ORIGINAL ARTICLE

Enhancing Immunization Uptake for Influenza and Pertussis in Thai Pregnant Women through Educational Sessions

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Objective: To describe influenza and pertussis vaccine uptake among pregnant women before and after receiving an educational session.

Materials and Methods: An interventional study was conducted at a tertiary care hospital and a specialized obstetric hospital in Thailand. In the first phase, the medical records of the non-intervention pregnant women received antenatal care (ANC) at the study sites were reviewed. In the second phase, the pregnant women completed a questionnaire about their knowledge and factors for vaccine acceptance then enrolled into the intervention, received an educational session. The vaccine uptake between phases were compared using chi-square test. Potential factors of vaccine acceptance were examined using multivariate logistic regression.

Results: Between May 2019 and July 2020, 785 pregnant women were enrolled with 375 in the non-intervention group and 410 in the intervention group. The median age of the pregnant women was 30 years (IQR of 26 to 34). Influenza vaccine uptake among the non-intervention group was 55.5% compared to 65.6% in the intervention group (p=0.004). The factor for influenza vaccine acceptance was the total number of visits at the ANC clinic at ten times or more (OR 1.38, 95% CI 1.04 to 1.84, p=0.03). Pertussis vaccine uptake was 52.8% in the non-intervention group compared to 67.0% in the intervention group (p=0.001). The factor for pertussis vaccine acceptance was receiving ANC at the tertiary care hospital (aOR 6.73, 95% CI 4.42 to 10.27). The most common reasons for not getting the vaccine were the concern of vaccine safety with 25.6% for influenza vaccine and 26.3% for pertussis vaccine.

Conclusion: The educational session increased the vaccine uptake for influenza and pertussis in Thai pregnant women.

Keywords: Immunization; Influenza; Pertussis; Pregnancy; Education

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Influenza is a respiratory infectious disease that causes burdens in both children and adults. It can lead to acute lower respiratory infection (ALRI) in young children. In 2018, approximately 109 million episodes of influenza-virus-associated ALRIs and 34,800 influenza-virus-associated severe ALRIs occurred in children under five years old globally. Among influenza-associated respiratory infections in hospitalized children under five years, 36% of the in-hospital deaths were in infants under six months[1]. Moreover, influenza in pregnant women is associated with an increased risk of late pregnancy loss and a decrease in birthweight of liveborn infants[2].

Another highly contagious respiratory infectious disease is pertussis. It is caused by the bacterium *Bordetella pertussis*. Clinical presentations are not limited to upper respiratory tract symptoms. Infants can die from severe pneumonia. This 'whooping cough' disease has rare complications such as seizures and brain disease[3]. The World Health Organization (WHO) estimated that 24.1 million children younger than five years old had pertussis and there were 160,700 deaths worldwide[4]. Moreover, a systematic review in 2020 reported the pertussis incidence rates in infants younger than three months of age

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exceeded 1,000 cases per 100,000 population during outbreaks[5]. This indicated that pertussis continues to be a problem worldwide.

As for Thailand, in 2021, the rate of influenza infection was 122 per 100,000 population, most of the infection occurred among infants, children, and young adults[6]. For pertussis, data between 2010 and 2019 showed an increasing rate of infection from 0.01 per 100,000 population to 0.26 per 100,000 population. Most of the infections, or 53.8%, were found in children younger than five years old[7]. Among infants age younger than one year, the incidence of pertussis was 0.12 per 100,000 infants and two deaths were reported[7].

Immunization against infectious diseases among newborn infants is limited. For example, the influenza vaccine can be given to infants older than six months old. Aside from that, the infants are vulnerable to pertussis during the period before they complete their 3-dose pertussis vaccination. Thus, the transfer of antibodies from pregnant women to their neonates and young infants is important[8,9]. As a result of this, it is recommended that pregnant women are vaccinated for influenza and pertussis to protect young infants from acquiring these infectious diseases. According to the American College of Obstetricians and Gynecologists (ACOG), pregnant women may receive influenza vaccine at any gestational age (GA), while pertussis vaccine is recommended to be given at 27 to 36 weeks of GA[10].

In Thailand, low influenza vaccine uptake among pregnant women was reported with 6% and 15% in the studies conducted at the tertiary care medical school in 2014 and 2015[11,12], which highlighting a concerning lack of awareness about vaccination in pregnant women. Previous studies demonstrated that numerous factors could affect vaccine acceptance in pregnant woman including advice from medical staff, knowledge, previous vaccine experience, economic status, and maternal age as well as vaccine safety and efficacy[13-15]. On the other hand, negative factors such as lack of knowledge about the vaccine, vaccine shortage, and negative information about the vaccine can affect vaccine acceptance[1,11,15-20]. Hence, it is important to increase vaccine acceptance among pregnant women by improving the positive factors and decreasing the negative factors.

The present study aimed to describe the vaccine uptake for influenza and pertussis among pregnant women before and after receiving an educational session provided by the medical staff during their antenatal care (ANC) at the clinic. In addition, the present study assessed the factors that affected the influenza and pertussis vaccination acceptance among pregnant women.

Materials and Methods

Study design

An interventional study with historical control among pregnant women attending an ANC clinic at the King Chulalongkorn Memorial Hospital (KCMH) and Health Promotion Center 5 (HPC5) Hospital was conducted. KCMH represented a large tertiary care medical school in the city of Bangkok and had 3,000 live births per year, while HPC5 Hospital represents a small size specialized hospital in Obstetrics and Gynecology, and Pediatrics in Ratchaburi Province with approximately 1,000 live births per year. The present study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University (IRB 382/63), and registered in the Thai Clinical Trials Registry (TCTR) (number TCTR20201218005).

Study participants

The sample size calculation was based on the study's objective to describe the vaccine uptake for influenza and pertussis among pregnant women in non-intervention and intervention group. The sample size was calculated by estimating an infinite population proportion. The data from a previous study showed that the influenza vaccine uptake was 42%, while the pertussis vaccine uptake was 36%[21,22] for non-intervention group, statistically significant level was 5% (alpha=0.05) and the desired precision was 5% (error=0.05. The calculated sample size for non-intervention group was 375 pregnant women. The sample size for the intervention group was calculated using the same formula. The data from a previous study showed that the vaccine uptake of influenza and pertussis after intervention was 61%[21,22]. Therefore, a total number of pregnant women needed for the intervention group after accounting for 10% drop out or lost to follow-up was 410.

Study procedures

Data of the non-intervention group were collected retrospectively from the electronic medical records of the pregnant women who delivered between May and June 2019. As for the intervention group, pregnant women who attended the ANC clinic between July 2019 and July 2020 were recruited. Pregnant women who attended the ANC clinic less than two times, had

received pertussis or influenza vaccine, or could not read or understand Thai were excluded from the study. The enrollment was conducted using convenience sampling. All pregnant women who visited the ANC clinic for the first time and did not meet the exclusion criteria were enrolled into the study until the total number of the pregnant women reached the required sample size. All of the participants were informed of the study and signed the informed consent. For the intervention group, a questionnaire was given to the pregnant woman to complete. The questionnaire was divided into three parts, 1) baseline characteristics such as maternal age, education, and family incomes, 2) knowledge on the necessity of influenza and pertussis vaccines during pregnancy, and 3) factors that affected influenza and pertussis vaccine acceptance, decision to get influenza or pertussis vaccine, and in cases refused to be vaccinated, the reasons for refusal to be vaccinated were assessed. After the pregnant women completed the questionnaires, they were then provided an educational session under medical personnel supervision to ensure that they paid attention to the VDO clip being shown, The educational session required the pregnant women to watch a pre-recorded video by the obstetrician regarding influenza and pertussis during pregnancy, disease burden on maternal and child health, vaccine efficacy, and side effects of both vaccines, followed by Q&A session with a trained medical personnel for 10 to 15 minutes.

Data record form was used to retrieve antepartum and intrapartum information from electronic medical record consisting of ANC site, GA at first ANC visit, total number of ANC visits, complications during pregnancy, type of vaccine received, GA when the vaccine was administered, birth order of the child, and GA at delivery. Pregnancy complications included elderly gravidarum for the mothers aged 35 years or older at the time of delivery, diabetes mellitus (DM) defined as overt or gestational DM, and anemia in pregnancy defined as hemoglobin of less than 11 g/dL during the first or third trimesters, or hemoglobin of less than 10.5 g/dL during the second trimester. All data were analyzed to determine the factors associated with vaccine acceptance among pregnant women.

Vaccines

There are two types of influenza vaccine in Thailand, trivalent influenza vaccine (TIV) and quadrivalent influenza vaccine (QIV). Also, there are two types of pertussis vaccine in Thailand, Tdap (tetanus, reduced diphtheria toxoid, and acellular pertussis) vaccine, and acellular pertussis (aP) vaccine. In Thailand, the national health immunization program provided TIV for pregnant women free of charge and it was available all year-round. If the pregnant women chose QIV, they would need to pay for the vaccine herself. QIV costs around 9 to 12 USD. For the pertussis vaccine, it was not offered through the national immunization program for pregnant women. Tdap vaccine costs around 15 to 18 USD, and aP vaccine costs 13.5 USD.

Outcomes

The primary outcome was the rate of vaccine uptake among non-intervention and intervention groups, calculated by the number of pregnant women receiving the vaccine divided by the total number of pregnant women who visited the ANC clinic within the study time frame. The secondary outcomes were factors associated with acceptance of influenza and pertussis vaccines.

Statistical analysis

Data were presented as number, percentage, mean with standard deviation (SD), and median with interquartile range (IQR). Chi-square test was used to assess the differences of the categorical data. Independent t-test or Wilcoxon rank sum test was used to assess the differences of the continuous data. Logistic regression was used to determine the factors associated with influenza or pertussis vaccine acceptance. Covariates from the univariate model with p-value less than 0.2 were adjusted in the multivariate models. All p-values reported were two-sided. Statistical significance was defined as p-value less than 0.05. Stata Statistical Software, version 15.1 (StataCorp LLC, College Station, TX, USA) was used for analysis.

Results

Between May 2019 and July 2020, 375 pregnant women were enrolled in the non-intervention group and 410 pregnant women in the intervention group. There were 36 (8.7%) pregnant women in the intervention group lost to follow-up.

Baseline characteristics

The present study enrolled 785 pregnant women, 589 from KCMH and 196 from HPC5 Hospital. The median age of the pregnant women was 30 years (IQR 26 to 34). The median GA at the first ANC visit at the clinic was nine weeks (IQR 7 to 13). The median GA at delivery was 38 weeks (IQR 37 to 39).

Table 1. Characteristics of 785 pregnant women in the study

	Total (n=785)	Non-intervention (n=375)	Intervention (n=410)	p-value
Site; n (%)				0.95
KCMH (A tertiary medical school)	589 (75.0)	281 (75.0)	308 (75.0)	
HPC5 (A specialized hospital)	196 (25.0)	94 (25.0)	102 (25.0)	
Baseline characteristics of the pregnant women; median (IQR)				
Age (years)	30 (26 to 34)	31 (26 to 35)	29 (25 to 33)	<0.001
GA (weeks) at first ANC visit	9 (7 to 13)	9 (7 to 13)	10 (7 to 14)	0.43
Number of ANC visits	9 (8 to 11)	9 (7 to 10)	10 (8 to 11)	<0.001
Pregnancy complications; n (%)				0.84
Yes	353 (45)	170 (45.3)	183 (44.6)	
• Elderly primigravida	179 (22.8)	102 (27.2)	77 (18.8)	0.005
• DM	49 (6.2)	18 (4.8)	31 (7.6)	0.11
• Anemia	76 (9.7)	22 (5.9)	54 (13.2)	0.001
GA at delivery				
Median (IQR)	38 (37 to 39)	38 (37 to 39)	38 (38 to 39)	0.41
Preterm; n (%)	69 (9.3)	38 (10.1)	31 (8.4)	0.41
Education; n (%)				N/A
Lower than bachelor's degree	-	-	208 (50.7)	
Bachelor's degree or higher	-	-	202 (49.3)	
Income; n (%)				N/A
≤900 US dollars	-	-	277 (67.6)	
>900 US dollars	-	-	133 (32.4)	

KCMH=King Chulalongkorn Memorial Hospital; HPC5=Health Promotion Center 5 Hospital; ANC=antenatal care clinic; GA=gestational age; DM=diabetes mellitus; IQR=interquartile range

Compare proportion using chi-square test, compare median using Wilcoxon rank sum test

The median GA when the intervention was provided at the first ANC visit was ten weeks (IQR 7 to 14). The median age of the pregnant women in the non-intervention group was 31 years (IQR 26 to 35) and they were older compared to the intervention group 29 years (IQR 25 to 33) (p<0.01). The median number of visits at the ANC clinic in the non-intervention group was nine times (IQR 7 to 10), and for the intervention group was ten times (IQR 8 to 11) (p<0.01). For the complications during pregnancy, in the intervention group, mothers had lower proportion of elderly primigravida at 18.8% versus 27.2% (p=0.005), and higher rate of anemia at 13.2% versus 5.9% (p=0.001). However, there were no significant differences of GA at delivery between the two groups as shown in Table 1.

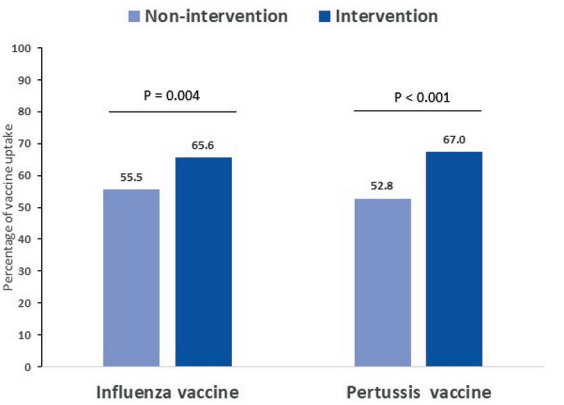

Figure 1. Vaccine uptake of influenza and pertussis among pregnant women in the nonintervention and intervention groups. Proportion of vaccine uptake was compared using chi-square test.

Vaccine uptake

Overall, the influenza vaccine uptake in the non-intervention group was 55.5% and 65.6% in the intervention group (p=0.004) (Figure 1). The median GA at time of receiving influenza vaccine was 22 weeks (IQR 19 to 27) in the non-intervention group, and 21 weeks (IQR 18 to 25) in the intervention group (p=0.02) (Table 2). Regarding pertussis vaccine, overall vaccine uptake in non-intervention group was 52.8% compared to 67.0% in the intervention group (p<0.001). The median GA at time of receiving pertussis vaccine was 29 weeks (IQR 27 to 32) in the non-intervention group, and 29 weeks (IQR 28 to 31) in the intervention group (p=0.27) (Table 2).

Table 2. Comparison of influenza and pertussis vaccine uptake between non-intervention and intervention groups

	Total	Non-intervention	Intervention	p-value
Influenza vaccine; n (%)	n=785	n=375	n=410	
No	308 (39.2)	167 (44.5)	141 (34.4)	0.004
Yes	477 (60.8)	208 (55.5)	269 (65.6)	<0.001
• TIV	217 (45.5)	120 (57.7)	97 (36.1)	
• QIV	260 (54.5)	88 (42.3)	172 (63.9)	
GA at vaccine; median (IQR)	22 (18 to 26)	22 (19 to 27)	21 (18 to 25)	0.02
Pertussis vaccine; n (%)	n=781	n=375	n=406*	
No	311 (39.6)	177 (47.2)	134 (33.0)	<0.001
Yes	474 (60.4)	198 (52.8)	272 (67.0)	<0.001
• Tdap	341 (72.6)	109 (55.1)	232 (85.3)	
• aP	129 (27.5)	89 (45)	40 (14.7)	
GA at vaccine; median (IQR)	29 (28 to 31)	29 (27 to 32)	29 (28 to 31)	0.27

TIV=trivalent influenza vaccine; QIV=quadrivalent influenza vaccine; GA=gestational age; Tdap=tetanus, reduced diphtheria toxoid, acellular pertussis vaccine; aP=acellular pertussis vaccine; IQR=interquartile range

Compare proportion using chi-square test, compare median using Wilcoxon rank sum test

* 4 pregnant women who were lost to follow-up before 27 weeks (gestational age to receive pertussis vaccine was 27 to 36 weeks) were excluded from the analysis

Table 3. Factors associated with influenza and pertussis vaccine uptake

	Influenza vaccination (n=785)				Pertussis vaccination (n=781*)			
	Univariate		Multivariate		Univariate		Multivariate	
	Odds ratio (95% CI)	p-value	Adjusted odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value	Adjusted odds ratio (95% CI)	p-value
Non-intervention	1		1		1		1	
Intervention	1.53 (1.15 to 2.04)	0.004	1.45 (1.08 to 1.95)	0.01	1.81 (1.36 to 2.42)	<0.001	1.68 (1.18 to 2.38)	0.004
Age ≥30 years vs. <30 years	0.92 (0.69 to 1.23)	0.59			1.42 (1.07 to 1.9)	0.02	1.33 (0.89 to 1.97)	0.16
GA at first ANC visit <10 weeks vs. ≥ 10 weeks	1.35 (1.02 to 1.8)	0.04	1.25 (0.92 to 1.71)	0.16	1.02 (0.76 to 1.35)	0.92		
Total ANC visits ≥10 times vs. <10 times	1.38 (1.04 to 1.84)	0.03	1.27 (0.92 to 1.76)	0.15	1.07 (0.8 to 1.43)	0.65		
Occurrence of complications								
Elderly primigravida	0.87 (0.62 to 1.22)	0.41			1.6 (1.12 to 2.28)	0.01	0.83 (0.52 to 1.32)	0.42
Diabetes mellitus	1.5 (0.8 to 2.8)	0.20			1.9 (0.99 to 3.65)	0.05	1.22 (0.59 to 2.54)	0.59
Anemia	1.12 (0.69 to 1.83)	0.65			1.59 (0.95 to 2.66)	0.08	0.68 (0.39 to 1.20)	0.19
Site								
KMCH	1.26 (0.91 to 1.74)	0.17	1.37 (0.98 to 1.94)	0.07	7.7 (5.32 to 11.15)	<0.001	6.73 (4.42 to 10.27)	<0.001
HPC5	1		1		1		1	

KCMH=King Chulalongkorn Memorial Hospital; HPC5=Health Promotion Center 5 Hospital; ANC=antenatal care clinic; GA=gestational age; CI=confidence interval

Using logistics regression, multivariate models were developed by adjusting the covariates obtained from the univariate models that had a p-value of <0.1

* 4 pregnant women who were lost to follow-up before 27 weeks (gestational age to receive pertussis vaccine was 27 to 36 weeks) were excluded from the analysis

Factors that affected the vaccine uptake

Influenza vaccine

In the univariate analysis, the total number of ANC visits was significantly associated with influenza vaccine uptake. Pregnant women who visited the ANC clinic more than or equal to 10 times had a higher rate of influenza vaccine uptake (OR 1.38, 95% CI 1.04 to 1.84, p=0.03) but in the multivariate analysis, it was not significantly associated (Table 3).

Pertussis vaccine

In the multivariate analysis, for the intervention group, the location of the ANC clinic was significantly associated with pertussis vaccine uptake. Pregnant women who received intervention during ANC visit had a higher rate of pertussis vaccine uptake (aOR 1.68, 95% CI 1.18 to 2.38, p=0.04). Pregnant women attended the ANC clinic at KCMH had a higher rate of

pertussis vaccine uptake compared to HPC5 Hospital (aOR 6.73, 95% CI 4.42 to 10.27, p<0.001) (Table 3).

Knowledge and attitude

Influenza vaccine

In the intervention group, only 58.0% stated that pregnant women should get influenza vaccination during pregnancy. The reasons for accepting the vaccine were vaccine safety for 46.6%, followed by vaccine efficacy for 36.6%, and advice from medical staff for 22.7%. After receiving an educational session, 89.7% stated they would get influenza vaccine. The reasons for not getting the vaccine were the concern of vaccine safety for 25.6%, lack of knowledge of the disease and vaccine for 16.3%, and previous vaccine experience for 14.0% (Table 4).

Pertussis vaccine

In the intervention group, only 32.7% stated that pregnant women should get pertussis vaccination during pregnancy. The reasons for accepting the vaccine were vaccine safety for 46.6%, followed by vaccine efficacy for 36.6%, and advice from medical staff for 22.7%. After receiving an educational session, 86.1% stated that they would get pertussis vaccination. The reasons for not getting the vaccine were vaccine safety for 26.3%, lack of knowledge of the disease and vaccine for 19.3%, and vaccine costs for 17.5% (Table 4).

Subgroup analysis of the intervention group

In the intervention group, the education and economic status were extracted from the questionnaire. The educational level among the pregnant women in the intervention group were 42.4% of the pregnant women had a bachelor's degree, 25.4% had vocational certificates, and 22.2% graduated from primary school. Pregnant women graduated with a bachelor's degree or higher were associated with higher pertussis vaccine uptake (aOR 1.87, 95% CI 1.13 to 3.09). The economic status was classified into four groups as shown in Table 4. Most pregnant women (58.5%) had incomes of 300 to 900 USD per month. However, the income was not associated with vaccine uptake (Table 5).

Table 4. Characteristics, knowledge, and attitudes of 410 pregnant women in the intervention group

	n=410	
Age in years; median (IQR)	29 (25 to 33)	
Education; n (%)		
Primary school	91 (22.2)	
Secondary school	13 (3.2)	
Vocational certificates	104 (25.4)	
Bachelor's degree	174 (42.4)	
Master's degree or higher	28 (6.8)	
Income; n (%)		
<300 US dollars	37 (9.0)	
300 to 900 US dollars	240 (58.5)	
900 to 1,500 US dollars	87 (21.2)	
>1,500 US dollars	46 (11.2)	
	Influenza	Pertussis
Respond to questionnaire that pregnant women should receive vaccination during pregnancy; n (%)	237 (58.0)	134 (32.7)
Top 3 reasons contributing to vaccine acceptance; n (%)		
Vaccine safety	191 (46.6)	
Vaccine efficacy	150 (36.6)	
Advice from medical staff	93 (22.7)	
Decide to vaccinate after intervention; n (%)	367 (89.7)	353 (86.1)
Reasons for not getting the vaccine; n (%)		
Vaccine safety	11 (25.6)	15 (26.3)
Previous vaccine experience	6 (14.0)	6 (10.5)
Vaccine costs	4 (9.3)	10 (17.5)
Vaccine efficacy	2 (4.7)	0 (0.0)
Knowledge of disease and vaccine	7 (16.3)	11 (19.3)
Vaccine shortage	2 (4.7)	2 (3.5)
Doctor's advice	4 (9.3)	4 (7.0)
Others	7 (16.3)	9 (15.8)

Discussion

Influenza and pertussis vaccine uptake were assessed among pregnant women in two hospital settings in Thailand and showed significantly higher vaccine uptake after receiving an educational session. The factor that affected the influenza vaccination among pregnant women in the present study was the total number of ANC visits at the ANC clinic more than 10 times. As for the pertussis vaccine acceptance, receiving ANC at the tertiary care hospital had higher vaccine uptake. The authors hypothesized that increased frequency of ANC visits would result in receiving more reminders and advice from healthcare providers. Additionally, ANC in a tertiary setting may offer opportunities for more updated practice guidelines or more costly practices compared to a primary setting. Moreover, potential differences in the financial status of pregnant women between hospitals may exist.

The results from the present study corroborate findings from previous studies[21,22] that educational sessions can increase the vaccine uptake among pregnant women. In the study, advice from the medical staff was associated with higher influenza

Table 5. Factors associated with influenza and pertussis vaccine uptake in the intervention group

	Influenza vaccination (n=410)				Pertussis vaccination (n=406*)			
	Univariate		Multivariate		Univariate		Multivariate	
	Odds ratio (95% CI)	p-value	Adjusted odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value	Adjusted odds ratio (95% CI)	p-value
Age ≥30 years vs. <30 years	0.93 (0.62 to 1.4)	0.74			1.67 (1.1 to 2.54)	0.02	1.12 (0.69 to 1.82)	0.64
Education								
Lower than bachelor's degree	1		1		1		1	
Bachelor's degree or higher	0.72 (0.48 to 1.09)	0.12	0.67 (0.44 to 1.02)	0.06	1.97 (1.29 to 3.01)	0.002	1.87 (1.13 to 3.09)	0.01
Income								
≤900 US dollars	1				1			
>900 US dollars	0.9 (0.58 to 1.38)	0.62			1.78 (1.12 to 2.83)	0.02	0.96 (0.55 to 1.67)	0.88
GA at first ANC visit <10 weeks vs. ≥10 weeks	1.59 (1.06 to 2.4)	0.03	1.55 (0.99 to 2.43)	0.06	0.93 (0.61 to 1.41)	0.73		
Total ANC visits ≥10 times vs. <10 times	1.44 (0.96 to 2.17)	0.08	1.25 (0.79 to 1.95)	0.34	1.11 (0.73 to 1.68)	0.63		
Site								
KMCH	1.25 (0.78 to 1.99)	0.35			7.21 (4.4 to 11.82)	<0.001	7.02 (4.20 to 11.73)	<0.001
HPC5	1				1			

KCMH=King Chulalongkorn Memorial Hospital; HPC5=Health Promotion Center 5 Hospital; ANC=antenatal care; GA=gestational age; CI=confidence interval

Using logistics regression, multivariate models were developed by adjusting the covariates obtained from the univariate models that had a p-value of <0.1

* 4 pregnant women who were lost to follow-up before 27 weeks (gestational age to receive pertussis vaccine was 27 to 36 weeks) were excluded from the analysis

vaccine acceptance among pregnant women to 61% compared to the non-intervention group at 42%[22]. In addition, in a systematic review, it was shown that the provider's knowledge on how to improve the uptake of pertussis vaccination among pregnant women had a vaccine acceptance of 61%[21]. In a randomized controlled trial among African American women using two interventions, an affective messaging video and a cognitive messaging iBook, resulted in pertussis vaccine uptake of 18% in the control group, 50% in the iBook group, with a risk ratio versus control group of 2.83 (95% CI 1.26 to 6.37), and 29% in the video group (RR 1.65, 95% CI 0.66 to 4.09)[23].

Reports have shown that pregnant women who refused to be vaccinated was due to the concerns of the vaccine's side effects to the baby and the mother[24-27]. Likewise, the present study also showed that vaccine safety was the reason given by pregnant women who refused to be vaccinated. Another factor that contributed to lower vaccine acceptance was not getting any advice from the medical staff. According to a previous study conducted at a tertiary care hospital in Thailand, vaccine uptake was associated with receiving advice from medical staff (aOR 2.61, 95% CI 1.55 to 4.39)[12]. Consequently, educational session to provide knowledge was crucial in improving the vaccination uptake. Not only that, but the information could change the attitude towards getting a vaccine among pregnant women. In addition, the educational session's effect lasted beyond delivery. It was found that the vaccine uptake occurred during the follow-up period. This showed that the advice from the medical staff provided during the ANC visit was important. However, it should be noted that one session may not be enough to answer all of the concerns of the pregnant women because the women also have questions pertaining to their babies. In a previous study, information on vaccinations were provided during the ANC clinic and were found to have increased the vaccine acceptance rate. In addition, a previous study conducted in the UK used social media to provide information on vaccination among pregnant women and this method was sustainable as well as able to increase vaccine uptake[28]. The authors found the difference between the acceptance rates after intervention at 89.7% and 86.1% and the actual vaccination uptake at 65.6% and 67.0% for influenza and pertussis, respectively, may be attributed to various factors. These factors include cost of vaccine, reminders from healthcare providers, and the awareness of the importance of vaccine among pregnant women post-educational sessions, extending until the actual vaccination date, which may last months.

There were differences in administering the influenza and pertussis vaccines among pregnant women. First, the influenza vaccine can be given at any trimester while pertussis vaccine can be given

at the 27 to 36 weeks of GA. In a previous study from Nicaragua, four or more ANC visits, from self-reported data that was corroborated by the vaccination cards and/or antenatal medical records, were associated with higher influenza vaccine uptake (aORs 2.58, 95% CI 1.15 to 5.81 and 2.37, 95% CI 1.12 to 5.0, respectively)[29]. This showed that the pregnant women had healthy behaviors because they attended the ANC clinic. The vaccine acceptance was positively correlated with the number of ANC visits. In the present study, ten or more ANC visits was associated with higher influenza vaccine uptake. As for the pertussis vaccine, studies have reported that the vaccine uptake was lower due to the costs of the vaccine. In the present study, pregnant women who had ANC at a tertiary care hospital had higher pertussis vaccine uptake. It is possible that the pertussis vaccine uptake between the two groups differed according to the financial status of the pregnant women, but this was not assessed in this study. Additional study should assess factors associated with pertussis vaccine acceptance in various hospital settings. For example, in a previous study in USA, a teaching practice had a higher rate of influenza and Tdap vaccination in pregnancy compared to private practices[27].

The strengths of the present study were the updated and reliable data that used questionnaire and data confirmed by the electronic medical record, on the rates of influenza and pertussis vaccine uptake among Thai pregnant women. The educational session used a pre-recorded video by the obstetrician shown to the pregnant women at both sites and therefore, the information conveyed in the educational session was the same between the two sites. The information given increased the vaccine uptake in the intervention group.

The present study had limitations. In the non-intervention group, data on education and income, which could affect vaccine uptake, were not available. For the intervention group, some of the pregnant women were lost to follow-up, therefore, the study could not ascertain whether the pregnant women were vaccinated or not. It was assumed that these women were not vaccinated for influenza or pertussis. In addition, pregnant women lost to follow-up before GA of 27 to 36 weeks were counted as dropouts from the study for pertussis vaccine. Second, the present study was conducted during the COVID-19 pandemic. It was possible that there were higher rates of pregnant women lost to follow-up or dropped out during this period. Due to travel restrictions and partial lockdown, this affected the present study's ability to provide the intervention to the pregnant women in 2019 during the first wave of COVID-19 pandemic. Last, it is possible that due to the pandemic of COVID-19, it could have affected the pregnant women's decision to be vaccinated for influenza and pertussis in both positive way, influence vaccination by raising awareness, or negative way with prohibit vaccination from misinformation.

In conclusion, maternal immunization with influenza and pertussis is an important strategy to protect their infants from vaccine-preventable disease. A major reason for vaccine hesitancy is concerns about vaccine side effects. The educational session increased vaccine uptake for influenza and pertussis among Thai pregnant women.

What is already known on this topic?

In Thailand, low influenza and pertussis vaccine uptake among pregnant women was reported. Multiple factors influence the vaccine acceptance in pregnant woman including advice from healthcare professionals, levels of knowledge, previous vaccine experience, economic status, maternal age, as well as perceptions of vaccine safety and efficacy. It is important to enhance vaccine acceptance among pregnant women.

What does this study add?

Influenza and pertussis vaccine uptake were assessed among pregnant women in two hospital settings in Thailand and showed significantly higher vaccine uptake after receiving educational session. The most common reasons for not getting the vaccine were the negative perceptions of vaccine safety at 25.6% for influenza vaccine and at 26.3% for pertussis vaccine. This is to emphasize an importance of the educational session by healthcare professionals to increase the vaccine uptake among pregnant women.

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Availability of data

The data used to support the findings of the present study is available upon request from the corresponding author.

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Conflicts of interest

The authors declared no conflict of interest.

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