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Research article

Prevalence and determinants of COVID-19 vaccine acceptance among vulnerable populations in Thailand: An application of the health belief model

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ABSTRACT

Background: Assessing the acceptance of vaccinations among vulnerable populations is essential to ensure proper coronavirus disease 2019 (COVID-19) control. This study used the Health Belief Model to examine the intention to vaccinate against COVID-19 among vulnerable populations in Thailand.

Methods: This analytical cross-sectional study was conducted in Thailand between October and November 2021. Using multistage random sampling, 945 individuals from vulnerable populations (i.e., older adults, pregnant women, market or street vendors, and individuals with chronic diseases) were selected and invited to complete a self-reported questionnaire. The questionnaire assessed participants' socioeconomic characteristics, COVID-19 preventive measures, knowledge, preventative health beliefs, and vaccine intention. A generalized linear mixed model was used to identify factors associated with the intention to receive the vaccine.

Results: The prevalence of intent to accept the COVID-19 vaccine was 75.03% (95% confidence interval [CI]: 72.16–77.68). The Health Belief Model factors associated with vaccine acceptance were cue to action (adjusted odds ratio [AOR] = 3.13; 95% CI: 2.07–4.71), perceived benefits (AOR = 2.04; 95% CI: 1.38–3.01), and perceived severity (AOR = 1.77; 95% CI: 1.18–2.65). Significant other covariates were wearing a face mask in the previous month (AOR = 2.62; 95% CI: 1.59–4.31), being 1–2 m away from other people (AOR = 1.58; 95% CI: 1.11–2.24), trust in government (AOR = 1.44; 95% CI: 1.03–2.02). Additionally, women were more likely to accept the COVID-19 vaccine compared to men (AOR = 1.43; 95% CI: 1.02–2.01).

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Conclusions: Approximately one quarter of vulnerable individuals do not intend to be vaccinated. Health Belief Models can explain vaccine acceptance, and aid the Ministry of Public Health in planning future efforts to increase vaccine uptake. Healthcare professionals' advice, village health volunteers' information, and partnership collaborations are critical. Facilitating mobile community units, launching educational campaigns, maintaining a distance of 1–2 m from others, and wearing masks may increase COVID-19 vaccine acceptability. This research can help prepare for future pandemics.

Abbreviations

COVID-19	Coronavirus disease 2019
CI	Confidence interval
AOR	Adjusted odds ratio
HBM	Health belief model

1. Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 [1]. The COVID-19 pandemic was declared by the World Health Organization on March 11, 2020; it has had a wide-ranging and detrimental impact on global health and the economy [1,2]. As of February 19, 2023, COVID-19 has led to more than 6.8 million deaths worldwide. The first wave of COVID-19 in Thailand began in March 2020. The epidemic is believed to have begun in Bangkok's boxing stadiums and nightclubs and spread to 68 provinces [3]. In the second wave, in December 2020, many undocumented migrant workers spread the virus in factories and a large wholesale seafood market in Samut Sakhon, infecting market vendors and ultimately resulting in many infected people. The third wave began at Bangkok bars, nightclubs, and entertainment venues and spread nationwide in April 2021 [3]. This wave affected communities, including the most vulnerable people. The mortality rates of COVID-19 were higher in older adults, patients with obesity, and pregnant women than in others [4]. Older people, those with chronic illnesses, pregnant women, and market or street vendors have been identified as vulnerable populations during the COVID-19 pandemic [5–7]. For example, older adults and chronically ill patients frequently experience severe symptoms that can lead to death. Pregnant women are more susceptible to outbreaks and other clinical conditions because of their altered immunological and physiological responses [8]; infection can cause life-threatening conditions in them and their infants, including preeclampsia, leading to morbidity and mortality. Market and street vendors are vulnerable to poverty and economic dynamics [5]. Emergency measures have caused significant economic loss. Despite the "stay at home" mandate, informal workers need to work to support their families. Owing to their mobility and exposure, vendors are at a higher risk of COVID-19 infection and are a potential source of disease transmission in cities [5].

Vaccination is one of the most effective countermeasures against the COVID-19 pandemic [1], it helps reduce disease transmission and promotes herd immunity [9]. According to the literature, 52–84% of vulnerable people in various countries are willing to receive the COVID-19 vaccine [8,10,11]. The Thai government provides free immunization to all citizens, and additional optional vaccines are at individuals' personal expense [2]. In the initial phase of vaccine roll-out in the second quarter of 2021, the Ministry of Public Health declared that vulnerable people would be the first to be vaccinated [3]. Due to COVID-19 vaccine scarcity in Thailand [2], only 0.29% of the population received vaccinations in April 2021 [12]. At present, around 75% of the Thai population have received at least two doses of the COVID-19 vaccine [12].

Vaccine acceptance is critical, and various factors influence vaccination uptake. Socioeconomics, health status, preventive measures, knowledge, and health beliefs affect people's willingness to receive COVID-19 vaccinations [13]. For example, individuals who perceive a disease to be harmful are more willing to be vaccinated [14]. Applying the Health Belief Model (HBM) involves understanding and influencing individuals' health-related behaviors [15]. It enables researchers to explain and predict health-promoting behavior in terms of belief patterns by addressing the relationship between health behaviors and the utilization of health services. The HBM effectively predicts COVID-19 vaccination intentions [8,13,14]. According to the HBM, previous research has focused on only individual vulnerable groups, such as pregnant women or adults with chronic disease [8,10], but no studies have assessed all vulnerable groups.

While previous studies have developed scales to predict vaccination intention using the HBM, it is essential to continue building upon this knowledge and refine the existing scales. The effectiveness of the scales developed in previous studies may vary depending on the specific population, region, or context. For example, one study examined vaccination intention among pregnant women in China [8], while another focused on healthcare workers in Lebanon [13]. Furthermore, a study investigated vaccination intention among chronically ill adults in Vietnam [10]. The current study targeted vulnerable individuals in southern Thailand, such as older adults, pregnant women, market or street vendors, and individuals suffering from chronic diseases. Therefore, conducting studies that encompass different populations and settings is crucial to ensure the applicability and generalizability of the findings. This study focuses on a specific population or context to provide precise and relevant insights into that particular group.

Acceptance of the COVID-19 vaccine among vulnerable populations in Thailand is an unexplored area with far-reaching implications for the entire country. In addition, evidence from 2017 revealed that only 34% of vulnerable Thai people received the influenza vaccine, which is relatively low [16] demonstrating that Thai authorities need to implement effective COVID-19 vaccination strategies. This may also aid in preparing for and responding to future outbreaks. Therefore, the current study used the HBM, a widely used theory for understanding people's health behaviors [15], to examine the intention to accept COVID-19 vaccination and factors associated with intention in vulnerable populations in Thailand. The specific objectives and research questions of the current study are as follows:

Research objective 1: To examine the willingness to receive COVID-19 vaccination among vulnerable populations in Thailand. The specific research question was: "What is the level of acceptance of COVID-19 vaccination among vulnerable populations in Thailand?"

Research objective 2: To explore the factors associated with the willingness to receive COVID-19 vaccination among vulnerable populations in Thailand. The specific research question was "What are the factors associated with the intention to accept COVID-19 vaccination among vulnerable populations in Thailand?"

2. Methodology

2.1. Study design and setting

This analytical cross-sectional study was conducted in Southern Thailand during October and November 2021. The rationale for selecting the Southern region of Thailand for the current study was threefold. First, the Southern region has the third-highest population and demographic diversity, with more than 9 million people residing in the 14 southern provinces [17]. Second, it borders Malaysia and Burma and 54% of the workforce is informal, including migrant workers. The tourism industry employs the most people in this region, and mobility is high. Third, in June 2021, the government declared 10 of the Southern provinces as requiring the strictest control because the number of infected people was higher than in other regions, necessitating COVID-19 containment measures.

2.2. Study participants and sampling

Participants in the current study were populations deemed vulnerable to COVID-19, defined as groups of individuals who have an increased risk of developing severe illness or complications from COVID-19 due to factors such as underlying health conditions, age, socioeconomic status, or disparities in accessing healthcare services and resources. The inclusion criteria for the current study were (i) no history of COVID-19 vaccination, (ii) Thai nationality, (iii) willingness to participate in research, and (iv) belonging to one of four risk groups: market or street vendors aged 18–60 years, people ≥60 years, people with chronic diseases aged 18–60 years, and pregnant women ≥18 years old. This study excluded patients with severe illnesses, except those with congenital diseases for whom data could be collected.

The sample size was estimated using a standard formula [18]. A minimum of 945 participants were required. The required proportions for the sample size calculation were obtained from a previous study conducted in Kuwait [19].

Multistage random sampling was used to select the study participants. First, Southern Thailand's 14 provinces were clustered into

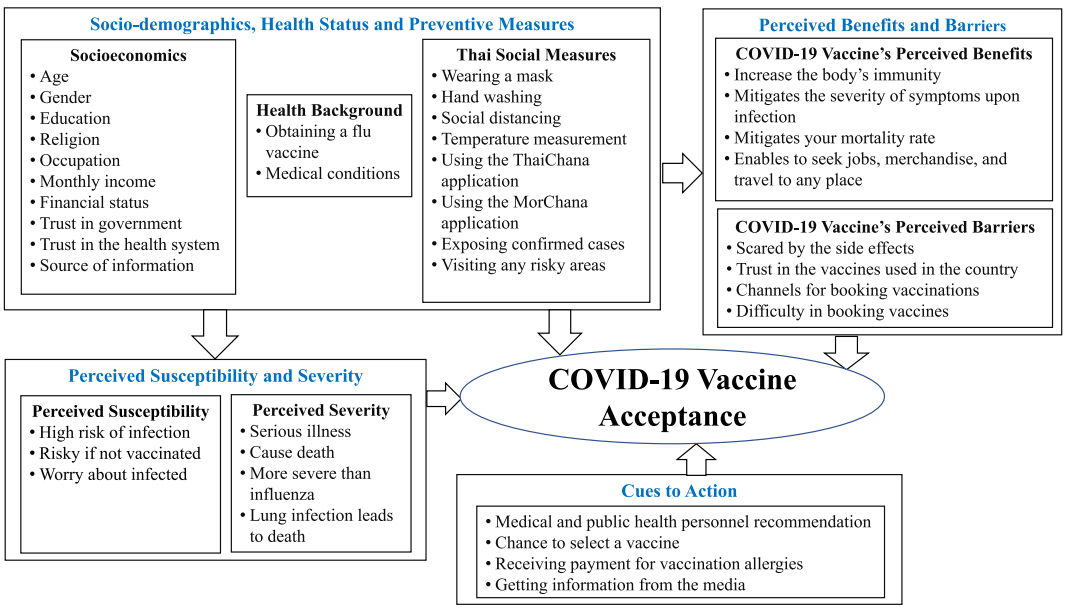

Fig. 1. The health belief model used to assess COVID-19 vaccine acceptance among vulnerable people in Southern Thailand.

seven lower and seven upper provinces based on the health management area. Province names were written on slips of paper and, three provinces were selected from each cluster using simple random sampling by selecting a slip of paper and removing it from the collection of paper slips. Simple random sampling was used to select two districts from each province in the same manner as above. Thereafter, two sub-districts were randomly selected from each district. To select participants, simple random sampling from the list of participants in each sub-district was conducted as described above.

While simple random sampling may not guarantee a perfectly representative sample, it is a widely employed technique that ensures equal and unbiased chances of selection within the target population [20]. In this study, steps were taken to enhance representativeness by employing a multistage random sampling approach that incorporated geographic clustering at different levels (provinces, districts, and sub-districts). This approach accounts for the diversity within the target population and provides a framework for obtaining a more representative sample. Furthermore, due to restricted access to individuals in each area during the COVID-19 pandemic, our use of simple random sampling at each stage, encompassing provinces, districts, and sub-districts, may have resulted in a sample that does not fully represent the target population. It is important to note that these limitations, though not compromising the fundamental validity of our research, highlight the significance of enhancements and further considerations in future studies.

2.3. Theoretical framework

The current study adopted the HBM to examine the intention to accept the COVID-19 vaccination. This model was selected because it provides a practical, theoretical framework for examining the motivations of those who are willing or unwilling to be vaccinated, which is critical. Fig. 1 shows the five key components of the HBM: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action [15]. Perceived susceptibility is a person's belief regarding the likelihood of contracting a disease. Perceived severity refers to an individual's beliefs regarding illness severity. Perceived benefit relates to the positive consequences perceived to result from a specific action. Perceived barriers reflect an individual's assessment of the obstacles that may prevent people from engaging in that particular health behavior. Finally, cues to action stimulate specific behaviors [15].

2.4. Measures

Based on a literature review [10,21–23], a five-part questionnaire was developed.

2.4.1. Socioeconomics and health status

The 13-item questionnaire assessed the participants' socioeconomic characteristics, such as sex, age, and education level. Participants also answered questions regarding their health and lifestyle.

2.4.2. Preventive measures

The questionnaire assessed the participants' compliance with eight COVID-19 preventive measures, such as wearing face masks, hand washing, and maintaining physical distancing. Researchers asked respondents how often they followed Thailand's social actions in the previous month. Respondents selected "never," "sometimes," "almost every time," or "every time" for social measures [21]. Respondents also reported installing Thailand's COVID-19 smartphone application, being exposed to any confirmed cases, and traveling to high-risk areas; there were two options: "yes" and "no."

2.4.3. COVID-19 knowledge

Participants' knowledge of COVID-19 was assessed using 12 items in terms of the cause of infection, transmission, symptoms, prevention, and treatment. The respondents selected one correct response from a list of multiple choices. Correct answers earned one point, whereas incorrect responses earned zero points. Bloom's cut-off point classifies knowledge as low ($<$60 %), moderate (60–79%), and high ($\geq$80%) [22].

2.4.4. COVID-19-preventive health beliefs

Participants' COVID-19-preventive health beliefs were assessed using 19 items: The HBM included susceptibility, infection severity, COVID-19 vaccination barriers and benefits, and cues to action. The researcher asked respondents to rate each statement out of three points (3 = agree, 2 = unsure, and 1 = disagree). For example, for the statement, "you are at a high risk of contracting COVID-19", perception ratings were low (less than or equal to the mean) or high (above the mean) [24].

2.4.5. COVID-19 vaccine intention

Participants' intention to receive the COVID-19 vaccine was assessed using a single yes/no question: "Do you intend to receive the COVID-19 preventive vaccine within a year?" [10].

2.4.6. Validity and reliability

This study employed the index of item-objective congruence, a test development procedure for assessing content validity. It is worth noting that the selection of three experts for content validity assessment is a common practice in many research studies [11,14,25]. This sample size is often considered sufficient for initial content validity assessment. Three experts in behavioral science, epidemiology, and medicine evaluated the questionnaire's content validity for clarity, accuracy, and completeness, yielding an

Table 1
Socioeconomic factors among people vulnerable of COVID-19 (n = 945).

Socioeconomic factors	Number	Percentage
Province		
A	213	22.54
B	179	18.94
C	176	18.62
D	147	15.56
E	135	14.29
F	95	10.05
Sex		
Male	271	28.68
Female	674	71.32
Age (Years)		
≤30	168	17.78
31–40	153	16.19
41–50	141	14.92
51–59	179	18.94
≥60	304	32.17
Mean ± SD	49.73 ± 18.29	
Median (IQR: Q1-Q3) (Min-Max)	50 (34–64) (17–99)	
Highest education level		
Uneducated	80	8.47
Primary school	386	40.84
Secondary school	337	35.66
Bachelor's degree	139	14.71
Higher than Bachelor's degree	3	0.32
Religion		
Buddhism	800	84.66
Islam	145	15.34
Occupation		
Merchant	310	32.80
Agriculturist	297	31.43
Unemployed/jobless	141	14.92
Employee	106	11.22
Self-employed	79	8.36
Public official/Government employee/Government officer	12	1.27
Medical condition		
No	529	55.98
Yes	416	44.02
Income (Baht/month)		
Less than or equal to 10,000	415	43.92
10,001–20,000	399	42.22
20,001–30,000	106	11.22
Above 30,001	25	2.64
Financial status		
Insufficient and indebted	176	18.62
Insufficient but debt-free	157	16.61
Sufficient without savings	421	44.55
Sufficient with savings	191	20.22
Vaccinated against influenza in the past year		
Yes	383	40.53
No	562	59.47
Believe that the government could cope with the COVID-19 pandemic		
Strongly believe	186	19.68
Rarely believe	484	51.22
Do not believe	275	29.10
Believe the public health system could cope with COVID-19		
Strongly believe	477	50.48
Rarely believe	386	40.85
Do not believe	82	8.67
Provided with health information concerning COVID-19		
No	41	4.34
Yes	904	95.66
Source of this information[a]		
Village health volunteer	743	78.62
Public health officer	684	72.38
Radio/Television	659	69.74
Internet/Facebook/Line	485	51.32
Public relations sign	331	35.03
Friend	255	26.98
Another community volunteer	18	1.90
Officer of a non-governmental organization	7	0.74

[a] Multiple sources of information were selected.

item-objective congruence (IOC) index ranging from 0.66 to 1. According to established criteria [26], an IOC index between 0.5 and 1.00 indicates the acceptability of an item. However, if the IOC falls below 0.5, it suggests that the item may require removal or further review in order to improve its alignment with the intended construct. Before the main study, a pilot study of 30 participants was conducted to assess the feasibility of the questionnaire. As a result, the health belief's Cronbach's alpha coefficient was good at 0.89, and the knowledge's Kuder-Richardson 20 reliability was acceptable at 0.76.

2.5. Data collection

The research team contacted the public health staff in each district and enquired regarding their willingness to act as research assistants. The university requested permission to collect research data from the chief of the provincial public health office, district public health director, health center director, and community hospital director. We trained the research assistants. The research assistants recorded the interview data in Google Forms.

2.6. Statistical analysis

Data analysis was conducted using STATA version 10 (StataCorp., Texas, USA). After descriptive statistics, bivariate analysis with simple logistic regression was used to identify the determinant factors for COVID-19 vaccine acceptance. Then, covariates with p-values <0.25 [27] and the five factors of health belief were processed into multivariable analysis using a generalized linear mixed model with the six provinces selected as "random effects" corresponding to various clusters in the sampling design.

Backward elimination was used for model fitting. The goodness-of-fit model selected the Akaike's information criterion's best correlation structure. An adjusted odds ratio (AOR) with a 95% confidence interval (CI) and $p < 0.05$ was considered statistically significant. An AOR of 1 indicated no association, >1 indicated a positive association, and ≤ 1 indicated a protective effect.

3. Results

3.1. Participant characteristics

In total, 945 participants completed the survey. Most participants were female (71.32%), 32.17% were over 60 years old, 50.69% had completed secondary school, and most (84.66%) were Buddhist. The most common occupation was merchants (32.80%), followed closely by agriculturist (31.43%). Almost half had a health problem (44.02%) and an income $\leq$10,000 baht per month (43.92%). Nearly half of the participants (44.55%) had good financial status without savings. Nearly half had received an influenza vaccination the previous year (40.53%). More than half of the participants rarely believed that the government could handle the COVID-19 pandemic (51.22%), but they did believe the public health system could (50.48%). Regarding COVID-19, nearly all participants reported receiving health-related information (95.66%), with village health volunteers (VHVs) providing the majority of the information (78.62%) (Table 1).

3.2. COVID-19 vaccine uptake intentions

Three-quarters of participants (75.03%) reported an intention to obtain the COVID-19 vaccination within a year, while 24.97% did not intend to do so (Table 2).

3.3. Multivariable analysis

The random effects model showed that respondents with a high perception of COVID-19 severity were 1.77 times (95% CI: 1.18–2.65) more likely to receive the COVID-19 vaccine than those with a low perception. Respondents with a high benefit perception were 2.04 times (95% CI: 1.38–3.01) more likely to receive the COVID-19 vaccine than respondents with a low benefit perception. Perceived susceptibility and barriers were not statistically significant. During the COVID-19 pandemic, individuals with a high level of cue to action encouraging vaccination were 3.13 times (95% CI: 2.07–4.71) more likely to receive the vaccine compared to those with a low level of such cues. Women were 1.43 times (95% CI: 1.02–2.01) more likely to want to receive the COVID-19 vaccine than men.

Respondents with high confidence that the government could handle the COVID-19 pandemic were 1.44 times (95% CI: 1.03–2.02)

Table 2
Number, percentage, and 95% confidence interval of participants intending to receive the COVID-19 vaccine within a year (n = 945).

Intention to receive the COVID-19 vaccine	Number	Percentage	95% CI
No	236	24.97	22.32–27.84
Yes	709	75.03	72.16–77.68

CI, confidence interval.

more likely to intend to receive the COVID-19 vaccine than those with low confidence. Individuals who wore a face mask in public spaces during the previous month, either almost every time or every time, were 2.62 times (95%CI: 1.59–4.31) more likely to express willingness to receive the COVID-19 vaccine than those who never or occasionally wore a face mask. Those who distanced themselves 1–2 m away from others almost every time or every time were 1.58 times (95% CI: 1.11–2.24) more likely to receive the COVID-19 vaccine than those who were never or sometimes distanced 1–2 m from others (Table 3).

4. Discussion

This study investigated the acceptance of vulnerable people and their relationship to the HBM domains. The main results are as follows. First, one-quarter of the vulnerable people did not intend to receive COVID-19 vaccination within a year. Second, cue to action, perceived benefits, perceived severity, wearing a face mask in the previous month, being 1–2 m away from anyone, government trust, and sex were significant predictors of vaccination intention. These results suggest that in the event of future disease outbreaks, the vaccine information communicated by the personal physician and village health volunteer will be an effective strategy for encouraging vulnerable people to get vaccinated. To the best of our knowledge, this is the first study to examine the acceptance of the COVID-19 vaccine among vulnerable people in Thailand, including the elderly, people with chronic diseases, pregnant women, and market or street vendors.

Three of four participants in the current study reported their intention to receive the COVID-19 vaccine within a year. Similar results have been reported in the Republic of China [8]. As a possible explanation, over three-quarters of our participants received information about COVID-19 from VHVs, a group of primary healthcare delivery system volunteers who support Thailand's healthcare system by playing a health promotion role in their village [28]. Previous studies have demonstrated that VHVs assisted in communicating COVID-19 vaccine information to the public and encouraged acceptance of the vaccine as a positive way to reduce the spread of the disease [28]. Therefore, it is vital to train VHVs to maximize their potential by increasing their knowledge of COVID-19 vaccines and their ability to communicate with vulnerable groups to encourage them to get vaccinated. The Ministry of Public Health should campaign for VHVs to vaccinate against COVID-19 because they need to be role models in persuading people in the community to get vaccinated.

Consistent with other studies demonstrating the ability of HBM constructs to predict COVID-19 vaccination-related behaviors [14], our findings suggest that HBM domains could be used to better understand vaccine uptake behavior. The cue to action was the most influential factor affecting the willingness for receiving COVID-19 vaccination. A previous study revealed that people chose to get the COVID-19 vaccine because health authorities and facilities recommended it [10]. The current results demonstrate the trust of most people in the public health system. According to a Vietnamese study, vulnerable people who were motivated to perform well were three times more likely to receive a COVID-19 vaccine than those who were motivated to perform poorly [10]. Because vulnerable

Table 3
Factors associated with the willingness to receive the COVID-19 vaccine (n = 945).

Factors	Number	% intend to receive the vaccine	COR	AOR	95% CI of AOR	P-value
Perceived susceptibility						0.511
Low	564	74.47	Ref.	Ref.		
High	381	75.85	1.07	0.87	0.58 to 1.30	
Perceived severity						0.005
Low	454	74.67	Ref.	Ref.		
High	491	75.36	1.03	1.77	1.18 to 2.65	
Perceived benefits						<0.001
Low	324	64.20	Ref.	Ref.		
High	621	80.68	2.32	2.04	1.38 to 3.01	
Perceived barriers						0.958
Low	482	73.65	Ref.	Ref.		
High	463	76.46	1.16	0.99	0.71 to 1.38	
Cues to action						<0.001
Low	579	67.88	Ref.	Ref.		
High	366	86.34	2.99	3.13	2.07 to 4.71	
Sex						0.038
Male	271	71.22	Ref.	Ref.		
Female	674	76.56	1.31	1.43	1.02 to 2.01	
Believe that the government could deal with the COVID-19 pandemic						0.037
Do not and rarely believe	275	69.82	Ref.	Ref.		
Strongly believe	670	77.16	1.46	1.44	1.03 to 2.02	
Wore a face mask in the past one-month						<0.001
Never - Sometimes	109	56.88	Ref.	Ref.		
Almost every time- every time	836	77.39	2.59	2.62	1.59 to 4.31	
Distanced 1–2 m from anyone						0.010
Never - Sometimes	332	66.57	Ref.	Ref.		
Almost every time- every time	613	79.61	1.96	1.58	1.11 to 2.24	

CI, confidence interval; COR, crude odds ratio; AOR, adjusted odds ratio.

people change their minds when discussing vaccines with their doctors and nurses at hospitals [29], personal doctors may play a crucial role in advising vulnerable populations and increasing vaccination acceptance. Pharmacists, nurses, and public health officers should be encouraged to proactively recommend COVID-19 vaccinations.

Moreover, people with a high perception of disease preventive benefits were more likely to accept a COVID-19 vaccine than those with a low perception. According to a study in the People's Republic of China, people who perceived that the COVID-19 vaccine could prevent and control disease were 1.56 times more likely to be vaccinated than those who did not (95% CI: 1.08–2.25) [9]. In our study, this likelihood was even higher at 2.04 times (95% CI: 1.38–3.01). In Malaysia, public willingness to accept the COVID-19 vaccine increases when people perceive its benefits, such as reducing infection risk, anxiety, and symptoms related to various complications that may lead to death [30]. Vulnerable Australians perceived the vaccine protected themselves, their family, friends, and the community, including the ability to travel domestically and internationally, return to normal life, and visit friends in aged care without restrictions [31]. It is necessary to conduct educational campaigns emphasizing the advantages of vaccination, such as returning to social normalcy and prevention of infections and complications.

Furthermore, vulnerable people are more likely to receive the COVID-19 vaccine if they believe the disease is severe, which is consistent with previous research [8]. Those who comprehend the severity of COVID-19 complications, fear infection, and realize that they will undoubtedly suffer if those who are infected do not receive the vaccine [14]. However, individuals who believe the disease is severe may choose not to be vaccinated if they believe that the vaccine is unsafe [14]. Vulnerable populations have a high COVID-19 mortality rate [10]. Facilitating effective communication among the public on various issues is crucial. This can be achieved through widespread, trusted media coverage, coupled with the implementation of a national policy that includes the introduction of mobile units for home vaccination services in the near future.

These mobile units will play a key role in ensuring accessibility and outreach, complementing the broader communication strategy supported by media coverage. While media coverage disseminates information widely, mobile units bridge the gap by bringing vaccination services directly to communities [32,33]. This approach is particularly beneficial for individuals who may face barriers in accessing centralized vaccination centers, such as transportation challenges or geographical distance.

Moreover, media coverage provides extensive visibility, and mobile units enable targeted outreach to specific populations or regions [34,35]. In the United States, for instance, mobile health clinics have demonstrated success in reaching vulnerable populations by offering services directly at curbsides in underserved communities [34]. Strategic deployment of these units to areas with higher vaccine hesitancy or lower vaccination rates allows public health officials to address specific concerns and customize communication efforts to local needs.

In addition, women were more likely to accept the COVID-19 vaccine than men; unlike in other studies [25] where men were more likely to receive a vaccine because epidemiological evidence suggested that they were more at risk of infection and have a higher mortality rate. It is possible that, as in an Australian study [36], women in our study may have engaged in more health-protective hygiene and distancing behaviors, such as handwashing, hand sanitization, and surface cleaning, than men. However, we should not neglect female health promotion in favor of male interventions. Providers should promote vaccination regardless of sex.

Mask-wearers are more likely to be vaccinated than non-mask-wearers. According to a Chinese study, people who always wore masks were 1.34 times more likely to accept the COVID-19 vaccine than those who did not [21]. Due to the belief that they will become seriously ill if infected, some people wear masks and receive vaccines [37]. Healthcare professionals should encourage vulnerable groups to wear masks when going outdoors.

Individuals who consistently maintained a distance of 1–2 m from non-family members were more inclined to accept the COVID-19 vaccine compared to those who rarely or occasionally observed this precaution. According to a survey in Saskatchewan, older adults who lived in social isolation, with minimal or no contact with others, expressed concerns about the spread of the virus and were more likely to accept vaccination [37]. Future interventions should focus on educating older adults to avoid crowds and maintain a 1–2 m distance from individuals coughing or sneezing.

The influence of maintaining a safe distance and wearing masks on vaccine acceptability is acknowledged [21,37]. Public health authorities, including the Ministry of Public Health, play a pivotal role in promoting these behaviors, influencing vaccine acceptability [37]. The present study underscores the interplay between individual choices and public health measures, illustrating their collective significance in enhancing vaccine acceptability, particularly in the context of a pandemic.

In addition, consistent with a Belgian study, participants who believed that the government could effectively manage the COVID-19 pandemic were more likely to receive the vaccine [38]. As the evidence shows a need for trusted information [29], the Thai government should target messaging and community engagement via television and radio, where 70% of respondents receive information. Health authorities should collaborate with VHVs, village heads, local politicians, and private and other government officers to promote vaccination, build public confidence, and reduce vaccine reluctance.

5. Limitations

Certain limitations of the current study merit mentioning. First, this study relied on self-reported questionnaires rather than objective measurements of actual vaccination, which is subjective and can lead to bias. Second, a causal relationship was not established. However, the information can also be used to assess COVID-19 vaccine acceptance. Third, the data were from Southern Thailand, and the findings may not apply to vulnerable people in other regions or countries. Fourth, we used simple random sampling at each level, but did not use targeted sampling of subgroups, so diverse characteristics might not have been detected. The utilization of simple random sampling may have resulted in a sample population that does not fully mirror the target population. To ensure equitable representation, future sampling procedures should consider proportional selection based on population demographics. Fifth, while we

acknowledge the impact of the time lag on the practical implications of our study's findings during the endemic phase of COVID-19, the focus on the health behavior model provides valuable insights into individual health beliefs and behaviors beyond vaccination. Understanding health behaviors is crucial for the development of effective interventions targeting various health domains. Future studies should prioritize recent data to inform current practices and policies.

5. Conclusion

This study supports the HBM theory that perception encourages vulnerable people to protect themselves from disease. Our findings showed that the acceptance rate of the intention to receive the COVID-19 vaccine was 75.03%. Cues to action had the most significant potential to increase acceptance of the COVID-19 vaccine. This study also demonstrated the importance of perceived severity, perceived benefit, sex, trust in the government, wearing masks, and social distancing. Future research may examine the COVID-19 vaccine's side effects on vulnerable populations. It may investigate communication with vulnerable people in coping with emerging pandemics.

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Ethics statement

Informed consent was obtained from all the participants in this study. The research was conducted in accordance with the Declaration of Helsinki, and approved by the Research Ethics Committee of Walailak University (WUEC-21-231-01, August 27, 2021).

Additional information

No additional information is available for this paper.

Data availability statement

Data will be made available on reasonable request.

CRediT authorship contribution statement

Navarat Rukchart: Writing – original draft, Resources, Methodology, Investigation. **Kanit Hnuploy:** Writing – original draft, Visualization, Methodology, Formal analysis, Data curation. **Sameh Eltaybani:** Writing – review & editing. **Kittipong Sonlom:** Visualization, Formal analysis, Data curation. **Nirachon Chutipattana:** Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Cua Ngoc Le:** Formal analysis. **Patthanasak Khammaneechan:** Resources, Methodology. **Wajinee Jongjit:** Resources, Methodology. **Suttakarn Supaviboolas:** Resources, Methodology.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e26043.

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