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Knowledge, attitudes, and behaviors towards COVID-19 prevention: a cross-sectional study at University Medical Center in Ho Chi Minh City, Vietnam

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Abstract: ***Introduction:*** The COVID-19 pandemic has spread around the world that severely affects people's life and the health system of countries. Enhancing the population's awareness and prevention behaviors are crucial. This study aims to assess the knowledge, attitudes, and behaviors regarding COVID-19 prevention of outpatients and visitors at the University Medical Center in Ho Chi Minh City (UMC). ***Methods:*** A cross-sectional study was conducted on 765 participants who were conveniently selected when they arrived at UMC between March 2021 and April 2021. A questionnaire was developed based on guidelines of Viet Nam Ministry of Health (Viet Nam MOH), World Health Organization (WHO), and other prior studies to evaluate the general knowledge regarding COVID-19 disease, disease prevention, attitude, and behaviors on prevention methods. ***Results:*** The results showed low proportions of participants who had good knowledge of COVID-19 disease (29.15%) and prevention measures (38.17%) that were in contrast with a high percentage of positive attitudes (89.08%). There were 22.09% of participants were identified as good preventive behaviors based on seven surveyed measures. An association between prevention knowledge and prevention behaviors was observed when participants with good knowledge showed 2.15 times-higher odds of good behaviors (95%CI: 1.52, 3.04, p-value<0.001) compared to those with insufficient knowledge. Gender, occupation, accommodation, living with family or friends, comorbidities, and history of COVID-19 -related isolation were associated with good behaviors (adjusted p-value <0.05). ***Conclusions:*** The percentage of knowledge and the compliance rate for COVID-19 prevention measures is low, and there is a positive association between prevention knowledge and good behaviors. Therefore, communication programs to improve the community's knowledge and to increase good practice rates are necessary and urgent.

Keywords: COVID-19 prevention; Viet Nam; knowledge; attitudes; behaviors.

1. INTRODUCTION

COVID-19 first appeared in China in 2019 and quickly became a global pandemic, seriously affecting people's health and lives. Nevertheless, the COVID-19 pandemic has also hurt the health system, causing heavy social-economic, and security losses to countries around the world (1). To effectively control the pandemic, besides applying solutions

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such as vaccination, preparation of drugs; enhancing the role of individuals in terms of prevention including wearing the mask, washing hands, avoiding gathering in crowded public always play a crucial role. Therefore, the knowledge, attitudes, and behaviors of people are crucial components in the fight against COVID-19 (1-3).

Vietnam is one of the few countries highly appreciated by the WHO for the prevention of the pandemic, however, Vietnam has been also strongly affected by COVID-19. By August 2021, Viet Nam reported nearly 449,489 cases and 11,064 deaths (4, 5). In the face of a complicated epidemic situation, people's knowledge, attitudes, and practices are one of the major contributing factors in preventing the disease from spreading in the community. Several prior studies were conducted to evaluate knowledge, attitudes, and practices in the Vietnamese population with varied participants including healthcare workers (6), outpatients with chronic diseases (7), and adults aged between 18-59 years (8). And all mentioned studies explored that good knowledge regarding COVID-19 disease and prevention was associated with good behaviors Therefore, health education communication is one of the strategies prioritized to implement by Viet Nam MOH. However, changes in the community's knowledge, attitudes, and behaviors towards COVID-19 prevention measures may vary according to the evolution of the local as well as a national epidemic, especially attitudes and compliance with prevention measures. This study aimed to update the status regarding the knowledge, attitudes, and behaviors toward COVID-19 prevention of outpatients and visitors at the University Medical Center in Ho Chi Minh City.

2. MATERIALS AND METHOD

2.1. Design and setting

A cross-sectional study was conducted at UMC between March 2021 and April 2021. Participants were 765 people including outpatients, visitors, and students (hereinafter referred to as the visitors) who presented at UMC during study periods.

Inclusion criteria

- Vietnamese visitors who presented at UMP for their health services or their works during the study period
- Aged 18 years or older
- Agreed to participate in the study.

Exclusion criteria

- Visitors with severe health conditions who were unable to respond to survey questions
- Visitors with communication limitations including illiteracy or hearing and speech disabilities

2.2. Sample size

The sample size was calculated using the formula to estimate a single proportion:

$$n = Z^2_{1-\alpha/2}\frac{p(1-p)}{d^2}$$

The confidence intervals were chosen of 95% (95% CIs), margin errors of 4%, selected p-value of 57.7%, which was the percentage of UMC patients who had a good practice on COVID-19 prevention (9), resulting in the minimum number of participants of 587. A total of 765 participants were recruited.

2.3. Data collection

A convenient sampling method was applied to select participants following inclusion and exclusion criteria. Thereby, interviewers approached participants when they presented at the UMC to introduce to them the purpose and contents of the study. Then, written informed consent was obtained from each eligible participant after the introduction. Participants were face-to-face interviewed by trained interviewers using a prepared questionnaire. The survey questionnaire was presented in Vietnamese language and its content was developed based entirely on guidelines and recommendations of WHO, Viet Nam MOH, and other reference studies (1-3, 10-13). This questionnaire was pilot tested on 10 samples to correct the contents and words before being officially applied. Interviewers were members of the Faculty of Public Health, University of Medicine and Pharmacy at Ho Chi Minh City, who were with experience in face-to-face interviews. In addition, the interviewers were noted not to suggest answers and let the participants answer themselves according to their knowledge, attitudes, and behaviors to ensure objectivity.

The questionnaire consisted of 39 questions to obtain information on participants' characteristics and to evaluate their general knowledge, preventive knowledge, attitudes, and behaviors regarding COVID-19 disease and COVID-19 prevention measures. Information on participants' characteristics was collected including gender, age, hometown, occupation, average monthly income, living status, current morbidities, and history of isolation due to COVID-19.

Surveyed general knowledge on COVID-19 consisted of 11 questions on the modes of disease transmission, high-risk infectious behaviors, definition of close contact, the survival of SAR-COV-2 in the environment, the survival of SAR-COV-2 in low-temperature environments, incubation duration, COVID-19 typical symptoms, high-risk population who need to be isolated, high-risk population of COVID-19 infection, availability of medication for COVID-19 treatment, and availability of COVID-19 vaccination. For knowledge on COVID-19 prevention, participants were asked 7 questions regarding preventive measures according to Viet Nam MOH at the individual level, at family, and community level as well as the time when they should wash their hands, hand washing methods, the duration for each handwashing session, and activities if they were suspected COVID-19 infection (including those who had typical COVID-19 symptoms, or having a history of close contact with COVID-19 patients, or coming from areas with the epidemiology of COVID-19 as MOH classification). To evaluate the knowledge on COVID-19 disease and COVID-19 prevention, each correct answer was counted as 1, and 0 for the wrong one, giving the total score of 0-11 for general knowledge and 0-7 for knowledge regarding COVID-19 prevention, respectively.

For attitudes, 6 Likert 5-scale questions were used to evaluate the participant's attitudes to COVID-19 prevention measures recommended by Viet Nam MOH at the individual, family, and community levels. Six questions were used to

examine participants' attitudes toward the need for recommendations for COVID-19 prevention measures with 5 levels including "very unnecessary", "unnecessary", "normal", "necessary", and "very necessary" that correspond to the agreement of participants to each recommendation. Participants were classified as having a good attitude (strongly agree and agree) when answering was "necessary" or "very necessary" with corresponding questions. Similar to the knowledge section, each good attitude (strongly agree and agree) was counted as 1 and other answers were counted as 0 (corresponding for strongly disagree, disagree, undecided) (7). Thereby, the total score of attitudes was arranged between 0 and 6.

For practices, participants were asked 7 questions regarding their behaviors on COVID-19 prevention including the frequency of wearing facemasks, washing hands, average time for each handwashing session, avoiding gathering in crowded places; the solution if they had close contact with COVID-19 patients and/or had typical symptoms, the individual activities to prevent COVID-19 infection, and compliance to COVID-19 prevention measures at home. Similarly, each correct answer was counted as 1, and 0 for the wrong one; giving the total score of 0-7.

Knowledge, attitudes, and behaviors were defined as "Good" if the participant answered correctly 80% of all questions of corresponding patterns (corresponding to 9/11 score for general knowledge, 6/7 for knowledge on COVID-19 prevention, 5/6 for attitudes, and 6/7 for behaviors). The cutoff of 80% was referred to following the recommendation by Richard E. Biddle et al. (14) for the knowledge test, and it was also used by prior studies (6).

2.4. Statistical analysis

Collected data was inputted using Epidata 3.0 and analyzed using STATA 14. Chi-square test and Fisher-exact tests were used to examine the difference between independent variables. Univariate and multivariate logistic regressions were used to estimate the relationship between the demographic variables with the percentage of good knowledge, good attitudes, and good behaviors. Thereby, all interesting variables with a p-value less than 0.05 in univariate analysis were added to the multivariate model. Then variables with p-value greater than 0.05 were excluded, leaving the final model. All p-values were two-sided, and $p \leq 0.05$ (alpha value) was considered to indicate statistical significance.

2.5. Study site

UMC is one of the general university hospitals under the Viet Nam MOH, located in Ho Chi Minh City (HCMC), the biggest city in Vietnam. Each year, the hospital receives an average of more than 2 million outpatient visits (about 7,000 people per day), inpatient treatment of 55,000 people, and surgery of about 30,000 cases. Patients come to the hospital from all over the country, mainly from the southern regions. Therefore, this is also an ideal location for research to be conducted when people are diverse, coming from many different regions.

2.6. Ethical consideration

The present study was approved by the Ethics Committee of the University of Medicine and Pharmacy in HCMC and UMC (IRB-VN01002/IRB00010293/FWA00023448).

3. RESULTS

3.1. Demographic characteristic

Table 1. Demographic characteristic variables

Variable	Frequent	%
Gender		
Male	384	50.20
Female	381	49.80
Age groups		
18 – 29 years	358	46.80
30 – 49 years	338	44.18
50 – 64 years	56	7.32
≥65 years	13	1.70
Average age	32.77 ± 11.22 (18-76)[a]	
Occupation		
Civil servant	295	38.56
Student	134	17.52
Pensioner - Housewife	109	14.25
Business	108	14.12
Freelancer	73	9.54
Unemployed workers	46	6.01
Monthly income		
No income	113	14.77
1 - <5 million VND	76	9.93
5 - <10 million VND	216	28.24
10 – 15 million VND	216	28.24
>15 million VND	144	18.82
Average income (million VND)	10,306 ± 9160.31 (0-70,000)[a]	
Hometown		
Other provinces	183	23.92
HCMC	582	76.08
Living status		
Alone	366	47.84
With family, friends	399	52.16
Current morbidities		
No risk	458	59.87
Risk	307	40.13
History of isolation		
Isolated	720	94.12
Not yet	45	5.88

[a]*Mean ± SD (min- max)*

Characteristics of 765 eligible participants were shown in **Table 1**. The mean age of participants was 32.77 ± 11.22 years. Most of them were HCMC residents (76.08%), and the main occupation were civil servants, who are working for companies and government agencies (38.56%), followed by students (17.52%), pensioners/ housewives (14.25%), and business (14.12%). The average monthly income was 10.3 million VND, of which, three fourth had an income of 5 million VND or higher. There were 40.13% reported to have morbidities that were concerned as high risk for severity of illness including diabetes, cardiovascular disease, hypertension, kidney disease, and neurological disorders. There were 5.88% of participants who reported a history of being in centralized isolation areas due to close contact with COVID-19 patients (classified as F1) or being isolated at home because of close contact with F1 (classified as F2) followed government regulations.

3.2. General knowledge

As shown in **Table 2**, the present study observed a low percentage (29.15%) of participants who had sufficient knowledge on COVID-19 disease while partial knowledge was likely to be good. Thereby, the majority of participants (over 75%) knew about the modes of SARS-CoV-2 transmission, incubation time, infectious agent, safe distance for preventing transmission, and typical symptoms of the disease. In contrast, significantly lower proportions of participants had the correct answers for the questions relating to suspicious epidemiological factors (49.54%), whether the virus is only active in a cold environment (47.71%), and high-risk population (43.01%). Univariate logistic regression analysis found statistically significant differences related to general COVID-19 knowledge within occupation groups and income groups. Thereby, the proportion of general good knowledge was higher in civil servants compared to others (OR=1.92, 95% CI: 1.40 – 2.64, p<0.001,); and participants with income of 10 million VND or greater were higher than others (OR=1.39, 95% CI 1.01-1.90, p=0.038) (**Table 5**).

Table 2. The percentage of good knowledge, good attitudes, and good behaviors

Variable	Frequent (n=765)	%
General knowledge on COVID-19	223	29.15
Modes of Covid-19 transmission	730	95.42
High risk infectious behaviors	582	76.08
Definition of close contact	579	75.69
Survival of SAR-COV-2 outside the body	579	75.69
Survival of SAR-COV-2 in low temperature environments	365	47.71
Incubation duration	716	93.59
Typical Covid-19 symptoms	600	78.43
High-risk populations who need to be isolated and/or monitored	379	49.54
High-risk population	329	43.01
Availability of medication for COVID-19 treatment	514	67.19
Availability of COVID-19 vaccination	476	62.22
Knowledge on COVID-19 prevention	292	38.17
Preventive measures at the individual level	646	84.44
Preventive measures at family level	600	78.43
Preventive measures at community	570	74.51
The time when a person should wash the hands	322	42.09
Hand washing methods	629	82.22
The duration for each handwashing session	165	21.57
Activities if they were suspected COVID-19 infection	679	88.76
Attitudes	687	89.80
Recommendations on preventive measures at the individual level are necessary	677	88.50
Recommendations on preventive measures at family level are necessary	693	90.59
Recommendations on preventive measures at community level are necessary	702	91.76
Wearing mask is necessary	699	91.37
Handwashing is necessary	694	90.72
Recommendations to handle when getting suspected symptoms is necessary	662	86.54
Behaviors	169	22.09
The frequency of wearing facemask	742	96.99
The frequency of handwashing	707	92.42
Average time for each handwashing session	189	24.71
Avoiding gathering in crowded public	381	49.80
The individual activities to prevent COVID-19	413	53.99
Compliance with COVID-19 prevention measures at home	384	50.20
The solution if they close contact with COVID-19 patients/or had typical symptoms	478	62.48

3.3. Preventive knowledge

The findings indicated that 38.17% of participants had sufficient knowledge regards to COVID-19 prevention, who correctly answered 6 among 7 surveyed questions. Although most participants showed good knowledge on measures and how to prevent COVID-19 infection for themselves, at family, and in the community (accounting for 84.44%, 78.43%, and 74.51%, respectively), very few correctly knew the time when they should wash their hand (42.09%), or how much time was enough to spend on handwashing (21.57%). Most of them reported that they only washed their hands at the times after touching surfaces (85.2%, 652/765 reported), or after coughing/sneezing (88.1%, 674/765 reported), and they misunderstood that it was better to do handwashing for a longer time rather than between 20 seconds and 60 seconds as recommendation (31.24%, 239/765 reported) (**Supplementary Table 1**). Multivariate analysis showed that the knowledge on COVID-19 prevention was better in the

group of females (OR=1.56, 95%CI: 1.16, 2.12; p-value = 0.003); the age of 65 years and older (OR=4.79, 95%CI: 1.23, 18.57; p-value = 0,023), participants with high risk for severity of illness (p-value = 0.010), or those who with history of COVID-19 -related isolation (p-value <0.001), but worse in the income group of 10 million VND and over (OR=0.021, 95%CI: 0.50, 0.94; p-value=0,021), compared to comparison groups (**Table 3**).

Table 3. Multivariate Logistic regression analysis

Variable	Preventive knowledge				Behaviors			
	Unadjusted OR	**p-value**	**Adjusted OR**	**p-value**	**Unadjusted OR**	**p-value**	**Adjusted OR**	**p-value**
Gender								
Female	1.65 (1.23-2.21)	**0.001**	1.56 (1.16-2.12)	**0.003**	1.90 (1.34-2.69)	**<0.001**	1.53 (1.04-2.26)	**0.028**
Male	1		1		1		1	
Age groups								
≥65 years	5.55 (1.51-20.35)	**0.010**	4.79 (1.23-18.57)	**0.023**	1,58 (0.48-5.19)	0.451	//	//
<65 years	1		1		1			
Occupation								
Civil servant	1.27 (0.94-1.71)	0.112	//	//	1.91 (1.35-2.70)	**<0.001**	1.70 (1.17-2.47)	**0.005**
Others	1				1		1	
Monthly income								
≥ 10 million VND	0.70 (0.52-0.95)	**0.022**	0.69 (0.50-.94)	**0.021**	0.84 (0.59-1.19)	0.335	//	//
<10 million VND	1		1		1			
Hometown								
HCMC	1.54 (1.08-2.20)	**0.016**	//	//	4.38 (2.46-7.78)	**<0.001**	3.27 (1.72-6.20)	**<0.001**
Other provinces	1				1		1	
Living status								
With family, friends	1.62 (1.20-2.18)	**0.001**	//	//	3.89 (2.63-5.74)	**<0.0001**	2.87 (1.90-4.34)	**<0.001**
Alone	1				1		1	
Current morbidities								
Risky	1.50 (1.11-2.02)	**0.007**	1.50 (1.08-1.98)	**0.010**	1.81 (1.28-2.55)	**0.001**	1.75 (1.20-2.55)	**0.003**
No risky	1						1	
History of isolation								
Isolated	5.53 (2.75-11.10)	**<0.001**	5.36 (2.67-10.73)	**<0.001**	8.35 (4.37-15.96)	**<0.001**	7.82 (4.15-14.73)	**<0.001**
n-isolated	1		1		1		1	

// Unidentified

3.4. Attitudes

The present study observed a positive attitude of participants towards COVID-19 prevention measures recommended by MOH. Thereby, 89.08% of participants were categorized as good attitude groups. The majority of participants showed positive attitudes to MOH's recommendations on COVID-19 prevention measures at individual level (88.50%), family level (90.59%), and community level (91.76%). Participants also expressed their agreement with the necessity of the MOH's recommendations on wearing medical masks (91.37%), washing hands (90.72%), and measures to handle when having suspected symptoms (86.54%). No association between their characteristics and attitudes was found (**Table 4**, **Table 5**).

Table 4. The difference about good knowledge, good attitudes, good behaviors among demographic characteristic variables

Variable	General knowledge		Preventive knowledge		Attitude		Behavior	
	Good (%)	P-value	Good	P-value	Good	P-value	Good	P-value
Gender								
Male	27.86	0.432	32.29	**0.001**	89.84	0.971*	16.67	**<0.001***
Female	30.45		44.09		89.76		27.56	
Age groups								
18 – 29 years	28.21	0.144	35.75	**0.013***	86.31	**0.015**	19.83	0.267
30 – 49 years	32.25		37.87		93.20		22.78	
50 – 64 years	17.86		46.43		89.29		30.36	
≥65 years	23.08		76.92		100		30.77	
Occupation								
Civil servant	37.63	**0.003**	41.69	0.466	88.81	0.183	29.15	**0.009**
Student	24.63		38.06		89.55		17.16	
Pensioner - Housewife	20.18		36.70		90.83		20.18	
Business	25.93		30.56		92.59		14.81	
Freelancer	26.03		39.73		94.52		20.55	
Unemployed workers	21.74		34.78		80.43		15.22	
Monthly income								
No income	25.66	0.178	44.25	0.053	93.81	0.194	9.73	**<0.001**
1 - <5 mil VND	22.37		51.32		82.89		22.37	
5 - <10 mil VND	27.31		37.50		89.35		31.02	
10 – 15 mil VND	30.56		30.56		90.28		19.91	
>15 mil VND	36.11		38.89		90.28		21.53	
Hometown								
Other provinces	27.87	0.662	30.60	**0.016**	90.16	0.854*	7.65	**<0.001***
HCMC	29.55		40.55		89.69		26.63	
Living staus								
Alone	27.05	0.221	32.24	**0.001**	90.71	0.427*	10.93	**<0.001***
Family, friends	31.08		43.61		88.97		32.33	
Current morbidities								
No risky	27.07	0.123	34.28	**0.007**	89.08	0.421*	17.90	**<0.001***
Risky	32.25		43.97		90.88		28.34	
History of isolation								
Not yet	28.61	0.189	35.83	**<0.001***	89.31	0.068*	19.31	**<0.001***
Isolated	37.78		75.56		97.78		66.67	

**Fisher's exact*

Table 5. Univariate Logistic regression analysis

Variable	General knowledge		Preventive knowledge		Attitudes		Behaviors	
	OR (95%CIs)	P-value	OR (95%CIs)	P-value	OR (95%CIs)	P-value	OR (95%CIs)	P-value
Gender								
Female	1.13 (0.82-1.54)	0.432	1.65 (1.23-2.21)	**0.001**	0.99 (0.62-1.58)	0.971	1.90 (1.34-2.69)	**<0.001**
Male	1		1		1		1	
Age groups								
≥65 years	0.72 (0.19-2.66)	0.628	5.55 (1.51-20.35)	**0.010**	//	//	1,58 (0.48-5.19)	0.451
<65 years	1		1		//	//	1	
Occupation								
Civil servant	1.92 (1.40-2.64)	**<0.001**	1.27 (0.94-1.71)	0.112	0.84 (0.52-1.35)	0.474	1.91 (1.35-2.70)	**<0.001**
Others	1		1		1		1	
Monthly income								
≥ 10 million VND	1.39 (1.01-1.90)	**0.038**	0.70 (0.52-0.95)	**0.022**	1.10 (0.68-1.76)	0.683	0.84 (0.59-1.19)	0.335
<10 million VND	1		1		1		1	
Hometown								
HCMC	1.08 (0.75-1.57)	0.662	1.54 (1.08-2.20)	**0.016**	0.94 (0.54-1.65)	0.854	4.38 (2.46-7.78)	**<0.001**
Other provinces	1		1		1		1	
Living status								
With family, friends	1.21 (0.88-1.66)	0.221	1.62 (1.20-2.18)	**0.001**	0.82 (0.51-1.32)	.428	3.89 (2.63-5.74)	**<0.0001**
Alone	1		1		1		1	
Current morbidities								
Risky	1.28 (0.93-1.75)	0.123	1.50 (1.11-2.02)	**0.007**	1.22 (0.75-1.98)	0.421	1.81 (1.28-2.55)	**0.001**
No risky	1		1		1			
History isolation								
Isolated	1.51	0.192	5.53 (2.75-11.10)	**<0.001**	5.26 (0.71-38.78)	0.103	8.35 (4.37-15.96)	**<0.001**
Non-isolated	1		1		1		1	
General knowledge								
Good							1.41 (0.98-2.03)	0.063
Not good							1	
Preventive knowledge								
Good							2.15 (1.52-3.04)	**<0.001**
Not good							1	
Attitude								
Good							1.81 (0.93-3.52)	0.076
Not good							1	

3.5. Preventive behaviors

Regarding preventive behaviors, there was 22.09% of participants were determined to have good behaviors, and the good practice was much varied between surveyed behaviors (arranging from 24.71% or 96.2%). The most compliance rates were observed for frequency wearing facemask and washing hands with the percentage of 96.99% and 92.42%, respectively. In contrast, only 24.71% of participants spent enough time for each handwashing session. The adherence rates of other surveyed behaviors were between 50.20% and 62.48% (**Table 2**). Multivariate analysis indicated the higher proportion of good behaviors in females (p-value of 0.028), civil servants (p-value of 0.005), HCM residents (p-value < 0.001), participants who were living with their family/friends (p-value < 0.001), those who with high risk for severity of illness (p-value = 0.003), and those who with a history of COVID-19 -related isolation (p-value < 0.001) compared to comparison groups **(Table 3)**. In addition, the study observed the relationship between preventive knowledge and preventive behaviors. The results showed that participants with good preventive knowledge had significantly higher odds of good preventive behaviors (OR=2.15, 95%CI: 1.52, 3.04; p-value<0.001). There was no statistically significant between good general knowledge, good attitudes, and good preventive behaviors even though a greater proportion of good behaviors still observed among participants with good general knowledge (OR=1.41, 95%CI: 0.98, 2.03; p-value=0.0063) and good attitudes (OR=1.81, 95%CI: 0.93, 3.52; p-value=0.076) (**Table 5**).

4. DISCUSSION

The present study evaluated the knowledge, attitudes, and behaviors of 765 participant outpatients and visitors at a university hospital in southern Viet Nam. The findings showed that most of the participants had good attitudes regarding COVID-19 prevention (89.80%), however, the minority of them have comprehensive knowledge on COVID-19 disease (29.15%) as well as COVID-19 prevention measures (38.17%). There was only 22.09% of them practiced sufficiently seven surveyed protective measures. The present study found differences in participants' knowledge, attitudes, and behaviors according to their characteristics. Moreover, we observed an association between participants' knowledge and their behaviors regarding COVID-19 prevention.

The findings indicated a small proportion of participants had sufficient knowledge of COVID-19 disease and prevention. Prior studies in the Vietnamese population reported higher figures which were arranged between 68.4% and 93.7% (6-9). However, the overestimation of participants' knowledge in previous studies should be considered due to the recruitment of inpatients, participants with chronic diseases, or healthcare workers. Giao Huynh et al. (7) analyzed outpatients with chronic diseases which may lead to a higher proportion of good knowledge due to their illness. Thereby, patients with underlying medical conditions are likely to learn more about COVID-19 to prevent themselves from infections which could increase their own risk of severe COVID-19 illness and death. Our study also explored that participants with a high risk for severity of illness had a better knowledge compared to another group. Similarly, Hoang Bac Nguyen et al. performed the analysis mostly based on inpatients (one examination department and 14 inpatient departments) which also may lead to a higher good percentage due to the influences of hospital communication programs (9). Other prior studies might report higher figures because of the recruitment of healthcare workers who usually was with better medical knowledge (7, 8). The proportion of adequate knowledge on COVID-19 disease in our study was also lower than that of population-based studies in other countries which were reported of 80.5% (Malaysia) (15), 81.64% (Kingdom of Saudi Arabia) (16). In general, the present study reported a much lower percentage of good knowledge on COVID-19 compared to previous ones. We also found that knowledge regarding COVID-19 disease and prevention including the survival of SARS-COV-2 in the environment, high-risk population was lacking in the community. According to the convention of the MOH, the following people with one of the suspected epidemiological factors will be considered as high-risk people. Those factors included people traveling from epidemic areas within 14 days, the subject is identified as F1 or F2 and finally, the person has typical symptoms such as fever, cough, difficulty breathing, loss of smell/taste. According to Viet Nam MOH, these people need to undergo home isolation or centralized isolation at facilities built by the health sector, taking samples and limiting contact with relatives and the community (3). The mentioned knowledge is necessary for the community so that people can properly handle these situations to protect themselves and prevent COVID-19 transmission. In addition, the results also found that participants had insufficient knowledge of handwashing. Results showed that less than half of participants had the correct answer regarding the time when they need to do handwashing (42.95%), and how long for each handwashing session (21.57%). Handwashing is one key measure to control and prevent COVID-19 transmission, therefore the provision of this information for the community is crucial that needs to be considered in health education communication programs for the community.

Regarding attitudes, our study reported a great proportion (89.80%) of participants with a positive attitude towards COVID-19 prevention measures recommended by MOH. This finding was consistent with prior studies which indicated a high percentage of positive attitudes regarding COVID-19 among the Vietnamese population arranging from 71.5% to 90.8% (6, 9). The results indicated a high consensus of the community for the COVID-19 prevention measures of the MOH. This partly showed the community's belief in the guidelines of the MOH, which benefits for current and future implementation of COVID-19 prevention intervention programs.

The present study observed a low percentage of participants who reported comprehensive practices of COVID-19 preventive measures (22.09%). This percentage was significantly lower compared to reports in the Vietnamese population, including healthcare workers (83.1%) (8) outpatients with chronic diseases (77.2%) (7) and adults aged between 18-59 years (75.8%) (6) as well as other countries such as Malaysia (over 50%) (15), Kingdom of Saudi Arabia (86.8%) (16), and China (96.4% of participants avoided visiting crowded places, and 98.0% wore masks when going out (17). The low rate observed in our study may be since our study evaluated more content than the prior studies. Thereby, besides assessing compliance with handwashing and avoiding crowded places as in previous studies, we evaluated participants' compliance to other measures including practices the prevention measures when they had close contact with COVID-19 patients and/or had typical symptoms, individual activities to prevent COVID-19 infection, and application COVID-19 prevention measures at home. However, a highlight was that the two lowest compliance percentages recorded in the present study included spending enough time for handwashing (24.71%) and avoiding crowded places (49.80%). This is similar to Giao Huynh's report (7) on outpatients with chronic diseases, which showed that the compliance rate for handwashing time ($\geq$ 20 seconds) was 40.4%. However, other previous studies in Viet Nam reported high compliance rates to handwash (no mention to average hand-washing time) and avoiding crowded places of 71.2% and 93.2% by Bac Nguyen et al (9), 98.5%, 92.7% by Ha Van Nhu et al (6), and 99.7% and 92.1% by Truong Quang Tien et al (8). Although our study was conducted when Vietnam had experienced a longer period of the pandemic compared to previous studies, the low comprehensive rates to proper hand hygiene and avoiding going to crowded places were still observed. Because these are two effective measures to prevent COVID-19 transmission, our findings have raised great attention which requires appropriate interventions from policymakers to improve the effectiveness of educational programs. Moreover, our multivariate analysis showed that good knowledge of COVID-19 prevention was associated with good practice, which was similar to previous studies (15-18). These findings suggest that having a good attitude is not enough to improve people's practice, but improving their knowledge is the key issue. Therefore, comprehensive

education programs from the government and related authorities are essential.

The findings observed the discrepancies of knowledge and practices regarding COVID-19 prevention by participant characteristics. The proportion of good knowledge and practices were found in females, HCM residents, participants who were living with their family/friends, and those who with high risk for severity of illness or who with a history of COVID-19 -related isolation. Besides, the association between age and monthly income level with sufficient knowledge on COVID-19 prevention also was indicated. Our finding consisted with the report by Bac Nguyen et al (9) which showed a greater knowledge among the younger age group; however, other studies (8) could not find any association. Regarding income, the present study showed participants with higher income had lower good knowledge. This result was in contrast with several studies which reported that high-income earners were likely to have better knowledge about COVID-19 (6, 8, 12, 17, 18) However, Mohammed K. Al-Hanawi et al (16) lso indicated that practices were almost unchanged across income groups. To our best knowledge, analysis of the influence of income on knowledge about COVID-19 in the Vietnamese population is limited. Therefore, further studies are needed to draw a definite conclusion.

Several limitations should be mentioned in our study. First, a hospital-based survey limited the external validity of the present study. However, community-based face-to-face interviews were difficult to implement in the context of the movement restriction of people during the COVID-19 pandemic. Second, recall biases were unavoidable even though trained interviewers with experience in face-to-face were used. Third, missing information on participants' education level was a limitation in the present study. A previous study indicated an association between education and knowledge and behaviors regarding COVID-19(6). Fourth, our study conducted data collection between March 2021 and April 2021 while Vietnam had experienced a fourth COVID-19 outbreak (from April 27, 2021, up to now). Therefore, the current population's knowledge, attitudes, and behaviors may be significantly improved than those reported in this study due to the influence of mass media education programs as well as the strong interest of the population for COVID-19. Therefore, further studies are still needed to continuously update the current status. However, the low percentages of good knowledge and good practice were shown in this study were remarkable and require great attention.

Conclusion

The present study showed that participants had positive attitudes towards COVID-19 prevention measures but had poor knowledge and practices. In addition, the study also observed the relationship between good knowledge and good practice. Therefore, health education programs to improve the community's knowledge in the prevention of COVID-19 are necessary and urgent.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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SUPPLEMENTARY MATERIALS

Supplementary Table 1. Supplement data

Variable	Frequent (n=765)	%
Preventive knowledge		
Washing hand after touching surface	652	85.20
Washing hand after coughing/sneezing	674	88.10
Washing hand within 20 – 60 seconds	239	31.24