



Knowledge, Attitudes, and Practices Concerning Maternal Immunization Among Pregnant/Postpartum Women and Health Care Professionals in Peru

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ABSTRACT

Introduction: For pregnant women, vaccination with inactivated influenza vaccine (IIV) and tetanus, diphtheria, acellular pertussis vaccine (Tdap) is recommended. In Peru, uptake is nonetheless low. A study was conducted to identify factors affecting maternal vaccination coverage. The study's primary objectives were to describe the knowledge, attitudes, and practices regarding maternal immunization among

pregnant/postpartum women and health care professionals (HCPs). The secondary objective was to determine the vaccination coverage and the impact of Ministry of Health (MOH) recommendations.

Methods: An observational multicenter, cross-sectional survey study was conducted from February 1, 2021 to June 30, 2021 in five cities in Peru. Two surveys were conducted to assess knowledge, attitudes, and practices concerning maternal immunization: one among pregnant/postpartum women and one among HCPs.

Results: Participants were 668 pregnant/postpartum women with a mean age of 29.6 years and 219 HCPs—mostly midwives (46.6%) and obstetricians/gynecologists (44.7%). Of the pregnant/postpartum women, 66.9% knew that, in general, vaccinations are given for prevention, and 98.5% believed vaccines are important. Nonetheless, 69.6% of pregnant/postpartum women had poor or moderate knowledge of maternal vaccination. Disease knowledge of influenza (89.1%) and tetanus (87.0%) was high, while knowledge of pertussis (37.7%) was low. Women agreed/strongly agreed that they would get vaccinated with Tdap if a doctor (96.3%), midwife (88.9%), or nurse (72.0%) recommended it. Of the HCPs, 81.3% routinely recommended Tdap vaccination for pregnant women.

Conclusions: To enhance vaccine acceptance in pregnant women in Peru, we must improve knowledge of the diseases, MOH

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recommendations, and benefits of the offered vaccinations. HCPs could provide this vaccination knowledge and information along with their vaccination recommendation as the pregnant/postpartum women indicated they would

take the vaccines if recommended by their HCPs. Our findings are important for the successful implementation of maternal immunization programs in Peru.

PLAIN LANGUAGE SUMMARY

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**What is the context?**

- ◆ Vaccination of pregnant women protects both the women and their newborns from vaccine-preventable diseases.
- ◆ The World Health Organization recommends vaccination of pregnant women against influenza, tetanus, diphtheria, and pertussis.
- ◆ The Ministry of Health in Peru provides the vaccines against these diseases for free.
- ◆ Nonetheless, vaccination uptake by pregnant women is low in Peru.
- ◆ We performed two surveys, one among 668 pregnant and postpartum women and another among 219 health care professionals (HCPs) involved in their care. The purpose was to determine their knowledge, attitude, and practice of these diseases, the vaccines against them, and vaccination of pregnant women.

**What is the impact?**

- ◆ Almost 70% of the pregnant and postpartum women had poor or moderate knowledge of vaccinations for pregnant women. Many also did not know about the potential severity of pertussis, tetanus, and influenza.
- ◆ The HCPs know the vaccinations against influenza, tetanus, diphtheria, and pertussis are safe and claim to recommend them routinely. Nevertheless, only 25.3% of the women were vaccinated against influenza and 30.1% against tetanus, diphtheria, and pertussis.
- ◆ Many women who did not get vaccinated did not realize these vaccinations were recommended for pregnant women.

**What is new?**

- ◆ We determined the factors that hamper the vaccination of pregnant women in Peru. We found that the knowledge, attitude, and practice of HCPs were good.
- ◆ To increase vaccination uptake, the women need more information about the diseases, especially pertussis, and the vaccinations against them.
- ◆ The HCPs could provide this information as the women indicated they would take the vaccinations if the HCPs recommended them.

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Keywords: Coverage; Knowledge; Maternal immunization; Influenza; Pertussis; Tetanus; Peru

Key Summary Points

We interviewed 668 pregnant/postpartum women and 219 health care providers (HCPs).

Most women knew that, in general, vaccinations are for prevention and are important.

Nearly 70% of women had poor or moderate knowledge of maternal vaccination.

HCPs agree tetanus, diphtheria, acellular pertussis vaccine (Tdap) and inactivated influenza vaccine (IIV) are safe for pregnant women and routinely recommend them.

To enhance vaccine uptake, women need more information on diseases and vaccinations.

DIGITAL FEATURES

This article is published with digital features, including a graphical plain language summary, to facilitate understanding of the article. To view digital features for this article, go to <https://doi.org/10.6084/m9.figshare.22183855>.

INTRODUCTION

Pregnancy is associated with elevated risks to both mother and infant from vaccine-preventable diseases (VPDs) such as tetanus, influenza, and pertussis. Vaccination of pregnant women (maternal immunization) protects both the women and their newborns from VPDs [1]. Maternal immunization induces high levels of maternal antibodies that can be transferred via the placenta to the fetus and via

breastfeeding to the newborn. The maternal antibodies help protect newborns directly during their first months of life until they are old enough to be protected through vaccination and indirectly by preventing transmission of disease via an infected mother [2–4].

The World Health Organization (WHO) recommends vaccination for pregnant women against seasonal influenza [5], pertussis [6], tetanus [7], and COVID-19 [8]. In 2019, of the 52 countries and territories in the Americas, 34 recommended vaccination with inactivated influenza vaccine (IIV), and 16 recommended vaccination with tetanus, diphtheria, and acellular pertussis vaccine (Tdap) for pregnant women [9]. Despite the implementation of these vaccination policies, many maternal vaccination programs in the Latin America region are poorly executed and with low uptake. For instance, in 2018, influenza vaccination coverage for pregnant women ranged from 2% (St. Kitts and Nevis) to 91% (Nicaragua) in this region [10].

In Peru, maternal immunization against tetanus, diphtheria (with tetanus, diphtheria vaccine [Td]), and seasonal influenza has been recommended since 2013, and vaccines are given free of charge [11, 12]. In 2018, the Ministry of Health (MOH) recommended maternal immunization against pertussis as well (with Tdap) [13]. However, uptake and vaccination coverage, at least for influenza, have been low since the implementation of the recommendations [14, 15]. Influenza vaccination coverage among pregnant women in Peru was 36% in 2015, 26% in 2016, and 38% in 2018 (data for 2017 are not available) [15]. Vaccination coverage data for Tdap vaccination in pregnant women is not yet published, but the administrative data show that Td vaccination coverage in pregnant women is low and decreasing since the introduction in 2018 (12–50%) [16].

To improve the success of maternal immunization programs, certain aspects need to be considered. These aspects include providing safety information about the vaccine in pregnant women, strong national recommendations, and health care professionals (HCPs) who recommend and provide the vaccine to their patients [17]. In addition, it is important to

determine the knowledge and behavior of pregnant women regarding common barriers in maternal immunization [18] in order to design strategies to overcome these barriers. Several studies worldwide have investigated these barriers [18, 19], but evidence is limited in Latin America, where cultural norms may differ compared to the published data.

We performed a Knowledge, Attitude, and Practice (KAP) survey study to identify factors affecting maternal vaccination coverage in Peru. The primary objectives of the study were (1) to describe the knowledge, attitudes, and practices regarding maternal immunization among pregnant and postpartum women in Peru; and (2) to describe the knowledge, attitudes, and practices regarding maternal immunization among HCPs in Peru. The study's secondary objectives were to determine the vaccination coverage trends of the vaccines in the maternal immunization program and the impact and awareness of MOH recommendations and campaigns to promote these vaccine programs.

METHODS

Study Design

This was an observational, multicenter, cross-sectional survey study conducted from February 1, 2021 to June 30, 2021 in five cities in Peru, namely Lima, Piura, Cajamarca, Trujillo, and Huancayo. The cities and health centers were selected to ensure representativeness, using convenience sampling and considering multiple factors such as logistic feasibility, target population size, and the availability of the centers to participate (Fig. 1).

Two different surveys were administered according to the target populations: survey A among pregnant/postpartum women and survey B among HCPs. Participants for survey A were recruited among pregnant and postpartum women attending survey sites during antenatal or postnatal checkups with a gynecologist or obstetrician or during infant health checkups with a pediatrician. Participants for survey B were recruited among HCPs (i.e., obstetricians,

gynecologists, nurses/midwives) from participating survey sites. Participants were excluded from either survey if they were unable or unwilling to give informed consent.

The survey protocol was approved by the ethics committees: Comité Institucional de Bioética de Vía Libre RCEI-32; Comité Institucional de Ética para Humanos de la Universidad Peruana Cayetano Heredia RCEI-14; Comité Institucional de Ética en Investigación HNHU, RCEI-54; and the Instituto Nacional Materno Perinatal RCEI-81. The survey followed the local regulatory requirements for Peru and was conducted in accordance with the Declaration of Helsinki. All participants gave written informed consent or assent before enrolment. All data collected were anonymized.

Survey Methods and Data Collection

Survey A consisted of the following sections: (1) enrolment and demographic data; (2) knowledge of disease and vaccination; (3) attitudes/perception; (4) practices/utilization. Survey A was adapted from a survey conducted among pregnant women in the USA in 2014 [20], also incorporating components of the Health Belief Framework Model for predicting health behavior (perceived susceptibility and severity, perceived safety and benefits, perceived barriers, cues to action, self-efficacy) and the Social Norms Model (social norms and intentions) [21, 22].

Survey B consisted of the following sections: (1) enrolment and demographic data; (2) disease priority; (3) safety of vaccines; (4) effectiveness of vaccines; and (5) awareness of MOH recommendations and campaigns. Survey B was adapted from a survey conducted among physicians in Thailand in 2013 [23]. Both surveys were designed in local Spanish and piloted in the field to determine whether they were culturally appropriate and if any adaptations were needed.

The surveys were structured, computer-assisted personal questionnaires with both multiple-choice and open-ended questions. Terms for HCPs used in the surveys were obstetrician (*obstetra*), gynecologist (*ginecólogo*), obstetrician–gynecologist (*gineco-obstetra*), nurse (*enfermera*), and midwife (*obstetriz*). In Peru, most

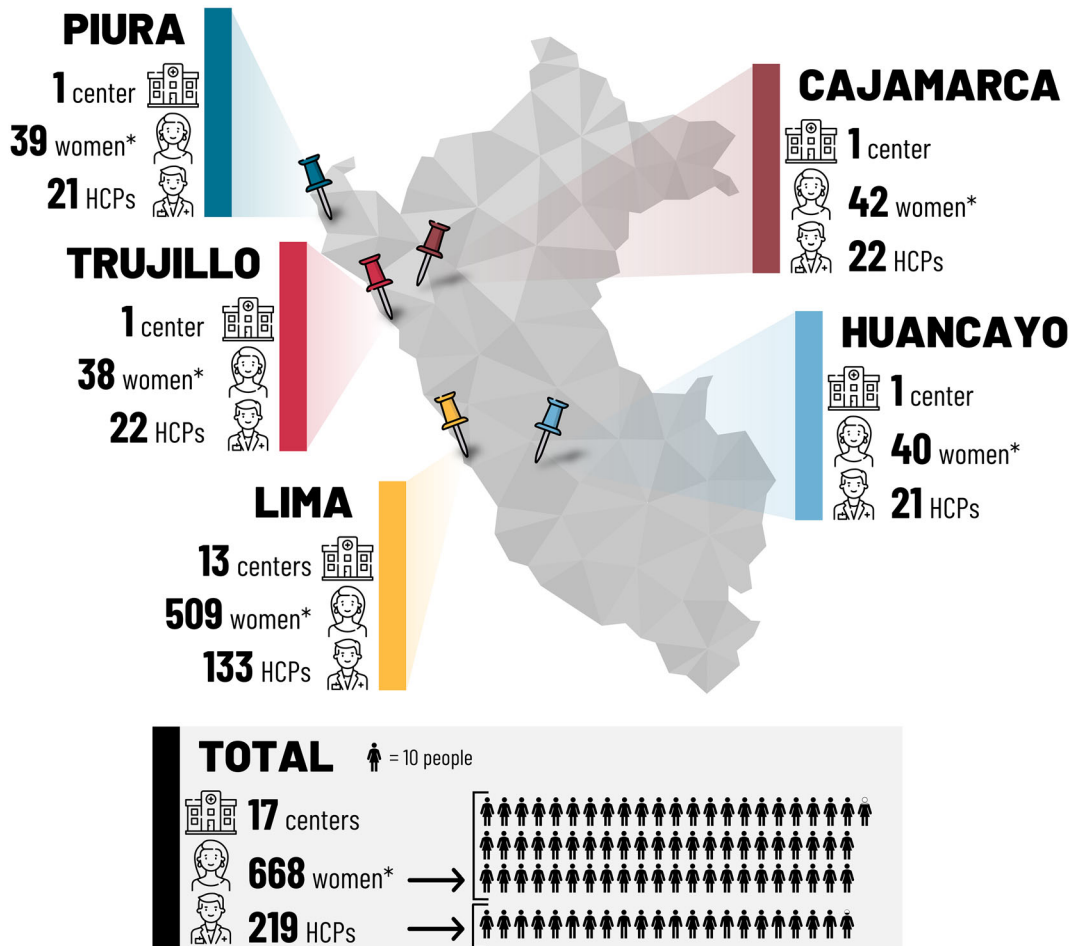


Fig. 1 Centers and participants in Peru. *HCPs* health care professionals. *Pregnant/postpartum women

obstetricians have the dual specialization as obstetrician/gynecologist. For context, in Peru, pregnant women usually first seek prenatal care with a midwife. If the pregnancy is high risk (or in the private sector), a gynecologist or obstetrician–gynecologist specialist manages the prenatal control [27].

Trained survey personnel identified eligible participants from survey sites and conducted the appropriate interview on the basis of the participant’s eligibility criteria. To verify whether the women were vaccinated, we inspected their vaccination cards or medical charts. All data collected during the surveys was entered onto an electronic data collection form in an electronic database. All data in the database was fully edited (reviewed and checked) to determine that all required information was present.

Assessment and Analysis of Knowledge and Perceived Health Beliefs

The frequency and percentages of pregnant/postpartum women’s answers were presented for each knowledge-related question regarding maternal immunization. Responses to open-ended questions such as “what do you think vaccines are used for?” were categorized in themes via content analysis and then presented descriptively.

To assess knowledge of maternal vaccination, questions with the response options “Yes”, “No”, or “Don’t know” (Table S1: Knowledge in the electronic supplementary material, ESM) were scored by assigning a value of 1 to correct answers and a value of 0 to wrong answers and “Don’t know”. These scores were summed to

create a knowledge score. To determine the internal consistency of the questions in this category, Cronbach's α was calculated. Cronbach's α is expressed on a scale of 0 to 1, with a high number indicating good consistency [24]. The knowledge scores were then divided into three parts, each containing a third of the scores and categorized as poor (lowest tertile), moderate (middle tertile), and good (highest tertile) knowledge of immunization.

Attitude and perceptions relating to Tdap and influenza vaccination based on the Health Belief Framework Model and Social Norms Model were scored on 5-point Likert scales and summarized. The responses were recoded from 0 to 5 with the most positive response recoded 5 and the option "Don't know" recoded as 3. The most positive response in all the perception questions, except for perceived barriers, was "Strongly agree". For questions about perceived barriers, the most positive response was "Strongly disagree". A score for total health belief for each vaccine category was created by the sum of the responses of the Likert scale items (Table S1: Total Perceived Health Beliefs in the ESM). The internal consistency of each category was again evaluated by calculating Cronbach's α . The total health benefit score per vaccine category was categorized as poor, moderate, and good by dividing the scores into tertiles.

Statistical Analysis

Target sample sizes were $N = 660$ for pregnant/postpartum women, and $N = 216$ for HCPs. The sample sizes were calculated according to the formula $n = (Z_{\alpha/2} + Z_{\beta})^2 \times [p(1 - q)/d^2]$ for one proportion, where $Z_{\alpha/2}$ = normal deviate of the level of significance (1.96, α of 5%), Z_{β} = normal deviate of type II error ($1 - \beta$ of 80%), p = proportion in the target population estimated to have a particular characteristic (prevalence of correct knowledge). For pregnant/postpartum women, the percentage of correct knowledge was estimated as 60%, and for HCPs it was estimated as 80%, based on the literature [21, 25–27]. q is the proportion in the target population estimated

not to have a particular characteristic: $1 - p$. d is the precision of the estimate: 6% for women and 0.8% for HCPs. The assumption of the non-response rate was 10%.

Descriptive statistics were used to present the responses of all survey questions. Continuous variables were presented with number (n), percentage (%), mean, standard deviation (SD), median, minimum, and maximum (range). Categorical data were presented with number (n) and percentage (%) of observations. Vaccination coverage was calculated as the proportion of subjects who received vaccination from all surveyed subjects who had a vaccination card presently or the medical chart contained vaccination information.

RESULTS

Participants and Demographic Data

A total of 668 pregnant or postpartum women participated in the study. Of these, 307 (46.0%) women were pregnant and 361 (54.0%) were postpartum. Their mean age was 29.6 (SD 6.5) years. Most of the pregnant or postpartum women lived in an urban area ($n = 589$, 88.2%) and were of Mestiza ethnicity ($n = 582$, 87.1%). Fifty-one (7.7%) women only had initial or primary education, while 283 (42.4%) had secondary, 148 (22.2%) technical, and 186 (27.8%) university education. The monthly household income was low for many, with 319 (47.8%) in the lowest income bracket of just 500 to 1500 soles (around \$135–400) (Fig. 2, Table S2 in the ESM).

A total of 219 HCPs participated in the study; their mean age was 44.8 (SD 11.1) years. The most common professions of the HCPs were midwife ($n = 102$, 46.6%) and obstetrician/gynecologist ($n = 98$, 44.8%), followed by gynecologist ($n = 11$, 5.0%) and nurse ($n = 8$, 3.7%). A total of 146 (66.7%) of the HCPs were female, 199 (90.9%) worked at a hospital, and 20 (9.1%) at a health center. Their mean number of years in practice was 14.7 (SD 9.9), ranging from 1 to 48 years (Table S3 in the ESM).

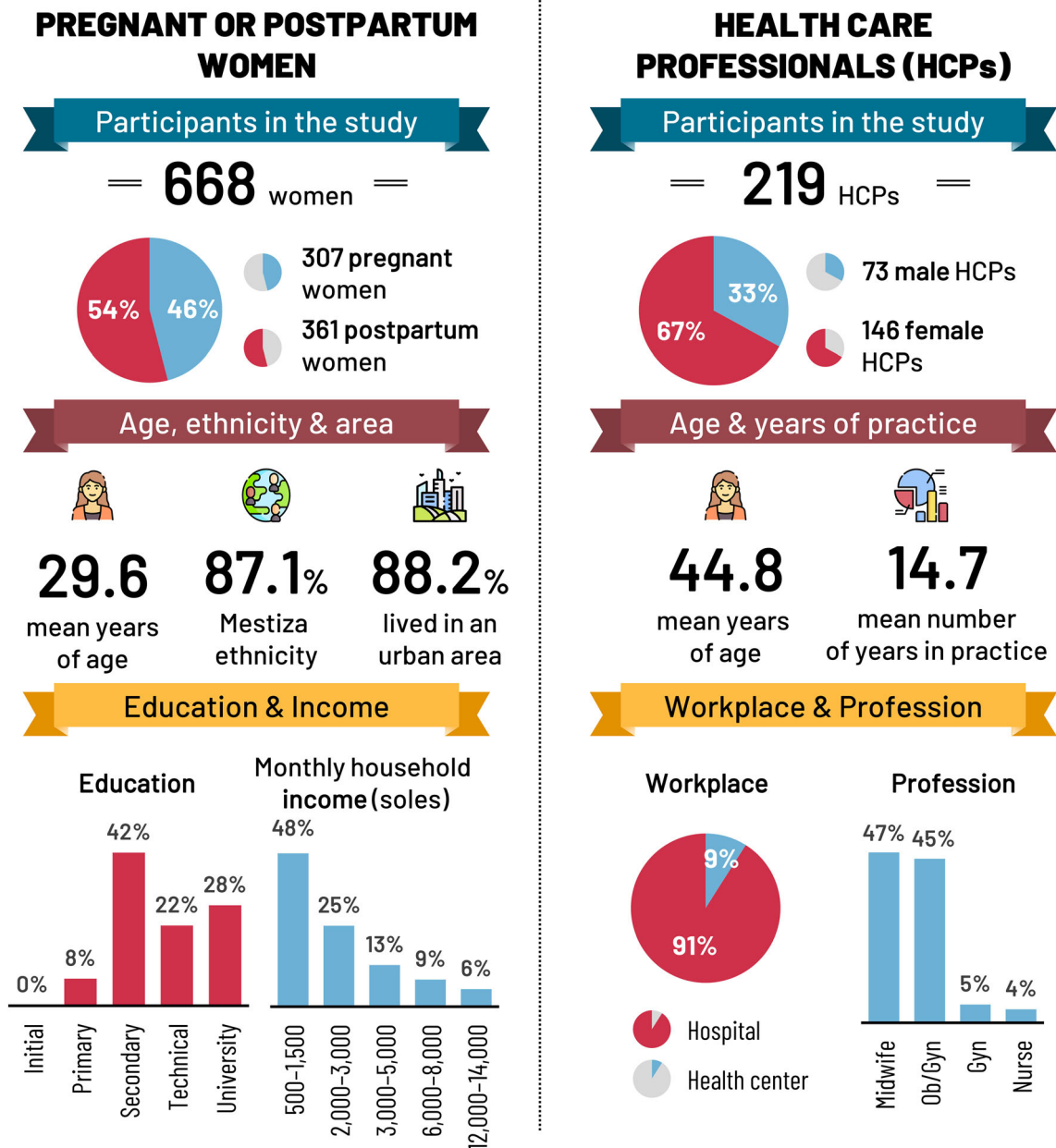


Fig. 2 Participants and demographic data. *Gyn* gynecologist, *HCPs* health care professionals, *Ob* obstetrician

Knowledge of Maternal Vaccination Among Pregnant/Postpartum Women

Most pregnant/postpartum women were aware that vaccines are “important” ($n = 658$, 98.5%), are used “for prevention” from diseases ($n = 447$, 66.9%), and can be taken during pregnancy ($n = 581$, 87.0%). This last

percentage differed between pregnant (92.2%) and postpartum women (82.6%) (Table 1, Table S4 in the ESM). However, about half of the pregnant and postpartum women reported that they did not receive any specific information related to vaccination during the current pregnancy (50.6%) and the previous pregnancy (43.0%). More than half knew about tetanus ($n = 581$, 87.0%) and influenza ($n = 595$,

Table 1 Knowledge of maternal vaccination among pregnant/postpartum women

Question	Response, <i>n</i> (%)	Respondent type		
		Pregnant, <i>N</i> = 307	Postpartum, <i>N</i> = 361	Overall, <i>N</i> = 668
Maternal vaccination in general				
What do you think vaccines are used for?	Don't know	6 (2.0%)	7 (1.9%)	13 (2.0%)
	For immunization	15 (4.9%)	21 (5.8%)	36 (5.4%)
	For prevention	221 (72.0%)	226 (62.6%)	447 (66.9%)
	Others	58 (18.9%)	101 (28.0%)	159 (23.8%)
	To create antibodies	7 (2.3%)	6 (1.7%)	13 (2.0%)
Do you think vaccines are important?	Yes	303 (98.7%)	355 (98.3%)	658 (98.5%)
	No	1 (0.3%)	0 (0.0%)	1 (0.2%)
	Don't know	2 (0.7%)	5 (1.4%)	7 (1.1%)
Do you think vaccines can be given during pregnancy?	Yes	283 (92.2%)	298 (82.6%)	581 (87.0%)
	No	10 (3.3%)	33 (9.1%)	43 (6.4%)
	Don't know	13 (4.2%)	29 (8.0%)	42 (6.3%)
Have you received any specific information related to vaccination during your current pregnancy?	Yes	163 (53.1%)	147 (40.7%)	310 (46.4%)
	No	140 (45.6%)	198 (54.9%)	338 (50.6%)
	Don't know	2 (0.7%)	12 (3.3%)	14 (2.1%)
	NA	2 (0.7%)	4 (1.1%)	6 (0.9%)
Have you received any specific information related to vaccination during a previous one?	Yes	110 (35.8%)	169 (46.8%)	279 (41.8%)
	No	141 (45.9%)	146 (40.4%)	287 (43.0%)
	Don't know	4 (1.3%)	9 (2.5%)	13 (2.0%)
	NA	52 (16.9%)	37 (10.3%)	89 (13.3%)
Pertussis disease				
What do you think vaccines are used for?	For prevention	106 (34.5%)	122 (33.8%)	228 (34.1%)
	Others	17 (5.5%)	15 (4.2%)	32 (4.8%)
	Don't know	131 (42.7%)	159 (44.0%)	290 (43.4%)
	To prevent cough	53 (17.3%)	65 (18.0%)	118 (17.7%)
Do you know what pertussis is?	Yes	126 (41.0%)	126 (34.9%)	252 (37.7%)
	No	173 (56.4%)	203 (56.2%)	376 (56.3%)
	Don't know	7 (2.3%)	32 (8.9%)	39 (5.8%)

Table 1 continued

Question	Response, <i>n</i> (%)	Respondent type		
		Pregnant, <i>N</i> = 307	Postpartum, <i>N</i> = 361	Overall, <i>N</i> = 668
Have you heard of a vaccine to protect against pertussis?	Yes	137 (44.6%)	142 (39.3%)	279 (41.8%)
	No	160 (52.1%)	201 (55.7%)	361 (54.0%)
	Don't know	9 (2.9%)	18 (5.0%)	27 (4.0%)
Tetanus disease				
What do you think vaccines are used for?	Others	20 (6.5%)	11 (3.1%)	31 (4.6%)
	Don't get sick	0 (0.0%)	1 (0.3%)	1 (0.2%)
	Don't remember/know	42 (13.7%)	33 (9.1%)	75 (11.2%)
	For flu	0 (0.0%)	1 (0.3%)	1 (0.2%)
	Health protection	8 (2.6%)	5 (1.4%)	13 (2.0%)
	Immunization	2 (0.7%)	0 (0.0%)	2 (0.3%)
	To avoid tetanus	233 (75.9%)	290 (80.3%)	523 (78.3%)
	To protect the mother or baby	2 (0.7%)	20 (5.5%)	22 (3.3%)
Do you know what tetanus is?	Yes	271 (88.3%)	310 (85.9%)	581 (87.0%)
	No	33 (10.8%)	43 (11.9%)	76 (11.4%)
	Don't know	3 (1.0%)	7 (1.9%)	10 (1.5%)
Have you heard of a vaccine to protect against tetanus?	Yes	274 (89.3%)	326 (90.3%)	600 (89.8%)
	No	32 (10.4%)	29 (8.0%)	61 (9.1%)
	Don't know	1 (0.3%)	5 (1.4%)	6 (0.9%)
Influenza disease				
What do you think vaccines are used for?	Others	22 (7.2%)	17 (4.7%)	39 (5.8%)
	Don't know	30 (9.8%)	26 (7.2%)	56 (8.4%)
	For coughs	1 (0.3%)	3 (0.8%)	4 (0.6%)
	Infections	0 (0.0%)	1 (0.3%)	1 (0.2%)
	To avoid illness	24 (7.8%)	25 (6.3%)	49 (7.3%)
	To be healthy	2 (0.7%)	3 (0.8%)	5 (0.8%)
	To prevent flu	228 (74.3%)	285 (79.0%)	513 (76.8%)
Do you know what influenza is?	Yes	274 (89.3%)	321 (88.9%)	595 (89.1%)
	No	30 (9.8%)	35 (9.7%)	65 (9.7%)
	Don't know	3 (1.0%)	4 (1.1%)	7 (1.1%)

Table 1 continued

Question	Response, <i>n</i> (%)	Respondent type		
		Pregnant, <i>N</i> = 307	Postpartum, <i>N</i> = 361	Overall, <i>N</i> = 668
Have you heard of a vaccine to protect against influenza?	Yes	281 (91.5%)	325 (90.0%)	606 (90.7%)
	No	25 (8.1%)	30 (8.3%)	55 (8.2%)
	Don't know	1 (0.3%)	5 (1.4%)	6 (0.9%)

N total number, *n* number in the specified category, *NA* not available; % = (*n*/*N*) × 100

Table 2 Summary of knowledge and perceived health beliefs among pregnant/postpartum women

Response ^a , <i>n</i> (%)	Respondent type		
	Pregnant (<i>N</i> = 307)	Postpartum (<i>N</i> = 361)	Overall (<i>N</i> = 668)
Knowledge			
Poor (scores 0–2)	71 (23.1%)	114 (31.6%)	185 (27.7%)
Moderate (scores 3–5)	134 (43.7%)	146 (40.4%)	280 (41.9%)
Good (scores 6–8)	102 (33.2%)	101 (28.0%)	203 (30.4%)
Perceived health belief about Tdap			
Poor (scores 18–28)	88 (28.7%)	105 (29.1%)	193 (28.9%)
Moderate (scores 29–38)	96 (31.3%)	113 (31.3%)	209 (31.3%)
Good (scores 39–48)	123 (40.1%)	143 (39.6%)	266 (39.8%)
Perceived health belief about influenza			
Poor (scores 19–28)	138 (45.0%)	120 (33.2%)	258 (38.6%)
Moderate (scores 29–38)	60 (19.5%)	92 (25.5%)	152 (22.8%)
Good (scores 39–48)	109 (35.5%)	149 (41.3%)	258 (38.6%)

N total number, *n* number in the specified category, *Tdap* Tetanus, diphtheria, acellular pertussis vaccine; % = (*n*/*N*) × 100

^aKnowledge scores were divided into three parts each containing a third of the scores and categorized as poor (lowest tertile), moderate (middle tertile), and good (highest tertile)

Table 3 Practice and recommendation of Tdap vaccination among HCPs

Response, <i>n</i> (%)	Respondent type				
	Obstetrician (<i>N</i> = 98)	Gynecologist (<i>N</i> = 11)	Nurse (<i>N</i> = 8)	Midwife (<i>N</i> = 102)	Overall (<i>N</i> = 219)
Treated case of pertussis in pregnant woman					
Yes	10 (10.2%)	2 (18.2%)	1 (12.5%)	12 (11.8%)	25 (11.4%)
No	88 (89.8%)	9 (81.8%)	7 (87.5%)	90 (88.2%)	194 (88.6%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Treated case of tetanus in pregnant woman					
Yes	11 (11.2%)	2 (18.2%)	3 (37.5%)	14 (13.7%)	30 (13.7%)
No	87 (88.8%)	9 (81.8%)	5 (62.5%)	88 (86.3%)	189 (86.3%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Received Tdap vaccine at least once from 2016 to 2020					
Yes	74 (75.5%)	8 (72.7%)	7 (87.5%)	86 (84.3%)	175 (79.9%)
No	23 (23.5%)	3 (27.3%)	1 (12.5%)	13 (12.7%)	40 (18.3%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	3 (2.9%)	4 (1.8%)
Have Tdap vaccine services in the place of work					
Yes	90 (91.8%)	10 (90.9%)	7 (87.5%)	96 (94.1%)	203 (92.7%)
No	7 (7.1%)	0 (0.0%)	1 (12.5%)	3 (2.9%)	11 (5.0%)
Don't know	1 (1.0%)	1 (9.1%)	0 (0.0%)	3 (2.9%)	5 (2.3%)
Ever recommended Tdap vaccine for pregnant women					
Yes	90 (91.8%)	11 (100.0%)	8 (100.0%)	87 (85.3%)	196 (89.5%)
No	8 (8.2%)	0 (0.0%)	0 (0.0%)	15 (14.7%)	23 (10.5%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Routinely recommend Tdap vaccine in current practice					
Yes	81 (82.7%)	11 (100.0%)	8 (100.0%)	78 (76.5%)	178 (81.3%)
No	17 (17.3%)	0 (0.0%)	0 (0.0%)	24 (23.5%)	41 (18.7%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

HCPs health care professionals, *N* total number, *n* number in the specified category, *Tdap* tetanus, diphtheria, acellular pertussis vaccine; % = $(n/N) \times 100$

Table 4 Practice and recommendation of influenza vaccination among HCPs

Response, <i>n</i> (%)	Respondent type				
	Obstetrician (<i>N</i> = 98)	Gynecologist (<i>N</i> = 11)	Nurse (<i>N</i> = 8)	Midwife (<i>N</i> = 102)	Overall (<i>N</i> = 219)
Treated case of influenza in pregnant woman					
Yes	35 (35.7%)	5 (45.5%)	2 (25.0%)	30 (29.4%)	72 (32.9%)
No	63 (64.3%)	6 (54.5%)	6 (75.0%)	72 (70.6%)	147 (67.1%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Received influenza vaccine at least once from 2016 to 2020					
Yes	86 (87.8%)	10 (90.9%)	7 (87.5%)	99 (97.1%)	202 (92.2%)
No	12 (12.2%)	1 (9.1%)	1 (12.5%)	3 (2.9%)	17 (7.8%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Have influenza vaccine services in the place of work					
Yes	89 (90.8%)	10 (90.9%)	7 (87.5%)	98 (96.1%)	204 (93.2%)
No	8 (8.2%)	0 (0.0%)	1 (12.5%)	3 (2.9%)	12 (5.5%)
Don't know	1 (1.0%)	1 (9.1%)	0 (0.0%)	1 (1.0%)	3 (1.4%)
Ever recommended influenza vaccine for pregnant women					
Yes	83 (84.7%)	9 (81.8%)	6 (75.0%)	87 (85.3%)	185 (84.5%)
No	14 (14.3%)	2 (18.2%)	2 (25.0%)	14 (13.7%)	32 (14.6%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	2 (0.9%)
Routinely recommend influenza vaccine in current practice					
Yes	78 (79.6%)	8 (72.7%)	6 (75.0%)	78 (76.5%)	170 (77.6%)
No	20 (20.4%)	3 (27.3%)	2 (25.0%)	23 (22.5%)	48 (21.9%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	1 (0.5%)

HCPs health care professionals, *N* total number, *n* number in the specified category; % = (*n*/*N*) × 100

89.1%), while only 252 (37.7%) women knew about pertussis. Of all the women, 89.8% had heard of a vaccine against tetanus, and 90.7% of a vaccine against influenza. In contrast, 54.0% of women had not heard of a vaccine against pertussis (Table 1, Table S4).

The internal consistency of the responses on knowledge about maternal vaccination of the pregnant/postpartum was high (Cronbach's α was 0.68), and the mean score on the knowledge questions was 6.2 (SD 1.6) (Table S1). Knowledge about maternal immunization was

good in 203 (30.4%), moderate in 280 (41.9%), and poor in 185 (27.7%) women, and scores were similar in pregnant and postpartum women (Table 2).

Attitudes, Beliefs, and Perception About Pertussis and Tetanus Disease and Vaccination Among Pregnant/Postpartum Women

As for perceived susceptibility, most pregnant/postpartum women agreed/strongly

Table 5 Disease priority perception about pertussis among HCPs

Response, <i>n</i> (%)	Respondent type				
	Obstetrician (<i>N</i> = 98)	Gynecologist (<i>N</i> = 11)	Nurse (<i>N</i> = 8)	Midwife (<i>N</i> = 102)	Overall (<i>N</i> = 219)
Pertussis causes substantial disease burden					
Agree	84 (85.7%)	9 (81.8%)	7 (87.5%)	89 (87.3%)	189 (86.3%)
Disagree	13 (13.3%)	2 (18.2%)	1 (12.5%)	11 (10.8%)	27 (12.3%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	2 (2.0%)	3 (1.4%)
Pertussis causes a great deal of illness among the general population					
Agree	88 (89.8%)	8 (72.7%)	7 (87.5%)	95 (93.1%)	198 (90.4%)
Disagree	10 (10.2%)	3 (27.3%)	1 (12.5%)	7 (6.9%)	21 (9.6%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Pertussis is a high-priority illness					
Agree	81 (82.7%)	9 (81.8%)	7 (87.5%)	86 (84.3%)	183 (83.6%)
Disagree	15 (15.3%)	2 (18.2%)	0 (0.0%)	16 (15.7%)	33 (15.1%)
Don't know	2 (2.0%)	0 (0.0%)	1 (12.5%)	0 (0.0%)	3 (1.4%)
Pertussis causes a great deal of illness among pregnant women					
Agree	84 (85.7%)	10 (90.9%)	8 (100.0%)	94 (92.2%)	196 (89.5%)
Disagree	13 (13.3%)	1 (9.1%)	0 (0.0%)	8 (7.8%)	22 (10.0%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.5%)
Pertussis causes a great deal of illness among newborn babies					
Agree	92 (93.9%)	10 (90.9%)	8 (100.0%)	100 (98.0%)	210 (95.9%)
Disagree	6 (6.1%)	1 (9.1%)	0 (0.0%)	1 (1.0%)	8 (3.7%)
Don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	1 (0.5%)
Pregnant women are at increased risk for developing severe pertussis					
Agree	86 (87.8%)	9 (81.8%)	8 (100.0%)	89 (87.3%)	192 (87.7%)
Disagree	8 (8.2%)	2 (18.2%)	0 (0.0%)	10 (9.8%)	20 (9.1%)
Don't know	4 (4.1%)	0 (0.0%)	0 (0.0%)	3 (2.9%)	7 (3.2%)

HCPs health care professionals, *N* total number, *n* number in the specified category; % = (n/N) × 100

Table 6 Disease priority perception about influenza among HCPs

Response, <i>n</i> (%)	Respondent type				
	Obstetrician (<i>N</i> = 98)	Gynecologist (<i>N</i> = 11)	Nurse (<i>N</i> = 8)	Midwife (<i>N</i> = 102)	Overall (<i>N</i> = 219)
Influenza causes substantial disease burden					
Agree	89 (90.8%)	10 (90.9%)	6 (75.0%)	92 (90.2%)	197 (90.0%)
Disagree	8 (8.2%)	1 (9.1%)	2 (25.0%)	9 (8.8%)	20 (9.1%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	2 (0.9%)
Influenza causes a great deal of illness among the general population					
Agree	91 (92.9%)	11 (100.0%)	8 (100.0%)	96 (94.1%)	206 (94.1%)
Disagree	6 (6.1%)	0 (0.0%)	0 (0.0%)	6 (5.9%)	12 (5.5%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.5%)
Influenza is a high-priority illness					
Agree	81 (82.7%)	10 (90.9%)	7 (87.5%)	87 (85.3%)	185 (84.5%)
Disagree	16 (16.3%)	1 (9.1%)	1 (12.5%)	14 (13.7%)	32 (14.6%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	2 (0.9%)
Influenza causes a great deal of illness among pregnant women					
Agree	86 (87.8%)	10 (90.9%)	8 (100.0%)	92 (90.2%)	196 (89.5%)
Disagree	11 (11.2%)	1 (9.1%)	0 (0.0%)	10 (9.8%)	22 (10.0%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.5%)
Influenza causes a great deal of illness among newborns					
Agree	84 (85.7%)	10 (90.9%)	8 (100.0%)	88 (86.3%)	190 (86.8%)
Disagree	12 (12.2%)	1 (9.1%)	0 (0.0%)	13 (12.7%)	26 (11.9%)
Don't know	2 (2.0%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	3 (1.4%)
Pregnant women are at increased risk for developing severe influenza					
Agree	88 (89.8%)	10 (90.9%)	8 (100.0%)	91 (89.2%)	197 (90.0%)
Disagree	9 (9.2%)	1 (9.1%)	0 (0.0%)	11 (10.8%)	21 (9.6%)
Don't know	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.5%)

HCPs health care professionals, *N* total number, *n* number in the specified category; % = (n/N) × 100

agreed with “If I don’t get the Tdap shot, I may catch tetanus, diphtheria, or pertussis” (81.4%), and “If I don’t get the Tdap shot, my baby may catch tetanus, diphtheria, or pertussis” (76.1%). As for perceived severity, most pregnant/postpartum women agreed/strongly agreed with “I could die from tetanus, diphtheria, or pertussis” (64.9%) and “My baby could die from tetanus, diphtheria, or pertussis” (66.6%). In addition, most women agreed with the perceived benefits “Getting the Tdap shot will protect me from getting tetanus, diphtheria, or pertussis” (85.3%) and “Getting the Tdap shot while pregnant will protect my baby from getting tetanus, diphtheria, or pertussis” (79.3%) (Table S5 in the ESM).

Perceived barriers were not “Getting the Tdap shot while pregnant could harm me”, “Getting the Tdap shot while pregnant could harm my baby”, or “It’s too much trouble to get the Tdap shot” as most women disagreed/strongly disagreed with these statements (73.6%, 73.4%, and 77.5%, respectively). As for cues to action, most women agreed/strongly agreed that they would get vaccinated with Tdap if a doctor (96.3%), midwife (88.9%), or nurse (72.0%) recommended it, while only 38.6% and 37.9% would get vaccinated if a husband or relative recommended the Tdap vaccine, respectively. As for self-efficacy, the women agreed/strongly agreed that they were confident they could get the Tdap shot even if they had to come back to the clinic (88.0%) or if the shot hurts a little bit (91.6%) (Table S5).

To assess their intentions women were asked “If you were offered the Tdap shot during your current pregnancy, how likely are you to get the shot?” 80.8% agreed/strongly agreed. Only one (0.2%) woman strongly disagreed. For the latter question, the percentage that agreed/strongly agreed was higher among pregnant women (92.5%) than among postpartum women (70.9%). With the statement “do you plan to get the Tdap shot during your current pregnancy?” 71.3% of all women agreed/strongly agreed, and only one woman disagreed (0.2%) (Table S6 in the ESM).

Social norms were assessed with two statements. Almost equal percentages of women agreed (43.4%) and disagreed (46.4%) with “I

would get the Tdap shot if my family or friends thought I should”, while more than half of the women agreed (53.3%) than disagreed (39.7%) with “I would get the Tdap shot since other pregnant women are getting it” (Table S6).

To assess total perceived health beliefs about Tdap among the pregnant/postpartum women, scores on 10 of the questions were analyzed (Table S1). The internal consistency of the questions was high (Cronbach’s α was 0.79), and the mean score on the knowledge questions was 37.2 (SD 4.2) (Table S1). Perceived health belief about Tdap was good in 266 (39.8%), moderate in 209 (31.3%), and poor in 193 (28.9%) women and scores were similar in pregnant and postpartum women (Table 2).

Attitudes, Beliefs, and Perceptions About Influenza Disease and Vaccination Among Pregnant/Postpartum Women

The results on perceived susceptibility, severity, benefits and barriers among pregnant/postpartum women were very similar for influenza (Table S7 in the ESM) as for pertussis and tetanus. Also, the cues to action, as to whose recommendation would make them get vaccinated with the influenza shot, and their self-efficacy to get the influenza shot were very similar (Table S7) to the cues to action and self-efficacy for getting vaccinated with Tdap.

Social norms were assessed with two statements. Almost equal percentages of women agreed (45.4%) and disagreed (46.0%) with “I would get the influenza shot if my family or friends thought I should”, while more women agreed (53.1%) than disagreed (39.4%) with “I would get the influenza shot since other pregnant women are getting it” (Table S8 in the ESM). These answers were again very similar to the answers for the Tdap shot.

To assess their intentions women were asked “If you were offered the influenza shot during your current pregnancy, how likely are you to get the shot?” the majority agreed/strongly agreed (79.2%). The percentage that agreed was, similar to for the Tdap shot, higher among pregnant women (82.1%) than among postpartum women (62.3%). With the statement “do

you plan to get the influenza shot during your current pregnancy?" many women also agreed/strongly agreed (71.3%) (Table S8).

To assess total perceived health belief about influenza among the pregnant/postpartum women, scores on 10 of the questions were analyzed (Table S1). The internal consistency of the questions was high (Cronbach's α was 0.81), and the mean score on the knowledge questions was 36.8 (SD 5.0) (Table S1). Perceived health belief about influenza was good and poor in exactly the same number of women ($n = 258$, 38.6%) and moderate in the rest ($n = 152$, 22.8%). Unlike for health belief of Tdap, for influenza more pregnant than postpartum women had poor scores (45.0% vs. 33.2%), and vice versa for good and moderate scores (Table 2).

Practice and Recommendation of Tdap and Influenza Vaccination Among HCPs

Few of the HCPs ever treated a case of pertussis ($n = 25$, 11.4%) or tetanus ($n = 30$, 13.7%) in pregnant women. A total of 175 HCPs (79.9%) received the Tdap vaccine themselves in the past 5 years, and 203 (92.7%) stated that there are Tdap vaccine services at their place of work. Of the HCPs, 196 (89.5%) claimed they have recommended Tdap to pregnant women, and 178 (81.3%) claimed that they do this routinely in their current practice (Table 3).

Seventy-two HCPs had treated cases of influenza in pregnant women (32.9%). A total of 202 HCPs (92.2%) received the influenza vaccine themselves in the past 5 years, and 204 (93.2%) stated that there are influenza vaccine services at their place of work (93.2%). A total of 185 (84.5%) also claimed they had recommended influenza vaccine to pregnant women, and 170 claimed that they do this routinely in their current practice (77.6%) (Table 4).

Perceptions of Disease Priority About Pertussis and Influenza Among HCPs

Of the 219 HCPs, 189 (86.3%) agreed that pertussis causes a substantial disease burden, 198 (90.4%) agreed that it causes a great deal of

illness in the general population, and 183 (83.6%) agreed that it is a high-priority illness. A total of 196 (89.5%) HCPs agreed that pertussis causes a great deal of illness among pregnant women, 210 (95.9%) agreed that the same was true for newborn babies, and 192 (87.7%) agreed that pregnant women are at an increased risk of developing severe pertussis (Table 5).

The same or higher disease priority perceptions are seen for influenza as for pertussis. A total of 197 (90.0%) HCPs agreed that influenza causes a substantial disease burden, 206 (94.1%) agreed it causes a great deal of illness in the general population, and 185 (84.5%) agreed that it is a high-priority illness. A total of 196 (89.5%) HCPs also agreed that influenza causes a great deal of illness among pregnant women, 190 (68.8%) agreed to the same for newborn babies, and 197 (90.0%) agreed that pregnant women are at an increased risk of developing severe influenza (Table 6).

Perception of Tdap and Influenza Vaccination Safety and Effectiveness Among HCPs

Of the HCPs, 213 (97.3%) agreed that the Tdap vaccine is safe for pregnant women, and 209 (95.4%) agreed that Tdap vaccination of pregnant women is safe for their fetuses. A total of 215 (98.2%) also agreed that the Tdap vaccine is an effective way to prevent pregnant women from getting sick from pertussis, and 209 (95.4%) agreed that Tdap vaccination of pregnant women protects infants during the first 6 months of their life (Table S9 in the ESM).

Of the HCPs, 218 (99.5%) agreed that the influenza vaccine is safe for pregnant women, and 215 (98.2%) agreed that influenza vaccination of pregnant women is safe for their fetuses. A total of 217 (99.1%) HCPs also agreed that the influenza vaccine is an effective way to prevent pregnant women from getting sick from influenza and that influenza vaccination of pregnant women protects infants during the first 6 months of their life (Table S9).

Awareness of MOH Recommendations for Tdap and Influenza Vaccine Among HCPs

Of the HCPs, 217 (94.5%) were aware that the MOH advises Tdap vaccine for pregnant women, and 197 (90.0%) were aware that the MOH prioritizes pregnant women for receiving Tdap vaccine. Also, 178 (81.3%) HCPs agreed that MOH recommendations regarding Tdap vaccination of pregnant women are clear (Table S10 in the ESM).

Of the HCPs, 213 (97.3%) were aware that the MOH advises influenza vaccine for pregnant women, and 196 (89.5%) were aware that the MOH prioritizes pregnant women for receiving influenza vaccine. Also, 195 (89.0%) HCPs agreed that MOH recommendations regarding influenza vaccination of pregnant women are clear (Table S10).

Practice and Utilization of Pertussis and Tetanus Vaccine

When pregnant/postpartum women were asked whether they had received the Tdap vaccination for their most recent pregnancy, 201 (30.1%) said yes, 432 (64.7%) said no, and 27 (4.0%) did not know. In those who received the Tdap vaccination, it was recommended by a midwife ($n = 92$), physician ($n = 45$), gynecologist ($n = 22$), obstetrician–gynecologist ($n = 15$), nurse ($n = 10$), or others ($n = 17$), and received at a health center/hospital ($n = 121$), a (poly-)clinic ($n = 60$), or elsewhere ($n = 20$) (Table S11 in the ESM).

Of the 432 women who did not receive the Tdap vaccination, 27.5% ($n = 184$) said it was not recommended to them, and 26.7% ($n = 178$) stated unspecified other reasons (Table S11).

Practice and Utilization of Influenza Vaccine

When the 668 pregnant/postpartum women were asked whether they had received the influenza shot for this pregnancy, 169 (25.3%) said yes, 490 (73.4%) said no, and 4 (0.6%) did

not know. The influenza shot was recommended to 245 (36.7%) women; this was recommended to 54 (8.1%) by a midwife, to 40 (6.0%) by a physician, to 19 (2.8%) by an obstetrician–gynecologist, and to 50 (7.5%) by various others, while 82 (12.3%) did not recall who recommended it. The influenza shot was received by 113 (16.9%) at a health center/hospital, by 44 (6.6%) at a clinic, and by 12 (1.8%) elsewhere. The influenza shot was not received by 490 (73.4%) women, as 207 (31.0%) said it was not recommended to them and 110 (16.5%) stated unspecified other reasons (Table S12 in the ESM).

Vaccination Card and Chart Review of Pregnant/Postpartum Women

Of the 668 women, 512 (76.7%) did not have a vaccination card, and 459 (68.7%) did not have vaccination information in their medical chart. Only 148 and 63 women had vaccination cards and medical charts with vaccination history, respectively. The medical chart was entirely missing for 146 (21.9%) women (Table S13 in the ESM).

On the basis of the information available in the vaccination cards and medical charts ($n = 211$), 129 women (61.1%, $n = 129/211$, assuming that no women had vaccination cards and medical charts) received the Tdap vaccine during the current pregnancy, of which 62.0% ($n = 80/129$) received it during the third trimester and 38.0% ($n = 49/129$) during the second trimester. A total of 16 women received the Tdap during their previous pregnancy. The IIV was received by 71 women (33.6%, $n = 71/211$) during the current pregnancy, 54.9% ($n = 39/71$) during the second trimester, 42.3% ($n = 30/71$) during the third, and 1.4% ($n = 1/71$) during the first trimester. Eleven women received the IIV during their previous pregnancy. There were also 87 women who, during the current pregnancy, received the Td vaccine that protects against tetanus and diphtheria but not against pertussis. Of those, 60.9% ($n = 53/87$) were vaccinated during the second trimester, and 37.9% ($n = 33/87$) during the third trimester.

Nineteen received the Td during a previous pregnancy (Table S13).

DISCUSSION

To identify factors that affect maternal vaccination coverage in Peru, we performed an observational cross-sectional study consisting of two surveys, one among 668 pregnant/postpartum women and one among 219 HCPs. We assessed the KAPs and perceptions regarding maternal immunization among pregnant/postpartum women and HCPs and determined the vaccination coverage and the impact and awareness of MOH recommendations.

We found that the majority of pregnant/postpartum women knew that in general vaccinations are given for prevention, and almost all believed that vaccines are important. Nevertheless, nearly 70% of pregnant and postpartum women only had poor or moderate knowledge of maternal vaccination. They specifically lacked knowledge about pertussis disease, the existence of a pertussis vaccine, and that this vaccine is recommended for pregnant women. In a previous small qualitative study among pregnant women in Peru, the main reason for not getting vaccinated was the lack of knowledge about vaccination during pregnancy [28]. Also, in focus group discussions of pregnant women in Peru and other Latin American countries, it was found that women desired more information from providers on the reasons for maternal vaccination, such as information about the disease, its complications, and the protection a vaccine would give [29].

The perceived health beliefs about pertussis, tetanus, and influenza and the Tdap and influenza vaccines were qualified as good in less than 40% of pregnant/postpartum women. In particular, the severity of pertussis, tetanus, and influenza, expressed as the possibility to die from these diseases, is not apparent to many. If these VPDs are perceived as non-severe, women are less likely to actively seek vaccination. Nevertheless, if a doctor, midwife, or nurse would recommend it, the majority would take it. A similar intention was observed regarding pertussis vaccination in Mexico; over 80% of

pregnant women would take it if recommended by an obstetrician–gynecologist [30]. For pregnant women in Pakistan, recommendation by an HCP was also the most important reason to accept pertussis vaccination [31], while in Taiwan, recommendation by a physician was the second most important reason [32].

In the present study, the vast majority of the HCPs were aware of pertussis, tetanus, and influenza risks and the MOH recommendations regarding Tdap and influenza vaccinations for pregnant women. They were also well aware of the safety and effectiveness of the Tdap and influenza vaccines. Consequently, around 80% of the HCPs stated that they routinely recommend these vaccinations for pregnant women (81.3% Tdap, 77.6% flu). Nevertheless, according to the pregnant/postpartum women, only 27.5% said an HCP recommended the Tdap vaccine, and only 20.4% said an HCP recommended the influenza vaccine. It appears that there is a discrepancy between what the HCPs state they routinely recommend and what the women perceive they get recommended. This may indicate that the HCPs need to make clearer and stronger recommendations.

Although many pregnant/postpartum women were aware of the pertussis, tetanus, and influenza risks, as well as the benefits of Tdap and influenza vaccination, of the 211 women with vaccination cards or medical charts, 61.1% were vaccinated with Tdap, and 33.6% with IIV. A study in 2016 found that only 19% of pregnant women in Peru were vaccinated against influenza during the previous year, even though the majority (96%) perceived influenza as a serious illness [14]. This may have been because Peru only issued their maternal influenza vaccination recommendation in 2013 [11] and that only 13% of the pregnant women considered themselves as belonging to a vaccination target group [14]. According to official data, influenza vaccination coverage among pregnant women was 38% in Peru in 2018 [33]. An exit survey at health care units in Peru at the end of 2018 found that 54.4% of pregnant women and mothers of young children were vaccinated against influenza in the last year [34]. Vaccine confidence and complacency were positively associated with educational level in that study.

Pregnant women and mothers were the most informed and least complacent among various risk groups [34]. No data has been published yet on Tdap vaccination coverage in pregnant or postpartum women in Peru [16]. There is still a gap to better evaluate the real Tdap and influenza vaccination coverage of pregnant/postpartum women in Peru.

The association between knowledge of maternal vaccination and vaccination coverage was not directly analyzed in the current study, but it appears logical to make this assumption. Indeed, in a previous study in Peru, pregnant women and older adults who were aware of the recommendations for annual influenza vaccination were more likely to be vaccinated [14]. We expect that providing more information on MOH recommendations for maternal immunization, the safety of the vaccines for both mother and fetus, and the diseases these vaccinations aim to prevent may improve vaccination coverage.

Our study is the first to analyze KAPs of maternal vaccination with Tdap among pregnant/postpartum women and HCPs in Peru. In addition, it is the first study to analyze knowledge, attitude, and perceptions of maternal vaccination with IIV among HCPs in Peru. The results provide an important baseline assessment of knowledge and perceptions of maternal immunization and vaccination coverage and may help evaluate future programs aimed at increasing vaccine uptake. Moreover, there is a need to design further quantitative studies to explore additional knowledge and perception categories, vaccination hesitancy, and practical approaches to improve vaccination practices in both maternal and adult populations.

Our study also has some limitations. First, additional quantitative studies in pregnant/postpartum women are needed to establish an unequivocal association between recommendations and vaccine uptake practice. Second, the generalizability of our findings to other countries may be limited to countries that share similar socio-cultural characteristics and also provide free access to vaccines for pregnant women. Third, the participants may not accurately represent the overall population of Peru as 87.1% of pregnant/postpartum women in

this study were identified as Mestiza and 1.7% as indigenous. In comparison, the census of 2017 in Peru found that 60.2% of inhabitants identified as Mestiza and over 25.7% as indigenous [35]. The low representation of indigenous women is likely due to the study location in five cities, as indigenous women are more likely to live in rural areas [35]. Lastly, the study implementation was delayed 1 year from the original plan (mid-2020) because of the lockdown of health facilities and strict policies for antenatal and pregnancy services during the COVID-19 pandemic. As a result, this study was conducted amid the global pandemic (mid-2021), when the general population was overly informed (not necessarily correctly) and aware of vaccination and respiratory disease-related topics. This may have led to higher knowledge and perception scores than in pre-pandemic years.

CONCLUSIONS

High rates of vaccination acceptance in pregnant women are needed to deliver a successful maternal immunization program against VPDs. To achieve high vaccination acceptance, it is important to identify health beliefs or gaps in knowledge that hamper vaccine uptake in order to better prioritize interventions. This study determined the KAPs in Peru of pregnant and postpartum women as well as those of their HCPs. In addition, this study assessed the vaccination coverage and the MOH recommendation awareness that affect vaccine uptake. We found that to enhance vaccine uptake in pregnant women we must improve their knowledge of the diseases, the MOH recommendations, and the benefits of the vaccinations they are offered. HCPs should provide clear vaccination knowledge and information along with their vaccination recommendation as the pregnant/postpartum women indicated they would take the vaccines if recommended by their HCPs. Our findings are important for successful implementation of maternal immunization programs in Peru.

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Disclosures. Adriana Guzman-Holst and Patricia Juliao are employed by GSK. Patricia Juliao holds shares in GSK. Veronica Petrozzi was previously an employee of Merck Sharp &

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Compliance with Ethics Guidelines. The survey protocol was approved by the ethics committees: Comité Institucional de Bioética de Vía Libre RCEI-32; Comité Institucional de Ética para Humanos de la Universidad Peruana Cayetano Heredia RCEI-14; Comité Institucional de Ética en Investigación HNHU, RCEI-54; and the Instituto Nacional Materno Perinatal RCEI-81. The survey followed the local regulatory requirements for Peru and was conducted in accordance with the Declaration of Helsinki. All participants gave written informed consent or assent before enrolment.

Data Availability. All data generated or analyzed during this study are included in this published article/as supplementary information files.

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