Integrating Health Behavior Theories to Predict Intention to Get a COVID-19 Vaccine

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ABSTRACT: COVID-19 vaccines are put forward as the most promising solution for combatting the COVID-19 pandemic. This study aims to assess the willingness to get vaccinated against COVID-19 by using the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) as a theoretical framework. A self-administered questionnaire was considered among Vietnamese adult patients between March and May 2021. The dependent variable was a COVID-19 vaccine acceptance, the hierarchical multivariable regression was done to assess the fit of the predictor model and the associations of variables. A total of 462 participants completed the questionnaire, with 80.5% vaccination intention. A model containing demographics, as well as HBM and TPB variables, demonstrated to be a predictor of intention to receive a COVID-19 vaccine, interpreting 39% of the variance (adjusted $R^2 = 0.39$). For HBM and TPB constructs, respondents were more likely to accept vaccination if they had higher level of cues to action, self-efficacy, and a lower level of the perceived barriers (all $P < .001$). The theoretical framework provided a predictor of intention to get a COVID-19 vaccine, which is important for elaborating intervention plans to ensure the success of conducting mass vaccination campaigns.

KEYWORDS: COVID-19 vaccine, health behavior, intention, Vietnam

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Introduction

Around the end of December 2019, the Novel Coronavirus disease 2019 (COVID-19) was first reported in China, and thereafter developed into a global pandemic in March 2020.[1] Since then, the pandemic has devastated many aspects of people's lives around the world. As of July 15th, 2021, the total number of confirmed cases surpassed 188 million and over 4.0 million deaths globally.[2] The symptoms of COVID-19 are changeable, ranging from mild to severe illness with acute respiratory distress syndrome, especially asymptomatic people who can rampantly spread the virus within the incubation period.[3] To control the pandemic, most countries focused on preventive measures such as physical distancing, wearing masks and hand hygiene. Besides, COVID-19 vaccines are put forward as the most promising solution for combatting the COVID-19 pandemic. At present, some vaccines have been used and are showing some efficacy such as Pfizer-BioNTech, Moderna, Gamaleya, Johnson & Johnson, and AstraZeneca-Oxford vaccines, which give relative risk reductions from 95% to 67%.[4] Vaccination has been shown to reduce the effects of severe illness and the risk for COVID-19 associated hospitalization in older adults.[5] From the beginning, Vietnam has lead the way with COVID-19 thanks to considerable efforts of the government on all fronts, including the health care system, security forces and economic policies, along with creative and effective communication campaigns.[6] However, new confirmed cases are still being recorded daily, including the emergence of the new variants from India and the UK.[7] Mass immunization programs were recorded previously as contributing to the control of infectious diseases such as polio, measles, pertussis, smallpox, rabies, influenza pandemic, and so on.[8] However, vaccination hesitancy, which means to delay or refuse accepting vaccination even though the vaccine is available, remains a significant roadblock in achieving optimal vaccination targets, with anti-vaccine sentiment potentially increasing because of the recent reports relating to adverse events following immunization (AEFIs) toward COVID-19 vaccine.[9,10] Therefore, it is important to understand the determinants that relate to intention to get vaccinated against COVID-19 by using health behavior theories which will help elaborate on intervention plans to promote and successfully achieve mass vaccination campaigns, which includes minimizing the waste of vaccines.[11] The Health Belief Model (HBM) has been used extensively as the theoretical framework to explain health behaviors and appropriate interventions to change behaviors such as vaccination uptake. It's interpreted that, if an individual believes that s/he has a high probability of susceptibility to an illness, and it could lead to severe consequences, and believes that the benefits greatly outweigh the barriers to vaccination (costs, time,

inconvenience, AEFIs), s/he will have an increased acceptability of vaccination uptake. Besides, individuals who receive cues to action, such as reminders or announcements, are more likely to react to recommendations.[12,13] The Theory of Planned Behavior (TPB) has successfully dealt with the complexities of the health behaviors, which are correlated to motivation factors of an individual, including the attitudes, subjective norm, perceived behavioral control (PBC), and self-efficacy.[14] Multiple confirmations in the previous studies have used the HBM and TPB as the key contributors to establish many effective interventions toward health-related behavior. The integrating of the HBM and TPB constructs accounted for 43% to 66%[15-19] and the comparison of the theories suggests that the TPB explained the variance of intention rather than the HBM, such as in receiving HPV vaccination (from 39% to 48.2% for TPB and 26% for HBM[15,20]; H1N1 vaccine (39% for TPB and 30% for HBM)[16] and swine flu (44% for TPB and 16% for HBM).[18] By contrast, Shmueli's[21] study showed that the HBM is a better predictor of intention to receive a COVID-19 vaccine rather than the TPB (45% and 35%, respectively). Therefore, this study aims to predict the intention to receive a vaccination against COVID-19 in the non-priority group which integrated the HBM and TPB models, which is important for elaborating intervention plans to ensure the success of conducting mass vaccination campaigns, in order to achieve herd immunity.

Methods

Participants and survey design

A cross-sectional survey was performed by using a convenient sample between March and May 2021. The sample size was based on the estimated rate of intention to get a COVID-19 vaccine among US adults in Guidry et al[19] study at 60% with an alpha of 5% and 95% confidence level. The minimum sample size was 369. Taking into consideration about 30% of participants incomplete the survey, the designated sample size was 528.

Data collection

All Vietnamese adult patients who visited 2 rural health centers in the south of Vietnam for health checks were recruited to partake in the study. After patients checkup their health, they were notified about the aims of the study and signed the consent form before taking part in the survey. Individuals agreed to take part in the survey would complete a self-administered questionnaire. It took approximately 10 to 15 minutes to complete each survey. Exclusion criteria included cognitive limitations or missed out on any items of the TPB and HBM scale.

Measure

The self-administered questionnaire included the following sections: (1) the demographics of participants, (2) the 12-items of the HBM scale which was calculated for validity and reliability from our preliminary study, with Cronbach's alpha of .765, which consisted of 4 items for assessing the perceived susceptibility and severity of COVID-19, 3 items for evaluating the perceived benefits of and 3 items for assessing barriers to a vaccination, and 2 items toward cues to action to receive a COVID-19 vaccine,[22] (3) the 12-items of the TPB scale that was evaluated in the previous study of Myers and Goodwin[18] composed one for assessing attitude, 5 items regarding subjective norms, 3 items toward the PBC, and 3 items about self-efficacy, and the final section for assessing the intention to get a future COVID-19 vaccine was measured by each item "If a COVID-19 vaccine is available, would you have it?". The questionnaire was then pilot-tested for clarity and simplicity by 10 persons at a health center in Dong Thap province before distributing it to the community (Appendix 1).

Statistical methods

The independent variables were classified into 3 blocks. The first block consisted of demographic variables, with the second and third blocks containing the key variables of HBM and TPB. Each item of the HBM and TPB scale was measured on a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree." While items for assessing the vaccination intention was considered as a dependent variable, participants who responded "certain," or "very likely," or "somewhat likely" were recorded as having an intention to get vaccinated, and responses of being "not likely" or "none" were defined as unwilling to get a vaccination.

Processing data and analysis were conducted using STATA 14 software. The internal consistency of each HBM and TPB scale was calculated and reported separately by Cronbach's alpha. The descriptive statistics displayed the frequencies (percentages) and mean scores (standard deviations), the mean scores for each item, and each subscale in the HBM and TPB scale were calculated separately. The Chi-square and *t*-tests were used in the univariate analysis to evaluate the association between the main outcome variable (intent to get vaccinated) and independent variables including 3 blocks.

All independent variables that have significant levels of $<.05$ were then weighed in the hierarchical multivariable logistic regression to investigate determinants of vaccine intention, that first model includes demographics and HBM variables, the second model included demographics and TPB variables, the third model contained demographics as well as HBM and TPB constructs. The goodness-of-fit for the LR model assessed by the Hosmer-Lemeshow test, the Wald statistic. Also, the Cox and Snell R^2 measure was used. Additionally, Odds ratios (OR) with 95% confidence intervals (CI) were reported to each independent variable, the *P*-value less than .05 was considered statistically significant.

Ethical considerations

All participants agreed and signed confirmation before participating in the study. The study was approved by the Ethics

Council, University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam (protocol number 27/UMP-BOARD).

Results

Characteristics of participants by intention to get vaccinated against COVID-19

Among 528 of invited eligible participants, a total of 462 subjects finished and returned questionnaire (a response rate of 87.5%), with half of the group between the ages of 18 and 39 (50.2%). The ratio between male and female respondents was 50.7% and 49.3%, most had no religion (95.8%), a high school level or higher education (65.6%), occupation of seller (46.1%), without chronic illness condition (64.3%), using health insurance (96.8%). COVID-19 information was received, predominately, via relatives and social media (87.7% and 86.4%, respectively), and 80.5% showed intent to get a COVID-19 vaccine. There was a significant difference between vaccination willingness and the characteristics of participants including religion, occupation, gross household income, and source of COVID-19 information (Table 1).

Relationship between the HBM and TPB constructs and intention to get vaccinated against COVID-19

Table 2 descriptive variables in the HBM and TPB model which showed that most of participants recorded the high mean score for the perceived susceptibility and severity (3.37 ± 0.83), perceived benefits (3.20 ± 0.69) and cues to action (4.21 ± 0.66) and all the fields in the TPB model including attitude (4.35 ± 0.71), subject norms (4.05 ± 0.61), perceived behavioral control (3.96 ± 0.71), self-efficacy (3.37 ± 0.79). By contrast, the item of perceived barriers reported a low score (2.83 ± 0.59). The Cronbach's alpha of the total HBM and TPB scale was .79 and .83, respectively.

Regarding the results of the univariate analyses between the HBM and TPB constructs and intention to receive a COVID-19 vaccine showed in Table 3. There was a significant difference between vaccination intention and the domains of HBM, including the perception of susceptibility and severity of COVID-19, barriers to vaccination, and cues to action ($P < .05$). Also, there was a significant relationship between vaccination intention and the 4 dimensions of TPB, including the attitude toward vaccination, subjective norms, PBC, and self-efficacy (all $P < .001$).

Factors associated with intention to get vaccinated a COVID-19 vaccine

Our first model, which included HBM constructs and demographics (Table 4; model 1), explained that 30% of the variance in intention to COVID-19 vaccine (adjusted $R^2 = 0.3$). The main factors of the hierarchical regression were the HBM variables, which was 27% of the described variance. The second model, which included TPB constructs and demographics (Table 4; model 2), explained 28% of the variance in intention to COVID-19 vaccine (adjusted $R^2 = 0.28$). The main factors of the hierarchical regression were the TPB variables, which was 25% of the described variance, on top of the 3% interpreted by the demographic factors.

The third model, a combination of both the HBM and TPB constructs as well as demographic variables. interpreted as 39% of the variance of intention to receive a COVID-19 vaccination. The Hosmer-Lemshow test results ($\chi^2 = 4.5$, 8 degrees of freedom, $P = .805$) indicated that the goodness of it was satisfactory, that was the fitted model can explain 39% of the variation in the dependent variable, on top of the 30% interpreted by the demographic factors and HBM variables, TPB variables added 9% to the total explained variance. Based on this model, 2 variables of demographics in the first block, including occupation and gross household income, were correlated to the intent to be vaccinated against COVID-19. Accordingly, participants who were retailers/sellers, and had high gross household income, were less intention to get vaccinated against COVID-19 compared to those who were workers and reported low gross household income (OR 0.3, 95% CI 0.09-0.68; OR 0.1 95% CI 0.02-0.39, all $P < .05$, respectively).

Regarding the domains of HBM and TPB in the third model, respondents were more likely to accept vaccination if they had a higher level of perceived susceptibility and severity (OR 4.7, 95% CI 2.76-7.95, $P < .001$), of cues to action (OR 3.0, 95% CI 1.19-7.65, $P < .05$), of subjective norms (OR 2.9, 95% CI 1.25-6.68, $P < .05$), and of self-efficacy (OR 6.6, 95% CI 3.29-13.2, $P < .001$), however, the reverse showed for the perceived barriers (OR 0.23, 95% CI 0.11-0.50, $P < .001$). The remaining domains reported no significant difference between the 2 groups of acceptance and unacceptance to receive vaccination ($P > .05$).

Discussion

This study investigated the predictors for intention to receive a COVID-19 vaccination of the non-priority group by using the HBM and TPB, along with sociodemographic. It is considered an important issue to intensify vaccine uptake in the context that the total daily COVID-19 cases are rapidly increasing around the world, especially in South-East Asia.[2] At present, vaccines are considered the key to control to arrest the pandemic, above applying current preventive measures such as social distancing, wearing masks and frequent hand washing. Our study showed that the overall intention to get a COVID-19 vaccination was relatively high (80.5%). This result is consistent with previous findings in healthcare workers and high-risk people (76.1% and 80%, respectively).[23,24] This finding was also reported in previous studies in Israeli and the United States populations.[21,25] These results indicated that a high intention to receive the COVID-19 vaccine among the general population, which is advantageous for implementing mass immunization. This is particularly important as

Table 1. Characteristics of participants by intention to get vaccinated against COVID-19 (N = 462).

VARIABLES	OVERALL N (%)	COVID-19 VACCINE INTENTION		*P*-VALUE*
		YES, N (%) 372 (80.5%)	NO, N (%) 90 (19.5%)	
Age				
18-39	232 (50.2)	187 (80.6)	45 (19.4)	
40-64	193 (41.8)	159 (82.4)	34 (17.6)	.234
65+	37 (8.0)	26 (70.3)	11 (29.7)	
Gender				
Male	234 (50.7)	189 (80.8)	45 (19.2)	.891
Female	228 (49.3)	183 (80.3)	45 (19.7)	
Religion				
Irreligion	441 (95.5)	360 (81.6)	81 (18.4)	.010#
Other	21 (4.5)	12 (57.1)	9 (42.9)	
Education				
Primary	42 (9.1)	30 (71.4)	12 (28.6)	
Secondary school	117 (25.3)	96 (82.1)	21 (17.9)	.290
High school and higher	303 (65.6)	246 (81.2)	57 (18.8)	
Occupation				
Worker/famer	162 (35.1)	141 (87.0)	21 (13.0)	
(Retailer)seller	213 (46.1)	171 (80.3)	42 (19.7)	.003
Housewives/retired	87 (18.8)	60 (68.9)	27 (31.1)	
Gross household income				
Poor, near-poor households	51 (11.0)	33 (64.7)	18 (35.3)	
Moderate	330 (71.4)	279 (84.6)	51 (15.4)	.001
High	81 (17.6)	60 (74.1)	21 (25.9)	
History of Illness				
Chronic disease	165 (35.7)	240 (80.8)	57 (19.2)	.834
No chronic disease	297 (64.3)	132 (80.0)	33 (20.0)	
Health insurance				
Yes	447 (96.8)	363 (81.2)	84 (18.8)	.088
No	15 (3.2)	9 (60.0)	6 (40.0)	
Source of COVID-19 information				
Television	264 (57.1)	186 (93.9)	12 (6.1)	<.001
Social media	399 (86.4)	327 (81.9)	72 (18.1)	.050
Relatives	405 (87.7)	324 (80.0)	81 (20.0)	.452
Website of hospital/Ministry of Health	309 (66.9)	234 (75.7)	75 (24.3)	<.001

**P*-value was calculated via Chi-square test or #Fisher's exact.

Table 2. Descriptive data for the HBM and TPB variables (N = 462).

ITEM	MEAN	SD
The Health Belief Model (Cronbach's α = .79)		
Perceived susceptibility and severity	3.37	0.83
I am at high risk of COVID-19 infection	3.31	1.21
I think I will get COVID-19 in the near future	3.13	1.22
I could be severely ill if I got COVID-19	3.49	1.02
I am afraid of even think about getting illness with COVID-19	3.54	1.00
Perceived benefits	3.20	0.69
Immunization will prevent me from contracting COVID-19	3.81	0.86
By being immunized and not getting illness, I will protect others from COVID-19	2.77	1.08
By being immunized, I feel less worried about possibility of severe illness from getting COVID-19	3.01	1.04
Perceived barriers	2.83	0.59
I am afraid that COVID-19 vaccine can cause AEFIs	3.11	1.16
COVID-19 infection can be self-limiting and unnecessary vaccination	2.17	1.08
I think that the cost of COVID-19 vaccine will be expensive	3.22	0.93
Cues to action	4.21	0.66
I think that all people should be vaccinated to promote public health	4.25	0.91
I will receive a COVID-19 vaccine if my healthcare workers recommended a vaccination	4.16	0.63
The Theory of Planned Behavior (Cronbach's α = .83)		
Attitude		
Once a recommended COVID-19 vaccine is available to the public, getting it would be good	4.35	0.71
Subject norms	4.05	0.61
My family who is important to me would approve of me getting a COVID-19 vaccination when it is available	4.29	0.76
My relatives who are important to me would approve of me getting a COVID-19 vaccination when it is available	4.27	0.71
My friends who are important to me would approve of me getting a COVID-19 vaccination when it is available	4.26	0.71
I feel under social pressure to have a COVID-19 vaccination	3.67	1.03
People who are important to me influence my decision to have a COVID-19 vaccination	3.98	0.89
Perceived behavioral *control*	3.96	0.71
The very few numbers of events outside my control that would prevent me from having a COVID-19 vaccination	3.45	1.32
It is mostly up to me whether or not I have a COVID-19 vaccination	4.21	0.75
I could control do I have over whether I do or do not have a COVID-19 vaccination	4.22	0.86
Self-efficacy	3.37	0.79
For me to have a COVID-19 vaccination, it would be easy	2.88	1.05
If I wanted to I could easily have a COVID-19 vaccination	3.54	0.95
I am certain that I could get a future COVID-19 vaccination	3.69	0.91

Vietnam currently faces a fourth wave of COVID-19 with the number of cases are increasing daily. We examined several sociodemographics that may predict a willingness to get a COVID-19 vaccination among people who were sellers and had high gross household income and it showed lower rates of vaccine intention (OR 0.3, 95% CI 0.09-0.68; OR 0.1, 95%

Table 3. Univariate analyses between variables of the HBM and TPB and the intention to get vaccinated against COVID-19 (N = 462).

	COVID-19 VACCINE INTENTION		*T*-TEST	*P*-VALUE*
	YES (N = 372)	NO (N = 90)		
The HBM model	Mean ± SD	Mean ± SD		
Perceived susceptibility and severity	3.45 ± 0.82	3.01 ± 0.76	−4.73	<.001
Perceived benefits	3.23 ± 0.70	3.09 ± 0.66	−1.71	.088
Perceived barriers	2.79 ± 0.59	3.00 ± 0.52	3.06	.002
Cues to action	4.38 ± 0.57	3.53 ± 0.59	−12.5	<.001
The TPB model				
Attitude	4.49 ± 0.56	3.80 ± 0.85	−8.99	<.001
Subjective norms	4.15 ± 0.56	3.63 ± 0.65	−7.63	<.001
Perceived behavioral control	4.07 ± 0.69	3.52 ± 0.63	−6.83	<.001
Self-efficacy	3.53 ± 0.74	2.67 ± 0.63	−10.2	<.001

**P*-value was calculated via *t*-test.

CI 0.02-0.39, all $P < .05$, respectively). These results are in line with those of previous studies that reported occupation and monthly family income influenced the intention.[23,26] A possible explanation for this is that they easily accessed more information toward COVID-19 while some recent reports mention adverse events following immunization (AEFIs) toward COVID-19 vaccine,[9,10] which may impact their intention. Besides, there still exists about 20% of respondents who are unwilling to get the vaccine. Public health campaigns need to focus on the population especially retailers or sellers who have a high income to increase the rate of vaccination uptake. Moreover, future research needs to explore the reason why people were unwilling to get a vaccine thus developing suitability guidelines, policies to enhance the coverage of immunization as soon as possible.

Regarding the integrating of the theoretical framework, the use of the HBM and TPB to help understand and obtain insight into public perceptions and behaviors during outbreaks can develop effective public health plans to counter the effect of the pandemic. The Cronbach's alpha of the total HBM and TPB scale was .79 and .83, respectively, which were considered acceptable with a value of Cronbach's $\alpha \geqslant .7$.[27] The combined use of the HBM and TPB models was able to explain 32% of the variance in the intention to receive a COVID-19 vaccination. This finding is lower than previous studies that have suggested that the integrated model explains 43% to 66% of intention to vaccinate.[15-19] A possible explanation for this might be that our studies conducted in an environment where COVID-19 cases are increasing, while vaccines are not yet available for the population, and the vaccination coverage is reported at less than 4%[2] so the Government has focused its effort to provide adequate vaccines to achieve herd immunity by the end of this year. Also, the explaining of HBM and TPB may be influenced by the sociodemographics, such as education and the local economy, which differ from other countries, that have an effect on predictors of vaccination intention. However, the results also accord with Guidry et al,[19] who showed that two models explaining only 35% of the variance in intention to get a COVID-19 vaccination under an Emergency Use Authorization. Findings can provide the basis for developing policies or guidelines to improve the coverage of the vaccine when it is available for the population. According to the HBM, the constructs accounted for 27% of vaccination intentions. This is higher than Myers and Goodwin's predicted intention to get swine flu vaccination (16%) and other previous studies about HPV vaccination (26%), but lower than the H1N1 vaccine (30%).[15,16,18] Perceived susceptibility and severity and cues to action were significant predictors of intention (OR 4.7 95% CI 2.76-7.95, OR 3.0, 95% CI 1.19-7.65, $P < .001$). Conversely, the vaccination intention group was less likely to have the perceived barriers to vaccination (OR 0.2, 95% CI 0.11-0.50, $P < .001$). These findings are in line with our previous study,[23] which suggest that a health campaign should continuously increase communication, such as reminders or announcements, toward risk and severity perception in the community, in particular people who perceive COVID-19 as being non-dangerous, decline the barriers through emphasizing the safety and effectiveness of the vaccines to enhance the rate of vaccination acceptance. Besides, TPB has successfully dealt with the complexities of the health behaviors, which

Table 4. Hierarchical multivariable logistic regression predicting the intention to get vaccinated against COVID-19 (N = 462).

VARIABLES	MODEL 1: DEMOGRAPHIC AND HBM MODEL			MODEL 2: DEMOGRAPHIC AND TPB MODEL			MODEL 3: DEMOGRAPHIC, HBM AND TPB		
	R^2	OR (95% CI)	*P*-VALUE	R^2	OR (95% CI)	*P*-VALUE	R^2	OR (95% CI)	*P*-VALUE
Block 1: demographic	0.03			0.03			0.03		
Religion (No)		0.81 (0.26-2.54)	.723		0.5 (0.13-1.67)	.246		0.3 (0.07-1.12)	.072
Occupation									
Worker		1			1			1	
Seller(retailer)		0.5 (0.22-1.02)	.055		0.42 (0.19-0.92)	.031		0.3 (0.09-0.68)	.007
Retired/housewife		0.5 (0.19-1.15)	.097		0.9 (0.38-2.22)	.864		0.7 (0.26-1.99)	.518
Gross household income									
Poor, near-poor households		1			1			1	
Moderate		1.4 (0.54-3.43)	.515		0.9 (0.39-2.54)	.995		0.6 (0.18-1.85)	.351
High		0.5 (0.15-1.33)	.147		0.2 (0.06-0.76)	.016		0.1 (0.02-0.39)	.002
Block 2: HBM	0.30						0.30		
Perceived susceptibility and severity		2.3 (1.59-3.34)	.000					4.7 (2.76-7.95)	.000
Perceived benefits		1.8 (1.06-3.11)	.030					1.01 (0.56-1.98)	.994
Perceived barriers		0.5 (0.24-0.84)	.012					0.23 (0.11-0.50)	.000
Cues to action		8.5 (4.99-14.5)	.000					3.0 (1.19-7.65)	.020
Block 3: TPB				0.28			0.39		
Attitude					2.5 (1.48-4.19)	.001		1.8 (0.89-3.65)	.099
Subjective norms					3.1 (1.54-6.19)	.002		2.9 (1.25-6.68)	.013
Perceived behavioral control					2.3 (1.39-3.80)	.001		2.1 (0.99-4.34)	.052
Self-efficacy					3.3 (2.01-5.48)	.000		6.6 (3.29-13.2)	.000
Overall model evaluation	χ^2	*df*	*P*-Value	χ^2	*df*	*P*-Value	χ^2	*df*	*P*-Value
Wald test	50.5	7	.000	45.4	7	.000	81.7	11	.000
Hosmer and Lemeshow test goodness of fit test	39.7	8	.000	28.9	8	.0003	4.5	8	.805

Model 1: $R^2 = 0.30$ (Cox and Snell); Model 2: $R^2 = 0.28$ (Cox and Snell); Model 3: $R^2 = 0.39$ (Cox and Snell).

explains 25% of the variance in this study, with the 4 dimensions of TPB including the attitude toward vaccination, subjective norms, PBC, and self-efficacy, which were all associated with the intention (all $P < .05$). In the integrated model, higher rates of vaccination intention were reported if they had a higher level of self-efficacy and subjective norms (OR 6.6, 95% CI 3.29-13.2, OR 2.9 95% CI 1.25-6.68, all $P < .05$). This finding was also reported by Shmueli[21] and Myers and

Goodwin.[18] This suggests that people confident in their ability to receive the vaccines, as well as accessing information toward COVID-19 and subjective norms such as families, friends and relatives. Therefore, intervention should encourage individuals to update information and share their positive thoughts and experience with others, which contributes to controlling the pandemic in Vietnam.

The limitation of this study is the convenience sample, which is not used to represent the nations position. However, this study has investigated the rate of vaccination intention in the fourth wave of this pandemic in Vietnam and integrating theoretical frameworks that might explain vaccination hesitancy and aimed at finding some predictors that could help guide efforts to improve vaccine uptake when the vaccine becomes available across the community.

Conclusions

The theoretical framework provided a predictor of intention to get a COVID-19 vaccine, which is important for elaborating intervention plans to ensure the success of conducting mass vaccination campaigns.

Author Note

Binh Duong Uyen Pham is also affiliated to Graduate School of Medicine, International University of Health and Welfare, Japan.

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Author contributions

All authors substantially contributed to drafting and revising the article, as well as the final approval of the version to be submitted. Giao Huynh, An Le Pham, and Han Thi Ngoc Nguyen contributed to the conception and design of the study and acquisition of the data. Quynh Ho Ngoc Huynh and Hop Thi Bich Dang, Binh Duong Uyen Pham conducted the data analysis and Giao Huynh, Binh Duong Uyen Pham, and Han Thi Ngoc Nguyen were the contributors to the interpretation of the data.

Data Sharing Statement

Available upon request to the first author.

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Appendix 1: integrating health behavior theories to predict intention to get a COVID-19 vaccine

Please note that we are asking you to choose a correct or write a text with each item.

Personal Information

1. Gender: ☐ Male ☐ Female
2. Age: ☐ years old
3. Religion: ☐ Yes ☐ No
4. Education:
   ☐ Primary ☐ Secondary school
   ☐ High school and higher
5. Occupation: ☐ Worker/Famer
   ☐ (Retailer)Seller ☐ Housewives/Retired
6. Gross household income: ☐ Poor, near-poor households
   ☐ Moderate ☐ High
7. History of chronic illness: ☐ Yes ☐ No
8. Health insurance: ☐ Yes ☐ No
9. Source of COVID-19 information (*you can choose many options*)
   ☐ Social media ☐ Websites of hospital/ Health ministry/WHO
   ☐ Television ☐ Relatives
   ☐ Other:

The Health Belief Model (12-questions)

Perceived susceptibility and severity

10. I am at high risk of COVID-19 infection
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
11. I think I will get COVID-19 in the near future
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
12. I could be severely ill if I got COVID-19
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
13. I am afraid of even think about getting illness with COVID-19
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree

Perceived benefits

14. Immunization will prevent me from contracting COVID-19
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
15. By being immunized and not getting illness, I will protect others from COVID-19
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
16. By being immunized, I feel less worried about possibility of severe illness from getting COVID-19
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree

Perceived barriers

17. I am afraid that COVID-19 vaccine can cause AEFIs
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
18. COVID-19 infection can be self-limiting and unnecessary vaccination
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
19. I think that the cost of COVID-19 vaccine will be expensive
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree

Cues to action

20. I think that all people should be vaccinated to promote public health
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree
21. I will receive a COVID-19 vaccine if my healthcare workers recommended a vaccination
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree

The theory of planned behavior

Attitude

22. Once a recommended COVID-19 vaccine is available to the public, getting it would be good
    ☐ Strongly disagree ☐ disagree
    ☐ Neither agree nor disagree
    ☐ Agree ☐ Strongly agree

Subject norms

23. My relatives who are important to me would approve of me getting a COVID-19 vaccination when it is available?
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

24. My family who is important to me would approve of me getting a COVID-19 vaccination when it is available?
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

25. My friends who are important to me would approve of me getting a COVID-19 vaccination when it is available?
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

26. I feel under social pressure to have a COVID-19 flu vaccination
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

27. People who are important to me influence my decision to have a COVID-19 vaccination
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

Perceived behavioral control

28. The very few numbers of events outside my control that would prevent me from having a COVID-19 vaccination
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

29. It is mostly up to me whether or not I have a COVID-19 vaccination
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

30. I could control do I have over whether I do or do not have a COVID-19 vaccination
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

Self-efficacy

31. For me to have a COVID-19 vaccination, it would be easy
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

32. If I wanted to I could easily have a COVID-19 vaccination
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

33. I am certain that I could get a future COVID-19 vaccination
☐ Strongly disagree ☐ disagree
☐ Neither agree nor disagree
☐ Agree ☐ Strongly agree

Intention to get a COVID-19 vaccine

34. Will you intend to get a COVID-19 vaccination when it becomes available?
☐ Certain
☐ Very likely
☐ Somewhat likely
☐ Not likely
☐ None