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Knowledge, attitudes, and practices associated with pertussis vaccination during pregnancy: Japan, 2016–2017

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Summary

Neonatal pertussis has the potential for severe complications, even death. Mothers have been identified as the most frequent source of neonatal pertussis. Almost a dozen countries have implemented pertussis vaccination programs for pregnant women to protect neonates, but Japan has not yet done so. The aim of this questionnaire-based study was to ascertain the willingness of women to be vaccinated during pregnancy and the factors associated with willingness. Subjects were 977 pregnant women who visited either of two selected hospitals for maternity health checks. Most of the women were in their first pregnancy (96%) and about half considered a physician to be the most reliable source of information about vaccination (481/977, 49%). “Willingness to receive pertussis vaccination” was significantly associated with the factors “no fear of receiving vaccination” (odds ratio [OR]=3.10, 95% confidence interval [CI]: 2.21–4.34), “necessary to prevent pertussis” (OR=8.70, 95% CI: 6.17–12.28), “effective in pregnancy” (OR=5.46, 95% CI: 3.94–7.56), and “no concern about side effects after vaccination” (OR=3.03, 95% CI: 1.66–5.55). Pregnant women are likely to consider vaccination if they have a good understanding of the disease and its outcomes. Physicians are well positioned to improve knowledge and attitudes toward pertussis vaccination during pregnancy.

Introduction

Neonatal pertussis is associated with high risk of mortality and serious complications, including atelectasis and difficulty breathing.(1) When the source of infection can be identified, *Bordetella pertussis* in infants most often comes from a family member, with mothers twice as likely as fathers to be the source.(2)

To protect infants, some countries such as Australia, France, Germany, and the United States introduced a cocooning strategy whereby all family members who will come in contact with an infant receive pertussis vaccination.(3,4) WHO SAGE reported that there is no evidence that pertussis vaccination during pregnancy resulted in earlier delivery or increased risk of maternal or neonatal death.(4) In addition, vaccination of pregnant women has been suggested as a more cost-effective strategy.(5) The United States Advisory Committee on Immunization Practices (ACIP) and the U.S. Centers for Disease Control and Prevention recommend that pregnant women receive acellular pertussis vaccination (Tdap) in the third trimester of each pregnancy.(5) Similar strategies have been recommended in Argentina, Brazil, Israel, New Zealand, and the United Kingdom.(4,6,7)

In Japan, the safety of pertussis vaccination in pregnant women and women of childbearing potential has not been confirmed, and the vaccine is administered only if a physician considers that the benefits outweigh the risks.(8) This leaves women who wish to be vaccinated without a physician's recommendation to pay the cost themselves. While we await confirmation of the safety of pertussis immunization during pregnancy, there is a need to prepare for effective communication of policy on pertussis vaccination during pregnancy in Japan. Toward this goal, we conducted this study on knowledge, attitudes,

and practices regarding pertussis vaccination among pregnant women in Japan.

Materials and methods

Data collection

This cross-sectional study used a self-administered questionnaire and convenience sampling to ascertain pregnant women's knowledge, attitudes, and practices regarding pertussis vaccination during pregnancy. A questionnaire was created specifically for the study and tailored to the background characteristics of pregnant women in Japan.

We selected two hospitals in Kumamoto and Mie prefectures as participating institutions. These hospitals have over 1,000 births per year and receive pregnant women regardless of socioeconomic status. All pregnant women who visited either of these hospitals for a pregnancy health check from September 2016 through March 2017 were invited to participate in the survey. Of 1,287 women who were willing to participate, 977 provided complete responses and were included in the study.

Hospital reception staff distributed the paper-based questionnaire in the waiting area to all potential participants who met the eligibility criteria while they waited for their health care provider to become available. Staff informed the women of the objective of the study, assured them that no personal information would be collected, and told them that a summary of the survey results would be published. The women could participate in the survey after providing informed consent. When all items on the questionnaire had been answered, the unnamed respondent returned it to the hospital staff, a nurse then checked the questionnaire for blank answers or other missing information and asked the

participant to provide any missing data.

Statistical analysis

We analyzed all questionnaire items as categorical binominal variables. We used SAS 9.4 to conduct logistic regression and calculate odds ratios (ORs) with 95% confidence intervals (CIs) to assess relationships between the dependent variable (willingness to receive pertussis vaccination during pregnancy) and the independent variables (knowledge about pertussis as a disease, knowledge of pertussis vaccination, and attitudes toward pertussis and vaccination).

Ethical considerations

The study protocol was approved by the National Institute of Infectious Diseases, F Hospital, and S Women's Hospital.

Results

Participant characteristics

Of approximately 1300 women who were invited to participate in the survey, 977 provided complete data for analysis (Table 1). Eighty-one percent of the respondents (792/977) were from F Hospital and 185 (19%) were from S Women's Hospital. Most of the women were born in the period 1980–1989 (n=651, 67%), with others being born in 1990–1999 (n=189, 19%). The highest reported levels of educational attainment were completing junior college (n=330, 34%) and graduating high school (n=326, 33%). More than half reported being housewives with some income (58%). Almost all of the respondents reported being married (n=936, 96%) and that the pregnancy was their first

(n=936, 96%).

Among respondents, 29% (n=279) were willing to receive pertussis vaccination. This willingness varied by 5% according to socioeconomic status (Table 2). There was no statistically significant association between the willingness to be vaccinated and socioeconomic status.

Source of information, knowledge, attitudes, and practice

Respondents reported physicians to be the most reliable source of information about pertussis vaccination (n=481, 49%; Table 3). Regarding knowledge about pertussis, the most frequent correct answer was that neonates could easily develop severe complications (n=343, 35%). The next most frequent correct answer was that women who are not vaccinated during pregnancy can be infected during pregnancy or after delivery (n=232, 24%). The most common attitude toward vaccination expressed by the participants was that the vaccine is effective for pregnant women and their infants (n=209, 21%).

Of 279 women who were willing to receive pertussis vaccination during pregnancy, 242 (87%) reported having knowledge of the characteristics of pertussis. However, less than half knew that unvaccinated pregnant women could transmit pertussis to their infants during pregnancy or after birth (n=119, 43%). About half of respondents who were willing to be vaccinated (n=134, 48%) regarded pertussis vaccination as necessary during pregnancy; fewer regarded vaccination as effective for pregnant women and their infants (n=122, 44%). Of the women who were willing to receive pertussis vaccination during pregnancy, 66% (n=183) were also willing to be vaccinated against Zika virus during

pregnancy if available (Table 3).

Association between willingness to receive pertussis vaccination during pregnancy and knowledge and attitudes

Physicians were considered a reliable source of information about vaccination by the largest proportion of respondents, but willingness to receive pertussis vaccination was not significantly associated with physicians as a source of information (odds ratio [OR]=1.20, 95% confidence interval [CI]: 0.91–1.59) (Table 3). Compared with unwillingness to receive pertussis vaccination, willingness to receive pertussis vaccination was significantly associated with knowledge about pertussis infection among family members or acquaintances (OR=3.03, 95% CI: 1.66–5.55), the possibility of preventing pertussis infection (OR=3.21, 95% CI: 1.72–6.00), no concerns about pertussis vaccination during pregnancy in other countries (OR=3.10, 95% CI: 2.21–4.34), no concerns about side effects in the neonate after receiving pertussis vaccination during pregnancy (OR=3.03, 95% CI: 1.66–5.55), and that women who are not vaccinated during pregnancy could be source of pertussis infection for their infants (OR=3.85, 95% CI: 2.82–5.26; Table 3).

Similarly, willingness to receive pertussis vaccination during pregnancy were significantly associated with the belief that pertussis vaccination was necessary during pregnancy (OR=8.70, 95% CI: 6.17–12.28) and that the vaccine was effective for both pregnant women and their infants (OR=5.46, 95% CI: 3.94–7.56).

Willingness to receive pertussis vaccination during pregnancy was also significantly associated with having received the seasonal influenza vaccination during pregnancy

(OR=1.38, 95% CI: 1.00–1.90) and willingness to receive the Zika virus vaccination during pregnancy if available (OR=6.85, 95% CI: 5.05–9.29).

Discussion

Less than one-third of nearly 1,000 pregnant women attending either of two hospitals in Japan were willing to receive pertussis vaccination during pregnancy. The most important factors associated with willingness to be vaccinated were belief in the importance of the vaccine during pregnancy and willingness to receive Zika virus vaccination during pregnancy if available; in other words, they viewed vaccination as necessary and effective, and understood that pregnant women could become infected during or after pregnancy if they were not vaccinated.

This study contributes to our current understanding of pertussis vaccination in pregnant women by reporting the associated knowledge and attitudes of Japanese women who are willing to receive pertussis vaccination during pregnancy. Our findings support the argument for intervening on knowledge and attitudes to improve the rate of uptake of the vaccine during pregnancy in Japan. Attitudes about vaccine efficacy and safety also have been shown to be important predictors of influenza vaccination during pregnancy.⁽⁹⁾

Our study attempted to enroll all eligible subjects, but the prevalence of first-time births in our study was approximately two times higher than the expected national proportion, with over 95% reported being married and in their first pregnancy, compared with 46% first-time births and 37% second births among all births in Japan in 2017.⁽¹⁰⁾ It is unlikely that this large difference occurred by chance, and there may be important

differences with respect to knowledge and attitudes between our study population and women who were not included, such as non-married pregnant women and women in their second or later pregnancies.

Our findings raise several important considerations. Knowledge about pertussis needs to reach women of childbearing age. Knowledge has been shown to be an important determinant of health-related behaviors.⁽¹¹⁾ Our study found that if pregnant women knew that they could transmit pertussis to their infants during or after birth and that they themselves could become infected if not vaccinated, they were significantly more likely to favor vaccination. Moreover, knowledge about pertussis as a disease was significantly associated with willingness to be vaccinated. Thus, if more pregnant women were provided with this information and educated, they would be more likely to accept pertussis vaccination if offered.

Pregnant women also need to be knowledgeable of the potentially severe complications of pertussis in neonates. The highest association identified was a willingness to receive the Zika virus vaccination during pregnancy if it were available. Zika virus infection has been an emerging disease since 2007,⁽¹²⁾ but it was not until 2015 that the link between Zika infection and microcephaly in neonates was reported in Brazil.⁽¹³⁾ Until 2014, the association of Zika virus infection with severe complications was not well understood. After the microcephaly outbreak, development of a Zika virus vaccine began worldwide to prevent the complications of Zika infection, including in Japan.^(14–16) In a previous study, pregnant women were willing to receive Zika virus vaccination to prevent

microcephaly if one were available.(17) This implies an association between knowing the severity of an infectious disease in infants and willingness to be vaccinated to prevent it.

Vaccine safety is one of the most important factors affecting immunization uptake in pregnant women.(18–20) Several studies have identified safety concerns, mistrust, a perception that the risk of contracting an infectious disease is low, and poor knowledge about vaccines as barriers to seasonal influenza immunization in pregnant women.(18–21) Moreover, advice from a physician was identified as one of the effective methods for promoting immunization against pertussis and influenza.(22) We therefore recommend that pregnant women receive precise information about immunization from their physicians.

Our results show a significant association between willingness to receive pertussis vaccination and the beliefs that “pertussis vaccination is necessary” and “pertussis vaccination is effective” in pregnant women. Increasing awareness of the efficacy and safety of vaccination during pregnancy in other countries could be an effective way to improve attitudes about vaccinating against pertussis during pregnancy in Japan. For example, in the United Kingdom, the vaccine was promoted to pregnant women and prevention of neonatal pertussis and its severe complications has been successful.(18) This type of evidence should be translated and disseminated among women of childbearing age in Japan to allay their concerns about vaccination during pregnancy.

In terms of the absolute difference, physicians were considered a reliable source of the information about vaccines by the largest proportion of respondents, at around 50%. On

the other hand, other sources of information were under 15%. These results suggest that information about pertussis vaccination is best communicated to pregnant women by physicians. Importantly, strong recommendation for vaccination by a physician has been positively associated with willingness of pregnant women to accept vaccination in the United States.(19) Similarly, in London, general practitioners and midwives were similarly identified as important messengers regarding pertussis vaccination during pregnancy.(20) An internet survey by the U.S. Centers for Disease Control and Prevention also found that a physician's recommendation increased the uptake of seasonal influenza vaccination among pregnant women in China.(23) Moreover, several reports have identified the confidence of pregnant women in their health care providers to be a key factor in the success of maternal immunization programs (24–26), and positive feedback from a physician is known to be an important reinforcer of healthy behavior.(11) Therefore, physicians are likely to have an important role in promotion of maternal immunization to pregnant women.

Our study has some limitations. First, it was limited to two obstetrics and gynecology centers in Mie and Kumamoto, which might attract pregnant women with certain characteristics that are not necessarily representative of the general population. Therefore, the study could have included a degree of sampling bias. More representative sampling could be achieved in future studies by including more hospitals that receive pregnant women from a range of socioeconomic backgrounds. Second, some pregnant women at these centers might have missed their health checks during pregnancy, and the characteristics of these women may be different from those in women who did attend and participated in the study. However, only about 0.4% of pregnant women in Japan do not

attend for pregnancy checks,(27) so we consider this limitation unlikely to have affected our results.

In 2012, ACIP recommended that provides of prenatal care implement Tdap vaccination programs for all pregnant women during each pregnancy.(28) Other developed countries have implemented similar recommendations or strategies. The DTP vaccination became available for all ages in 2017 in Japan, so it is now time for this country to implement a formal pertussis vaccination strategy in pregnancy. Our findings indicate that physicians play a major role in improving pregnant women's knowledge about pertussis and its effects on neonates and in allaying their concerns about adverse events following vaccination.

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Conflict of Interest

None of the authors has any conflict of interest to report.

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Table 1. Characteristics of study participants (n=977)

	Medical institution					
	F Hospital (n=792)				S Women's Hospital (n=185)	
					Total	
	n	%	n	%	n	%
Decade of birth						
1960s	2/792	<1	0/185	0	2/977	<1
1970s	113/792	14	18/185	10	131/883	13
1980s	520/792	66	131/185	71	651/977	67
1990s	153/792	19	36/185	19	189/977	19
2000s	1/792	<1	0/185	0	1/977	<1
Unknown	3/792	<1	0/185	0	3/977	<1
Education						
Junior high school	35/792	4	7/185	4	42/977	4
High school	227/792	29	49/185	26	326/977	33
Junior collage	266/792	34	64/185	35	330/977	34
College/University	245/792	31	62/185	34	297/977	30

Graduate school	19/792	2	3/185	2	22/977	2
Housewife	468/792	59	101/185	55	569/977	58
Employed	437/792	55	91/185	49	528/977	54
Marital status						
Married	753/792	95	183/185	99	936/977	96
Separated or widowed	4/792	1	0/185	0	4/977	<1
Single	35/792	4	2/185	1	37/977	4
Number of pregnancies						
First	753/792	95	183/185	99	936/977	96
Second	4/792	1	0/185	0	4/977	<1
Third	35/792	4	2/185	1	37/977	4
Health problems ^a with current pregnancy	57/792	7	10/185	5	67/977	7
Willing to receive pertussis immunization	225/792	28	54/185	29	279/977	29

^aComplications, such as hypertension, diabetes mellitus, or renal failure

Table 2. Association between socioeconomic status and willingness to receive pertussis vaccination during pregnancy (n=977)

	Willingness to receive pertussis vaccination						OR	95% CI
	Total		during pregnancy					
			Yes		No			
	n	%	n	%	n	%		
Education: at least university/college	329/977	34	95/279	34	234/698	34	1.02	0.76–1.37
Occupation: housewife	408/977	42	106/279	38	302/698	43	1.25	0.94–1.65
Income: working	528/977	54	157/279	56	371/698	53	1.13	0.86–1.50
Married	936/977	96	270/279	97	666/698	95	1.44	0.68–3.06
First pregnancy	435/977	45	130/278	47	305/695	44	1.12	0.85–1.49
Health problems experienced in this pregnancy	67/977	7	24/279	9	43/698	6	1.43	0.85–2.41

CI, confidence interval; OR, odds ratio

Table 3. Association between willingness to receive pertussis immunization and knowledge and attitudes (n=977)

	Willingness to receive pertussis vaccination						OR	95% CI
	Total		during pregnancy					
			Yes		No			
	n	%	n	%	n	%		
	<u>Most reliable source of information about pertussis immunization</u>							
Television	108/974	11	28/279	10	80/695	12	0.86	0.54–1.35
Internet	65/974	7	18/279	6	47/695	7	0.95	0.54–1.67
Family member	67/974	7	18/279	6	49/695	7	0.91	0.52–1.59
Friend	27/974	3	6/279	2	21/695	3	0.71	0.28–1.77
Physician	481/974	49	147/279	53	334/695	48	1.20	0.91–1.59
Midwife	45/974	5	18/279	6	27/695	4	1.71	0.92–3.15

Public health nurse	34/974	3	12/279	4	22/695	3	1.37	0.67–2.82
<hr/>								
<u>Knowledge</u>								
Heard about characteristics of pertussis	101/977	10	40/279	14	61/698	9	1.75	1.14–2.68
Family members/acquaintances have had pertussis	45/977	5	24/279	9	21/698	3	3.03	1.66–5.55
Neonates can develop severe complication if infected	343/977	35	109/279	39	234/698	34	1.27	0.95–1.70
No side effects for newborn baby after receiving pertussis vaccination	45/977	5	24/279	9	21/698	3	3.03	1.66–5.55
No fear about pertussis vaccination because it occurs in other countries	176/977	8	87/279	31	89/698	13	3.10	2.21–4.34
Pregnant women can be a source of pertussis infection for their infants	42/977	4	23/279	8	19/698	3	3.21	1.72–6.00
Pregnant women can be infected before or after birth if not vaccinated	232/977	24	119/279	43	113/698	16	3.85	2.82–5.26
<u>Attitudes</u>								
Pertussis vaccination is necessary	201/977	21	134/279	48	67/698	10	8.70	6.17–12.28
Vaccine is effective for pregnant women and their infants	209/977	21	122/279	44	87/698	12	5.46	3.94–7.56

No concern about side effects in the newborn after maternal pertussis vaccination	45/977	5	24/279	9	21/698	3	3.03	1.66–5.55
Other vaccinations								
Seasonal influenza vaccination received during pregnancy	228/977	23	77/279	28	151/698	22	1.38	1.00–1.90
Willing to receive Zika virus vaccination during pregnancy	335/977	34	183/279	66	152/698	22	6.85	5.05–9.29

CI, confidence interval; OR, odds ratio