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## RESEARCH

## Knowledge about COVID-19 vaccine and vaccination in Vietnam: A population survey

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## ABSTRACT

**Background:** Coronavirus disease 2019 (COVID-19) vaccine acceptance is essential in controlling the virus. Vaccine knowledge influences vaccine acceptance and understanding this is vital in planning immunization strategies.

**Objectives:** This study aimed to examine the public COVID-19 vaccine knowledge levels and predictors of low knowledge levels in Vietnam.

**Methods:** A cross-sectional, community-based survey was conducted between April 16 and July 16, 2021. To examine the community knowledge levels regarding the vaccine essentialness and efficacy, a self-administered questionnaire was developed and comprised 7 questions with 5 Likert scale responses corresponding to the levels of agreement or disagreement with the provided statements and scores ranging from 0 to 4. An individual's knowledge score above the mean score of all participants was defined as "acceptable" and that below was defined as "low."

**Results:** Among 1708 respondents, the mean age was  $34.3 \pm 13.4$  years, 942 (55.2%) were females, and 797 (46.7%) had acceptable knowledge levels. Age (adjusted odds ratio [AOR] 0.984 [95% CI 0.972–0.995],  $P = 0.005$ ) and being vaccinated against COVID-19 (0.653 [0.431–0.991],  $P = 0.045$ ) were inversely associated with lower knowledge levels. Those with a Gapminder income of \$8 to < \$15 per day (1.613 [1.117–2.329],  $P = 0.001$ ), \$2 to < \$8 (2.093 [1.313–3.335],  $P = 0.002$ ), and < \$2 (3.341 [1.951–5.722],  $P < 0.001$ ), less than a high school education (4.214 [1.616–10.988],  $P = 0.003$ ), and nonclinical professionals and nonhealth lecturers (1.83 [1.146–2.922],  $P = 0.01$ ) were positively associated with lower knowledge levels.

**Conclusion:** To ensure a successful vaccine rollout, it is crucial to improve community knowledge about vaccine essentialness and efficacy. Those who are at young age, who have low income or education levels, and working in nonclinical and nonhealth education fields should be the target of the intervention programs. Community education programs may benefit from using those who have been immunized as role models.

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## Background

The coronavirus disease 2019 (COVID-19) pandemic has caused enormous economic hardship, morbidity, and mortality.<sup>1</sup> Preventive measures including quarantine and social distancing, regular hand hygiene, and use of face masks in public have been implemented worldwide.<sup>2–5</sup> However, these efforts alone have proven insufficient to completely control viral transmission and hospitalizations owing to COVID-19.<sup>4</sup> Vaccination remains one of the most effective measures in the fight against infectious diseases.<sup>1</sup> In the context of COVID-19, in addition to other control measures, vaccination plays an

**Key Points****Background:**

- Vaccines play an important role in paving the way for controlling the coronavirus disease 2019 (COVID-19) pandemic.
- Vaccine uptake is complex and multifactorial.
- COVID-19 vaccine knowledge influences vaccine acceptance.

**Findings:**

- The study identifies people whose vaccine knowledge is low.
- It is crucial to improve the knowledge about vaccine essentialness and efficacy in the community.
- The target of the community education programs should be those who are at young age, who have low income or education levels, and working in nonclinical and nonhealth education fields.

important role in paving the way to eliminate COVID-19.<sup>6</sup> Hence, development of a safe and effective COVID-19 immunization is the long-term solution toward averting the pandemic for most countries.<sup>7</sup> However, the availability of a vaccine does not guarantee sufficient population vaccination coverage.<sup>8</sup> Like other vaccine preventable diseases, uptake of COVID-19 vaccine is multifactorial and includes the knowledge about the vaccine.<sup>9–11</sup> Giving people information or education to assist them in making informed decisions about their health is an important part of all patient-centered health systems.<sup>10</sup> Given that COVID-19 vaccines are being used, identifying those in most need of this information is crucial to improving vaccine uptake and ensuring equity within health systems.<sup>10,12</sup> General knowledge about COVID-19 vaccines is highly variable with surveys reporting “correct answers” between 26% and 86% in Ethiopia, Jordan, Oman, Bangladesh, India, Libya, and Italy.<sup>9,12–17</sup> COVID-19 vaccine knowledge is associated with age, income and education levels, medical-related professions, and COVID-19 immunization status; however, these may also be context dependent.<sup>14,16,17</sup>

Despite the successful control of the first wave of COVID-19, Vietnam has experienced ongoing domestic outbreaks.<sup>5,18</sup> Like other countries, large-scale COVID-19 vaccine coverage is among the most important control strategies in Vietnam.<sup>19</sup> In Vietnam, studies suggest that uptake of vaccines that are not included in the National Expanded Program on Immunization such as influenza vaccine is suboptimal even among health professionals.<sup>20,21</sup> In addition, concern over adverse events has led to large reductions in the coverage of vaccines such as hepatitis B vaccine in recent years.<sup>22</sup> However, the public COVID-19 vaccine knowledge remains unknown in Vietnam.

**Objectives**

The objective of this study was to examine the general community's COVID-19 vaccine knowledge and associated predictors in Vietnam. This study was important because it

will assist Vietnam and comparable countries in guiding interventional measures aimed at building and maintaining community's receptiveness of COVID-19 vaccine.

**Methods***Study context*

Vietnam has experienced the fourth COVID-19 wave starting on April 27, 2021.<sup>23</sup> This is considered the first “real wave” with 40,609 cumulative incident cases being reported in more than half of cities (52.4%, 33 of 63) across Vietnam as of the end of the study period.<sup>23</sup> Of these affected areas, Ho Chi Minh City—one of the 2 research sites for the paper-based survey—was hit hard by the outbreak with 23,913 cumulative incident cases (58.9%).<sup>23,24</sup> Considering this situation, we were able to examine the public COVID-19 vaccine knowledge in the context of an ongoing severe COVID-19 outbreak. During this time, the AstraZeneca/Oxford COVID-19 vaccine was available to priority groups including frontline health care workers and those working in COVID-19 prevention and control. A few fatal cases related to COVID-19 vaccine were reported.<sup>25,26</sup> Vietnam has started its largest-ever COVID-19 vaccination campaign since July 10, 2021.<sup>27</sup>

*Study design*

A cross-sectional, anonymous survey using a self-administered questionnaire was conducted across Vietnam between April 16, 2021, and July 16, 2021. The questionnaire was administered by 2 different data collection methods including online and paper-based questionnaires. The paid SurveyMonkey platform ([www.surveymonkey.com](http://www.surveymonkey.com)) was used for the online component of the survey given favorable characteristics of SurveyMonkey including easier access, avoidance of input and data coding errors, and faster distribution.<sup>28</sup> Participants were asked to read the online participant information sheet and consent form and answer a yes-no question to confirm their willingness to participate voluntarily in the survey. After answering this question, participants were directed to complete the online questionnaire. This informed consent procedure is validated elsewhere.<sup>29</sup> In the paper-based survey, participants were asked to read a hard copy of the participant information sheet and complete a written informed consent form and a hard copy of the questionnaire. Only participants who fully understood and agreed to participate in the study were enrolled in the study. Vietnamese people aged 18 years and older who were able to read and answer the survey were eligible to participate in the study. After the survey, information on the year of birth of participants was used to cross-check their age. Data of those participants aged younger than 18 years were excluded from the analysis. At the end of the data collection period, to prevent duplicate entries obtained from the online survey, entries submitted from the same Internet protocol address were separately reviewed by the researchers (M.C.D. and H.T.N.) and included in the analysis once consensus was reached. The study was approved by the Phenikaa University Ethics Committee (reference 216/QĐ-ĐHP-KHCN).

To recruit both online and paper-based participants, a snowball sampling technique was used, using the authors'

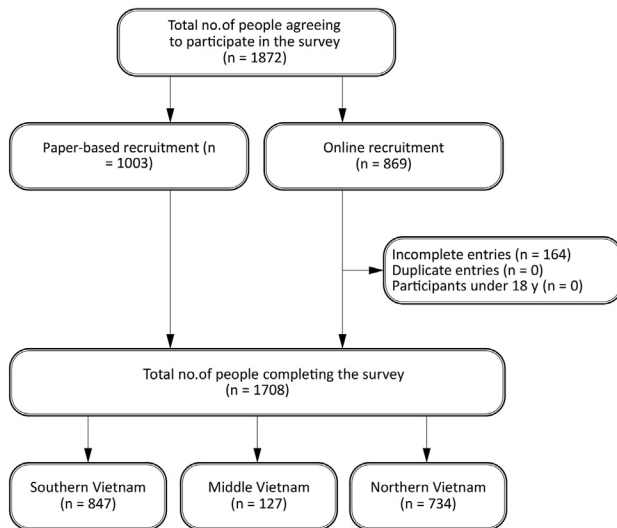


Figure 1. Flowchart of study participants.

current social networks including family members, friends, and colleagues in Vietnam who were health professionals, university lecturers, students, and people in the general community. Essentially, this method is a chain-referral sampling where existing participants recruit future participants from among their acquaintances.<sup>30</sup> A recruitment poster together with the survey link was e-mailed to the authors' social networks and posted to their accounts on LinkedIn, Zalo, and Facebook, which are the most common social media applications in Vietnam. A request to disseminate the poster and the survey link to the recipients' social networks was also included in the poster so that online responses could be from across Vietnam. The paper-based survey was conducted in Ho Chi Minh City, which is the largest city and located in southern Vietnam, and Hanoi, which is the capital and located in northern Vietnam. The rationale for selecting these cities as research sites was that these cities are the 2 largest cities and the main destinations of internal migration in Vietnam.<sup>31</sup> Therefore, selecting these research sites would enable us to have study participants from different socioeconomic backgrounds and regions in Vietnam. Paper-based participants may opt to complete the online survey, if they had an Internet-enabled device or Internet connection.

A self-administered questionnaire was designed specifically to be completed by respondents without intervention of the researchers and comprised 2 parts: demographics and COVID-19 vaccine knowledge. Demographic variables included year of birth, gender, region of current residence (southern, northern and middle Vietnam as per administrative division),<sup>32</sup> household composition (living alone, with family or with friends), education levels, jobs, income categorized based on the Gapminder Institute income levels,<sup>33</sup> chronic health conditions (having chronic communicable or non-communicable diseases), being vaccinated against COVID-19, and COVID-19 disease experience (acquiring COVID-19 or having family members or friends/colleagues acquiring COVID-19) (Appendix 1). The vaccine knowledge section focused on the essentialness and efficacy of COVID-19 vaccine and vaccination including the ability to protect the community

through herd immunity. This section included 7 Likert scale questions with 5 options corresponding to the levels of agreement or disagreement with the provided statements and scores ranging from 0 to 4. The scores were evenly distributed for 7 categories without any leading questions. Therefore, the total maximum knowledge score was 28. These 7 questions were developed based on the available literature about COVID-19 vaccines and information from the manufacturers, World Health Organization (WHO), and Vietnam Ministry of Health.<sup>24,27,34-40</sup> Pilot online and paper-based surveys were conducted and included 100 individuals (i.e., 50 participants each) from different backgrounds to help refine the final survey and confirm its validity and reliability.<sup>41</sup> To ensure study participants' understanding of the questionnaire, the online and paper-based surveys used a questionnaire that was written in Vietnamese. Contact details of the researchers (M.C.D. and H.T.N.) were provided so that study participants could contact for assistance.

### Statistical analysis

Data were analyzed using the SPSS version 26 (IBM Corp, Armonk, NY). Continuous variables were displayed as mean  $\pm$  1 SD and range. Categorical variables were presented as a count and percentage. Study participants' vaccine knowledge levels were defined in relation to the mean score achieved by all participants. Scores above the mean were defined as "acceptable" and those below were defined as "low." This analysis approach has been validated elsewhere.<sup>18</sup> Chi-square test and chi-square test for trend were used to compare categorical data. *t* test was used to compare continuous data. A binary logistic regression model was developed to examine predictors of a low vaccine knowledge. All independent variables were entered into the model. Alpha was set at 5% level.

### Maintenance of study standard

The online survey was a part of this study. Like the online survey, the paper-based survey used the snowball sampling technique to recruit participants. Therefore, to increase the study's transparency and possibilities for interpreting the results, this paper was reported in accordance with the recommended Checklist for Reporting Results of Internet E-Surveys<sup>42,43</sup> and the Strengthening the Reporting of Observational Studies in Epidemiology Statement guidelines for reporting observational studies.<sup>44</sup>

## Results

### Baseline characteristics

A total of 1872 people including 1003 paper-based (53.6%) and 869 online participants (46.4%) agreed to participate in the study (Figure 1). Of these 1872 people, 164 online participants (8.8%) had missing answers and were removed from the analysis. Therefore, 1708 (91.2%) people were included in the study. The mean age of all participants was  $34.3 \pm 13.4$  years (Table 1). Female participants accounted for 55.2% (942 of 1708). Just less than half of participants (49.6%, 847 of 1708) was from southern Vietnam, more than two-thirds (69.3%, 1184 of 1708) earned less than \$15 per day, and 74.5% (1272 of

**Table 1**  
Baseline characteristics of study participants (N = 1708)

Characteristics	Summary statistics <sup>a</sup>
Age (y)	34.3 ± 13.4 (18–80)
Age groups (y)	
≤ 20	379 (22.2)
21–40	818 (47.9)
41–60	430 (25.2)
≥ 61	81 (4.7)
Female	942 (55.2)
Region of current residence	
Northern Vietnam	734 (43)
Middle of Vietnam	127 (7.4)
Southern Vietnam	847 (49.6)
Gapminder income levels (US\$ per day)	
< 2	348 (20.4)
2 to < 8	253 (14.8)
8 to < 15	583 (34.1)
15–32	343 (20.1)
≥ 32	181 (10.6)
Household composition	
Alone	135 (7.9)
With family	1272 (74.5)
With friends	301 (17.6)
Education levels	
< high school	29 (1.7)
High school	140 (8.2)
College	140 (8.2)
≥ Undergraduate level	1399 (81.9)
Jobs	
Health students	126 (7.4)
Nonhealth students	378 (22.1)
Working in nonhealth-related fields	856 (50.1)
Clinical doctors and/or health lecturers	152 (8.9)
Working in other health-related fields	196 (11.5)
Chronic health conditions <sup>b</sup>	222 (13)
Experiences with COVID-19 disease <sup>c</sup>	48 (2.8)
Vaccinated against COVID-19	129 (7.6)

Abbreviation used: COVID-19, coronavirus disease 2019.

<sup>a</sup> Mean ± SD (minimum–maximum) for continuous variables and n (%) for categorical variables.

<sup>b</sup> Chronic communicable and/or noncommunicable diseases.

<sup>c</sup> Acquiring COVID-19 and/or having family members or friends/colleagues acquiring COVID-19.

1708) lived with their family. Most participants (81.9%, 1399 of 1708) had an undergraduate or a postgraduate degree, and 72.2% (1234 of 1708) were students of nonhealth-related subjects or people working in nonhealth-related fields. Only 222 participants (13%) had chronic health conditions, 48 (2.8%) had experiences with COVID-19 disease, and 129 (7.6%) were vaccinated.

#### COVID-19 vaccine knowledge score

Given that the maximum number of points awarded for correct answers of each of 7 knowledge questions was 4, the percentage of participants who got 4 points for each question ranged from 2.2% to 41.6% (Appendix 2). Only 2.2% (38 of 1708) strongly disagreed that they are completely protected against COVID-19 and 36.4% (621 of 1708) strongly disagreed that they do not need to undertake any other preventive measures after they fully complete the vaccination schedule. Less than one-third strongly agreed that being vaccinated themselves contributes to the protection of the community against COVID-19 (30.3%, 518 of 1708) and getting vaccinated is a good way to

**Table 2**  
COVID-19 vaccine knowledge score of study participants (N = 1708)

Characteristics	Summary statistics <sup>a</sup>
Knowledge score (points)	19.2 ± 2.8 (11–28)
Score groups	
≤ 14	134 (7.8)
15–19	777 (45.5)
20–24	768 (45.0)
≥ 25	29 (1.7)
Knowledge levels	
Low	911 (53.3)
Acceptable	797 (46.7)

Abbreviation used: COVID-19, coronavirus disease 2019.

<sup>a</sup> Mean ± SD (minimum–maximum) for continuous variables and n (%) for categorical variables.

protect oneself from COVID-19 (20.6%, 352 of 1708). Less than half (41.6%, 710 of 1708) strongly disagreed that they do not need to get vaccinated because the outbreak was controlled very well in Vietnam. Less than one-fifth strongly agreed that vaccines developed by different manufacturers have different levels of efficacy (17.1%, 292 of 1708), and the available vaccines may not be effective on new variants compared with the original strain detected in Wuhan (12.8%, 219 of 1708).

The mean knowledge score of all participants was 19.2 ± 2.8 (Table 2). Hence, a score at least 20 indicated an acceptable level of COVID-19 vaccine knowledge and accounted for 46.7% of study participants (797 of 1708). In large cities in northern Vietnam, the proportion of participants having a low knowledge level was 59.6% (31 of 52) in Bac Ninh, 59.4% (231 of 389) in Hanoi, and 58.1% (25 of 43) in Nghe An, whereas that of the middle of Vietnam was 56.7% (72 of 127) (Appendix 3). In southern Vietnam, this proportion was 80% (44 of 55) in Tien Giang, 43.5% (254 of 548) in Ho Chi Minh City, and 43.4% (53 of 122) in Can Tho.

#### Predictors of a low level of vaccine knowledge

A low knowledge level was significantly associated with age, gender, region, Gapminder income levels and jobs ( $P < 0.001$ ), and education levels ( $P = 0.035$ ) (Table 3). There was no statistically significant association between knowledge level and household composition, chronic health conditions, experiences with COVID-19 disease, and being vaccinated ( $P > 0.05$ ).

#### Model for predicting a low level of vaccine knowledge

Age (adjusted odds ratio [AOR] 0.984 [95% CI 0.972–0.995],  $P = 0.005$ ) and being vaccinated (0.653 [0.431–0.991],  $P = 0.045$ ) were negatively associated with a low knowledge level (Table 4). Having a Gapminder income of \$8 to < \$15 per day (1.613 [1.117–2.329],  $P = 0.001$ ), \$2 to < \$8 (2.093 [1.313–3.335],  $P = 0.002$ ), and < \$2 (3.341 [1.951–5.722],  $P < 0.001$ ) corresponded with higher odds of having a low knowledge level compared with those whose Gapminder income was \$32 or more per day. Having an education level of less than high school was positively associated with a low knowledge level compared with those whose education levels was undergraduate or above (4.214 [1.616–10.988],  $P = 0.003$ ). Working in other health-related fields was positively associated with a low knowledge level compared with those who

**Table 3**  
Unadjusted predictors tested for a low level of COVID-19 vaccine knowledge among study participants (N = 1708)

Predictors	COVID-19 knowledge levels <sup>a</sup>		P value OR (95% CI)
	Poor (n = 911)	Acceptable (n = 797)	
Age (y)	32.6 ± 12.9	36.2 ± 13.7	< 0.001 <sup>b</sup>
Female	526 (57.7)	416 (52.2)	0.02 <sup>b</sup> 1.25 (1.03–1.52)
Region			
Northern Vietnam	435 (47.8)	299 (37.5)	< 0.001 <sup>c</sup>
Middle Vietnam	72 (7.9)	55 (6.9)	
Southern Vietnam	404 (44.3)	443 (55.6)	
Gapminder income levels (US\$ per day)			
< 2	238 (26.1)	110 (13.8)	< 0.001 <sup>d</sup>
2 to < 8	155 (17.0)	98 (12.3)	
8 to < 15	297 (32.6)	286 (35.9)	
15–32	154 (16.9)	189 (23.7)	
≥ 32	67 (7.4)	114 (14.3)	
Household composition			
Alone	64 (7.0)	71 (8.9)	0.133 <sup>c</sup>
With family	674 (74.0)	598 (75.0)	
With friends	173 (19.0)	128 (16.1)	
Education levels			
< high school	23 (2.5)	6 (0.8)	< 0.035 <sup>d</sup>
High school	70 (7.7)	70 (8.8)	
College	76 (8.3)	64 (8.0)	
≥ Undergraduate level	742 (81.5)	657 (82.4)	
Jobs			
Health students	93 (10.2)	33 (4.1)	< 0.001 <sup>c</sup>
Nonhealth students	222 (24.4)	156 (19.6)	
Working in nonhealth-related fields	405 (44.4)	451 (56.6)	
Clinical doctors and/or health lecturers	68 (7.5)	84 (10.5)	
Working in other health-related fields	123 (13.5)	73 (9.2)	
Chronic health conditions <sup>e</sup>	113 (12.4)	109 (13.7)	0.471 <sup>c</sup>
Experiences with COVID-19 disease <sup>f</sup>	24 (2.6)	24 (3.0)	0.662 <sup>c</sup>
Vaccinated against COVID-19	63 (6.9)	66 (8.3)	0.313 <sup>c</sup>

Abbreviations used: COVID-19, coronavirus disease 2019; OR, odds ratio.

<sup>a</sup> Mean ± SD for continuous variables and number (%) for categorical variables.

<sup>b</sup> *t* test.

<sup>c</sup> Chi-square test.

<sup>d</sup> Chi-square test for trend.

<sup>e</sup> Chronic communicable and/or noncommunicable diseases.

<sup>f</sup> Acquiring COVID-19 and/or having family members or friends/colleagues acquiring COVID-19.

worked as clinical doctors or health lecturers (1.83 [1.146–2.922], *P* = 0.01).

## Discussion

Although there are similar studies conducted in other countries,<sup>9,12–15</sup> there was no study in Vietnam. To the best of our knowledge, this is the first study examining the level of COVID-19 vaccine knowledge in the general community in Vietnam. Our study identifies priority groups for intervention. The study also allowed us to get insight into the vaccine knowledge levels of different health professional groups who are central to vaccination education and role models, particularly those who are not clinical doctors such as nurses and pharmacists.

The study included 1708 selected individuals across Vietnam, including large cities and those with a high COVID-19 burden. The distribution of our participants by region of residence was skewed to southern Vietnam (49.6%) provided that this region accounts for 36% of the total population in Vietnam.<sup>45</sup> This may also explain the low number of participants experiencing COVID disease in our study given that the fourth

COVID-19 wave started in northern Vietnam. The number of participants getting vaccinated was low because the vaccine was exclusively available to frontline health care workers during the study period. Participants aged between 21 and 60 years and female gender were predominant in our study, which were comparable with the age and gender distributions in Vietnam.<sup>45</sup> Given that the average income per day in Vietnam is \$9.8,<sup>46</sup> more than two-thirds of our participants (69.3%) earned less than \$15 per day.

We found that more than half of participants (53.3%) had low vaccine knowledge levels. Given the mean knowledge score of 19.2 achieved by all participants, high proportions of participants having low knowledge levels, defined as their knowledge scores lower than this mean score, were documented in large cities across Vietnam. Our overall rate of low vaccine knowledge was comparable with that reported in community surveys conducted in India and Jordan.<sup>15,16</sup> However, our proportion was higher than that reported in Bangladesh (43%, 713 of 1658) and Ethiopia (26%, 128 of 492).<sup>9,14</sup> Although the questionnaires used in these studies were not the same, all questionnaires aim to explore essential aspects of COVID-19 vaccine knowledge including the vaccine

**Table 4**  
Binary logistic regression analysis for predictors of a low level of COVID-19 vaccine knowledge among study participants (N = 1708)

Predictors	P	Adjusted OR (95% CI)
Age (y)	0.005	0.984 (0.972–0.995)
Female	0.518	0.933 (0.756–1.151)
Region		
Northern Vietnam	0.725	0.928 (0.613–1.405)
Southern Vietnam	0.318	0.812 (0.54–1.221)
Middle Vietnam <sup>a</sup>		
Gapminder income levels (US per day)		
< 2	0.000	3.341 (1.951–5.722)
2 to < 8	0.002	2.093 (1.313–3.335)
8 to < 15	0.011	1.613 (1.117–2.329)
15–32	0.258	1.248 (0.85–1.833)
≥ 32 <sup>a</sup>		
Household composition		
Alone	0.441	0.839 (0.538–1.31)
With family	0.245	1.189 (0.888–1.591)
With friends <sup>a</sup>		
Education levels		
< High school	0.003	4.214 (1.616–10.988)
High school	0.975	1.006 (0.684–1.481)
College	0.515	1.133 (0.779–1.648)
≥ Undergraduate level <sup>a</sup>		
Jobs		
Health students	0.34	1.345 (0.732–2.471)
Nonhealth students	0.09	0.644 (0.387–1.072)
Working in nonhealth-related fields	0.921	0.981 (0.671–1.434)
Working in other health-related fields	0.01	1.83 (1.146–2.922)
Chronic health conditions <sup>b</sup>	0.27	1.207 (0.864–1.686)
Experiences with COVID-19 disease <sup>c</sup>	0.641	1.157 (0.628–2.13)
Vaccinated against COVID-19	0.045	0.653 (0.431–0.991)

Abbreviations used: COVID-19, coronavirus disease 2019; OR, odds ratio.

<sup>a</sup> Reference group.

<sup>b</sup> Chronic communicable and/or noncommunicable diseases.

<sup>c</sup> Acquiring COVID-19 and/or having family members or friends/colleagues acquiring COVID-19.

availability, essentialness, eligibility, efficacy, and adverse effects, all of which play a role in facilitating the community's vaccine confidence and acceptance.<sup>9,47</sup> In Vietnam, our finding regarding the proportion of people having low vaccine knowledge levels was inconsistent with studies examining the levels of knowledge toward COVID-19 disease and associated nonvaccine prevention and control measures. In detail, acceptable knowledge levels toward COVID-19 disease and associated nonvaccine prevention and control measures were documented in both the general community and specific groups including pharmacists and university students.<sup>5,18,48–50</sup>

We found that young age, low income, and education levels were associated with low vaccine knowledge levels. Our findings were consistent with previous studies in other countries.<sup>14,16</sup> It has been documented that young age, low income, and education levels are significantly related to low levels of health knowledge in general probably because these groups are less likely to have heard of the health information.<sup>51</sup> In contrast, people with high education levels are more knowledgeable and concerned about their health and life events that could affect them, such as COVID-19 vaccinations, through access to more sources of health information.<sup>14</sup> In line

with another study, we found that being vaccinated against COVID-19 was associated with a good vaccine knowledge level.<sup>17</sup> It is documented that health care workers who are willing to be COVID-19 vaccinated serve as an important role model function for the public.<sup>52,53</sup> It has also been found that the public vaccine acceptance is influenced by their peers and social networks.<sup>54</sup> Considering our finding of a positive association between being vaccinated against COVID-19 and acceptable vaccine knowledge levels, we believe that, regardless of the professions, people who are vaccinated can present role models for the community. Future research is needed to examine how the community education programs using these role models could effectively approach different population groups.

In our study, participants working in health-related fields rather than clinical doctors and health lecturers such as nurses and pharmacists were more likely to have lower knowledge levels compared with clinical doctors and health lecturers. To the best of our knowledge, there is no study examining the levels of COVID-19 vaccine knowledge among different health professional groups in Vietnam. However, a study conducted on Vietnamese health students found a difference in the levels of COVID-19 vaccine acceptance by their specialist fields with more public health students but less preventive medicine students accepting the vaccine compared with general medicine students although the differences in levels of vaccine knowledge between these students were not examined.<sup>55</sup> Similarly, a study in the United States found that direct medical care providers had higher vaccine acceptance (49%, 595 of 1207) than other health professionals although the vaccine knowledge levels among health professionals were not examined.<sup>56</sup> It should be noted that this U.S. study was conducted between October 7 and November 9, 2020, and thus, vaccine acceptance rate of this study population may have increased owing to the recent changes in the local COVID-19 situations and community education regarding COVID-19 vaccination. Studies in Jordan and Italy found that health care workers had higher vaccine knowledge levels than nonmedical-related professions.<sup>16,17</sup> The finding of our study was different than the Jordanian and Italian studies probably because of the difference in selecting the reference group. Based on our experience with the Vietnam context, clinical doctors and health lecturers are updated with medical scientific publications more regularly than those working in other health and nonhealth-related fields and, thus, were selected as our reference group. By doing this, we could be able to compare the vaccine knowledge levels of other health professionals who were not physicians and health lecturers with those of physicians and health lecturers. Unlike us, none of the Jordanian and Italian studies examined the differences in the vaccine knowledge levels between different health professional groups. Our study makes it possible to highlight the differences in the vaccine knowledge levels between health professional groups and, therefore, helps in developing more targeted intervention programs. It is clear that, in addition to vaccine knowledge, COVID-19 vaccine acceptance was influenced by other factors including enabling environments (e.g., convenient vaccination places and easy and accessible vaccination booking), social influences (e.g., salient social norms in favor of vaccination), and motivation (e.g., increasing motivation to get vaccinated through building timely trust in

vaccines).<sup>36</sup> However, like our study, the varied vaccine acceptance rates in different occupational roles in health care found in the U.S. study implied that the nonclinical professionals should be targeted—with educational interventions to ensure a successful COVID-19 vaccination. It should be noted that health professionals such as pharmacists, rather than physicians, have been identified as a professional figure in the health section who is qualified to improve the public vaccine acceptance in general.<sup>57</sup> Indeed, a study in Vietnam also found that community pharmacists could take an important part in disseminating COVID-19 related knowledge to the public.<sup>49</sup> Hence, to ensure a successful COVID-19 vaccine rollout, education programs in Vietnam should focus on improving the vaccine knowledge in those who are working in health-related fields but are not clinical doctors and health lecturers, such as nurses and pharmacists. Further studies are needed to examine the reasons for the low levels of vaccine knowledge in this group.

We found that only 41.6% of participants believed that vaccination was needed, despite the ongoing COVID-19 outbreak in Vietnam. In addition, only 20.6% of participants strongly agreed that getting vaccinated was a good way to protect oneself from COVID-19. At the time this manuscript was developed, the local government had been implemented the largest-ever vaccination campaign together with other preventive measures to control the outbreak.<sup>27</sup> This implies that vaccination together with these measures may be the only way to achieve this goal as can be seen in other vaccine preventable diseases.<sup>6,58</sup> In light of this, community education needs to emphasize the importance of the combined vaccination and nonvaccine measures in controlling the outbreak.

Our participants' vaccine knowledge regarding vaccine efficacy and essentialness needs to be improved because 16.2% of participants strongly agreed that they were completely protected against COVID-19 after they fully completed the vaccination schedule. Only 36.4% of participants strongly disagreed that they did not need to undertake any other preventive measures after they fully completed the vaccination schedule. In addition, less than one-fifth of participants strongly agreed that vaccines developed by different manufacturers had different levels of efficacy (17.1%), and the available vaccines may not be effective on new variants compared with the original strain (12.8%). The WHO has emphasized the importance of managing the community's expectations toward the vaccine to ensure that those who have been vaccinated do not stop practicing protective behaviors.<sup>36</sup> Another issue is that only 30.3% of our participants strongly agreed that being vaccinated themselves contributed to the protection of the community against COVID-19. Vaccination not only protects oneself from COVID-19 but also helps create herd immunity to stop its spread and protect vulnerable groups who cannot get vaccinated.<sup>37</sup> It is estimated that 65%–70% of the population needs to be vaccinated to achieve herd immunity against COVID-19.<sup>37</sup> Hence, vaccination can be conceptualized as a social responsibility, which plays an important role in educating the community regarding the essentialness of COVID-19 vaccination.<sup>59</sup> Indeed, it is documented that social responsibility is positively associated with COVID-19 vaccination intention.<sup>60</sup> Considering the loss of life and economic consequences owing to COVID-19, social responsibility attached to vaccination should be emphasized by

governments.<sup>59</sup> Our findings highlight the need to tailor the current education program to enhance the community knowledge regarding both the essentialness and efficacy of vaccine.

Our study has some limitations. First, the government started the largest-ever COVID-19 vaccination program and enhanced the community education toward COVID-19 vaccines on the media to respond to an outbreak of COVID-19 during the study period. This may have influenced our participants' responses to the survey. However, we believe that it is negligible given that we ended the study when the program started. Nevertheless, we have identified room for improvement of the community education programs. Second, many cities in Vietnam had been under lockdown during the study period making the online survey the most efficient method to collect data at large. Given the online survey, duplicate entries may be an issue and affect the validity of the study. However, before completing the survey, participants were asked to read the participant information sheet outlining the research purposes and what participants were required to do. Only participants who fully understood and agreed to participate in the study were enrolled in the study. We screened and reviewed potentially duplicate entries, and although we could not remove duplicates completely, these strategies should make them negligible. Third, given our study aimed to target the community at large, recruiting participants using a snowball sampling technique could cause selection bias. However, in addition to the online survey, we used a paper-based recruitment procedure in 2 largest cities in Vietnam to include those who were unable to complete the online survey such as the older and those who did not have an Internet-enabled device or Internet connection. The use of a combination of 2 different, complementary data collection methods helped include a diverse study population in our study, which increased the generalizability of the study's results. Finally, responses to our vaccine knowledge questions can be influenced by study participants' antivaccination attitudes, which were not assessed in this study. Consequently, our study may underestimate the true vaccine knowledge level among participants who want to avoid all vaccination or COVID-19 vaccination (antivaxxers).

## Conclusion

People who are at young age, have low income or education levels, and work in nonclinical and nonhealth education fields have low COVID-19 vaccine knowledge levels. To ensure a successful COVID-19 vaccine rollout and sustainable control and prevention of COVID-19, it is crucial to improve the knowledge about vaccine essentialness and efficacy in the community. Community education programs may be beneficial from using those who have been vaccinated as role models.

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## Appendix

### Appendix 1

#### Questionnaire

##### I. General information:

1. Year of birth (please specify):	.....
2. Gender:	<input type="checkbox"/> Male <input type="checkbox"/> Female
3. Residential address (please only specify the city name):	.....
4. Region of residence:	<input type="checkbox"/> Northern Vietnam <input type="checkbox"/> Middle Vietnam <input type="checkbox"/> Southern Vietnam
5. Gapminder income levels (US\$ per day)*:	<input type="checkbox"/> <2 <input type="checkbox"/> 2 - <8 <input type="checkbox"/> 8 - <15 <input type="checkbox"/> 15 - <32 <input type="checkbox"/> ≥32
6. Household composition:	<input type="checkbox"/> Living alone <input type="checkbox"/> Living with family <input type="checkbox"/> Living with friends
7. Education levels:	<input type="checkbox"/> Less than high school <input type="checkbox"/> High school <input type="checkbox"/> College <input type="checkbox"/> Undergraduate level or above
8. Majors:	<input type="checkbox"/> Health students <input type="checkbox"/> Non-health students <input type="checkbox"/> Working in non-health related fields <input type="checkbox"/> Being clinical doctor and/or health lecturer <input type="checkbox"/> Working in other health related fields
9. Health conditions:	<input type="checkbox"/> Do not have chronic conditions <input type="checkbox"/> Having chronic, noncommunicable diseases <input type="checkbox"/> Having chronic, communicable diseases
10. COVID-19 disease experience:	<input type="checkbox"/> Having COVID-19 or acquired COVID-19 previously <input type="checkbox"/> Having a family member who has COVID-19 or acquired COVID-19 previously <input type="checkbox"/> Having a friend/colleague who has COVID-19 or acquired COVID-19 previously <input type="checkbox"/> Never acquire COVID-19, or know anyone who has COVID-19 or acquired COVID-19 previously

\*To assist study participants in completing the questionnaire easily, the currency was converted to VND and the unit was VND per month in the Vietnamese version of the questionnaire.

##### II. COVID-19 vaccine knowledge:

##### 1. I am completely protected against COVID-19 after I fully complete the COVID-19 vaccination schedule

Strongly agree	Agree	Neutral/no opinion	Disagree	Strongly disagree
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##### 2. I do not need to undertake any other COVID-19 preventive measures after I fully complete the COVID-19 vaccination schedule

Strongly agree	Agree	Neutral/no opinion	Disagree	Strongly disagree
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##### 3. Being vaccinated for COVID-19 myself contributes to the protection of the community against COVID-19

Strongly agree	Agree	Neutral/no opinion	Disagree	Strongly disagree
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**4. Getting vaccinated for COVID-19 is a good way to protect myself from COVID-19**

Strongly agree	Agree	Neutral/no opinion	Disagree	Strongly disagree
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**5. I do not need to get vaccinated for COVID-19 because the COVID-19 outbreak is controlled very well in Vietnam.**

Strongly agree	Agree	Neutral/no opinion	Disagree	Strongly disagree
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**6. COVID-19 vaccines developed by different manufacturers have different levels of efficacy**

Strongly agree	Agree	Neutral/no opinion	Disagree	Strongly disagree
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**7. The available COVID-19 vaccines may be less effective on new variants compared with the original strain**

Strongly agree	Agree	Neutral/no opinion	Disagree	Strongly disagree
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## Appendix 2

## Details of participants' responses to COVID-19 vaccine knowledge questions

Questions response (assigned score)	Summary statistics n (%)
<b>Q1. I am completely protected against COVID-19 after I fully complete the COVID-19 vaccination schedule</b>	
Strongly agree (0)	277 (16.2)
Agree (1)	745 (43.6)
Neutral/no opinion (2)	389 (22.8)
Disagree (3)	259 (15.2)
Strongly disagree (4)	38 (2.2)
<b>Q2. I do not need to undertake any other COVID-19 preventive measures after I fully complete the COVID-19 vaccination schedule</b>	
Strongly agree (0)	25 (1.5)
Agree (1)	55 (3.2)
Neutral/no opinion (2)	199 (11.6)
Disagree (3)	808 (47.3)
Strongly disagree (4)	621 (36.4)
<b>Q3. Being vaccinated for COVID-19 myself contributes to the protection of the community against COVID-19</b>	
Strongly agree (4)	518 (30.3)
Agree (3)	919 (53.8)
Neutral/no opinion (2)	228 (13.4)
Disagree (1)	31 (1.8)
Strongly disagree (0)	12 (0.7)
<b>Q4. Getting vaccinated for COVID-19 is a good way to protect myself from COVID-19</b>	
Strongly agree (4)	352 (20.6)
Agree (3)	885 (51.8)
Neutral/no opinion (2)	323 (18.9)
Disagree (1)	133 (7.8)
Strongly disagree (0)	15 (0.9)
<b>Q5. I do not need to get vaccinated for COVID-19 because the COVID-19 outbreak is controlled very well in Vietnam</b>	
Strongly agree (0)	17 (1)
Agree (1)	28 (1.6)
Neutral/no opinion (2)	208 (12.2)
Disagree (3)	745 (43.6)
Strongly disagree (4)	710 (41.6)
<b>Q6. Vaccines developed by different manufacturers have different levels of efficacy</b>	
Strongly agree (4)	292 (17.1)
Agree (3)	819 (48)
Neutral/no opinion (2)	463 (27.1)
Disagree (1)	113 (6.6)
Strongly disagree (0)	21 (1.2)
<b>Q7. The available COVID-19 vaccines may be less effective on new variants compared with the original strain</b>	
Strongly agree (4)	219 (12.8)
Agree (3)	877 (51.3)
Neutral/no opinion (2)	552 (32.3)
Disagree (1)	54 (3.2)
Strongly disagree (0)	6 (0.4)

Appendix 3: Distribution of levels of COVID-19 vaccine knowledge in Vietnam.

