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**Maternal uptake of pertussis cocooning strategy and other pregnancy related recommended immunizations**

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**Maternal uptake of pertussis cocooning strategy and other pregnancy related recommended immunizations**

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Keywords

Health care provider, Immunisation, Influenza, Maternal, Pertussis

**Abstract**

Maternal immunization is an important strategy to prevent severe morbidity and mortality in mothers and their offspring. This study aimed to identify whether new parents were following immunization recommendations prior to pregnancy, during pregnancy, and postnatally. A cross-sectional survey was conducted by a questionnaire administered antenatally to pregnant women attending a maternity hospital with a follow-up telephone interview at 8-10 weeks post-delivery. Factors associated with uptake of pertussis vaccination within the previous five years or postnatally and influenza vaccination during pregnancy were explored using log

binomial regression models. A total of 297 pregnant women completed the questionnaire. For influenza vaccine, 20.3% were immunized during pregnancy and 3.0% postnatally. For pertussis vaccine, 13.1% were vaccinated within five years prior to pregnancy and 31 women received the vaccine postnatally, 16 (51.6%) received the vaccine > 4 weeks after delivery. Receiving a recommendation from a healthcare practitioner (HCP) was an independent predictor for receipt of both pertussis (RR 2.07,  $p < 0.001$ ) and influenza vaccine (RR 2.26,  $p = 0.001$ ). Non-English speaking mothers were significantly less likely to have received pertussis vaccination prior to pregnancy or postnatally (RR 0.24,  $p = 0.011$ ). Multiparous pregnant women were less likely to have received an influenza vaccine during their current pregnancy ( $p = 0.015$ ). Uptake of pregnancy related immunization is low and likely due to poor knowledge of availability, language barriers and lack of recommendations from HCPs. Strategies to improve maternal vaccine uptake should include education about recommended vaccines for both HCPs and parents and written information in a variety of languages.

#### Abbreviations

ABS ó Australian Bureau of Statistics

HCP - Health Care Provider

MMR - measles, mumps, rubella

USA ó United States of America

UK ó United Kingdom

WCH ó Women's and Children's Hospital

## Introduction

To reduce the morbidity and mortality from infectious diseases in pregnant women and their newborns, many countries recommend influenza immunization during pregnancy and pertussis immunization prior to pregnancy as part of pregnancy planning.<sup>1,2</sup> In Australia, the National Health and Medical Research Council guidelines recommend that a pre-conception health check should include assessment of measles, mumps, rubella (MMR), varicella, diphtheria, tetanus and pertussis immunization status.<sup>1</sup>

The majority of hospitalisations and deaths from pertussis occur in infants less than six months of age as they have not received a complete course of pertussis immunization<sup>3-5</sup> and infection mainly occurs via transmission from parents with waning vaccine-induced immunity.<sup>6-8</sup> Based on this evidence, it is recommended that potential parents and other adults within the same household receive a pertussis containing vaccine if not received in the preceding five years as part of a cocooning strategy. In response to previous pertussis epidemics, authorities in the United States of America (USA), the United Kingdom (UK), New Zealand and Australia now recommend pertussis immunization in the third trimester of pregnancy to protect newborns.<sup>9-11</sup>

Pregnant women are also at increased risk of severe illness, hospitalization and death from influenza, particularly evident during the H1N109 Influenza Pandemic.<sup>12-14</sup> Influenza immunization has been recommended as the most effective way of preventing hospitalizations and severe influenza-related complications in pregnant women and their infants to six months of age.<sup>15-18</sup> In Australia, seasonal influenza vaccine is available from March to October each year during the peak influenza season and is generally provided by family physicians.

This study aimed to determine whether parents were following the current immunization recommendations prior to, during and post-pregnancy. Our primary objective was to

determine the proportion of pregnant women who had received a pertussis vaccine as part of the cocooning strategy, and/or influenza vaccine during pregnancy. We also sought to determine facilitators and barriers to uptake of maternal immunizations.

## Results

### 1. Survey population and response rate

Of 465 pregnant women approached in the antenatal public and private obstetric clinics from December 2010-August 2011, 300 (64.5%) enrolled in the study and 297 completed the questionnaire (Figure 1). Women were asked if they were interested in participating in a research study on immunisation. Postnatal follow-up telephone calls were completed for 272 (91.6%) enrolled participants.

The mean age of participants was 30.4 years (range 17-44 years). The majority of respondents were Caucasian (86.9%; n=258) with 10.1% (n=30) of Asian ethnicity. The majority of participants were born in Australia (73.7%, n=219), married (61.6%, n=183) and almost half had no previous children (46.8%, n=139) (Table 1). These sample characteristics are similar to South Australian or Australian population characteristics for pregnant women according to the 2013 Australian Bureau of Statistics (ABS) data.<sup>19</sup> The ABS data indicates the median age for South Australian pregnant women as 30.4 years and the proportion of South Australian pregnant women who were married as 63.9%. Country of Mothers birth was also similar between our sample and Australian ABS data with Australia as the predominant birth country of new mothers (73.7% vs 67.5%). The proportion of pregnant women with no previous children was also similar between our cohort (46.8%) and ABS data for Australian (44.7%).

### 2. Uptake of recommended vaccines

#### 2.1. Pertussis

A total of 67 women (22.6%) had received pertussis vaccination within the previous five years (n=39) or following birth (n=31). Three of these participants received both pertussis vaccine prior to pregnancy and postnatally.

Whilst 43.1% (n=128) of respondents reported having received a pertussis (whooping cough) vaccine during their lifetime, only 1.3% (n=4) received the immunization as part of their pregnancy planning. Almost a quarter (24.2%, n=72) of participants were unsure whether they had previously received a whooping cough vaccine. Of the 128 women who reported receiving pertussis vaccination, 12.5% (n=16) had done so within the preceding 12 months and a further 18.0% (n=23) had been immunized between 12 months and five years prior. The remaining 64.1% (n=82) received their last pertussis vaccine more than five years previously and 5.6% (n=7) could not remember when it had been administered.

Factors associated with receiving pertussis vaccination prior to pregnancy or postnatally, were explored. Knowledge of pertussis vaccine availability prior to the study, a recommendation from a HCP, English as first language, age greater than 30 years and higher level of education were univariate predictors of having received pertussis vaccination. English as a first language and recommendation from a HCP remained significantly associated with uptake in a multiple log binomial regression analysis. Women who had English as a second language were almost five times less likely (RR 0.24, p=0.011) to have received a pertussis vaccination within the previous five years or postnatally (Table 2).

## 2.2 *Influenza*

Of 237 mothers whose influenza vaccination status was able to be determined, only 48 women (20.3%) received the influenza vaccine during their pregnancy, and an additional seven mothers (3.0%) received the vaccine postnatally. In a multiple regression analysis, multiparous pregnant women were up to 68% less likely to receive influenza vaccine during

pregnancy compared with nulliparous women ( $p=0.017$ ). Women who had received a recommendation to receive an influenza vaccine from a HCP were 2.26 times more likely to have received the vaccine during pregnancy than those who had not received a recommendation ( $p=0.001$ ). Women who were aware of the availability of influenza vaccination during pregnancy prior to study participation were 3.14 times more likely to be vaccinated ( $p=0.026$ ) (Table 3).

A total of 51.5% ( $n=153$ ) of mothers reported having received the influenza vaccine during their lifetime. Of these 153 individuals, 46.4% ( $n=71$ ) had received their last influenza vaccine in the preceding 12 months, with 41.2% ( $n=63$ ) having received it between 12 months and 5 years prior and 12.4% ( $n=19$ ) having received an influenza vaccine more than five years prior.

### 3. Parents' knowledge of vaccine preventable diseases and corresponding immunizations

#### 3.1 Pertussis (whooping cough)

Almost all respondents (95.0%,  $n=282$ ) indicated they had heard of whooping cough although only a minority of pregnant women (37.7%,  $n=112$ ) were aware that a pertussis vaccine was available prior to pregnancy or postnatally. Their source/s (multiple responses) of information included various HCPs (41.1%,  $n=46$ ; midwives and obstetricians ( $n=19$ ), family physicians ( $n=27$ )), family/or friends ( $n=24$ ) and media ( $n=18$ ).

#### 3.2 Influenza

The majority (70.0%,  $n=208$ ) of respondents were aware that influenza vaccine was available prior to, or during pregnancy. Almost half of these respondents (45.7%;  $n=95$ ) reported the source of information about influenza vaccine was their HCP. Other sources reported included media ( $n=40$ ), workplace ( $n=23$ ), family and friends ( $n=22$ ), posters and leaflets ( $n=10$ ) and university or school ( $n=3$ ).

Less than a quarter of respondents (21.9%, n=65) had received a recommendation from a HCP to receive an influenza vaccine prior to conception or during pregnancy. The majority of these recommendations came from family physicians (90.8%, n=59), with recommendations also reported from midwives (n=4), a travel doctor (n=1) and an obstetrician (n=1).

#### 4. Uptake of vaccines in the postpartum period

A total of 272 follow-up phone calls were completed. Of these, a total of 15.4% (n=42) respondents indicated they had received one or more vaccines postnatally, including pertussis vaccine (n=31), both influenza and pertussis (n=5), influenza alone (n=2) or both varicella and pertussis (n=1). Pertussis immunization was confirmed either by date of administration or with the immunization provider for all 31 mothers. Furthermore, 12.7% (n=35) of women reported their partner had received a pertussis vaccine. Three mothers received the vaccine within the first week after delivery with the remaining mothers being immunized between 8-90 days post-delivery (median 38 days post-delivery). The most common reason cited for receiving a pertussis vaccine was for newborn protection (36.6%), with 33.3% of respondents receiving a recommendation from HCPs and 16.6% from family and friends. Three mothers stated their decision had been influenced by participation in the study and three were influenced by knowledge of the pertussis epidemic.

Of those who had not received a pertussis or influenza vaccine since the birth of their baby and were contactable (n=230), commonly cited reasons were that vaccine/s were not offered or discussed, or they had no awareness of their need for immunization (30.9%, n=71), a belief that immunization so soon after delivery was unnecessary (17.8%, n=41), being time poor after delivery (17.4%, n=40) or simply forgetting (13.5%, n=31) (Table 4).

#### 5. Intention to accept the pertussis/influenza vaccines



A total of 73.4% (n=218) of respondents indicated they would have received a pertussis vaccine prior to pregnancy had it been recommended to them. During antenatal care, only 16.2% (n=48) had received a recommendation to receive pertussis vaccine postnatally. Of the 258 women who had not received a pertussis vaccine within the previous five years, 60.9% (n=157) had intended to receive the pertussis vaccine after their baby was born, 28.7% (n=74) were undecided and 9.3% (n=24) had never intended to have the vaccine. One hundred and fifty-four (59.7%) participants reported they would have received it had it been recommended, while 16.3% (n= 42) were undecided.

For the 226 women who had not received an influenza vaccine in the previous 12 months, 120 (53.1%) stated they would have received an influenza vaccine had it been recommended, and a further 41 (18.1%) were undecided.

#### 6. Identifying concerns/barriers for maternal immunization

Over a third (35.1%, n=104) of respondents indicated they had concerns about receiving a booster pertussis vaccine. The most common concerns were of potential side-effects of the vaccine to themselves (22.6%, n=67) or their infants through breast feeding (12.2%, n=36) or ineffectiveness of the vaccine (16.2%, n=48). A minority indicated cost as a concerning factor (3.4%, n=10) or disliked injections (5.7%, n=17).

Over half of the women surveyed (54.2%, n=161) indicated they had concerns about having any vaccine whilst pregnant. The most commonly reported concerns were potential side effects to themselves 46.7% (n=134) or their unborn baby 40.1% (n=115). Cost was a reported concern for 4.5% (n=13) and 4.2% (n=12) disliked injections.

#### **Comment**

Our results show low uptake of all recommended immunizations related to pregnancy, particularly pertussis and influenza immunization. Despite most respondents being aware of

the recommendation for influenza vaccine during pregnancy, of those who had not received it as part of pregnancy planning, the majority of women agreed they would have received the vaccine had it been recommended to them. Many respondents had concerns about potential side effects for themselves and/or their unborn child, and therefore avoided immunization during pregnancy.

In this study, a recommendation to receive vaccines provided greater likelihood of immunisation. This emphasises the importance of knowledge provision from HCPs to improve immunization uptake for pregnant women and their partners when planning a pregnancy, with appropriate educational materials provided to HCPs to ensure they are aware of the current recommendations and reasons influencing decision making by parents/ mothers. Women with English as a second language and lower educational levels were less likely to have received influenza or pertussis vaccinations. This suggests that current available information may be insufficient or inaccessible to these groups. Educational materials that are sensitive to ethnic diversity, easily readable and accessible to all new parents should be a priority for policy makers.

At the time of this study, cocooning was the only recommended strategy in Australia to provide protection to unimmunized or partly immunized infants. A recent study has shown evidence that pertussis immunization prior to conception or within 4 weeks after birth was protective against pertussis infection in infants.<sup>20</sup> Unfortunately, the majority of mothers in our study received the vaccine at least four weeks after delivery when there is less evidence of such benefit. Awareness of cocooning strategy is low in South Australia and this may relate to absence of funding for this program. In 2011, all States in Australia, except South Australia and Tasmania, provided funding to subsidise the cost of the pertussis vaccine for new parents.<sup>21</sup> When a recommended vaccine is not funded it may be perceived as less important than funded vaccines, or become inaccessible due to financial difficulties, thus reducing

uptake.<sup>22</sup> In addition, whilst the majority of women who had not recently been immunized with pertussis vaccine intended to receive the pertussis vaccine postnatally, very few followed through with this intention. Previous studies have shown that intent does not necessarily correlate with uptake.<sup>23</sup> Mothers indicated less concern about receiving pertussis immunization during pregnancy than other vaccines. The primary reason given for not having received pertussis vaccine postnatally was that it had not been offered to them or discussed with them, or that mothers were not aware of the health benefits of immunization in this setting. These are all potentially significant barriers to immunization receipt. A small number of women were alerted to the recommendation through participation in this study suggesting receipt of minimal information has the potential to improve uptake.

A recent study in the USA showed a high proportion (72%) of women received pertussis vaccine in the postpartum period when it was provided by the hospital before discharge. When women who had not been offered the vaccine were excluded from the analysis, however, uptake was 96.2%.<sup>24</sup> In this study, some women indicated that they did not receive the immunization after pregnancy because they were too busy after their baby was born. If pertussis immunization were available to postpartum women before hospital discharge this would be likely to increase uptake. This may also explain why multiparous women were less likely to receive influenza vaccine. Alternatively multiparous women may have considered repeat influenza immunization unnecessary. These data suggest that multiparous pregnant women should be targeted in influenza vaccine campaigns.

A limited proportion of mothers understood the importance or availability of pregnancy-related immunisation. A number of studies indicate that recommendations from HCPs play a major role in parents' decision making about vaccine acceptance.<sup>25-29</sup> A large proportion of the women in this study did not receive pre-pregnancy immunization planning, thus making maternal and postpartum pertussis immunization recommendation by HCPs even more important.

An effective maternal immunization program is reliant upon confident communication between HCP and prospective parents about the benefits and risks of pregnancy related immunization to optimise protection for pregnant women and their newborns. It is imperative that information to assist in vaccine awareness and vaccination decision making in Australian women with a non-English speaking background becomes widely available. This will begin to address the barriers to vaccination which may benefit all women and their newborns.

## **Materials and Methods**

### **Study design**

This cross-sectional observational study was undertaken between December 2010 and September 2011 at the Women's and Children's Hospital (WCH). The WCH is the largest of three major public maternity hospitals in South Australia, providing maternity care for metropolitan Adelaide and is the primary tertiary maternity hospital for complex care with approximately 5,000 births per year. Both public and private patients with diverse ethnicity and socio-economic status attend this obstetric hospital and were approached for participation in this study at any gestational period.

### *Interviews of pregnant women using a survey questionnaire*

A questionnaire directed interview was held with pregnant women, to identify whether prospective parents were following or intending to follow immunization recommendations for pregnant women or those planning a pregnancy. This questionnaire was developed to identify demographic and other factors associated with uptake of cocooning strategy and influenza vaccination based on previous literature and questionnaires developed and published by the research team.<sup>30</sup> A mixture of yes/no response and open-ended questions were used. A follow-up telephone call was made to participants eight to 10 weeks after the birth of their baby to record any vaccines that had been received since the initial interview and determine

the actual uptake of the recommended immunizations. A non-medical researcher asked the survey questions without any additional information being provided about the diseases under consideration, so as not to bias the participants' decisions about receiving further vaccinations. Information was collected at a follow-up call to ascertain reasons why mothers received any further immunizations and to identify whether participation in the study had influenced their decision.

#### *Participant recruitment*

Women attending the public and private antenatal clinics at the Women's and Children's Hospital (WCH) were provided with study information and invited to participate following informed consent until the desired sample size ( $n=297$ ) was achieved. Pregnant women were eligible to participate regardless of gestation or expected delivery date (peak influenza season or otherwise) with language barriers being the only exclusion criteria. The questionnaire was only available in English, although an Asian language interpreter was available. Participants' demographic characteristics, immunization history, awareness and knowledge of, and attitudes towards pregnancy-related immunization were recorded.

#### *Statistical analyses*

The sample size was estimated on the primary outcome: the expected proportion of mothers who had received a pertussis vaccine either within the previous five years or following delivery. An adult vaccination survey in 2009,<sup>31</sup> estimated that 7.8% of South Australians received a pertussis vaccine as an adult. Using a sampling error of 0.03 (i.e. 3% above or below the expected estimate) a sample size of 297 was calculated.

Multivariable analysis was used to identify factors independently associated with pertussis and influenza vaccine uptake. Predictors that had a global  $p$  value  $< 0.15$  in univariate models were included into a multivariable binomial regression model and outcomes reported as risk

ratios with 95% confidence intervals. A two-tailed p-value of less than 0.05 was considered to be statistically significant. Statistical analyses were performed using Stata statistical software, Version 11, College station: Stata corporation 2010.<sup>32</sup>

The study protocol was approved by the Women's and Children's Health Network Human Research Ethics Committee. Informed consent was obtained from all participants.

### **Contributors**

CW and NT assisted with study design, data collection, statistical analysis and prepared first draft of the manuscript under direct supervision of HM. CB contributed to study design and review and editing of the manuscript. JT assisted with data analysis and manuscript writing and editing. MC assisted in statistical design, analysis and manuscript writing. HM contributed to and reviewed and edited the manuscript. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed.

### **Trial Registration**

This study did not require registration on a clinical trials registry as it did not meet the WHO ICMJE definition for registration.

### **Source of Funding**

This research study was an Investigator led and designed study. No external funding was provided for this research.

### **Conflict of interest**

HM reports grants from Sanofi-Pasteur and GlaxoSmithKline for unrelated Investigator led projects. The remaining authors report no conflict of interest.

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Table 1: Demographic characteristic of respondents at antenatal interviews (n=297)

Variable	Levels	Number of individuals	Percentage
<b>Age Group</b>	Ö20 years	16	5.4
	21-30	138	46.5
	31-40	132	44.4
	>40	11	3.7
<b>Number of children at time</b>	0	139	46.8
	1	101	34.0
	2	36	12.1
	×3	21	7.1
<b>Marital Status</b>	Never married/Single	18	6.1
	Married	183	61.6
	Divorced/Separated	8	2.7
	Living with a partner	88	29.6
<b>Work Status</b>	Full-time employed	93	31.4
	Part-time/Casual	79	26.7
	Self-employed	7	2.4
	Unemployed/Home duties	101	34.1
	Student	16	5.4
<b>Born in Australia</b>	Yes	219	73.7
	No	78	26.3
<b>English first language</b>	Yes	247	83.2
	No	50	16.8
<b>Race</b>	Caucasian	258	86.9
	Aboriginal/Torres Strait	4	1.4
	Asian	30	10.1
	Other/mixed	5	1.7
<b>Area</b>	Metropolitan	245	82.5
	Non-metropolitan	52	17.5
<b>Highest educational attainment</b>	Did not complete high school	40	13.5
	Completed high school	60	20.2
	Trade/Apprenticeship/ Certificate/ Diploma	86	29.0
	Bachelor or higher	111	37.4
<b>Household income</b>	<\$20,000	13	4.4
	\$20,001-\$40,000	19	6.4
	\$40,001-\$80,000	88	29.6
	>\$80,001	83	28.0
	Refused	94	31.7

<b>Health care benefits</b>	Yes (health care/pensioner concession card)	87	29.4
	None	209	70.6
<b>Had pregnancy planning</b>	Yes	67	22.6
	No	230	77.4

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Table 2: Predictors of receipt of pertussis vaccination within last 5 years or following birth

Variable	Level	n	Risk ratio	95% CI	P-value	Adjusted Risk ratio	95% CI	P-value
Age group	Ö80 y	154	1.0			1.0		
	>30y	143	1.60	1.03,2.46	<b>0.034</b>	1.22	0.81,1.83	0.332
Area	Metropolitan	245	1.0					
	Regional	52	1.35	0.83,2.22	0.220			
English as first language	Yes	247	1.0			1.0		
	No	50	0.23	0.08,0.71	<b>0.010</b>	0.24	0.08,0.73	<b>0.011</b>
Educational attainment	Tertiary	197	1.0		<b>(0.043)</b>	1.0		<b>(0.083)</b>
	High school	60	0.68	0.38,1.22	0.196	0.66	0.38,1.16	0.149
	Did not complete high school	40	0.28	0.09,0.85	0.024	0.33	0.10,1.05	0.061
Number of children at home	0	139	1.0		<b>(0.604)</b>			
	1	101	1.19	0.75,1.89	0.451			
	×2	57	0.89	0.48,1.66	0.723			
Marital status	Married	183	1.0		<b>(0.321)</b>			
	Single/Separated/Widowed	26	0.62	0.25,1.60	0.326			
	Living with a partner	88	0.83	0.51,1.35	0.456			
Work status	Employed	179	1.0			1.0		
	Student/Unemployed/Home duties	117	0.67	0.42,1.06	0.09	0.93	0.61,1.41	0.731
Health care/pensioner	No	209	1.0					
	Yes	87	1.17	0.75,1.83	0.478			
Pregnancy planning with GP	No	230	1.0					
	Yes	67	1.36	0.86,2.14	0.188			
HCP recommended	No	241	1.0			1.0		
	Yes	52	2.80	1.89,4.16	<b>&lt;0.001</b>	2.07	1.37,3.14	<b>0.001</b>
Aware of adult pertussis vaccine	No	156	1.0			1.0		
	Yes	74	2.16	1.42,3.30	<b>&lt;0.001</b>	1.44	0.93,2.23	0.103

Global p values are presented in brackets where applicable

Only univariate associations with p value  $<0.15$  were included in the multivariate regression model due to the small number of respondents reporting the outcome of pertussis vaccination post birth or within 5 years (n=67).

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Table 3: Predictors of receipt of influenza vaccination during pregnancy.

Variable	Level	n	Risk ratio	95% CI	P-value	Adjusted Risk ratio	95% CI	P-value
<b>Age group</b>	Ö0 y	113	1.00					
	>30y	124	0.74	0.43,1.18	0.186			
<b>Area</b>	Metropolitan	193	1.00					
	Regional	44	1.30	0.72,2.35	0.376			
<b>English as first language</b>	Yes	199	1.00					
	No	38	0.61	0.26,1.44	0.258			
<b>Highest educational attainment</b>	Degree or higher	95	1.00		(0.880)			
	Trade/certificate/ diploma	62	1.05	0.56,1.97	0.883			
	High school	53	1.13	0.59,2.15	0.704			
	Did not complete high school	27	0.74	0.27,1.99	0.552			
<b>Number of children at home</b>	0	108	1.00		<b>(0.027)</b>	1.00		<b>(0.015)</b>
	1	82	0.61	0.35,1.08	0.092	0.58	0.34,1.00	0.045
	×2	47	0.31	0.11,0.82	0.019	0.32	0.12, 0.83	0.017
<b>Marital status</b>	Married	152	1.00		(0.309)			
	Single/Separated/ Widowed	16	0.68	0.18,2.59	0.570			
	Living with a	69	1.42	0.84,2.38	0.189			
<b>Work status</b>	Employed	147	1.00					
	Student/ Unemployed/Home duties	89	0.68	0.39,1.20	0.180			
<b>Health care/pensioner card</b>	No	55	1.00					
	Yes	134	0.62	0.32,1.21	0.165			
<b>Pregnancy planning with GP</b>	No	177	1.00			1.00		
	Yes	60	1.48	0.87,2.49	0.146	1.13	0.70,1.82	0.613
<b>Vaccine recommended by Health Professional</b>	No	182	1.00			1.00		
	Yes	55	3.04	1.89,4.92	<b>&lt;0.001</b>	2.26	1.39,3.69	<b>0.001</b>



<b>Aware of availability of flu vaccine</b>	No	67	1.00			1.00		
	Yes	170	4.33	1.62, 11.59	<b>0.003</b>	3.14	1.15,8.61	<b>0.026</b>

Global p values are presented in brackets where applicable

Only univariate associations with p value <0.15 were included in the multivariate regression model due to the small number of respondents who received influenza vaccine during pregnancy (n=48).

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Table 4: Reasons why women did not receive any recommended vaccines in the postpartum period (n=230)

<b>Reason</b>	<b>Number (n)</b>	<b>Percent (%)</b>
Not offered or discussed/ not aware of need for	71	30.9
Do not believe it is necessary to have vaccinations so soon after the birth	41	17.8
Time poor/ busy with the baby/ baby health issues	40	17.4
Forgot to have them/haven't thought about it	31	13.5
Already vaccinated for whooping cough	28	12.2
Cost	6	2.6
Accessibility / vaccine not available	6	2.6
Do not believe in vaccinations/vaccines are ineffective	6	2.6
Side effects of vaccines for myself	4	1.7
Medical	4	1.7
Doctor busy/ couldn't find anywhere close to home to get vaccines	3	1.3
Side effects of vaccines on my baby (through breastfeeding)	1	0.4
Do not like injections	1	0.4

Other	6	3.0
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Number does not equal 230 as multiple responses allowed. Other: no reason given (n=3),  
Going overseas soon, may have vaccines there (n=1), hospital or doctor claimed it was not  
necessary (n=2).

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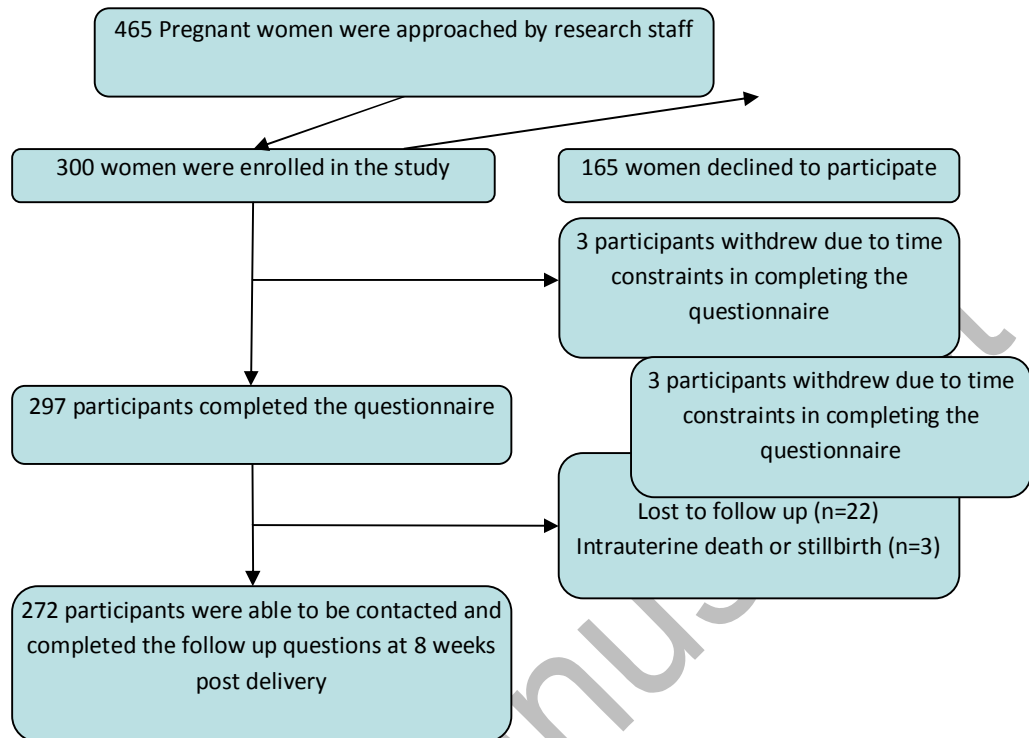


Figure 1. Study population.

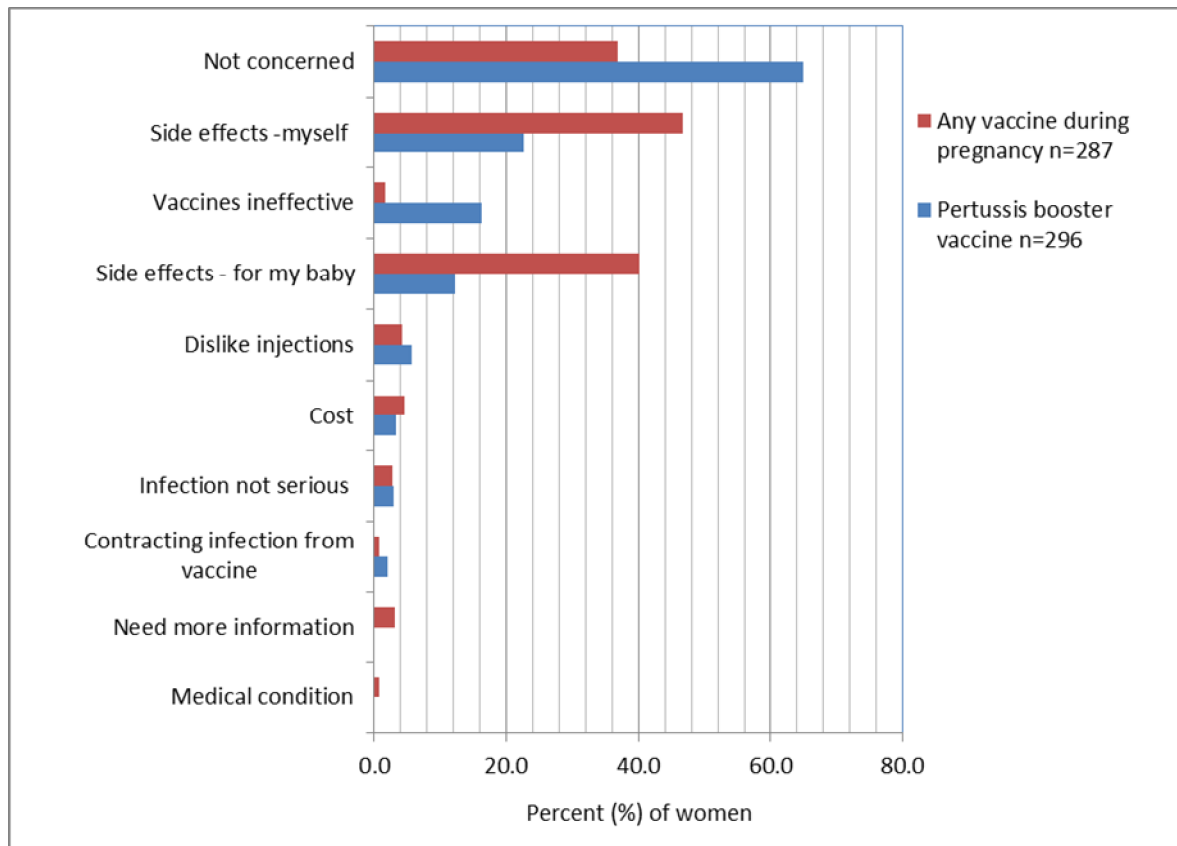


Figure 2: Concerns regarding recommended maternal vaccines

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