

Factors associated with COVID-19 Vaccine Hesitancy in Thai Seniors

Saran Thanaplueti Wong¹
Sirintorn Chansirikarnjana¹
Orapitchaya Sriwannopas¹
Taweewat Assavapokee¹
Pichai Ittasakul²

¹Division of Geriatric Medicine, Department of Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand;

²Department of Psychiatry, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Objective: Older people are the most vulnerable group for developing SARS-CoV-2 infection. Although vaccination against coronavirus disease 2019 (COVID-19) reduces infection, hospitalization, and mortality rates, some older people have refused to get vaccinated. Our study aimed to evaluate factors associated with COVID-19 vaccine hesitancy among Thai seniors.

Methods: We conducted a cross-sectional telephone survey on vaccine hesitancy in a geriatric clinic at Ramathibodi Hospital in Bangkok, Thailand. Patients aged ≥ 60 years were contacted and interviewed by trained interviewers between June 20 and July 25, 2021.

Results: In total, we interviewed 282 participants aged 60–93 years (mean age 73.0 ± 7.5 years). We found that 44.3% of participants were hesitant to get a COVID-19 vaccination. Factors associated with high vaccine hesitancy were low education, lack of confidence in the healthcare system's ability to treat patients with COVID-19, vaccine manufacturers, being offered a vaccine from an unexpected manufacturer, and a low number of new COVID-19 cases per day.

Conclusion: The prevalence of COVID-19 vaccine hesitancy among Thai seniors is relatively high, and is associated with specific factors. These findings will help in promoting COVID-19 vaccination among Thailand's senior citizens.

Keywords: vaccine acceptance, vaccine refusal, elderly, older adult, SARS-CoV-2

Introduction

As of the end of June 2021, over 180 million people worldwide have suffered from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, with 3.9 million deaths (2.17% mortality rate).¹ COVID-19 caused disruptions in many aspects of the health system,² and systematic reviews suggested the high prevalence of COVID-19 is potentially associated with long-term burden.^{3,4} In addition, co-infection of SARS-CoV-2 and endemic infections in Asia is a major concern.^{5,6} As of June 30, 2021, 259,301 people in Thailand had been infected with COVID-19, and there were 2,023 deaths.⁷ The most vulnerable group in the infected population was older people. SARS-CoV-2 infection in older people, particularly males, has been associated with more severe symptoms.^{8–11} In the United States, people aged 65 years and over accounted for approximately 80% of all COVID-19 deaths. Individuals over age 85 years had 630 times the mortality rate of those aged 18–29 years.¹² The Ministry of Public Health in Thailand reported death from SARS-CoV-2 among people over age 70 years was up to 12.1%.¹³

Many studies showed that COVID-19 vaccination decreased infection, hospitalization, and mortality rates. An observational study in Israel using national

Correspondence: Pichai Ittasakul
Department of Psychiatry, Faculty of Medicine Ramathibodi Hospital, Mahidol University, 270 Rama VI Road, Ratchathewi, Bangkok, 10400, Thailand
Tel +66 2-201-1235
Fax +66 2-354-7299
Email pichai118@gmail.com

surveillance data found that the Pfizer-BioNTech mRNA vaccine BNT162b2 was 96.5%, 98.0%, and 98.1% effective in preventing SARS-CoV-2 infection, hospitalization, and death, respectively.¹⁴ An interim analysis of the Oxford-AstraZeneca ChAdOx1 nCoV-19 vaccine showed 70.4% efficacy in preventing SARS-CoV-2 infection.¹⁵ A study in Chile using an inactivated SARS-CoV-2 vaccine (CoronaVac) showed its effectiveness in preventing infection, hospitalization, and death was 65.9%, 90.3%, and 86.3%, respectively.¹⁶ Therefore, to successfully manage SARS-CoV-2 infection, countrywide COVID-19 vaccination is needed to achieve herd immunity.

The ChAdOx1 nCoV-19 and CoronaVac vaccinations have been the most commonly available vaccines in Thailand. The ChAdOx1 nCoV-19 vaccination is mostly given to people over age 60 years. However, some older people refuse to be vaccinated against COVID-19. The Strategic Advisory Group of Experts on Immunization from the World Health Organization (WHO) defined vaccine hesitancy as the delay in acceptance or refusal of vaccination despite availability of vaccination services.^{17,18} Factors that can influence vaccine hesitancy can be grouped into three categories: contextual, individual and group, and vaccine/vaccination-specific influences.^{17,18}

A systematic review and meta-analysis of intended uptake and refusal of COVID-19 vaccines from 13 countries showed 60% of participants intended to get vaccinated, and 20% intended to refuse.¹⁹ Factors associated with vaccine refusal were being female, younger, having a lower income or education level, and being in an ethnic minority group.¹⁹ Despite older people benefiting the most from COVID-19 vaccination, few studies have investigated COVID-19 vaccine hesitancy in this group. To date, there has been no study on COVID-19 vaccine hesitancy in Thailand. Different social contexts, cultures, and politics may affect a person's intention to get vaccinated. Our study aimed to evaluate factors associated with COVID-19 vaccine hesitancy in Thai seniors. The findings will offer important insights for promoting vaccination among older people in Thailand.

Materials and Methods

Setting and Study Design

This study protocol was approved by the Human Research Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University (COA. MURA2021/441). We conducted a cross-sectional

telephone survey about vaccine hesitancy in an outpatient geriatric clinic at Ramathibodi hospital. Over the last 2 years, this hospital had approximately 2,600 senior patients and 16,000 clinic visits. Patients aged 60 years and over who visited the geriatric clinic in the past 2 years were retrieved from the hospital database. These patients were contacted and invited to participate in this survey. Because we performed a telephone-based survey and because it was inconvenient for participants to sign written informed consent forms and manage documents during the pandemic, we did not obtain written informed consent. However, all participants gave verbal informed consent, which was recorded in accordance with the verbal informed consent protocol approved by the Human Research Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University. Patients who agreed to participate were interviewed via telephone by a trained interviewer between June 20 and July 25, 2021. The survey was conducted in the Thai language. This study was conducted according to the Declaration of Helsinki and Good Clinical Practice guidelines.^{20,21}

Sample Size and Sampling

The sample size was calculated with based on a 95% confidence level, 0.05 margin of error, assuming an observed proportion of respondents selecting a specific response option of 50%, and finite correction for the study population of 2,600 patients. Using this method, the calculated sample size was 335 patients. The list of patients from the database was reordered using computerized randomization, and patients were contacted according to their order in the new randomized list.

Questionnaire

The questionnaire used in this study was self-developed following a review of the literature^{22–34} and agreement among experts. The questionnaire was structured into four sections covering sociodemographic data, medical history, COVID-19 pandemic-related information, and COVID-19 vaccine-related information. A pilot sample (N=10) was used to improve the language and clarity of expression of the survey items. The data from the pilot sample were not used in subsequent analyses. The final version of the questionnaire required around 30–45 minutes to complete. The questionnaire was originally developed in the Thai language.

Sociodemographic Characteristics and Medical History

Participants' sociodemographic characteristics were obtained, including age, gender, ethnicity, marital status, education, employment status, current residence, monthly income, and income loss due to COVID-19. In addition, participants were asked to report their medical history, including their body mass index (BMI), ambulation, hearing problems, vision problems, history of smoking and drinking alcohol, food and drug allergies, history of previous vaccinations (including influenza, pneumococcal, zoster and diphtheria-tetanus-pertussis vaccines), underlying diseases (including diabetes, chronic kidney disease, respiratory disease, and psychiatric illness), subjective cognitive complaints, hospitalization in the past year, and overall health perception.

COVID-19 Pandemic-Related Information

Participants were asked about their knowledge about COVID-19, primary source of COVID-19 information, confidence in COVID-19 information from government and public health agencies, confidence in the Thailand healthcare system's ability to treat patients with COVID-19, government measurements for controlling COVID-19 infection, risk for COVID-19 infection, self-perception about having severe COVID-19 infection, and attitude toward social distancing. Moreover, participants were asked if there was a patient with COVID in their neighborhood, if they knew anyone who had been infected with COVID-19, and if they knew anyone who had died from COVID-19.

COVID-19 Vaccine-Related Information

Participants were asked if they were hesitant to get a COVID-19 vaccine, which was defined as delay in acceptance or refusal of vaccination despite availability of vaccination services. They were asked if they knew anyone who had had a serious reaction to the COVID-19 vaccine, wanted to be vaccinated for COVID-19, thought the manufacturer of the COVID-19 vaccine influenced their decision to get vaccinated, and who they thought was the most desirable COVID-19 vaccine manufacturer. They were also asked whether they still wanted to get vaccinated if they were offered vaccines from a manufacturer they did not expect. Furthermore, those who were hesitant to receive a COVID-19 vaccine were asked why they were

hesitant, and all participants were asked if they were willing to have the vaccine.

Association Between Daily New COVID-19 Cases and Vaccine Hesitancy

Thailand was experiencing a new surge of COVID-19 infections at the time of our study, which was caused by a highly contagious Delta variant.³⁵ We retrieved daily new COVID-19 patient data for Thailand from the WHO (COVID-19) official website³⁶ to explore the association between the number of daily new cases and COVID-19 vaccine hesitancy.

Statistical Analysis

Nominal data (eg, presence of underlying diseases) were summarized as numbers and percentages. Continuous data (eg, age) were summarized as mean \pm standard deviation (SD), or median and interquartile range based on the normality of the distribution. Group comparisons were performed using chi-square or Fisher's tests for categorical variables and independent *t*-tests or Mann-Whitney *U*-tests for continuous parameters of continuous variables. Factors influencing vaccine hesitancy were investigated using binary logistic regression. Only variables that were statistically significant in the univariate logistic regression model were investigated in the multivariate logistic regression model. All statistical analyses were performed using SPSS version 26.0 for Windows (IBM Corp., Armonk, NY, USA). A *p*-value <0.05 was considered statistically significant.

Results

Of the 1,095 patients contacted, 282 (25.8%) patients were able to participate in the interview and were enrolled in this study. The remaining 813 (74.2%) patients were excluded from our study (Figure 1). In total, 125 (44.3%) of the 282 participants had vaccine hesitancy, and 157 (55.7%) indicated willingness to receive a vaccine.

Participants' Sociodemographic Characteristics and Medical History

Sociodemographic data are shown in Tables 1 and 2. Participants were older adults aged 60–93 years (mean \pm SD age: 73.0 \pm 7.5 years). Most participants were female (70.9%), of Thai ethnicity (96.5%), married (63.5%), and lived in Bangkok (67.4%). A comparison of characteristics between the vaccine hesitancy and vaccine acceptance

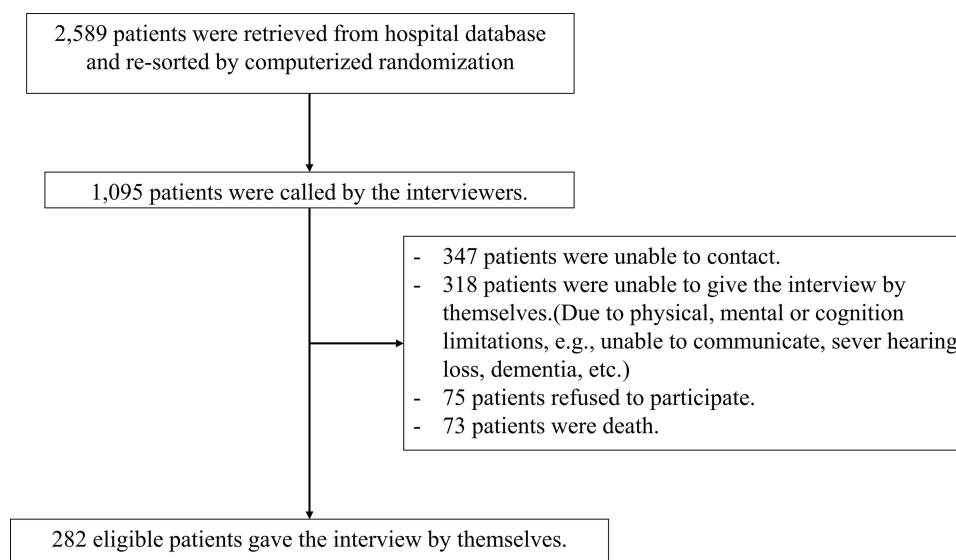


Figure 1 Study flow diagram.

groups showed that those who had an education level of elementary school or below had higher vaccine hesitancy than those who had graduated with a bachelor's degree or higher (odds ratio [OR] 2.56, 95% confidence interval [CI]: 1.06–6.16, $p=0.037$) (Table 3).

COVID-19 Pandemic Related Information

Table 4 presents the results for the items covering COVID-19 pandemic-related information. Most participants (62.0%) thought they knew quite a lot or a lot about COVID-19, and the majority (55.3%) said their COVID-19 information came from television or radio. Comparison of the vaccination hesitancy and vaccine acceptance groups showed that those who were not confident in the ability of the Thailand healthcare system to treat patients with COVID-19 were more likely to have vaccine hesitancy than those who were confident (OR 6.41, 95% CI: 1.28–32.10, $p=0.024$) (Table 3).

COVID-19 Vaccine-Related Information

COVID-19 vaccine related information outcomes are depicted in Table 4. Most participants (89.3%) did not know anyone who was severely allergic to the COVID-19 vaccine, but 44.3% expressed vaccine hesitancy. Approximately one-third of participants (33.3%) desired the Oxford-AstraZeneca ChAdOx1 nCoV-19 vaccine, followed by Moderna mRNA-1273 SARS-CoV-2 vaccine (16.7%), and the Pfizer-BioNTech mRNA vaccine BNT162b2 (9.6%) (Figure 2). The most common reasons for COVID-19 vaccine hesitancy were fear of COVID-19

vaccine-related adverse effects (35.2%), possible complications caused by an underlying disease (26.4%), and lack of confidence in COVID-19 vaccine efficacy or quality (16.8%) (Figure 3). The most important reasons for vaccination were that the COVID-19 vaccine could prevent severe COVID-19 infection or death (42.9%) and protect them from COVID-19 infection (21.3%), and that they were vulnerable group for COVID-19 infection (13.1%) (Figure 4). The comparison of the vaccine hesitancy and vaccine acceptance groups showed that people who believed COVID-19 vaccine manufacturers influenced their decision to receive vaccination had higher vaccine hesitancy (OR 5.16, 95% CI: 2.65–10.04, $p<0.001$). People who said they would reject vaccination if they were offered a vaccine from a manufacturer they had not heard of before had more vaccine hesitancy compared with those who accepted receiving different vaccines (OR 3.16, 95% CI: 1.26–7.95, $p=0.014$) (Table 3).

Association Between Daily New COVID-19 Cases and Vaccine Hesitancy

On the first day of our survey (June 20, 2021), there were 3,682 new COVID-19 cases. The number of new cases per day had substantially increased by the end of this study (on July 22, 2021) to 15,355 patients per day. We categorized the number of daily new cases into four groups: <5,000, 5,000–7,499, 7,500–9,999, and $\geq 10,000$ cases per day (Table 4). We discovered that when there were <5,000 new cases per day, people were more

Table 1 Baseline Characteristics of All Participants (N=282).

Characteristics	n	%
Age		
60–69 years	99	35.1
70–79 years	123	43.6
80+ years	60	21.3
Gender		
Male	82	29.1
Female	200	70.9
Ethnicity		
Thai	273	96.5
Chinese	9	3.2
Marital status		
Single	50	17.7
Married	179	63.5
Divorced	10	3.5
Widowed	43	15.2
Education		
Elementary school or below	41	14.5
High school	44	15.6
Bachelor's degree or higher	197	69.9
Current residence		
Bangkok	190	67.4
Other provinces	92	32.6
Employment		
Retired	233	82.6
Part-time job	24	8.5
Full-time job	25	8.9
Monthly income (baht) (n=216)		
10,000 or less	53	18.8
10,001–20,000	52	18.4
20,001–30,000	44	15.6
30,001 or more	67	23.8
Income loss due to COVID-19		
Yes	53	18.8
No	229	81.2
BMI (kg/m²)		
<18.5	12	4.3
18.5–22.9	111	39.4
23–24.9	71	25.2
25–30	68	24.1
>30	20	7.1
Ambulation		
Gait aid	14	5.0
Normal	268	95.0

(Continued)

Table 1 (Continued).

Characteristics	n	%
Hearing problem		
Hearing impairment	17	6.0%
Normal	265	94.0%
Vision problem		
Visual impairment	103	36.5
Normal	179	63.5
History of smoking		
No	243	86.2
Yes	39	13.8
History of drinking alcohol		
No	256	90.8
Yes	26	9.2
Food allergy		
No	259	91.8
Yes	23	8.2
Drug allergy		
No	202	71.6
Yes	80	28.4
Vaccination history		
Influenza vaccine		
No	24	8.5
Yes	258	91.5
Zoster vaccine		
No	224	79.4
Yes	58	20.6
Pneumococcal vaccine		
No	172	61.0
Yes	110	39.0
DTP vaccine		
No	121	42.9
Yes	161	57.1
Underlying disease		
Diabetes	52	18.4
Chronic kidney disease	11	3.9
Respiratory disease	17	6.0
Psychiatric illness	15	5.3
Subjective cognitive complaint		
No	118	41.8
Yes	164	58.2
Hospitalization in the past year		
No	238	84.4
Yes	44	15.6

(Continued)

Table 1 (Continued).

Characteristics	n	%
Overall health perception		
Worst/bad	7	2.5
Average	115	40.8
Good/best	160	56.7

Abbreviations: BMI, body mass index; DTP, diphtheria-tetanus-pertussis.

hesitant to get vaccinated than when there were $\geq 10,000$ new cases per day (OR 6.66, 95% CI: 2.48–17.68, $p < 0.001$) (Table 3).

Discussion

The present study is one of the few available studies on COVID-19 vaccination hesitancy in older adults, and the

Table 2 Baseline Characteristics Associated with COVID-19 Vaccine Hesitancy.

Characteristics	Acceptance (n=157)		Hesitancy (n=125)		χ^2	p-value
	n	%	n	%		
Age						
60–69 years	59	37.6	40	32.0	1.78	0.411
70–79 years	63	40.1	60	48.0		
80+ years	35	22.3	25	20.0		
Gender						
Male	50	31.8	32	25.6	1.32	0.251
Female	107	68.2	93	74.4		
Ethnicity						
Thai	152	96.8	121	96.8	0	1
Chinese	5	3.2	4	3.2		
Marital status						
Single	27	17.2	23	18.4	0.6	0.898
Married	98	62.4	81	64.8		
Divorced	6	3.8	4	3.2		
Widowed	26	16.6	17	13.6		
Education						
Elementary school or below	16	10.2	25	20.0	5.96	0.051
High school	28	17.8	16	12.8		
Bachelor's degree or higher	113	72.0	84	67.2		
Current residence						
Bangkok	105	66.9	85	68.0	0.04	0.842
Other provinces	52	33.1	40	32.0		
Employment						
Retired	128	81.5	105	84.0	7.78	0.678
Part-time job	13	8.3	11	8.8		
Full-time job	16	10.2	9	7.2		
Income loss due to COVID						
Yes	29	18.5	24	19.2	0.02	0.876
No	128	81.5	101	80.8		
Monthly income (baht) (n=216)						
10,000 or less	29	24.2	24	25.0	2.43	0.489
10,001–20,000	33	27.5	19	19.8		
20,001–30,000	21	17.5	23	24.0		
30,001 or more	37	30.8	30	31.3		

(Continued)

Table 2 (Continued).

Characteristics	Acceptance (n=157)		Hesitancy (n=125)		χ^2	p-value
	n	%	n	%		
BMI (kg/m²)					1.68	0.794
<18.5	8	5.1	4	3.2		
18.5–22.9	62	39.5	49	39.2		
23–24.9	41	26.1	30	24.0		
25–30	37	23.6	31	24.8		
>30	9	5.7	11	8.8		
Ambulation					2.38	0.123
Gait aid	5	3.2	9	7.2		
Normal	152	96.8	116	92.8		
Hearing problem					0.06	0.815
Hearing impairment	9	5.7	8	6.4		
Normal	148	94.3	117	93.6		
Vision problem					0.01	0.932
Visual impairment	57	36.3	46	36.8		
Normal	100	63.7	79	63.2		
History of smoking					2.22	0.137
No	131	83.4	112	89.6		
Yes	26	16.6	13	10.4		
History of drinking alcohol					3.52	0.061
No	138	87.9	118	94.4		
Yes	19	12.1	7	5.6		
Food allergy					6.46	0.011
No	150	95.5	109	87.2		
Yes	7	4.5	16	12.8		
Drug allergy					0.89	0.347
No	116	73.9	86	68.8		
Yes	41	26.1	39	31.2		
Vaccination history						
Influenza vaccine					0.5	0.482
No	15	9.6	9	7.2		
Yes	142	90.4	116	92.8		
Zoster vaccine					0.46	0.497
No	127	80.9	97	77.6		
Yes	30	19.1	28	22.4		
Pneumococcal vaccine					0.004	0.953
No	96	61.1	76	60.8		
Yes	61	38.9	49	39.2		
DTP vaccine					1.69	0.194
No	62	39.5	59	47.2		
Yes	95	60.5	66	52.8		

(Continued)

Table 2 (Continued).

Characteristics	Acceptance (n=157)		Hesitancy (n=125)		χ^2	p-value
	n	%	n	%		
Underlying disease						
Diabetes	25	15.9	27	21.6	1.49	0.222
Chronic kidney disease	3	1.9	8	6.4	2.74	0.066
Respiratory disease	7	4.5	10	8.0	1.54	0.215
Psychiatric illness	6	3.8	9	7.2	1.58	0.209
Subjective cognitive complaint						
No	64	40.8	54	43.2	0.17	0.68
Yes	93	59.2	71	56.8		
Hospitalization in the past year						
No	136	86.6	102	81.6	1.33	0.248
Yes	21	13.4	23	18.4		
Overall health perception						
Worst/bad	2	1.3	5	4.0	3.02	0.221
Average	61	38.9	54	43.2		
Good/best	94	59.9	66	52.8		

Abbreviations: BMI, body mass index; DTP, diphtheria-tetanus-pertussis.

first study on COVID-19 vaccine hesitancy in Thailand. We conducted a telephone survey of patients from the geriatric clinic at Ramathibodi Hospital, using information acquired from the hospital's database. Our survey was completed by 282 patients, of which 44.3% were hesitant to get vaccinated. Our study found that factors associated with high COVID-19 vaccine hesitancy were low education, lack of confidence in the healthcare system's ability to treat patients with COVID-19, vaccine manufacturers, being offered vaccines from an unexpected manufacturer, and a lower number of new COVID-19 cases per day. However, factors that influenced vaccine hesitancy in earlier studies^{19,22,23,28,33,37-42} such as gender, income, marital status, and influenza vaccine history in the previous year, did not demonstrate associations in our study.

We found that people with an education level of elementary school or below had more vaccine hesitancy than those who had graduated with a bachelor's degree or higher. This finding was consistent with previous studies^{22,25,40,41} from the United States, the United Kingdom, and Portugal. When compared with individuals who had confidence in the healthcare system's competence to manage patients with COVID-19, those who lacked confidence had 6.4 times higher vaccine hesitancy. A study from Portugal²⁵ reported comparable results, and a Saudi Arabian study found that people who trusted their

healthcare system were three times more likely to receive vaccines.³⁸

Vaccine manufacturers are one of Thailand's most controversial issues. Currently, only the ChAdOx1 nCoV-19 and CoronaVac vaccinations are available. Although the Delta variant was the COVID-19 variant most commonly of concern in Thailand,³⁵ research is only available on the efficacy of ChAdOx1 nCoV-19 against Delta (effectiveness: 67%, 95% CI: 6.3–71.8).⁴³ This could explain why the COVID-19 vaccine manufacturer influenced people's vaccine hesitancy. This was further supported by the finding from our study that people wanted to get vaccinated for two primary reasons: to prevent serious infection or death (42.9%) and to prevent infection (21.3%). To promote vaccination acceptability, the government and public health authorities should make high-potency COVID vaccine accessible to everyone. In addition, those who expected a certain vaccine but were instead given a different vaccine showed a higher rate of vaccine hesitancy. This could be a unique problem in the Thai situation, caused by the uncertain policies of the responsible agency. People's vaccine hesitancy could be reduced by open communication and a clear vaccine delivery strategy.

We observed that when the number of new COVID-19 infections grew, people's vaccine hesitancy decreased. Fear of COVID-19 was linked to risk perception in a previous investigation.⁴⁴ Research suggested that those

Table 3 Logistic Regression Results for COVID-19 Vaccine Hesitancy.

Variable	Univariate			Multivariate		
	OR	95% CI	p-value	aOR	95% CI	p-value
Education						
Elementary school or below	0.37	0.15–0.88	0.025	2.56	1.06–6.16	0.037
High school	0.48	0.24–0.95	0.034	0.7	0.30–1.65	0.412
Bachelor's degree or higher	Ref					
Food allergy						
No	Ref					
Yes	0.32	0.13–0.80	0.015	2.66	0.77–9.21	0.122
How confident are you in government and public health agency information on COVID-19?						
Not confident	2.55	0.92–7.04	0.072	1.06	0.28–4.07	0.930
Quite not confident	4.32	1.81–10.27	0.001	3.05	0.96–9.72	0.059
Quite confident	1.69	0.78–3.64	0.182	2.07	0.74–5.81	0.169
Confident	Ref					
How confident are you in Thailand's healthcare system's ability to treat patients with COVID-19?						
Not confident	6.22	1.62–23.93	0.008	6.41	1.28–32.10	0.024
Quite not confident	1.81	0.79–4.13	0.159	1.14	0.38–3.44	0.816
Quite confident	1.33	0.78–2.28	0.301	0.79	0.38–1.63	0.517
Confident	Ref					
What is your risk of getting COVID-19?						
Very low risk	Ref					
Low risk	1.55	0.75–3.23	0.237	1.56	0.56–4.29	0.393
High risk	2.88	1.29–6.44	0.01	2.57	0.83–7.99	0.103
Very high risk	2.79	0.90–8.69	0.077	3.05	0.68–13.75	0.147
What is your chance of having severe COVID-19 infection or life-threatening condition if you get COVID-19 infection?						
Very low chance	Ref					
Low chance	2.44	0.99–6.06	0.054	1.76	0.56–5.51	0.332
High chance	3.06	1.18–7.90	0.021	1.57	0.46–5.42	0.472
Very high chance	6.21	1.93–19.99	0.002	1.76	0.38–8.12	0.467
Do you think the manufacturer of the COVID-19 vaccine influenced your decision to get vaccinated?						
No	Ref					
Yes	6.20	3.69–10.43	<0.001	5.16	2.65–10.04	<0.001
Do you want to get vaccinated if you are offered a vaccine from a manufacturer that you did not expect?						
No	5.20	2.50–10.85	<0.001	3.16	1.26–7.95	0.014
Yes	Ref					
Unsure	4.29	2.20–8.38	<0.001	1.95	0.82–4.67	0.133
Number of new COVID-19 patients per day (patients)						
Less than 5000	3.89	1.77–8.54	0.001	6.62	2.48–17.68	<0.001
5000–7499	1.26	0.68–2.33	0.465	1.61	0.74–3.54	0.233
7500–9999	0.79	0.40–1.55	0.493	0.77	0.33–1.81	0.554
More than 10,000	Ref					

Abbreviations: OR, odds ratio; aOR, adjusted odds ratio; CI, confidence interval; Ref, reference group.

Table 4 COVID-19 Pandemic- and Vaccine-Related Factors Associated with COVID-19 Vaccine Hesitancy.

COVID-19 Pandemic and Vaccine Related Information	Acceptance (n=157)		Hesitancy (n=125)		χ^2	p-value
	n	%	n	%		
How much do you know about COVID-19?						
Nothing	5	3.2	7	5.6	1.45	0.694
Little	51	32.5	44	35.2		
Quite a lot	89	56.7	66	52.8		
A lot	12	7.6	8	6.4		
What is your primary source of COVID-19 information?						
Television, radio	85	54.1	71	56.8	4.16	0.527
Newspaper	2	1.3	1	0.8		
Friend	12	7.6	9	7.2		
News website	15	9.6	9	7.2		
Social network	39	24.8	35	28.2		
Others	4	2.5	0	0.0		
How confident are you in government and public health agency information on COVID-19?						
Not confident	14	8.9	14	11.2	14.37	0.002
Quite not confident	23	14.6	39	31.2		
Quite confident	92	58.6	61	48.8		
Confident	28	17.8	11	8.8		
How confident are you in Thailand's healthcare system's ability to treat patients with COVID-19?						
No confident	3	1.9	11	8.8	9.22	0.026
Quite not confident	15	9.6	16	12.8		
Quite confident	83	52.9	65	52.0		
Confident	56	35.7	33	26.4		
How effective are the government's measurements for controlling COVID-19 infection?						
Insufficient	50	31.8	46	36.8	3.01	0.39
Quite insufficient	45	28.7	42	33.6		
Quite sufficient	51	32.5	30	24.0		
Sufficient	11	7.0	7	5.6		
What is your risk of getting COVID-19 infection?						
Very low risk	29	18.5	13	10.4	8.77	0.033
Low risk	89	56.7	62	49.6		
High risk	31	19.7	40	32.0		
Very high risk	8	5.1	10	8.0		
What is your chance of having severe COVID-19 infection or life-threatening condition if you get COVID-19 infection?						
Very low chance	23	14.6	7	5.6	10.69	0.014
Low chance	82	52.2	61	48.8		
High chance	43	27.4	40	32.0		
Very high chance	9	5.7	17	13.6		
How uneasy/anxious/agitated/sad/worried do you feel when you have to practice social distancing?						
Never	112	71.3	76	60.8	3.91	0.271
Sometimes	36	22.9	39	31.2		
Often	5	3.2	7	5.6		

(Continued)

Table 4 (Continued).

COVID-19 Pandemic and Vaccine Related Information	Acceptance (n=157)		Hesitancy (n=125)		χ^2	p-value
	n	%	n	%		
Always	4	2.5	3	2.4		
Is there a patient with COVID-19 in your neighborhood?						
No	86	54.8	58	46.4	1.95	0.162
Yes	71	45.2	67	53.6		
Do you know anyone who has been infected with COVID-19?						
No	97	61.8	63	50.4	3.67	0.055
Yes	60	38.2	62	49.6		
Do you know anyone who has died as a result of COVID-19?						
No	130	82.8	97	77.6	1.2	0.273
Yes	27	17.2	28	22.4		
Do you know anyone who has had a serious reaction to the COVID-19 vaccine?						
No	145	92.4	107	85.6	3.34	0.068
Yes	12	7.6	18	14.4		
Will you refuse COVID-19 vaccination?						
No	151	96.2	118	94.4	0.5	0.479
Yes	6	3.8	7	5.6		
Do you think the manufacturers of the COVID-19 vaccine influenced your decision to get vaccinated?						
No	118	75.2	41	32.8	50.78	<0.001
Yes	39	24.8	84	67.2		
Do you want to get vaccinated if you are offered a vaccine from a manufacturer you did not expect?						
No	12	7.6	30	24.0	33.9	<0.001
Yes	129	82.2	62	49.6		
Unsure	16	10.2	33	26.4		
Number of new COVID-19 patients per day (patients)						
Less than 5000	13	8.3	32	25.6	17.47	0.001
5000–7499	49	31.2	39	31.2		
7500–9999	46	29.3	23	18.4		
More than 10,000	49	31.2	31	24.8		

who perceived a greater risk of infection were more likely to receive vaccines.^{25,33} We hypothesized that as the number of new COVID-19 infections rose, so did the risk of becoming infected, which resulted in less vaccination hesitancy.

Some previous studies that suggested females had higher COVID-19 vaccine hesitancy;^{22,37,39,42} however, we were unable to replicate this finding. In addition, we found no link between income and COVID-19 vaccine hesitancy, although several previous studies demonstrated people with higher income had lower vaccine

hesitancy.^{28,40,42} Our study found no relationship between marital status and COVID-19 vaccine hesitancy. However, in some previous research, married people exhibited less COVID-19 vaccine hesitancy.^{33,38} This may be related to the fact that our participants were older individuals with different marital status than younger groups. Furthermore, unlike some previous research,^{25,28,33,41} we were unable to show that those who had had an influenza vaccine injection in the previous year had less COVID-19 vaccine hesitancy. This could be because all older patients in our geriatric clinic

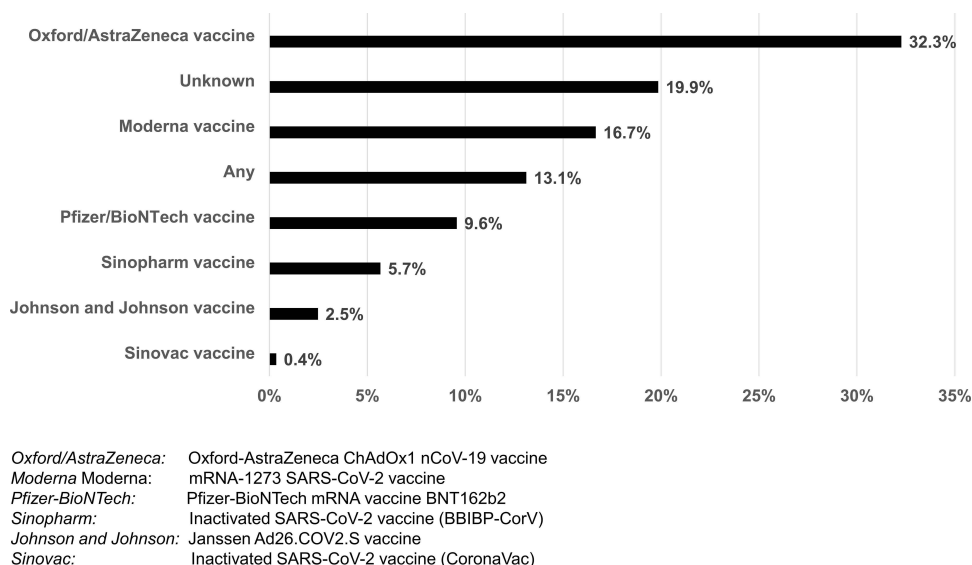


Figure 2 Most desirable vaccine manufacturer as perceived by participants.

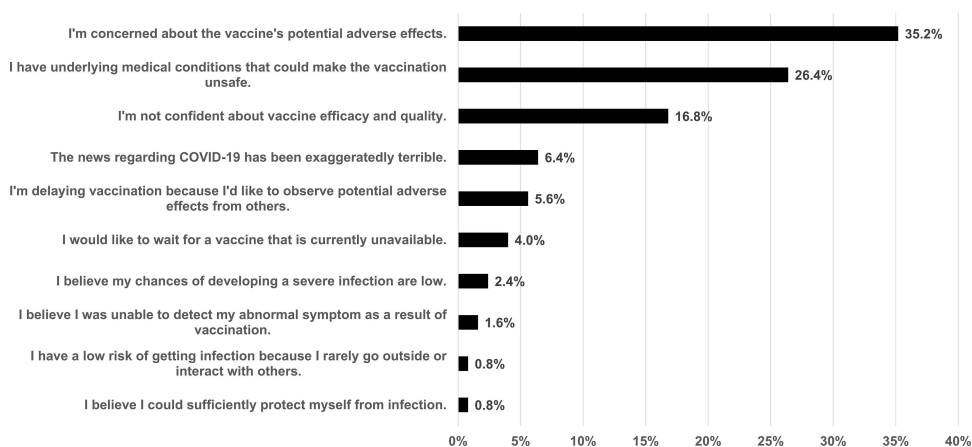


Figure 3 Most important reason for COVID-19 vaccine hesitancy.

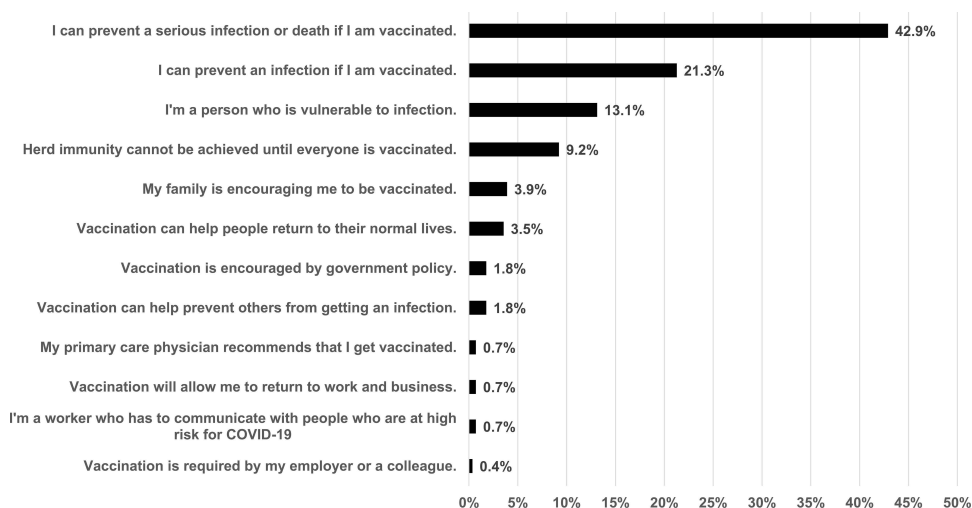


Figure 4 Most important reasons to get vaccinated against COVID-19.

were encouraged to get an annual influenza vaccine, with vaccination rates reaching 91.5%.

Our study was one of only a few studies on vaccine hesitancy that employed direct data gathering rather than an online volunteer survey. As a result, we were able to enroll diverse people in our study, including older adults who were unable to use technological devices. We began our research at a time when the number of COVID-19 patients was growing exponentially because of the Delta variant, so we could compare the incidence of COVID-19 vaccination hesitancy based on daily new cases. Furthermore, the majority of COVID-19 vaccine hesitancy studies were conducted while vaccinations were not generally available, whereas our study examined people's attitudes after vaccines became widely accessible.

Our study had several limitations. We recruited participants from a geriatric clinic, most of whom lived in Bangkok, and the results should be interpreted with caution in other settings. Only one-fourth of those who were contacted were able to participate in this study and complete the questionnaires on their own; therefore the number of participants was fewer than planned. We were unaware that some participants would refuse to answer questions on sensitive subjects such as their incomes, and therefore were missing some information. Finally, although we demonstrated associations between higher COVID-19 vaccine hesitancy and low education level, lack of confidence in the healthcare system's ability to treat patients with COVID-19, vaccine manufacturers, being offered vaccines from an unexpected manufacturer, and a lower number of new COVID-19 cases per day, we could not demonstrate causality.

Conclusion

The prevalence of COVID-19 vaccine hesitancy among Thai seniors is relatively high. Low education level, lack of confidence in the healthcare system's ability to treat patients with COVID-19, vaccine manufacturers, being offered vaccines from an unexpected manufacturer, and a lower number of new daily COVID cases are linked to greater COVID-19 vaccine hesitancy. These findings will help in promoting COVID-19 vaccination among Thailand's senior citizens.

Ethics Approval and Informed Consent

The study protocol was approved by the Human Research Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University (COA.

MURA2021/441). This study was conducted according to the Declaration of Helsinki and Good Clinical Practice guidelines. Because we performed a telephone-based survey and it was inconvenient for participants to sign written informed consent and manage documents during the pandemic, we did not receive written informed consent. However, all participants provided verbal informed consent, which was recorded.

Acknowledgments

We would like to thank Piangporn Charernwat for assistance with data collection and project coordination, Krittika Saranburut for statistical analysis advice, and all interviewers and participants.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This research project was supported by the Faculty of Medicine, Ramathibodi Hospital, Mahidol University.

Disclosure

The authors declare that they have no conflicts of interest for this work.

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