

ORIGINAL ARTICLE

Factors Associated With COVID-19 Vaccination Among Medical Students

Warrissara Punthong MD¹,  Basmon Manomaipiboon MD, MSc¹ 

¹ Department of Urban Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok 10300, Thailand

Corresponding author

Basmon Manomaipiboon
basmon@nmu.ac.th

Received 10 June 2025

Revised 3 March 2026

Accepted 31 March 2026

J Med Urban Health

2026;70(4):e7924

<https://doi.org/10.62691/jmuh.2026.7924>

ABSTRACT

Objectives: This study aims to evaluate the factors associated with vaccine hesitancy and acceptance of COVID-19 vaccination among medical students at the Faculty of Medicine, Vajira Hospital, Navamindradhiraj University.

Materials and Methods: A cross-sectional study was conducted among medical students. Data were collected using a structured, self-administered online questionnaire developed based on Lucia et al. The questionnaire included sections on demographic characteristics, perceptions and attitudes toward COVID-19 and COVID-19 vaccination, experience with COVID-19 infection, and vaccination behavior. Binary logistic regression analysis was performed to identify factors associated with vaccine hesitancy with the significant level of $p < 0.05$

Results: A total of 298 medical students participated in the survey, a response rate of 54.3%. Among the participants, 57.7% were male, 77.9% were in the preclinic, and 60.7% had a Grade Point Average classified as very good. Most of the participants (81.5%) reported to take the COVID-19 vaccine as soon as Food and Drug Administration approved is available. Almost all the participants would recommend the COVID-19 vaccine to family and friends (98.7%), to their patients (96.6%), and to the communities (98.3%). The vaccine acceptance group is significantly associated with the participants views that the COVID-19 vaccination is important for them as a healthcare provider (adjusted odd ratio (OR) = 10.82, 95% confidence interval (CI) 1.09-107.08, p -value = 0.042*) and the trust of information related to COVID-19 vaccine from public health experts (adjusted OR = 2.58, 95% CI 1.23-5.20, p -value = 0.009*) However, the serious side effects of the vaccine is significantly associated with the vaccine hesitancy (adjusted OR = 0.31, 95% CI 0.14-0.69, p -value = 0.004*).

Conclusion: Medical students exhibited a positive attitude toward the COVID-19 vaccine. However, the serious effects of the vaccine also associated with the vaccine hesitancy. Medical schools could emphasis vaccine-related education, focusing on the safety and potential consequences of vaccines to ensure students are confident in addressing vaccine-related issues

Keywords: attitude, covid-19 pandemic, covid-19 vaccination, medical student

INTRODUCTION

The COVID-19 pandemic, caused by the SARS-CoV-2 virus,¹ has emerged as one of the most significant global public health crises in recent history. First identified in December 2019 in Wuhan, China, the virus rapidly spread worldwide, including Thailand. COVID-19 primarily affects the human respiratory system, with transmission occurring via respiratory droplets, airborne particles, and direct contact.² The infection can lead to life-threatening conditions and other complications, such as respiratory failure, acute respiratory distress syndrome, sepsis, septic shock, thromboembolism, and multiorgan failure, including acute kidney injury and cardiac injury.³ The pandemic has resulted in widespread illness, substantial loss of life, and severe economic and social disruptions. Consequently, healthcare systems have been overwhelmed by a surge in infected patients, placing significant strain on resources. The World Health Organization launched a pandemic protocol, which led to the activation of necessary public health measures, including lockdowns, social distancing, and mask mandates, to mitigate the spread of COVID-19.⁴ According to the Center for Covid-19 Situation Administration,⁵ Ministry of Public Health of Thailand on March 12, 2021, the epicenters of the pandemic were Bangkok and Samut Sakhon, urban area in Thailand. At that time, 97.7% (26,056) of cases were treated, 0.3% (85) resulted in death, and 2% (538) were admitted to hospitals or isolated (412 individuals in hospitals and 126 in field hospitals).

Vaccination is an essential tool in disease prevention, particularly during pandemics as it helps establish herd immunity and prevent the spread of infectious diseases. During the crisis, healthcare professionals are typically among the first to receive the vaccine, not only to protect themselves but also to reduce the transmission of the disease to others. Although vaccines have been shown to effectively reduce infection rates, the vaccination coverage remains relatively low, with only 55%-82% among the population.⁶ Still, vaccine hesitancy remains a significant challenge affecting vaccination rate.⁷ Attitudes toward vaccination among healthcare professionals are associated with addressing vaccine-related challenges through confident counselling and recommendations. As a result, strong advice from healthcare professionals could significantly increase vaccination rates.⁸

Medical students, as an integral part of healthcare system and also a future physician, are in a position to influence public health awareness, particularly in the

promotion of vaccination. As part of their training, medical curricula provide education on vaccines, including their mechanisms of action and national guidelines for each vaccination program aiming to ensure that medical students have sufficient knowledge to advocate for and counsel patients on vaccines, including the COVID-19 vaccine. While medical curricula aim to promote vaccine knowledge and foster vaccine acceptance, recent studies have demonstrated vaccine hesitancy among medical students, which could undermine vaccination efforts and contribute to increased morbidity and mortality rates from infectious diseases.⁹ Attitudes toward vaccination are recognized as important determinants of health-related behaviors. According to behavioral theories, individuals' perceptions, beliefs, and concerns regarding vaccines may influence their acceptance or hesitancy.⁹

This study aims to evaluate medical students' attitude toward COVID-19 vaccination and the factors associated with vaccine hesitancy and acceptance in an urban setting at the Faculty of Medicine Vajira Hospital, Navamindradhiraj University. This information could provide valuable insights into medical students' attitude and concern about vaccination as well as guide the development of educational programs that equip students with the necessary knowledge to make informed decisions. Additionally, it could help address vaccine hesitancy among patients by ensuring that medical students are better prepared to counsel and support vaccine-hesitant individuals.

MATERIALS AND METHODS

This cross-sectional survey design was conducted among first to sixth year medical students at Faculty of Medicine, Vajira Hospital, Navamindradhiraj University from September 2021 to January 2022. The study was approved by the Institutional Review Board, Faculty of Medicine Vajira Hospital, Navamindradhiraj University (COA 159/2564). Eligible participants were first- to sixth- year medical students enrolled in the 2021 academic year who were aged 18 years or older, able to read Thai, and voluntary to participate in the study. The sample size was calculated using a finite population proportion formula to achieve the power level.¹⁰ Data were collected through a self-administered online survey. Participants were provided with a QR code linking to an information sheet, and electronic informed consent was obtained before participation.

The questionnaire was developed based on the study by Lucia et al.¹¹ and translated into Thai using a

forward-backward translation process to ensure conceptual equivalence with the original version. The translated questionnaire was reviewed by experts in public health and medical education to assess content validity before data collection. The final questionnaire consisted of five sections: Section 1 was demographic characteristics. This section included six items assessing sex, academic year (pre-clinical or clinical level), underlying diseases, grade point average (GPA), health insurance coverage, and hometown. Section 2 was general perceptions about vaccines. This section included two items measured using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Section 3A was knowledge and perceptions regarding COVID-19 and COVID-19 vaccines. This section consisted of six Likert-scale items assessing perceived importance of vaccine development, public health impact, occupational exposure risk, and trust in public health information. Section 3B was attitudes toward COVID-19 vaccination. This section included five Likert-scale items evaluating concerns regarding vaccine efficacy, potential side effects, and opinions on mandatory vaccination policies. For Sections 2–3B, higher scores indicated more positive attitudes toward COVID-19 vaccination. Negatively worded items were reverse-scored prior to analysis. Section 4 was experience with COVID-19 infection. This section consisted of four dichotomous (Yes/No) questions assessing personal infection history and related experiences. Section 5 was vaccination behavior and intention. This section included four dichotomous (Yes/No) questions evaluating vaccine acceptance and recommendation behavior. The internal consistency of the Likert-scale sections (Sections 2–3B) was assessed using Cronbach's alpha. The reliability coefficient was 0.766, indicating acceptable internal consistency in this study population. The questionnaire was administered via an online survey platform in which all items were mandatory. Participants were unable to submit the questionnaire without completing all questions; therefore, no missing data were present in the final dataset.

The primary dependent variable was vaccine hesitancy, defined as a binary outcome based on participants' responses regarding willingness to receive COVID-19 vaccination. Independent variables included demographic characteristics (academic year, GPA, underlying disease, and hometown), attitudinal variables toward COVID-19 and COVID-19 vaccination measured using Likert-scale items, and COVID-19-related experience variables (e.g., prior infection or exposure). Categorical

variables were coded appropriately for regression analysis. GPA was dichotomized at ≥ 3.50 to reflect high academic performance. Attitudinal variables were treated according to their scale distribution.

Demographic data, personal vaccination behavior, and their experience with COVID-19 were analyzed and reported using descriptive statistic. GPA was dichotomized at ≥ 3.50 according to institutional academic performance standards. Sensitivity analyses using alternative categorizations yielded similar adjusted odds ratios. Personal views on COVID-19 and vaccine were reported by frequency (%) with a 95% confidence interval (CI). Factors associated with vaccine acceptance and vaccine hesitance were analyzed using Pearson's Chi-square test, Fisher's exact test, and Binary logistic regression to identify significant associations. Variables were selected for multivariable logistic regression based on theoretical relevance and univariable screening ($p < 0.20$). Underlying disease was not included in the final model due to lack of significant association and to avoid overfitting given its multiple categories. The multivariable logistic regression analysis was performed using the full sample ($n = 298$). The reduced sample size observed in the gender characteristic table ($n = 291$) reflects non-response to that specific item only model stability was assessed using the events-per-variable (EPV) approach as recommended by Vittinghoff et al. With 55 events and three predictors included, the EPV was 18.3, exceeding recommended thresholds. Data were analyzed using IBM SPSS Statistics for Windows, version 26.0 Armonk, NY, USA: IBM Corp. at a statistical significance of $p < 0.05$.

RESULTS

A total of 298 questionnaire responses were obtained out of 548 medical students, resulting in a response rate of 54.3%, and the demographic data of the participants are presented in [Table 1](#). The majority of participants were male, accounting for 57.7%. Most of the participants were in the pre-clinical years (77.9%), which included first- to third-year medical students. Over half of the participants (60.7%) had a very good GPA. The most common underlying diagnosis was allergic rhinitis, reported by 33.6% of participants. The majority of the participants were covered by the Universal Health Coverage Scheme (53.7%), and most of the participants were from Bangkok (81.2%).

Behavior toward COVID-19 vaccination presents in [Table 2](#). Most of the participants (81.5%) reported

Table 1 Characteristic of Participants (n = 298)

Characteristics	n = 298	%
Gender		
Female	119	39.9
Male	172	57.7
Not specifie	7	2.3
Year in medical school		
Pre-clinical year (1 st -3 rd year)	232	77.9
Clinical year (4 th -6 th year)	66	22.1
Underlying disease		
Asthma	7	2.3
Allergic rhinitis	100	33.6
Obesity (BMI > 30.00)	16	5.4
Others	175	58.7
Grade point average		
4.00	18	6.0
3.50–3.99	181	60.7
3.00–3.49	79	26.5
2.50–2.99	17	5.7
2.00–2.49	3	1.0
< 1.99	0	0
Medical rights		
Government service fund	51	17.1
Social security fund	25	8.4
Universal coverage scheme	160	53.7
Self-pay	62	20.8
Hometown		
Bangkok (urban area)	242	81.2
Others	56	18.8

Abbreviations: BMI, body mass index; n, number

to take the COVID-19 vaccine as soon as Food and Drug Administration (FDA) approved is available. Additionally, almost all the participants prefer to recommend the COVID-19 vaccine to family and friends (98.7%), to their patients (96.6%), and to the communities (98.3).

Table 3 demonstrated the bivariate analysis of factors associated between vaccine acceptance or

vaccine hesitancy and (1) characteristic of participants, (2) personal views on COVID-19 and vaccine and (3) Experiences with COVID-19. Firstly, the bivariate analysis shows that characteristic of participants including gender (p-value = 0.352), year in medical school (p-value = 0.450), GPA (p-value = 0.559), their medical rights (p-value = 0.413), and hometown (p-value = 0.684) were not significantly associated with vaccine acceptance or hesitancy.

Secondly, personal views on COVID-19 and vaccine illustrated that nearly all participants (81.8%) consider that vaccine are important for their health as the will be a future physician (p-value = 0.442). The majority of the participants (81.1%) agree that their role as future physician to learn about vaccine both for themselves and their patients. In the aspect of COVID-19 vaccine, the vast majority of the participants (81.4%) agree that the development of COVID-19 vaccine is important to decrease the spread of disease (p-value = 0.348) as well as its important for the public health of our communities. 81.7% among the vaccine acceptance group agree that they will likely to be exposed to COVID as a future physician (p-value = 0.921). Additionally, the vaccine acceptance group is significantly associated with the participants views that the COVID-19 vaccination is important for them as a healthcare provider (adjust odd ratio (OR) = 10.82, 95% CI 1.09-107.08, p-value = 0.042*). Moreover, the vaccine acceptance group is statistically associated with the trust of information related to COVID-19 vaccine from public health experts (adjust OR = 2.58, 95% CI 1.23-5.20, p-value = 0.009*). However, the majority of the participants (81.3%) agree that they need more information about COVID-19 vaccine (p-value = 0.276) as well as they agree on the concerned point about COVID-19 vaccine such as the vaccine may not be effective (p-value = 0.656) and the serious side effects of the vaccine is significantly associated with the vaccine hesitancy (adjust OR = 0.31, 95% CI 0.14-0.69, p-value = 0.004*). Lastly, the majority of the participants agree that COVID-19 vaccination should be mandatory for the public (p-value = 0.669) as well as for all healthcare providers (p-value = 0.313).

Thirdly, experiences related to COVID-19, including personal acquaintance with COVID-19 patient (p-value = 0.128), experience in care for COVID-19 patients (p-value = 0.245), and personally known COVID-19 patient with mortality (p-value = 0.999), were not associated with vaccine acceptance or hesitancy.

Table 2 Behavior Toward COVID-19 Vaccination

Survey Items	Yes n, (%)	No n, (%)
I will take the COVID-19 vaccine as soon as an FDA approved vaccine is available.	243, (81.5)	55, (18.5)
I would recommend the COVID-19 vaccine to family and friends.	294, (98.7)	4, (1.3)
I would recommend the COVID-19 vaccine to my patient.	288, (96.6)	10, (3.4)
I would recommend the COVID-19 vaccine to the community.	293, (98.3)	5, (1.7)

Abbreviations: FDA, food and drug administration; n, number

Table 3 Factors Associated With COVID-19 Vaccination

Factors	Vaccine Acceptance n (%)	Vaccine Hesitancy n (%)	Crude OR	P-value	Adjusted OR	P-value
Characteristic of participants						
Gender (n = 291)				0.246		0.352
Female	94 (79.0)	25 (21.0)	1		1	
Male	145 (84.3)	27 (15.7)	1.43 (0.78–2.61)		1.39 (0.70–2.75)	
Year in medical school (n = 298)				0.137		0.450
Pre-clinic	185 (79.7)	47 (20.3)	1		1	
Clinic	58 (87.9)	8 (12.1)	1.84 (0.82–4.12)		1.42 (0.57–3.53)	
Grade point average (n = 298)				0.931		0.559
≥ 3.50	162 (81.4)	37 (18.6)	1		1	
< 3.50	81 (81.8)	18 (18.2)	1.03 (0.55–1.92)		0.80 (0.38–1.68)	
Medical rights (n = 298)				0.096		0.413
Government service fund, Social security fund, Universal coverage scheme	197 (83.5)	39 (16.5)	1		1	
Self-pay	46 (74.2)	16 (25.8)	0.57 (0.29–1.11)		0.72 (0.33–1.58)	
Hometown (n = 298)				0.898		0.684
Bangkok and urban area	197 (81.4)	45 (18.6)	1		1	
Others	46 (82.1)	10 (17.9)	1.05 (0.49–2.24)		1.19 (0.51–2.79)	
Personal views on COVID-19 and vaccine (n = 298)						
1. Vaccines are important for me to stay healthy as a future physician				0.662		0.442
Disagree	10 (76.9)	3 (23.1)	1		1	
Agree	233 (81.8)	52 (18.2)	1.34 (0.36–5.06)		1.94 (0.36–10.55)	

Table 3 Factors Associated With COVID-19 Vaccination (cont.)

Factors	Vaccine Acceptance n (%)	Vaccine Hesitancy n (%)	Crude OR	P-value	Adjusted OR	P-value
2. It is my role as a future physician to learn about vaccines for myself and my patients				n/a		
Disagree	7 (100.0)	0 (0.0)	1			
Agree	236 (81.1)	55 (18.9)	n/a			
3. The development of a COVID-19 vaccine is important to decrease the spread of the disease				0.774		0.348
Disagree	6 (85.7)	1 (14.3)	1		1	
Agree	237 (81.4)	54 (18.6)	0.73 (0.09–6.20)		0.22 (0.01–5.26)	
4. COVID-19 vaccination is important for the overall public health of our communities				0.774		
Disagree	6 (85.7)	1 (14.3)	1			
Agree	237 (81.4)	54 (18.6)	0.73 (0.09–6.20)			
5. I am likely to be exposed to COVID as a future physician				0.763		0.921
Disagree	15 (78.9)	4 (21.1)	1		1	
Agree	228 (81.7)	51 (18.3)	1.19 (0.38–3.74)		0.93 (0.21–4.16)	
6. COVID-19 vaccination is important for me as a health care provider				0.631		0.042*
Disagree	6 (75.0)	2 (25.0)	1		1	
Agree	237 (81.7)	53 (18.3)	1.49 (0.29–7.59)		10.82 (1.09–107.08)	
7. I need more information about the COVID-19 vaccine				0.681		0.276
Disagree	17 (85.0)	3 (15.0)	1		1	
Agree	226 (81.3)	52 (18.7)	0.77 (0.22–2.71)		0.37 (0.06–2.23)	
8. I trust the information I am receiving about the COVID-19 vaccine from the public health experts				0.016*		0.008*
Disagree	85 (74.6)	29 (25.4)	1		1	
Agree	158 (85.9)	26 (14.1)	2.07 (1.15–3.75)		2.58 (1.28–5.20)	
9. I am concerned that a COVID-19 vaccine may not be effective				0.645		0.656
Disagree	83 (83.0)	17 (17.0)	1		1	
Agree	160 (80.8)	38 (19.2)	0.86 (0.46–1.62)		1.19 (0.55–2.60)	
10. I am concerned about the serious side effects of a COVID-19 vaccine				0.041*		0.004*
Disagree	103 (87.3)	15 (12.7)	1		1	
Agree	140 (77.8)	40 (22.2)	0.51 (0.27–0.97)		0.31 (0.14–0.69)	
11. The COVID-19 vaccination should be mandatory for the public				0.080		0.669
Disagree	84 (76.4)	26 (23.6)	1		1	
Agree	159 (84.6)	29 (15.4)	1.70 (0.94–3.07)		1.23 (0.47–3.21)	

Table 3 Factors Associated With COVID-19 Vaccination (cont.)

Factors	Vaccine Acceptance n (%)	Vaccine Hesitancy n (%)	Crude OR	P-value	Adjusted OR	P-value
12. The COVID-19 vaccination should be mandatory for all health care providers				0.012*		0.313
Disagree	53 (71.6)	21 (28.4)	1		1	
Agree	190 (84.8)	34 (15.2)	2.21 (1.19–4.13)		1.66 (0.62–4.43)	
13. The only reason I will get a COVID-19 vaccine is if it is mandated by the health system/medical school				0.409		0.602
Disagree	196 (80.7)	47 (19.3)	1		1	
Agree	47 (85.5)	8 (14.5)	1.41 (0.62–3.18)		1.28 (0.51–3.24)	
Experiences with COVID-19						
1. I had a history of COVID-19 infection				n/a		
Yes	237 (81.2)	55 (18.8)	1			
No	6 (100.0)	0 (0.0)	n/a			
2. I personally know someone who has had a COVID-19 infection				0.208		0.128
Yes	101 (78.3)	28 (21.7)	1		1	
No	142 (84.0)	27 (16.0)	1.46 (0.81–2.62)		1.71 (0.86–3.39)	
3. I have experience of care for a COVID-19 infection patient				0.366		0.245
Yes	226 (81.0)	53 (19.0)	1		1	
No	17 (89.5)	2 (10.5)	1.99 (0.45–8.89)		3.86 (0.40–37.59)	
4. I personally know someone who has died from COVID-19 infection				0.673		0.999
Yes	221 (81.3)	51 (18.8)	1		1	
No	22 (84.6)	4 (15.4)	1.27 (0.42–3.84)		1.00 (0.29–3.48)	

Abbreviations: n, number; OR, odd ratio

* Binary logistic regression, significant level at < 0.05, adjusted for all variables except U/D, question 2,4 section 2, and question 1 section 3

DISCUSSION

This study was conducted during the COVID-19 pandemic in Thailand. A total of 298 questionnaire responses were collected from 548 first- to sixth- year medical students, resulting in a response rate of 54.3%. The respond rate was higher than the previous study by Lucia et al.,¹¹ which demonstrated the respond rate of 34%. The higher response rate observed in this study may be attributed to the lock down period, as pre-clinical year students (77.9%) were likely more available to complete the survey compared to clinical year students (22.1%) within the medical student cohort.

Most of the participants (81.5%) indicated a willingness to receive the vaccine as soon as it became available following FDA approval. As FDA approval serves as a mandatory requirement for individuals to receive vaccines, this approval could consider a critical step in the authorization of medications. The finding is congruence with the study from Victoria C. Lucia et al.¹¹ demonstrated that 77% of their participants, medical students, preferred to receive COVID-19 vaccine as soon as the FDA approval available. However, nearly one-fifth of the participants (18.5%) would not receive the COVID-19 vaccine as soon as FDA approval. This

could be related to the personal views on COVID-19 vaccine, such as the participants still concerned about the efficacy of the vaccine and its serious side effects.

Additionally, almost all of participants indicated a willingness to recommend the COVID-19 vaccine to their family and friend (98.7%), their patients (96.6%), and the community (98.3%). These finding are consistent a study conducted among medical students by Afonso et al.,¹² which reported that 82% of participants would recommend the COVID-19 vaccine to others. This result highlights positive attitudes toward promoting vaccination. Despite not having completed their degree, the majority of participants demonstrated a strong sense of willingness to advocate for the vaccine within their role as future healthcare professionals.

Participants characteristics, including gender, year in medical school, GPA, medical rights, and hometown, were not statistically associated with vaccine acceptance and hesitancy. Additionally, experiences with COVID-19—such as such as a history of infection, knowing someone personally infected with COVID-19, providing care for a COVID-19 patient, or knowing someone who died from the infection—were also not statistically associated with vaccine acceptance or hesitancy. These finding are similar to a study among medical students in India¹³ which demonstrated that participants characteristics and the experiences with COVID-19 were not associated with vaccine hesitancy. While the efficacy and serious side effect were demonstrated a statistically significant with vaccine hesitancy.

There are three factors associated with vaccine acceptance (1) COVID-19 vaccination is important for me as a healthcare provider (2) I trust the information I am receiving about the COVID-19 vaccine from the public health expert (3) I am concerned about the serious side effect of a COVID-19 vaccine. According to the regression model, vaccine acceptance is associated with the belief that COVID-19 vaccination is important for their role as healthcare providers. This finding is discordance with the study by Lucia et al.,¹¹ which presented that the importance of vaccination for their role of healthcare provider were not associated with vaccine acceptance. This could be influence by the difference between the Thai's medical curriculum, which medical students are also part of healthcare service. The Thai medical students who are in their clinical year will be experiences patients-visit under supervision. This could be highlighting that among our participant, the Thai medical students are also consider themselves as

healthcare provider. Therefore, medical schools should provide both information and service for medical students as part of healthcare provider.

Our study demonstrated that vaccine acceptance among medical students is associated with trust in information provided by public health experts. This finding aligns with the a study among medical students in the US,¹¹ which reported that the vaccine acceptance were associated to trust in information from the public health authorities. Similarly to the study among the US adults illustrated that a lack of trust among the participants was associated with vaccine hesitancy.¹⁴ This finding emphasizes the important role of public health experts in influencing medical students. Advocacy from government health authorities could serve as a key factor in guiding medical students and empowering healthcare professionals to adopt effective disease prevention strategies.

Importantly, concerns about serious side effects of the COVID-19 vaccine were associated with vaccine hesitancy. This finding is consistent with the studies conducted in France,¹⁵ Romania,¹⁶ and the US,¹¹ which highlighted that the unforeseeable and serious side effect are significantly associated with vaccine hesitancy. Additionally, Kernéis et al.¹⁵ highlighted the importance of providing adequate vaccine education and preparing future physicians to effectively communicate with patients about vaccine-related benefits and risks. Since vaccines play a crucial role in disease prevention, this finding highlights the importance of acknowledging potential adverse events among medical students. Transparency and effective communication about potential risks can empower individuals with sufficient information to make informed decisions. Incorporating this information into medical curricula, particularly during crises such as pandemics or the emergence of new diseases, would further enhance awareness and preparedness among future healthcare professionals. Similar to previous research, healthcare workers should be equipped with the skills to recommend the COVID-19 vaccine and provide reassurance to patients.¹⁷

The strength of this study lies in identifying factors associated with COVID-19 vaccination among medical students, which can be utilized to improve health literacy and empower medical students to advocate for increased vaccine uptake and address existing challenges. This study was a cross-sectional study conducted at a medical school and, therefore, may not be generalizable to other medical schools across Thailand. Additionally, this study employed binary

logistic regression to identify factors associated with vaccine hesitancy. While this approach allowed for clear interpretation of independent associations, alternative analytical strategies may provide a more comprehensive understanding of the relationship between attitudes and vaccination behavior. Future research with larger sample sizes may explore these advanced approaches. Furthermore, the quantitative design is limited to identifying associations but cannot capture the underlying reasons behind these associations. Future studies could adopt a qualitative approach to explore the reasons for vaccine hesitancy in greater depth, which could help address gaps and provide medical students with sufficient information to effectively counsel patients about receiving vaccines, as well as to ensure they fully understand the risks and benefits associated with vaccination.

CONCLUSION

During the COVID-19 pandemic, the majority of medical students demonstrated a willingness to receive the COVID-19 vaccine, recognizing its critical role in disease prevention and achieving herd immunity. Most participants acknowledged the importance of vaccination not only for their personal protection but also in fulfilling their roles as future healthcare providers. Furthermore, medical students expressed trust in information provided by public health experts. However, concerns about serious side effects were identified as a factor associated with vaccine hesitancy. To address these concerns, medical curricula should incorporate evidence-based information from experts, focusing on vaccine safety and effectiveness. Enhancing educational programs can promote vaccine uptake and better prepare medical students to advocate for vaccination within their professional roles.

Conflict of Interest

The authors have no conflict of interest. This study is sponsored by the Research Facilitation Division, Faculty of Medicine Vajira Hospital, Navamindradhiraj University. This research receives grant from funding of the Faculty of Medicine Vajira Hospital, Navamindradhiraj University research fund, Bangkok, Thailand.

Acknowledgments

We would like to acknowledge Victoria C. Lucia et al. for the original questionnaire that we have developed in the Thai language for this study and Anucha Kamsom and Witchakorn Ruamtawee for statistical advice. The research was granted from funding of the Faculty of Medicine Vajira Hospital, Navamindradhiraj University research fund, Bangkok, Thailand.

The authors used ChatGPT (OpenAI) solely for language editing and grammatical improvement during the preparation of this manuscript. The authors reviewed, edited, and approved all content and take full responsibility for the accuracy and integrity of the manuscript.

Author Contributions

Conceptualization: WP, BM

Data curation: WP, BM

Formal analysis: WP, BM

Funding acquisition: WP, BM

Investigation: WP

Methodology: WP, BM

Project administration: WP, BM

Resources: WP

Software: BM

Supervision: BM

Validation: BM

Visualization: BM

Writing – original draft preparation: WP, BM

Writing – review & editing: BM

Data Availability Statement

The data that support the findings of this study are available upon request from basmon@nmu.ac.th.

REFERENCES

1. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet* 2020;395(10223): 470-3. doi: [10.1016/S0140-6736\(20\)30185-9](https://doi.org/10.1016/S0140-6736(20)30185-9).
2. Ong SWX, Tan YK, Chia PY, Lee TH, Ng OT, Wong MSY, et al. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. *JAMA* 2020;323(16):1610-2. doi: [10.1001/jama.2020.3227](https://doi.org/10.1001/jama.2020.3227).
3. Epidemiology working group for NCIP epidemic response, Chinese center for disease control and prevention. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Zhonghua Liu Xing Bing Xue Za Zhi* 2020;41(2):145-51. doi: [10.3760/cma.j.issn.0254-6450.2020.02.003](https://doi.org/10.3760/cma.j.issn.0254-6450.2020.02.003).
4. Msemburi W, Karlinsky A, Knutson V, Aleshin-Guendel S, Chatterji S, Wakefield J. The WHO estimates of excess mortality associated with the COVID-19 pandemic. *Nature* 2023;613(7942):130-7. doi: [10.1038/s41586-022-05522-2](https://doi.org/10.1038/s41586-022-05522-2).
5. Ministry of Public Health. Report of COVID-19 Thailand [internet]. 2021 [cited 2024 Jun 8]. Available from: <https://ddc.moph.go.th/viralpneumonia/eng/situation.php>.
6. Sanche S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2. *Emerg Infect Dis* 2020;26(7):1470-7. doi: [10.3201/eid2607.200282](https://doi.org/10.3201/eid2607.200282).

7. Dubé E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger J. Vaccine hesitancy: an overview. *Hum Vaccin Immunother* 2013;9(8):1763-73. doi: [10.4161/hv.24657](https://doi.org/10.4161/hv.24657).
8. Zhang J, While AE, Norman IJ. Knowledge and attitudes regarding influenza vaccination among nurses: a research review. *Vaccine* 2010;28(44):7207-14. doi: [10.1016/j.vaccine.2010.08.065](https://doi.org/10.1016/j.vaccine.2010.08.065).
9. Venkatesan K, Menon S, Haroon NN. COVID-19 vaccine hesitancy among medical students: a systematic review. *J Educ Health Promot* 2022;11:218. doi: [10.4103/jehp.jehp_940_21](https://doi.org/10.4103/jehp.jehp_940_21).
10. Daniel WW. Biostatistics: a foundation for analysis in the health sciences. 6th ed. New York: John Wiley & Sons; 1995.
11. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. *J Public Health (Oxf)* 2021;43(3):445-9. doi: [10.1093/pubmed/fdaa230](https://doi.org/10.1093/pubmed/fdaa230).
12. Afonso NM, Kavanagh MJ, Swanberg SM, Schulte JM, Wunderlich T, Lucia VC. Will they lead by example? Assessment of vaccination rates and attitudes to human papilloma virus in millennial medical students. *BMC Public Health* 2017;17(1):35. doi: [10.1186/s12889-016-3969-x](https://doi.org/10.1186/s12889-016-3969-x).
13. Jain J, Saurabh S, Kumar P, Verma MK, Goel AD, Gupta MK, et al. COVID-19 vaccine hesitancy among medical students in India. *Epidemiol Infect* 2021;149:e132. doi: [10.1017/S0950268821001205](https://doi.org/10.1017/S0950268821001205).
14. Fisher KA, Bloomstone SJ, Walder J, Crawford S, Fouayzi H, Mazor KM. Attitudes toward a potential SARS-CoV-2 vaccine: a survey of U.S. adults. *Ann Intern Med* 2020;173(12):964-73. doi: [10.7326/M20-3569](https://doi.org/10.7326/M20-3569).
15. Kernéis S, Jacquet C, Bannay A, May T, Launay O, Verger P, et al. Vaccine education of medical students: a nationwide cross-sectional survey. *Am J Prev Med* 2017;53(3):e97-104. doi: [10.1016/j.amepre.2017.01.014](https://doi.org/10.1016/j.amepre.2017.01.014).
16. Candrea E, Vargha JL, Todor N, Coman RT, Baican A, Filip A. COVID-19 vaccine acceptance among medical students in Romania. *J Physiol Pharmacol* 2022;73(2). doi: [10.26402/jpp.2022.2.14](https://doi.org/10.26402/jpp.2022.2.14).
17. Schaffer DeRoo S, Pudalov NJ, Fu LY. Planning for a COVID-19 vaccination program. *JAMA* 2020;323(24):2458-9. doi: [10.1001/jama.2020.8711](https://doi.org/10.1001/jama.2020.8711).