of Experts is commonly used to identify hesitation in different situations based on factors such as confidence, complacency, and risk.[18] Previously, these measuring tools had been applied to the evaluation of COVID-19 vaccination intention,[19–22] and a few studies have recently investigated the public acceptance of COVID-19 booster vaccination with different survey tools.[23–26] However, there is no study to directly compare these survey scales for better investigating the vaccination intention yet.

In this study, we aimed to investigate the Chinese adults' acceptance of COVID-19 booster vaccination by PMT scale and VHS. More importantly, we compared their ability to explain participants' actual attitude and analyzed the main factors associated with the intentions of the PMT scale. This study will provide guidance when taking measures to reduce the people's VH about the booster vaccination in China and other countries.

2 | MATERIALS AND METHODS

2.1 | Study design and participants

This investigation was conducted during October 24–28, 2021, because China started booster vaccination to public from October, 2021. This study was a cross-sectional study and conducted in a population of 18–80 years old by snowball sampling in China. We set up an online structured questionnaire, which was available on the Wen Juan Xing platform (https://www.wjx.cn/). This online survey was disseminated via WeChat, a social network app, for participants to fill in and share with other people. The inclusion criteria were individuals who (1) were at least 18 years old; (2) were able to read and complete the self-administered questionnaire independently; and (3) voluntarily agreed to participate in this survey.

2.2 | Survey tools

2.2.1 | Data collection

The structured questionnaire contained information on demographic characteristics, the status of COVID-19 vaccination, intention to accept the booster shot of COVID-19 vaccine, PMT scale, and VHS. By reviewing the published meta-analyses on factors influencing Chinese people's intention to take the COVID-19 vaccine,[27,28] we collected the demographic characteristics including age, gender, education, residence, occupation, family monthly per capita income, frequency of domestic business trips, and health status. In addition, some questions of interest were set up to investigate the current status of COVID-19 vaccination.

A minimum sample size of 896 was estimated based on Equation 1, with the assumption that 70% of the participants were willing to receive the booster COVID-19 vaccine, a margin of error of 3%, and a confidence interval of 95%. Considering invalid questionnaires (20%), we increased the sample size to 1076.

$$N = [z_{1-\alpha}^2 \times p \times (1 - p)]/d^2 \qquad (1)$$

2.2.2 | Booster vaccination intention

The intention to receive the booster COVID-19 vaccine was measured depending on the answer of the question "To what extent do you want to take the booster COVID-19 vaccine?," and scored by "definitely yes," "unsure but tend to be willing," "unsure but tend to be unwilling," "definitely no." The responses to COVID-19 vaccine

intention were classified into two categories: willing group (definitely yes, unsure but tend to be willing) and unwilling group (unsure but tend to be unwilling, definitely no). Participants in the willing group were further asked about the reasons why willing to take a booster vaccination. Participants in the unwilling group were further asked to answer "Why don't you want a booster shot?." Hesitation, delay, or refusal to receive the COVID-19 booster shots was defined as VH.

2.2.3 | PMT scale

The PMT scale in this study consisted of five dimensions, including the perceived severity to COVID-19 (three items), the perceived susceptibility of COVID-19 (three items), the response efficiency (three items), the self-efficacy (three items), and the response cost (two items). This scale was adapted from previous studies.[19,29,30] Participants were asked about how they agreed with each statement, and a 5-point Likert-style scale was used to score each item, with a range from strongly disagree (1 point) to strongly agree (5 points). A higher score on each item indicates a higher level of threat appraisal, response efficacy, self-efficacy, and response cost, respectively. Reliability analysis showed that the total Cronbach's α of this PMT scale was 0.77, and the Cronbach's α of the five dimensions was 0.82, 0.93, 0.87, 0.86, and 0.80, respectively (Table 1).

2.2.4 | VHS

In this study, the VHS was adapted from previous studies.[18,31] This scale consisted of three dimensions: complacency (three items), convenience (three items), and confidence (four items). This scale also used a 5-point

Likert scale to score items, from strongly disagree (1 point) to strongly agree (5 points). A higher score indicated a more negative attitude toward COVID-19 vaccination. Total VH scale Cronbach's α was 0.86. The Cronbach's α in the three dimensions of "confidence," "complacency," and "risk" were 0.90, 0.66, and 0.81, respectively (Table 1). Exploratory factor analyses were conducted on the scores of PMT and VH scales, and the results indicated that both scales had high validities as well as high reliability (Supporting Information: Table S1).

2.3 | Data analysis

Cronbach's α values and confirmatory factor analysis were performed to test the reliability and validity of the two scales. The χ^2 test was used to compare the proportions of the participants between different vaccination intentions regarding COVID-19 booster vaccine. Then, the Wilcoxon rank-sum test was used to compare the scores of PMT and VH scales between different groups. Next, hierarchical multiple regressions were set up to compare the PMT scale and VH scale in predicting the intention of taking booster vaccination. Finally, multivariable logistic regression analyses were used to determine whether the constructs of PMT were associated with booster vaccination intention. After adjusting covariates, odds ratios (OR) and their 95% confidence interval (CI) were used to quantify the effects. All analyses were performed by SPSS26.0 (IBM Corporation). The alpha level was 0.05, and $p < 0.05$ was considered statistically significant.

2.4 | Ethical consideration

This study was approved by the Ethics Committee of the School of Public Health (Shenzhen), Sun Yat-sen University (Approval number: SYSU-PHS-IACUC-2021 -050).

3 | RESULTS

3.1 | Demographic characteristics

A total of 8229 qualified questionnaires were collected. Among them, 5674 participants were females (69.0%) and 2555 were males (31.0%). The participants' ages were mainly between 26 and 45 (78.5%), followed by ages between 46 and 59(11.4%). The major ethnic group was Han nationality (95.0%). In addition, 207 (2.5%) participants were medical staff, 385 (4.7%) suffered from chronic diseases, and 24 (0.3%) were self-reported cases of COVID-19 infection.

3.2 | Intention to receive COVID-19 booster vaccine

As for the intention to receive COVID-19 vaccine boosters, 6321 (76.8%) of participants in this study expressed "willing to be vaccinated," 1658

TABLE 1 Basic information of the PMT scale and VHS.

Scales and construct	Intention to receive booster vaccination			
	Willing (P$_{50}$)	Hesitant (P$_{50}$)	p	Cronbach's α
PMT scale	4.08	3.61	<0.001	0.77
Perceived severity	5.00	4.67	<0.001	0.82
Perceived susceptibility	2.00	2.00	0.047	0.93
Response efficacy	5.00	4.00	<0.001	0.87
Self-efficacy	5.00	4.00	<0.001	0.86
Response cost	3.00	3.00	<0.001	0.80
VHS	4.20	3.50	<0.001	0.86
Confidence	4.50	3.75	<0.001	0.90
Complacency	4.25	3.75	<0.001	0.66
Risk	3.00	3.00	<0.001	0.81

Abbreviations: PMT, protection motivation theory; VHS, vaccine hesitancy scale.

(20.1%) were "uncertain, but tend to be willing," 171 (2.1%) were "uncertain, but tend to be unwilling," and 79 participants (1.0%) were "unwilling to be vaccinated." Thus, in our survey, there were 6321 subjects (76.8%) who were willing to receive the booster vaccination and 1908 subjects (23.2%) who were hesitant about the booster vaccination. The male participants and health care staff were significantly more willing to receive the booster vaccination than those who were female ($p < 0.001$) and nonmedical staff ($p < 0.001$). Participants who did not feel uncomfortable after vaccination ($p < 0.001$) and had an interval of more than 6 months after last vaccination ($p < 0.001$) were more likely to accept the booster vaccination. The intention to vaccination was highest for those in junior high school or below ($p < 0.001$). In addition, those who take active attention to news about the COVID-19 pandemic at least once a day had the highest proportion of intention to accept the booster vaccination ($p < 0.001$) (Table 2).

3.3 | Contribution of PMT and VH scale in predicting the intention to receive the booster vaccine

Taking the intention of "receive the vaccine boosters" (range: 1–4) as continuous dependent variables and the average score of each construct in PMT scale as continuous independent variables, the first hierarchical regression model was established to test the relative contribution of the PMT scale in predicting intention to receive the booster COVID-19 vaccine (Table 3). Using the same dependent variable and taking the average score of each construct of VH scale as continuous independent variables, the second hierarchical regression model was established to test the relative contribution of VH scale in predicting the intention to receive the booster COVID-19 vaccine (Table 4). In those two hierarchical regression models, the first layer included six covariates: gender, age, occupation, whether have discomfort after receiving vaccines, vaccination interval, and the frequency of following COVID-19 news. The fit goodness for the first layer of both models was same, accounting for 4% of the variation in intention to receive the COVID-19 booster vaccine ($p < 0.001$). In the second regression of the first model, the overall adjusted goodness of fit for the PMT scale was 0.26 ($p < 0.001$), which means that the five constructs of the PMT can explain 26% of the variation in intention to receive the COVID-19 booster vaccine. In the second layer regression of the second model, the total adjusted goodness of fit of the VH scale was 0.22 ($p < 0.001$), which means that the three constructs of the VH scale can explain 22% of the variation in intention to receive the COVID-19 booster vaccine.

3.4 | The predicted factors to affect the booster vaccination intention

Taking the average score of each construct among all participants as the classification criteria, the scores of the participants in each construct in PMT scale were divided into "low scores" and "high scores." The score levels of five constructs were taken as the independent variables, and the "willing" or "hesitant" of the booster vaccination was taken as the dependent variable for multivariable

TABLE 2 Characteristics of various populations by intention to receive the booster vaccination.

Characteristic	Intention to receive booster vaccination		
	Willing n (%)	Hesitant n (%)	p
Gender	-	-	<0.001
Male	2046 (80.1%)	509 (19.9%)	-
Female	4275 (75.3%)	1399 (24.7%)	-
Age	-	-	<0.001
18–25	507 (66.0%)	261 (34.0%)	-
26–45	4941 (76.5%)	1518 (23.5%)	-
46–59	815 (87.2%)	120 (12.8%)	-
≥60	58 (86.6%)	9 (13.4%)	-
Ethnicity	-	-	0.419
The Han nationality	6009 (76.9%)	1805 (23.1%)	-
Other	312 (75.2%)	103 (24.8%)	-
Educational level	-	-	0.182
Junior high school or below	2095 (77.6%)	604 (22.4%)	-
High school	1829 (76.8%)	554 (23.2%)	-
Bachelor	2263 (76.5%)	695 (23.5%)	-
Master or above	134 (70.9%)	55 (29.1%)	-

Characteristic	Intention to receive booster vaccination		
	Willing n (%)	Hesitant n (%)	p
Occupation	-	-	<0.001
Health care workers	187 (90.3%)	20 (9.7%)	-
Other	6134 (76.5%)	1888 (23.5%)	-
Monthly income	-	-	0.790
≤5000RMB	3957 (76.8%)	1192 (23.2%)	-
5001–10,000RMB	1816 (77.1%)	538 (22.9%)	-
10,001–15,000RMB	345 (76.0%)	109 (24.0%)	-
≥15,001RMB	203 (74.6%)	69 (25.4%)	-
Chronic conditions[a]	-	-	0.706
No	6019 (76.7%)	1825 (23.3%)	-
Yes	302 (78.4%)	83 (21.6%)	-
Infected with COVID-19	-	-	0.833
No	6303 (76.8%)	1902 (23.2%)	-
Yes	18 (75.0%)	6 (25.0%)	-
People around infected with COVID-19	-	-	0.173
No	6078 (77.0%)	1817 (23.0%)	-
Yes	23 (76.7%)	7 (23.3%)	-
Not sure	220 (72.4%)	84 (27.6%)	-
Discomfort after vaccination	-	-	<0.001
No	4221 (78.9%)	1131 (21.1%)	-
Yes	2100 (73.0%)	777 (27.0%)	-
Interval between last vaccination	-	-	<0.001
<6 months	4096 (73.9%)	1450 (26.1%)	-
≥6 months	2225 (82.9%)	458 (17.1%)	-
Business travel frequency	-	-	0.25
Once a month	112 (82.4%)	24 (17.6%)	-
Once every 3 months	147 (73.1%)	54 (26.9%)	-
Once every 6 months	288 (75.8%)	92 (24.2%)	-
Barely	5774 (76.9%)	1739 (23.1%)	-
Plans to go abroad	-	-	0.161
No	6276 (76.8%)	1900 (23.2%)	-
Yes	45 (84.9%)	8 (15.1%)	-
Active attention to news	-	-	<0.001
Once a day	2263 (84.9%)	404 (15.1%)	-
Once a week	2667 (76.7%)	812 (23.3%)	-
Once a month	1071 (68.0%)	504 (32.0%)	-
Barely	320 (63.0%)	188 (37.0%)	-

Abbreviation: COVID-19, coronavirus disease 2019.

[a]Chronic conditions were defined as whether having a long-term medical follow-up or a long-term medication.

TABLE 3 Hierarchical regression model to test the PMT scale in COVID-19 booster vaccination intention.

| Independent variable | β | t | p | Collinearity statistics | | ΔR^2, F (x, y), p |
				Tolerance	VIF	
Block 1						
Gender (ref: male)	−0.01	−0.93	0.355	0.96	1.04	ΔR^2 = 0.05, F (x, y) = 66.15, p < 0.001
Age (ref: 18–25)	0.07	6.41	<0.001	0.96	1.04	
Occupation (ref: health care workers)	−0.03	−3.10	0.002	0.99	1.01	
Discomfort after receiving vaccine (ref: yes)	0.07	6.57	<0.001	0.97	1.03	
Interval between last vaccine (ref: <6 months)	0.08	7.25	<0.001	1.00	1.00	
Active attention to news frequency (ref: once a day)	−0.15	−13.81	<0.001	0.98	1.02	
Block 2						
Perceived severity	−0.11	−10.61	<0.001	0.86	1.16	ΔR^2 = 0.26, F (x, y) = 477.70, p < 0.001
Perceived susceptibility	0.05	4.64	<0.001	0.93	1.08	
Response efficacy	0.22	13.99	<0.001	0.38	2.65	
Self-efficacy	0.29	18.85	<0.001	0.38	2.61	
Response cost	−0.07	−6.90	<0.001	0.82	1.21	

Abbreviations: COVID-19, coronavirus disease 2019; PMT, protection motivation theory.

TABLE 4 Hierarchical regression model to test the VHS in COVID-19 booster vaccination intention.

| Independent variable | β | t | p | Collinearity statistics | | ΔR^2, F (x, y), p |
				Tolerance	VIF	
Block 1						
Gender (ref: male)	−0.01	−0.93	0.355	0.96	1.04	ΔR^2 = 0.05, F (x, y) = 66.15, p < 0.001
Age (ref: 18–25)	0.07	6.41	<0.001	0.96	1.04	
Occupation (ref: health care workers)	−0.03	−3.10	0.002	0.99	1.01	
Discomfort after receiving vaccine (ref: yes)	0.07	6.57	<0.001	0.97	1.03	
Interval between last vaccine (ref: <6 months)	0.08	7.25	<0.001	1.00	1.00	
Active attention to news frequency (ref: once a day)	−0.15	−13.81	<0.001	0.98	1.02	
Block 2						
Confidence	0.25	15.68	<0.001	0.36	2.75	ΔR^2 = 0.22, F (x, y) = 635.37, p < 0.001
Complacency	0.17	10.75	<0.001	0.37	2.68	
Risk	−0.08	−7.88	<0.001	0.84	1.20	

Abbreviations: COVID-19, coronavirus disease 2019; VHS, vaccine hesitancy scale.

logistic regression analysis. After adjusting some demographic factors, which were proved to influence people's intention in Section 3.2 (gender, age, occupation, whether have discomfort after receiving vaccines, vaccination interval, and the frequency of following COVID-19 news), the participants with higher scores of "perceived severity" (aOR = 0.69, 95% CI: 0.61–0.78) and "response cost" (aOR = 0.47, 95% CI: 0.41–0.54) were less likely to "be willing to receive the booster vaccination" than those with lower scores. On

the contrary, the participants with higher scores of "perceived susceptibility" (aOR = 1.19, 95% CI: 1.61–1.34), "response efficacy" (aOR = 2.13, 95% CI: 1.83–2.49), and "self-efficacy" (aOR = 3.33, 95% CI: 2.83–3.93) were more likely to "be willing to receive the booster vaccination" (Table 5).

4 | DISCUSSION

The VH increases the difficulty of achieving herd immunity and has a negative impact on the prevention and control of infectious diseases.[32] Although the COVID-19 pandemic has been effectively controlled in China, it remains extremely vulnerable to the imported SARS-CoV-2 transmission.[33] Therefore, it is imperative to reduce people's VH to build an immune barrier against SARS-CoV-2 infections. Understanding people's vaccination intention has become an urgent need to advance global vaccination coverage, especially in developing countries.[34] In this study, we used the modified PMT and VH scales as the measuring tools to investigate the key factors that influence the public's intention to receive the booster dose of COVID-19 vaccine. Our results demonstrated that the adults in China had a high intention to take COVID-19 booster shots, but quite a few people (23.2%) were still hesitant. These findings were consistent with other similar studies to investigate the COVID-19 booster vaccination willingness.[25,35]

PMT scale is usually used to predict the motivation of individuals towards self-protective measures. We modified the PMT scale in this study, based on people's judgment on the pandemic as the threat appraisals and people's understanding of taking booster vaccination as the coping appraisals. Of note, we found that this modified PMT scale was better to explain the differences in the participants' intention to receive the booster vaccination than that of the VH scale. In this study, our results of the PMT scale showed that coping appraisals, including response efficacy, self-efficacy, and response cost, were the key factors determining the COVID-19 booster vaccination behavior. The aOR of response efficacy and self-efficacy were 2.13 and 3.33, respectively, indicating that there was a higher intention of the booster vaccination, when participants have a higher belief in the booster vaccination and a higher confidence to take self-protective measures. In addition, the aOR value of response cost was 0.47, suggesting that the higher perception of adverse health costs with vaccination might be associated with the lower intention of the booster vaccination. Our results on the coping appraisal were consistent with a previous study on hepatitis B vaccination intention, which reported that the vulnerability, response efficacy, and self-efficacy were the determinant factors associated with the intentions.[29] As for the threat appraisals, our study showed that perceived severity and perceived susceptibility had different influence on the intention to receive the booster vaccination. A higher level of perceived susceptibility was associated with a higher intention of the booster vaccination, which is consistent with the previous study that

TABLE 5 Multivariate logistic regression to identify the constructs of PMT associated with the booster vaccination intention.

PMT variable	Intention to receive booster vaccination		aOR[a] (95% CI)	p
	Willing n (%)	Hesitant n (%)		
Perceived severity				
Low	2240 (72.7%)	840 (27.3%)	Ref	-
High	4081 (79.3%)	1068 (20.7%)	0.67 (0.59, 0.75)	<0.001
Perceived susceptibility				
Low	3945 (77.3%)	1159 (22.7%)	Ref	-
High	2376 (76.0%)	749 (24.0%)	1.19 (1.06, 1.34)	0.004
Response efficacy				
Low	2081 (60.4%)	1362 (39.6%)	Ref	-
High	4240 (88.6%)	546 (11.4%)	2.13 (1.83, 2.49)	<0.001
Self-efficacy				
Low	2445 (61.6%)	1525 (39.4%)	Ref	-
High	3876 (91.0%)	383 (9.0%)	3.33 (2.83, 3.93)	<0.001
Response cost				
Low	3455 (68.9%)	346 (31.1%)	Ref	-
High	2866 (89.2%)	1562 (10.8%)	0.47 (0.41, 0.54)	<0.001

Abbreviations: aOR, adjusted odds ratios; COVID-19, coronavirus disease 2019; PMT, protection motivation theory.

[a]aOR: Adjust the gender, age, occupation, whether feel uncomfortable after receiving vaccine, vaccination interval, and the frequency of following COVID-19 news in the multivariate logistic regression.

vaccination reduced the perceived susceptibility of COVID-19.[36] However, the aOR value of perceived severity was 0.67, suggesting that those individuals with the higher level of perceived severity had less intention to get booster vaccination. This observation seemed to be different from previous studies, which reported that the perceived severity was not significantly affected the intention to take COVID-19 vaccine,[19,20,37] and other studies reported that higher levels of perceived severity were associated with higher COVID-19 vaccination intentions.[38,39] The reason for this inconsistent observation might be that the perception of the severity of COVID-19 has been changing, likely because of the decreased pathogenicity of SARS-CoV-2 and the improved therapeutic drugs and clinical treatment.[40]

To further clarify the influencing factors, we investigated those participants who were hesitant to booster COVID-19 vaccination. Most of them (52.0%) expressed concerns about adverse events following immunization (AEFI) of booster shots, which was consistent with the results of the response cost of the PMT scale (Supporting Information: Table S2). Data from clinical trials have shown that the booster COVID-19 vaccines are safe and efficacious against SARS-CoV-2 infections.[41–44] But if more shots are needed to control COVID-19 in the future, it is worth to address how to timely inform the public about vaccine safety. Thus, the development of safety tracking system is important to better understand the safety of repeated vaccinations and timely release the information to the public, which will reduce public concerns about vaccine safety.[45]

The COVID-19 pandemic has lasted for more than 2 years, and the prevention and control of this pandemic have become a complex system in a globally connected world. Among them, VH and vaccine inequity are two major issues in the mass vaccination strategy for COVID-19 control.[46] To some extent, VH and vaccine inequity are correlated with the local level of economy, health service, and production capacity.[47] An in-depth understanding of people's attitude to booster shots would not only improve vaccination coverage in different regions but also increase incentives to expand production scale and develop a novel generation of vaccines for vaccine manufacturers, which will be helpful to reduce the social inequities and rehabilitate the social economy.

5 | STRENGTHS AND LIMITATIONS

In this study, a comprehensive analysis and comparison with a large sample size were performed for the study design and the selection of the measuring scale. To our best knowledge, this study is the first time to simultaneously use PMT and VHS to investigate booster vaccination intentions, and we found that the PMT scale was more powerful than the VH scale in explaining the results of vaccination intention. However, there are still some limitations in our study. First of all, this investigation was conducted through an online question-naire, using a snowball sampling method, and thus there might be a selection bias of sampling. For example, some people without smartphone and internet access might fail to participate in this survey. Second, it was difficult to guarantee the authenticity of the answers since we did not conduct the survey face-to-face, though we

set up quality control questions. Finally, the intention of the booster vaccination may be dynamically changed with the epidemic situation. Therefore, these findings may not fully reflect the latest intention of the Chinese population to take the COVID-19 booster vaccine.

6 | CONCLUSIONS

Overall, our study demonstrated that there was a high intention to receive the COVID-19 booster vaccine but quite a few people were still hesitant in Chinese adults. Of note, the PMT scale was powerful to study the vaccination intention. These data suggested that the PMT scale could be used not only to understand the intention of receiving the COVID-19 booster vaccine in a certain population but also to develop appropriate interventions to improve people's vaccination intention.

AUTHOR CONTRIBUTIONS

Fan Wu and Yue Yuan are joint first authors. Caijun Sun conceived and designed this project; Fan Wu, Yue Yuan, Zhaomin Deng, and Di Yin performed this project and analyzed the data; Qiufeng Shen, Jiehua Zeng, Yanhong Xie, Meifen Xu, Meiyi Yang, Shiqiang Jiang, and Chunhuan Zhang contributed the resources and discussion; Fan Wu, Yue Yuan, Zhaomin Deng, and Di Yin drafted the manuscript; Huixi Lu and Caijun Sun revised and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

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

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.