




# COVID-19 Vaccine Acceptance of Pregnant Women in Thailand

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**Objective:** This study investigated the COVID-19 vaccine acceptance rate among pregnant women in Thailand and explored factors influencing their willingness to receive the vaccine, to enhance vaccine uptake among hesitant pregnant women in the future.

**Methods:** A prospective study was conducted at Maharaj Nakorn Chiang Mai Hospital, Chiang Mai, Thailand, in October 2022. The data was collected using face-to-face questionnaires comprising 29 closed-end questions. Pregnant women aged 18 years old or over visiting the antenatal care clinic were included.

**Results:** The study included 200 participants, revealing a COVID-19 vaccine acceptance rate of 17%. Healthcare provider recommendations significantly increased vaccine acceptance by nearly two-fold (30.77%, p-value < 0.01). The major cause of vaccine hesitancy was the concern about vaccine safety that potentially harmed their babies (77.44%).

**Conclusion:** The COVID-19 vaccine acceptance rate among pregnant women in Thailand was low. Healthcare provider recommendations played a pivotal role in positively impacting vaccine acceptance, highlighting their importance in increasing acceptance rates in the future.

**Plain Language Summary:** This study investigated the COVID-19 vaccine acceptance rate among pregnant women in Thailand and explored factors influencing their willingness to receive the vaccine. The study included 200 participants, revealing a COVID-19 vaccine acceptance rate of 17%. Healthcare provider recommendations significantly increased vaccine acceptance by nearly two-fold (30.77%, p-value < 0.01). The major cause of vaccine hesitancy was the concern about vaccine safety that potentially harming their babies (77.44%). The COVID-19 vaccine acceptance rate among pregnant women in Thailand was low. Healthcare provider recommendations played a pivotal role in positively impacting vaccine acceptance, highlighting their importance in increasing acceptance rates in the future.

**Keywords:** COVID-19 disease, COVID-19 vaccine, pregnant women, vaccine acceptance, vaccine hesitancy

## Introduction

In the current situation, there has been a rapid rise in the number of pregnant women infected with COVID-19 disease. This situation has brought to light the concerning escalation of morbidity and mortality rates among pregnant women compared to non-pregnant women. Specifically, pregnant women affected by COVID-19 are at a higher risk of adverse outcomes, including intensive care unit admissions, the necessity for invasive ventilation or extracorporeal membrane oxygenation, and even maternal mortality. Additionally, the implications of COVID-19 infection extend to pregnancy outcomes, notably leading to an increased incidence of preterm labor. Notably, infants born to infected mothers face a higher risk of neonatal intensive care unit admissions in comparison to those born to non-infected mothers.<sup>1,2</sup> While vaccination may not fully prevent breakthrough infections due to waning humoral immune responses<sup>3-5</sup>, vaccines have been found effective in mitigating disease severity, reducing hospitalization rates, and lowering mortality. Additionally,

recent evidence highlights the effectiveness of vaccination in potentially lowering the risk of developing long COVID,<sup>6</sup> the most dreaded sequelae of acute infection, which can persist for up to two years.<sup>7</sup>

COVID-19 vaccination is an important strategy to mitigate the risks of complications for both mothers and fetuses. Recognizing its significance, the American College of Obstetricians and Gynecologists (ACOG), the Society for Maternal-Fetal Medicine (SMFM), and the Centers for Disease Control and Prevention (CDC) strongly recommend COVID-19 vaccination during pregnancy.<sup>8–10</sup> Their collective consensus rests on the pillars of safety and efficacy.<sup>11</sup> For individuals who have not received vaccination before pregnancy, the recommended approach involves initiating a two-dose mRNA vaccine series at any point during pregnancy, followed by a bivalent booster administered two months after the last dose of the primary series. Similarly, those who completed their primary vaccination series before pregnancy are advised to undergo bivalent boosters, administered two months after the last dose of the primary series.<sup>12</sup>

Drawing insights from international studies on COVID-19 acceptance during pregnancy, American pregnant women exhibited a 41% willingness to receive the vaccine, with vaccine safety being a central concern.<sup>13</sup> European trends varied, with the UK and Czechia reporting acceptance rates exceeding 62.1% and 76.6%, whereas Turkey, Switzerland, and France observed lower rates of 37%, 29.7%, and 29.5%, respectively.<sup>14–18</sup> In Asia, South Korea recorded a 26.6% acceptance rate,<sup>19</sup> while Indian pregnant women displayed a 78.52% acceptance rate.<sup>20</sup> In neighboring Southeast Asia, Malaysia recorded an acceptance rate of 77.1%.<sup>21</sup>

In Thailand, five COVID-19 vaccines gained approval under Emergency Use Authorization (EUA). The sequence of introduction began with inactivated vaccines like Sinovac<sup>®</sup> and Sinopharm<sup>®</sup>, followed by virus vector vaccines like AstraZeneca<sup>®</sup>, and subsequently mRNA-based vaccines like BioNTech-Pfizer<sup>®</sup> and Moderna<sup>®</sup>. In a previous Thai study on COVID-19 vaccine acceptance and attitude, less than half of Thai individuals (41.8%) expressed willingness to receive the vaccine. Notably, vaccine efficacy and safety were a major concern. The acceptance rate substantially increased when healthcare workers recommended vaccination (83.2%).<sup>22</sup>

While acceptance rates differ among countries, the common concern remains vaccine safety during pregnancy. Improving acceptance rates hinges on appropriate guidance from medical providers. Hence, this study's objective is to identify the acceptance rate among Thai pregnant women and discern factors that positively or negatively impact their willingness to receive the COVID-19 vaccine. Ultimately, the goal is to enhance vaccine uptake among hesitant pregnant women in the future.

## Materials and Methods

### Design

This prospective descriptive study was conducted at Maharaj Nakorn Chiang Mai Hospital from October 3–21, 2022. Data was collected through face-to-face questionnaire interviews with pregnant women attending the Antenatal Care Clinic.

### Participants

The study participants were pregnant women who sought antenatal care services at Maharaj Nakorn Chiang Mai Hospital. Eligibility criteria included being pregnant at any trimester and being 18 years of age or older. The sample size was determined based on a relevant study<sup>18</sup> where the vaccine acceptance rate was found to be 29.7%. Using this acceptance rate ( $p = 0.297$ ), a significance level ( $\alpha$ ) of 0.05, a power of test of 0.1, and a statistical error of 10%, the sample size was calculated to be 164.

### Instruments

The questionnaire was created and validated by the obstetricians, training house doctors in obstetrics, and professional obstetric nurses in the hospital to review its accuracy and to ensure mutual understanding before proceeding to interview the research participants. The creation of the questionnaire was based on the information from the literatures.<sup>14,15,17,18</sup> The questionnaire utilized in this study consisted of 29 closed-end questions with multiple-choice options. The questionnaire was organized into five main sections, each designed to gather specific information:

- **Demographic Data:** This section included variables such as age, ethnicity, religious background, education level, occupation, and gestational age of the pregnancy. These parameters aimed to establish the baseline characteristics of the study group.
- **Obstetric Data:** Variables in this section covered parity, complications during pregnancy, and underlying medical conditions. These details provided insights into the participants' obstetric history and health status.
- **History of Vaccination During Pregnancy:** Focusing on vaccines like influenza and tetanus, this section aimed to gather information about previous vaccination experiences and opinions, potentially influencing acceptance of the COVID-19 vaccine.
- **Attitude Toward COVID-19 Disease:** This section evaluated participants' attitudes using questions related to disease knowledge, history of COVID-19 infection, perception of severity and risk, awareness of COVID-19's impact, and its effect on daily life.
- **Attitude Toward COVID-19 Vaccination:** Focused on the participants' willingness to accept the COVID-19 vaccine during pregnancy, this section included a central question ("Would you accept to have COVID-19 vaccination during pregnancy?") with response options of "yes" or "no". Additional questions explored reasons behind their choice, healthcare provider suggestions, and prior information about COVID-19 vaccination.

The comprehensive data collection aimed to assess the COVID-19 vaccine acceptance rate among pregnant women and uncover positive and negative factors influencing their decisions.

## Ethics Approval

Informed consent was obtained from all participants. This study received approval from the Research Ethics Committee of the Faculty of Medicine, Chiang Mai University, Thailand (OBG-2565-09134).

## Statistical Analysis

Statistical analysis was performed using Stata version 15.1. The data were analyzed for numbers, percentages, means  $\pm$  standard deviation, and medians. Categorical variables were analyzed using the Chi-square test or Fisher's exact test, while continuous variables were analyzed using the Student's *t*-test or Mann–Whitney *U*-test. A *p*-value of less than 0.05 was considered statistically significant.

## Results

A total of 200 pregnant women participated in the study and completed the questionnaire.

### Demographic Characteristics

Among the 200 pregnant women included in the study, the mean age was found to be  $30.84 \pm 5.17$  years old. Notably, a majority of participants (65%) fell within the age group of 25 to 34 years. Regarding the trimester of pregnancy, the largest proportion of participants were in the third trimester (59%), followed by the second trimester (30%) and the first trimester (11%). In terms of education level, it was observed that all participants had an education level higher than elementary school. Most participants (62%) held a bachelor's degree, indicating a relatively high level of educational attainment within the study population. Furthermore, a proportion (10.5%) of participants identified themselves as healthcare providers (Table 1).

### Obstetric History

More than half of the participants were nulliparous (61%). 137 participants (68.5%) did not have any pregnancy risk during the time of participated in this study. 63 participants (31.5%) had pregnancy risk. The pregnancy risks were both obstetric complications (eg gestational diabetes, multifetal gestation, fetal growth restriction, placenta previa, and vasa previa) and underlying medical conditions (eg asthma, anemia, heart disease, chronic hypertension, chronic HBV infection, thyroid disease, pregestational diabetes, autoimmune disease, and end-stage renal disease). The pregnancy risk was not associated with the acceptance rate of COVID-19 vaccine (Table 2)

**Table 1** Demographic Characteristics

	<b>Total (n = 200)</b>	<b>Not willing to receive vaccine (n = 166)</b>	<b>Willing to receive vaccine (n = 34)</b>	<b>P-value</b>
<b>Age (years) N (%)</b>				0.74 <sup>b</sup>
< 25	19 (9.50)	16 (9.64)	3 (8.82)	
25–34	130 (65.00)	106 (63.86)	24 (70.59)	
≥ 35	51 (25.50)	44 (26.51)	7 (20.59)	
<b>Gestational age (weeks) Median (q<sub>1</sub> – q<sub>3</sub>)</b>	30.50 (24–36)	31 (24–36)	30 (24–35)	0.64 <sup>a</sup>
<b>Trimester of pregnancy N (%)</b>				0.51 <sup>b</sup>
1	22 (11.00)	19 (11.45)	3 (8.82)	
2	60 (30.00)	47 (28.31)	13 (38.24)	
3	118 (59.00)	100 (60.24)	18 (52.94)	
<b>Education level N (%)</b>				0.23 <sup>b</sup>
No education	0 (0.00)	0 (0.00)	0 (0.00)	
Elementary school	0 (0.00)	0 (0.00)	0 (0.00)	
High school	34 (17.00)	27 (16.27)	7 (20.59)	
Vocational/Technical school	30 (15.00)	27 (16.27)	3 (8.82)	
Bachelor's degree	124 (62.00)	100 (60.24)	24 (70.59)	
Master's or higher degree	12 (6.00)	12 (7.23)	0 (0.00)	
<b>Occupation N (%)</b>				0.10 <sup>c</sup>
Healthcare worker	21 (10.50)	16 (9.64)	5 (14.71)	
Government officer	24 (12.00)	22 (13.25)	2 (5.88)	
Trader	31 (15.50)	30 (18.07)	1 (2.94)	
Company employee	70 (35.00)	53 (31.93)	17 (50.00)	
University employee	1 (0.50)	1 (0.60)	0 (0.00)	
Self-employed	24 (12.00)	21 (12.65)	3 (8.82)	
Unemployed	29 (14.50)	23 (13.86)	6 (17.65)	

**Notes:** Data expressed as means ± standard deviation, median (q<sub>1</sub> – q<sub>3</sub>), or N (%).<sup>a</sup> assessed by Mann–Whitney U-test, <sup>b</sup> assessed by Chi-square test, and <sup>c</sup> assessed by Fisher's exact test.

**Table 2** Obstetric History

	<b>Total (n = 200)</b>	<b>Not willing to receive vaccine (n = 166)</b>	<b>Willing to receive vaccine (n = 34)</b>	<b>P-value</b>
<b>Parity N (%)</b>				0.68 <sup>b</sup>
0	122 (61.00)	103 (62.05)	19 (55.88)	
1	65 (32.50)	51 (30.72)	14 (41.18)	
2	11 (5.50)	10 (6.02)	1 (2.94)	
3	2 (1.00)	2 (1.20)	0 (0.00)	
<b>Obstetric complications N (%)</b>				0.99 <sup>a</sup>
None	159 (79.50)	132 (79.52)	27 (79.41)	
Gestational DM	37 (18.50)	30 (18.07)	7 (20.59)	0.73 <sup>a</sup>
Multifetal gestation	2 (1.00)	2 (1.20)	0 (0.00)	> 0.99 <sup>b</sup>
FGR	2 (1.00)	2 (1.20)	0 (0.00)	> 0.99 <sup>b</sup>
Placenta previa	1 (0.50)	1 (0.60)	0 (0.00)	> 0.99 <sup>b</sup>
Vasa previa	1 (0.50)	1 (0.60)	0 (0.00)	> 0.99 <sup>b</sup>

(Continued)

**Table 2** (Continued).

	<b>Total (n = 200)</b>	<b>Not willing to receive vaccine (n = 166)</b>	<b>Willing to receive vaccine (n = 34)</b>	<b>P-value</b>
<b>Underlying medical conditions N (%)</b>				
None	172 (86.00)	145 (87.35)	27 (79.41)	0.22 <sup>a</sup>
Asthma	3 (1.50)	2 (1.20)	1 (2.94)	0.43 <sup>b</sup>
Anemia	2 (1.00)	1 (0.60)	1 (2.94)	0.31 <sup>b</sup>
Heart disease	5 (2.50)	4 (2.41)	1 (2.94)	> 0.99 <sup>b</sup>
Chronic hypertension	7 (3.50)	6 (3.61)	1 (2.94)	> 0.99 <sup>b</sup>
Chronic HBV infection	6 (3.00)	5 (3.01)	1 (2.94)	> 0.99 <sup>b</sup>
Thyroid disease	6 (3.00)	3 (1.81)	3 (8.82)	0.06 <sup>b</sup>
Systemic lupus erythematosus	4 (2.00)	3 (1.81)	1 (2.94)	0.53 <sup>b</sup>
End-stage renal disease	3 (1.50)	2 (1.20)	1 (2.94)	0.43 <sup>b</sup>
Antiphospholipid syndrome	2 (1.00)	1 (0.60)	1 (2.94)	0.31 <sup>b</sup>
Overt diabetes mellitus	3 (1.50)	2 (1.20)	1 (2.94)	0.43 <sup>b</sup>
<b>Risk of pregnancy N (%)</b>				0.60 <sup>a</sup>
No	137 (68.50)	115 (69.28)	22 (64.71)	
Yes	63 (31.50)	51 (30.72)	12 (35.29)	

**Notes:** Data expressed as means ± standard deviation, median (q<sub>1</sub> – q<sub>3</sub>), or N (%).<sup>a</sup> assessed by Chi-square test, and <sup>b</sup> assessed by Fisher's exact test.

## History of Vaccination During Pregnancy

121 participants (60.50%) received the tetanus vaccine during pregnancy, 58 participants (29%) received the influenza vaccine and 72 participants (36%) did not receive any tetanus or influenza vaccine before completing the questionnaire. A majority of participants (80.5%) reported receiving recommendations from healthcare providers regarding tetanus and influenza vaccination during pregnancy. Of those who received these recommendations, a substantial 96% indicated willingness to receive the suggested vaccinations. (Table 3)

## Attitude Toward COVID-19 Disease

Regarding participant's data about COVID-19 disease, the majority (98.5%) indicated that they had received information about COVID-19. Only 1.5% of the participants did not receive information about this disease. 31.5% of participants had never been infected with COVID-19, while others reported previous infections before pregnancy (27.5%) or during

**Table 3** History of Vaccination During Pregnancy

	<b>Total (n = 200)</b>	<b>Not willing to get vaccine (n = 166)</b>	<b>Willing to get vaccine (n = 34)</b>	<b>P-value</b>
<b>Vaccination during pregnancy N (%)</b>				
No vaccination	72 (36.00)	57 (34.34)	15 (44.12)	0.28 <sup>a</sup>
Tetanus vaccine	121 (60.50)	46 (27.71)	12 (35.29)	0.37 <sup>a</sup>
Influenza vaccine	58 (29.00)	105 (63.25)	16 (47.06)	0.08 <sup>a</sup>
<b>Healthcare provider recommendations regarding tetanus and influenza vaccine N (%)</b>				0.51 <sup>a</sup>
Not receive recommendation	39 (19.50)	31 (18.67)	8 (23.53)	
Receive recommendation	161 (80.50)	135 (81.33)	26 (76.47)	
<b>If healthcare providers suggested tetanus and influenza vaccine, were you willing to receive it? N (%)</b>				> 0.99 <sup>b</sup>
No	8 (4.00)	7 (4.22)	1 (2.94)	
Yes	192 (96.00)	159 (95.78)	33 (97.06)	

**Notes:** Data expressed as means ± standard deviation, median (q<sub>1</sub> – q<sub>3</sub>), or N (%).<sup>a</sup> assessed by Chi-square test, and <sup>b</sup> assessed by Fisher's exact test.

pregnancy (41%). Among those who were infected, the severity of symptoms was predominantly mild (92.81%). Forty-four percent of the participants had contact with COVID-19 patients in their daily lives. All participants reported practicing preventive measures such as handwashing, maintaining distance, and wearing masks during COVID-19 outbreaks. The impact of the pandemic on daily life was evaluated, with the majority (64.5%) reporting no significant impact. Some concerns about infection during pregnancy were noted (1.5%), along with impacts on work (22.5%), transportation (5%), finance (2%), and other aspects. (Table 4)

## Data About COVID-19 Vaccination

Regarding the COVID-19 vaccine, nearly all participants (99.5%) have received information about it. Approximately 92% of participants believe that they have adequate information about the COVID-19 vaccine. Before participating in the questionnaire, 99% of participants had received at least one dose of the COVID-19 vaccine, although only 15% of them had received the vaccine during pregnancy. (Table 5)

Concerning the type of vaccine participants received, 73.5% were administered mRNA-based vaccines such as BioNTech-Pfizer<sup>®</sup> and Moderna<sup>®</sup>. On the other hand, 26.5% did not receive any mRNA-based vaccines; instead, they have received virus vector vaccines (eg, AstraZeneca<sup>®</sup>) or inactivated vaccines (eg, Sinovac<sup>®</sup>, Sinopharm<sup>®</sup>). The

**Table 4** Attitudes Toward COVID-19 Disease

	Total (n = 200)	Not willing to receive vaccine (n = 166)	Willing to receive vaccine (n = 34)	P-value
<b>Have you received information about COVID-19 disease? N (%)</b>				> 0.99 <sup>b</sup>
No	3 (1.50)	3 (1.81)	0 (0.00)	
Yes	197 (98.50)	163 (98.19)	34 (100.00)	
<b>Have you ever been infected with COVID-19 disease? N (%)</b>				0.71 <sup>a</sup>
Never	63 (31.50)	54 (32.53)	9 (26.47)	
Infected before pregnancy	55 (27.50)	44 (26.51)	11 (32.35)	
Infected during pregnancy	82 (41.00)	68 (40.96)	14 (41.18)	
<b>Severity of symptoms during infection N (%)</b>				0.76 <sup>a</sup>
No symptoms	9 (6.47)	8 (7.02)	1 (4.00)	
Mild severity	129 (92.81)	105 (92.11)	24 (96.00)	
Moderate severity	1 (0.72)	1 (0.88)	0 (0.00)	
Severe symptoms	0 (0.00)	0 (0.00)	0 (0.00)	
<b>Have you contacted COVID-19 patients in your daily life? N (%)</b>				0.06 <sup>a</sup>
Never	112 (56.00)	88 (53.01)	24 (70.59)	
Yes	88 (44.00)	78 (46.99)	10 (29.41)	
<b>Do you practice handwashing, distancing, and mask-wearing during COVID-19 outbreaks? N (%)</b>				NA
No	0 (0.00)			
Yes	200 (100.00)	166 (100.00)	34 (100.00)	
<b>Has the COVID-19 pandemic impacted your daily life? N (%)</b>				0.45 <sup>b</sup>
No impact	129 (64.50)	109 (65.66)	20 (58.82)	
Concerned about infection during pregnancy	3 (1.50)	3 (1.81)	0 (0.00)	
Impact on work	45 (22.50)	38 (22.89)	7 (20.59)	
Impact on travel	1 (0.50)	1 (0.60)	0 (0.00)	
Impact on finance	4 (2.00)	3 (1.81)	1 (2.94)	
Impact on transportation	10 (5.00)	7 (4.22)	3 (8.82)	
Being extra cautious about touching various objects	8 (4.00)	5 (3.01)	3 (8.82)	

**Notes:** Data expressed as means ± standard deviation, median (q<sub>1</sub> – q<sub>3</sub>) or N (%).<sup>a</sup> assessed by Chi-square test, and <sup>b</sup> assessed by Fisher's exact test.

**Table 5** Attitude Toward COVID-19 Vaccination

	Total (n = 200)	Not willing to get vaccine (n = 166)	Willing to get vaccine (n = 34)	P-value
<b>Have you received information about COVID-19 vaccines before?</b> N (%)				> 0.99 <sup>c</sup>
No	1 (0.50)	1 (0.60)	0 (0.00)	
Yes	199 (99.50)	165 (99.40)	34 (100.00)	
<b>Do you think you have sufficient information about COVID-19 vaccines?</b> N (%)				0.32 <sup>c</sup>
No	16 (8.00)	15 (9.04)	1 (2.94)	
Yes	184 (92.00)	151 (90.96)	33 (97.06)	
<b>Have you ever received a COVID-19 vaccine before?</b> N (%)				> 0.99 <sup>c</sup>
No	2 (1.00)	2 (1.20)	0 (0.00)	
Yes	198 (99.00)	164 (98.80)	34 (100.00)	
<b>Have you ever received COVID-19 vaccine during pregnancy?</b> N (%)				< 0.01 <sup>c*</sup>
No	185 (92.50)	161 (96.99)	24 (70.59)	
Yes	15 (7.50)	5 (3.01)	10 (29.41)	
<b>Type of COVID-19 vaccine received?</b> N (%)				
BioNTech-Pfizer <sup>®</sup>	95 (47.50)	77 (46.39)	18 (52.94)	0.49 <sup>c</sup>
Moderna <sup>®</sup>	63 (31.50)	48 (28.92)	15 (44.12)	0.08 <sup>b</sup>
AstraZeneca <sup>®</sup>	114 (57.00)	96 (57.83)	18 (52.94)	0.60 <sup>b</sup>
Sinovac <sup>®</sup>	89 (44.50)	77 (46.39)	12 (35.29)	0.24 <sup>b</sup>
Sinopharm <sup>®</sup>	56 (28.00)	45 (27.11)	11 (32.35)	0.53 <sup>b</sup>
<b>Number of COVID-19 vaccine doses received?</b> N (%)				0.40 <sup>c</sup>
Never	2 (1.00)	2 (1.20)	0 (0.00)	
1 dose	1 (0.50)	1 (0.60)	0 (0.00)	
2 doses	64 (32.00)	57 (34.34)	7 (20.59)	
3 doses	97 (48.50)	76 (45.78)	21 (61.76)	
4 doses	33 (16.50)	28 (16.87)	5 (14.71)	
5 doses	3 (1.50)	2 (1.20)	1 (2.94)	
<b>Have you received mRNA-type COVID-19 vaccine?</b> N (%)				0.09 <sup>b</sup>
No	53 (26.50)	48 (28.92)	5 (14.71)	
Yes	147 (73.50)	118 (71.08)	29 (85.29)	
<b>Time since last COVID-19 vaccine (months) Median (q<sub>1</sub> – q<sub>3</sub>)</b>	9 (7–10)	9 (8–10)	8 (6–9)	0.03 <sup>a,*</sup>
<b>Time since last COVID-19 vaccine</b> N (%)				0.07 <sup>b</sup>
≤ 6 months	32 (16.16)	23 (14.02)	9 (26.47)	
> 6 months	166 (83.84)	141 (85.98)	25 (73.53)	
<b>Have you received medical personnel advice for COVID-19 vaccination during pregnancy?</b> N (%)				< 0.01 <sup>b,*</sup>
No	135 (67.50)	121 (72.89)	14 (41.18)	
Yes	65 (32.50)	45 (27.11)	20 (58.82)	
<b>Did medical personnel advice affect your willingness to get vaccinated during pregnancy?</b> N (%)				< 0.01 <sup>b,*</sup>
Not willing	154 (77.00)	152 (91.57)	2 (5.88)	
Willing	46 (23.00)	14 (8.43)	32 (94.12)	

(Continued)

**Table 5** (Continued).

	Total (n = 200)	Not willing to get vaccine (n = 166)	Willing to get vaccine (n = 34)	P-value
<b>Type of COVID-19 vaccine you would choose during pregnancy N (%)</b>				
BioNTech-Pfizer®			14 (41.18)	< 0.01 <sup>c,*</sup>
Moderna®			24 (70.59)	< 0.01 <sup>c,*</sup>
AstraZeneca®			4 (11.76)	< 0.01 <sup>c,*</sup>
Sinovac®			2 (5.88)	0.03 <sup>c,*</sup>
Sinopharm®			3 (8.82)	< 0.01 <sup>c,*</sup>
<b>Reasons for willing to receive COVID-19 vaccine during pregnancy N (%)</b>				
To prevent infection and reduce the severity of the disease			33 (97.06)	> 0.99 <sup>c</sup>
To protect my child			24 (70.59)	> 0.99 <sup>c</sup>
Recommendations from people around me			4 (11.76)	> 0.99 <sup>c</sup>
Medical personnel advised vaccination			4 (11.76)	0.26 <sup>c</sup>
Other reasons			1 (2.94)	> 0.99 <sup>c</sup>
<b>Reasons for not willing to receive COVID-19 vaccine during pregnancy N (%)</b>				
Vaccine might be harmful to me		42 (25.61)		
Vaccine might be harmful to my baby		127 (77.44)		
Vaccine might cause a COVID-19 infection		5 (3.05)		
Low risk of COVID-19 infection		35 (21.47)		
Believe COVID-19 will not cause severe symptoms for me or the baby		8 (4.88)		
Vaccine is not effective in preventing disease		6 (3.66)		
My family did not allow me to get vaccinated		11 (6.71)		
Vaccine safety data lacking for pregnant women		30 (18.29)		
Cannot choose vaccine type		11 (6.71)		
Did not receive medical personnel advice		12 (7.32)		
Other reasons		8 (4.88)		

**Notes:** \* p-value of less than 0.05 was considered statistics significant.

Data expressed as means ± standard deviation, median (q<sub>1</sub> – q<sub>3</sub>), or N (%).<sup>a</sup> assessed by Mann–Whitney U-test, <sup>b</sup> assessed by Chi-square test, and <sup>c</sup> assessed by Fisher's exact test.

majority of participants (48.5%) received a total of three doses of the COVID-19 vaccine. Moreover, 83.84% received their last dose of the COVID-19 vaccine more than six months before the questionnaire. (Table 5)

## COVID-19 Acceptance

Out of the 200 participants, only 34 individuals (17%) expressed their willingness to receive the COVID-19 vaccine during pregnancy. Conversely, the majority of participants, 166 individuals (83%), stated that they were not willing to receive the COVID-19 vaccine during pregnancy. Notably, among those participants who indicated their willingness to receive the COVID-19 vaccine during pregnancy, the preference leaned towards mRNA-type vaccines, which were the most favored (45%). (Table 5)

## Attitude Toward COVID-19 Vaccination

The factors influencing participants' willingness to receive the COVID-19 vaccine were investigated, and the following reasons were collected. The primary reason cited by a majority of participants was the desire to prevent infection and reduce the severity of the disease (97.22%). Subsequently, participants expressed the motivation to safeguard their baby's well-being, with 72.22% mentioning this as a driving factor. Followed advice from their medical personal providers



(13.89%) and from people around them (11.11%). Some participants also noted that their decision was influenced by research findings recommending COVID-19 vaccination for pregnant women (2.78%). (Table 5)

The reasons behind participants' reluctance to get the COVID-19 vaccine were studied, revealing different factors. The main concern for many was the worry that the vaccine might harm their baby (77.44%). Another worry was the vaccine being harmful to themselves (25.61%). Some people, around 21.47%, felt their risk of getting COVID-19 was low, so they did not see the need for a vaccine. About 18.29% were concerned about the vaccine's safety during pregnancy due to a lack of evidence. Interestingly, 7.32% had not received advice from their doctors. Around 6.71% could not get the vaccine because their family did not allow it, and the same percentage could not choose the type of vaccine they wanted. A few participants, 4.88%, thought they would not have severe symptoms from COVID-19, so they did not need the vaccine. Some others believed the vaccine would not work (3.66%) or might even cause COVID-19 (3.05%). Additionally, 4.88% had other reasons like already having enough doses or concerns about the vaccine and breastfeeding. (Table 5)

Among the participants, 67.5% received advice from medical professionals regarding the COVID-19 vaccine during pregnancy. Notably, within this group, 30.77% expressed willingness to receive the COVID-19 vaccine. This observation highlights the significance of medical provider advice concerning vaccine acceptance. (Table 5)

## Discussion

Our study revealed a COVID-19 acceptance rate of only 17% among the 200 participants during pregnancy. This rate is notably lower compared to general population studies in Thailand, where acceptance rates range from 44.0% to 88.8% and show an upward trend over time.<sup>23</sup> A major concern among pregnant women was vaccine safety for their babies, which likely contributed to the lower acceptance rate compared to the general population. Our findings align with studies conducted in European countries such as Turkey (37%), Switzerland (29.7%), and France (29.5%), as well as in Asian countries like South Korea (26.6%). In contrast, countries like the UK (62.1%), Czechia (76.6%), India (78.52%), China (77.4%), and Malaysia (77.1%) demonstrate higher rates of willingness to receive the COVID-19 vaccine.<sup>13–21,24</sup>

The predominant reason for vaccine hesitancy among Thai pregnant women was the fear that the vaccine might harm their babies, which likely contributed to the lower vaccine acceptance rate observed in our study. Interestingly, a different study conducted in Thailand reported a higher acceptance rate of 60.8%,<sup>25</sup> highlighting the contrasting results within the same country. This discrepancy may be attributed to variations in the timing of the studies; our investigation took place during a period when a substantial portion of the population had already received at least one dose of the COVID-19 vaccine, leading some participants to believe they may not require another dose during pregnancy.

Regarding baseline characteristics, no significant associations were found between COVID-19 vaccine acceptance and age group, trimester of pregnancy, education level, or occupation. In terms of obstetric history, parity and obstetric risk were not related to vaccine acceptance. Interestingly, the willingness to receive Influenza and tetanus vaccines did not directly correlate with the willingness to receive the COVID-19 vaccine. Interestingly, a correlation was observed when participants received recommendations for these vaccines from healthcare providers, and the vaccine acceptance rate was increased (96%). (Table 3) This result correlated with the COVID-19 vaccine acceptance rate that increased significantly (30.77%) ( $p < 0.01$ ) if they received advice from healthcare providers.

Regarding attitudes toward COVID-19 disease, nearly all pregnant women indicated receiving information about COVID-19 and demonstrated a high level of concern for infection prevention measures like handwashing, social distancing, and mask-wearing. While attitudes toward COVID-19 disease were not directly correlated with COVID-19 vaccine willingness, only a small percentage (1.5%) expressed concern about COVID-19 infection during pregnancy. This minimal concern might be attributed to the fact that the majority of participants (92.8%) had previously experienced mild symptoms from COVID-19 infections. (Table 4)

Despite nearly all participants (99%) having received at least one dose of the COVID-19 vaccine, not all had received mRNA-based vaccines as recommended by ACOG, SMFM, and CDC.<sup>8,9</sup> Interestingly, there was no association found between prior receipt of mRNA-based vaccines and the acceptance of COVID-19 vaccines during pregnancy. This suggests that pregnant women might not be overly concerned about the specific vaccine type required to protect both

themselves and their babies. This information can be used to support advice about COVID-19 vaccines for pregnant women, to increase vaccine willingness in the future.

Although the overall risk of thrombosis is increased during pregnancy and after delivery, the mechanism underlying thrombocytopenia linked to these vaccines is distinct from pregnancy-associated thrombosis and, therefore, there is no specific concern for pregnant women compared to non pregnant women. Pregnant women of the same age group. However, the use of mRNA vaccines rather than adenoviral vaccines is preferably recommended on the basis of these safety concerns. There are no known or theoretical risks of vaccination when it comes to vaccinating lactating people.<sup>26</sup>

Positive factors influencing COVID-19 vaccine acceptance included the desire to prevent infection and reduce disease severity, followed by the motivation to protect their babies. On the other hand, vaccine hesitancy was primarily driven by concerns about vaccine safety during pregnancy and its potential harm to babies, followed by personal vaccine safety concerns. These findings align with studies conducted in various countries, including the USA, China, France, the UK, Czechia, Switzerland, Turkey, India, South Korea, and Malaysia.<sup>13–21,24</sup>

Notably, our study found that medical health provider recommendations were a significant factor that could nearly double the COVID-19 vaccine acceptance rate. This is consistent with the broader population in Thailand, where information from healthcare professionals is considered the most trustworthy source. Similar trends were observed in other countries, such as France, the USA, China, the UK, Switzerland, Turkey, South Korea, and Malaysia, where pregnant women who discussed vaccination with their healthcare providers were more inclined to receive the vaccine.<sup>13–19,21,24</sup> These findings underscore the importance of conveying positive and negative factors of COVID-19 vaccine acceptance, along with information about COVID-19's effects on pregnancy and babies, vaccine safety and efficacy, all delivered by healthcare providers. This approach has the potential to significantly enhance COVID-19 vaccine acceptance rates in the future.

Strengths of this study include a comprehensive examination of COVID-19 vaccine acceptance among pregnant women, shedding light on a critical aspect of public health during the ongoing pandemic. Moreover, the inclusion of various demographic characteristics, obstetric history, and attitudes toward COVID-19 disease provided a holistic understanding of factors influencing vaccine acceptance. The study also delved into both positive and negative factors affecting vaccine willingness, thereby offering valuable insights for designing effective interventions to promote vaccine acceptance.

However, there are certain limitations to consider. Firstly, the study's sample size was too small to demonstrate robust statistical power, potentially limiting the ability to detect subtle relationships or differences. Secondly, the study was conducted within a specific geographical and cultural context (Chiang Mai, Thailand), which may restrict the generalizability of findings to regions with distinct sociocultural backgrounds. Additionally, the timing of data collection, which occurred after a substantial portion of the population had received at least one COVID-19 vaccine dose, might have influenced participants' perception of the necessity of additional doses during pregnancy, potentially impacting their vaccine acceptance.

To enhance the study's robustness, future research could employ a larger and more diverse sample size, spanning various geographic locations and cultural contexts. This approach would not only enhance statistical power but also increase the study's external validity by facilitating more generalizable findings across pregnant populations.

## Conclusion

In conclusion, this study sheds light on the COVID-19 vaccine acceptance rate among pregnant women in Thailand, revealing a notable challenge with only 17% of pregnant women expressing willingness to receive the vaccine. The effect of healthcare provider advices significantly increased vaccine acceptance of the pregnant women by nearly two-fold (30.77%). The main reason of vaccine reluctance was the concern about vaccine safety that potentially harming their babies (77.44%). The study highlights the central role of healthcare provider in positively impacting vaccine acceptance rates. The findings emphasize the importance of comprehensive public health interventions that involve healthcare professionals in promoting vaccine acceptance among pregnant women.

## Ethics Approval and Consent to Participate

This study was complied with the Declaration of Helsinki. Informed consent of all participants was obtained. The project was approved by the Research Ethics Committee of the Faculty of Medicine, Chiang Mai University (OBG-2565-09134).

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## 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. WL and WP contributed equally to this work and share corresponding authorship.

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The authors have no competing interests to declare that are relevant to the content of this article.

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