Utilization of the 2009 H1N1 Vaccine by Pregnant Women in a Pandemic Year

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Abstract

Objective: To determine the proportion of pregnant women in a community-based cohort who received the H1N1 vaccine during the 2009–2010 influenza pandemic, and to identify sociodemographic factors that were associated with receiving the vaccine.

Methods: Women in Alberta from a cross-sectional community-based cohort who were participating in a study of prenatal care were asked about their receipt of the 2009 H1N1 and seasonal influenza vaccines and whether they had contracted influenza. Univariable and backwards multivariable logistic regression were used to identify the sociodemographic factors associated with receiving the 2009 H1N1 vaccine.

Results: Approximately 72% of women in this sample (n = 402) received an influenza vaccine in 2009; 29.4% received both H1N1 and seasonal influenza vaccines, 40.8% received only the 2009 H1N1 vaccine, 1.7% received only the seasonal influenza vaccine, and 28.1% did not receive either vaccine. Univariable analysis found that receiving the 2009 H1N1 vaccine was significantly associated with household income, education, current employment status, and contentment about the pregnancy. After multivariable analysis, education and having a planned pregnancy remained as independent predictors of vaccination status.

Conclusion: During the 2009–2010 pandemic influenza season, over 70% of this cohort received influenza vaccinations, a much higher proportion than seen in previous influenza seasons. The majority of women who received the 2009 H1N1 vaccine were likely influenced by the increased media attention given to the 2009–2010 pandemic and the replacement of seasonal vaccine by the 2009 H1N1 vaccine.

Key Words: Influenza vaccines, pregnancy, disease outbreaks

Competing Interests: None declared.

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Résumé

Objectif : Déterminer, au sein d'une cohorte communautaire, la proportion des femmes enceintes qui ont reçu le vaccin H1N1 pendant la pandémie de grippe 2009–2010, ainsi qu'identifier les facteurs sociodémographiques qui étaient associés au fait de se voir administrer le vaccin.

Méthodes : Nous avons demandé aux femmes qui, au sein d'une cohorte communautaire transversale en Alberta, participaient à une étude portant sur les soins prénatals si elles avaient reçu les vaccins contre le virus H1N1 et la grippe saisonnière en 2009, et si elles avaient contracté la grippe. Une régression logistique univariée et une régression logistique multivariée descendante ont été utilisées pour identifier les facteurs sociodémographiques associés au fait de se voir administrer le vaccin H1N1 2009.

Résultats : Environ 72 % des femmes de cet échantillon (n = 402) ont reçu un vaccin antigrippal en 2009; 29,4 % ont reçu les vaccins contre le virus H1N1 et la grippe saisonnière, 40,8 % n'ont reçu que le vaccin H1N1 2009, 1,7 % n'ont reçu que le vaccin contre la grippe saisonnière et 28,1 % n'ont reçu aucun de ces vaccins. L'analyse univariée a permis de constater que le fait de se voir administrer le vaccin H1N1 2009 présentait une association significative avec le revenu du ménage, le niveau de scolarité, le statut actuel quant à l'emploi et la satisfaction envers la grossesse. À la suite de l'analyse multivariée, le niveau de scolarité et le fait de connaître une grossesse souhaitée sont demeurés des facteurs prédictifs indépendants du statut quant à la vaccination.

Conclusion : Au cours de la pandémie de grippe 2009–2010, plus de 70 % de cette cohorte ont reçu des vaccins antigrippaux, soit une proportion beaucoup plus élevée que ce que l'on a constaté au cours des saisons de grippe précédentes. La plupart des femmes ayant reçu le vaccin H1N1 2009 ont probablement été influencées par l'attention médiatique accrue qui a été accordée à la pandémie 2009–2010 et au remplacement du vaccin saisonnier par le vaccin H1N1 2009.

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INTRODUCTION

In April 2009 a novel strain of influenza A (H1N1) was identified, and by June 2009 the spread of this virus had been declared a pandemic by the World Health Organization.[1–3] While pregnant women have not been shown to be more susceptible to influenza, they are more likely to suffer from serious complications and have a higher risk of death if they become ill.[2–4] The impact of maternal infection on the developing fetus is not well understood, but data from the 1918–1919 and the 1957–1958 influenza pandemics suggest that maternal infection is associated with pregnancy loss, preterm birth, and central nervous system defects.[4] Due to the high risk of maternal and fetal complications and the lack of harm associated with receiving inactivated influenza vaccine at all stages of pregnancy, pregnant women were granted priority access to the 2009 H1N1 vaccine.[4–7] While the Public Health Agency of Canada recommendations stated that unadjuvanted vaccine was the preferred vaccine for pregnant women, they also stated that adjuvanted vaccine was safe for women who were at least 20 weeks pregnant or who were less than 20 weeks' gestation but also suffered from chronic health conditions, because the risk to the mother of not receiving the vaccine was greater than the hypothesized risk of the vaccine to the fetus.[6] These recommendations were significant, as unadjuvanted vaccine was not initially available.

Historically, pregnant women have had the lowest uptake of influenza vaccine among high risk priority groups.[8] Data from the National Health Interview Survey in the United States found that between 1997 and 2005 only 9.3% to 14.4% of pregnant women received a seasonal influenza vaccine, despite recommendations from the Advisory Committee on Immunization Practices and the American College of Obstetricians and Gynecologists.[5,8]

The first case of 2009 H1N1 infection in Alberta was identified in April 2009.[7] From September 2009, seasonal influenza vaccines were made available at no cost to the three million Albertans aged six months or older.[9] High risk groups (pregnant women, people with chronic conditions, children between 6 and 23 months of age, adults over age 65, and residents of long-term care facilities) were eligible to receive the 2009 H1N1 vaccine at no cost from October 26, 2009, and the vaccine was made available to all Albertans aged six months or older at no cost on November 23, 2009.[9] By the end of February 2010, more than 1.25 million doses of 2009 H1N1 vaccine had been administered in the province.[9]

This study aimed to assess the utilization of the 2009 H1N1 and seasonal influenza vaccines by pregnant women in Calgary, Alberta during the 2009-2010 pandemic and to identify any sociodemographic factors associated with receiving the vaccine.

MATERIALS AND METHODS

We obtained the data for this study from the All Our Babies Prediction of Preterm Birth Cohort. Pregnant women were recruited for this cohort through physicians' practices, laboratory services, and community advertising in Calgary and surrounding communities. The inclusion criteria for enrolment in the All Our Babies Study were: women over 18 years of age, at less than 18 weeks' gestation, able to complete a written questionnaire in English, and having had fewer than two prior term births.

Participants were asked to complete three questionnaires: the first before 24 weeks of pregnancy, the second between 34 and 36 weeks of pregnancy, and the third at four months postpartum. Sociodemographic factors were assessed in the first questionnaire, and questions related to influenza vaccination and illness were included in the second questionnaire (Appendix). Recruitment for this study began on September 8, 2009, and is ongoing. By September 22, 2010, 1576 women had been recruited, with a retention rate of 85%. The sample of the cohort used in the current study comprised women who received the second questionnaire between November 18, 2009, and March 31, 2010 (n = 509). The remaining women in the cohort were not included because they had either already delivered prior to the 2009–2010 influenza pandemic or were not pregnant during the pandemic.

We used descriptive statistics to assess the characteristics of study participants and women's vaccination status. Categorical variables were expressed as frequencies and percentages with 95% confidence intervals, and continuous variables were reported as medians with interquartile ranges. Univariable logistic regression was used to assess associations between vaccination status and sociodemographic factors. A P-value < 0.05 indicated statistical significance. Multivariable logistic regression was undertaken to determine what sociodemographic (annual household income, education, employment status, maternal age, ethnicity, presence of other children in the home) and pregnancy-related (planned pregnancy, feelings about current pregnancy) variables predicted uptake of the 2009 H1N1 influenza vaccine. All variables of interest were initially included in the model and backwards elimination was used until only statistically significant variables

remained ($\alpha = 0.05$). All statistical analyses were conducted using Stata SE, Version 11 software (StataCorp LP, College Station, TX).

Ethics approval for this study was provided by the Conjoint Health Research Ethics Board at the University of Calgary.

RESULTS

Vaccination data were received from 402 of 509 women (response rate 79%). As seen in Table 1, the majority of women had had post-secondary education (70.6%), were currently working or attending school (60.2%), had an annual household income >$60 000 (78.1%), had planned their pregnancy (76.8%), and reported feeling happy or very happy when they learned they were pregnant (85.3%).

Two hundred eighty-nine women (71.9%) in this sample received either a seasonal influenza vaccine or the 2009 H1N1 vaccine in the 2009–2010 influenza season (Table 2). Most women received their influenza vaccines (seasonal and 2009 H1N1) in their second trimester. Almost 30% of women reported having influenza during their pregnancy, and 85% of women who thought they had the flu and worked or attended school took time off (Table 2). Of those who reported having influenza, 28.6% acquired it before they were vaccinated, 36.9% acquired it after they were vaccinated, and 34.5% were never vaccinated.

No significant differences were found between women who received both the seasonal and the 2009 H1N1 vaccines and women who only received the 2009 H1N1 vaccine; therefore, these categories were combined to compare women who received the 2009 H1N1 vaccine with women who did not receive any influenza vaccinations. The number of women who only received the seasonal influenza vaccine (n = 7) was insufficient for comparison, and this subgroup of women was eliminated from further analyses. In the univariable analysis (Table 3), women who were attempting to conceive were more likely to be vaccinated (OR = 2.53; 95% CI 1.55 to 4.14), and women who were happy when they learned that they were pregnant were also more likely to be vaccinated (OR = 2.66; 95% CI 1.51 to 4.68). Women with higher household incomes (OR = 2.12; 95% CI 1.27 to 3.53), higher education attainment (OR = 2.03; 95% CI 1.28 to 3.23), and who were currently working or attending school (OR = 1.70; 95% CI 1.09 to 2.64) were also more likely to be vaccinated (Table 3). Of note, there was no significant association between vaccination status and influenza status (OR = 0.81; 95% CI 0.50 to 1.31). Multivariable logistic regression revealed that education (OR = 1.78; 95% CI 1.11 to 2.87) and having a planned pregnancy (OR = 2.28; 95% CI 1.38 to 3.77) remained independent predictors of vaccination (see Table 4).

Table 1. Participant characteristics (n = 402)

Variable	n	%	95% CI
Annual household income, $			
< 60 000	85	21.9	17.8 to 26.0
≥ 60 000	303	78.1	74.0 to 82.2
Graduated from trade school/ college/university			
Yes	283	70.6	66.1 to 75.1
No	118	29.4	24.9 to 33.9
Currently working or attending school			
Yes	242	60.2	55.4 to 65.0
No	160	39.8	35.0 to 44.6
Maternal age			
Median (IQR)	400	31 (29–35)	
Range		19 to 47	
Born in Canada			
Yes	313	78.1	74.0 to 82.1
No	88	21.9	17.9 to 26.0
Ethnicity			
Caucasian	323	80.6	76.7 to 84.4
Non-Caucasian	78	19.5	15.6 to 23.3
Currently has a partner			
Yes	395	98.5	97.3 to 99.7
No	6	1.5	0.3 to 2.7
Has other children in the home			
Yes	207	51.5	46.6 to 56.4
No	195	48.5	43.6 to 53.4
Planned pregnancy			
Yes	308	76.8	72.7 to 81.0
No	93	23.2	19.0 to 27.3
Feelings about becoming pregnant			
Very happy/happy	341	85.3	81.8 to 88.7
Not sure/unhappy	59	14.8	11.3 to 18.2

DISCUSSION

In this cohort of pregnant women, approximately 72% of respondents received the 2009 H1N1 influenza vaccine during the 2009–2010 pandemic, and approximately 40% also received a seasonal influenza vaccine. These rates are much higher than those reported in previous studies.[8,10–12] Preliminary United States data from a survey of 150 women reported that 38% (95% CI 24 to 52) of pregnant women received the 2009 H1N1 vaccine.[10] A national population-based Canadian study found that 47.2% (95% CI 37.4% to 39.9%) of pregnant women received the 2009 H1N1 influenza vaccine, and that 43.8% (95% CI 39.0% to 48.6%) of women in the province of Alberta received this vaccine.[12] A survey of pregnant women in Nova Scotia found that

Table 2. Vaccination and influenza status (n = 402)

Variable	n	%	95% CI
Vaccination status			
Received both H1N1 and seasonal influenza vaccines	118	29.4	24.9 to 33.8
Received H1N1 vaccine only	164	40.8	36.0 to 45.6
Received seasonal influenza vaccine only	7	1.7	0.5 to 3.0
Did not get vaccinated	113	28.1	23.7 to 32.5
Influenza during pregnancy (self-report)			
Yes	111	27.6	23.2 to 32.0
No	291	72.4	68.0 to 76.8
Of those who had influenza and are currently working or attending school, took time off due to influenza			
Yes	47	85.5	75.8 to 95.1
No	8	14.5	4.9 to 24.2
Of those who had influenza, timing of influenza in relation to being vaccinated			
Before receiving vaccine	24	28.6	18.7 to 38.4
After receiving vaccine	31	36.9	26.4 to 47.4
Did not get vaccinated	29	34.5	24.1 to 44.9

although 60% would have an influenza vaccination during their pregnancy if their physician recommended it to them, no data were presented on the proportion of women who actually received the vaccine.[13] This study also found that only 15% of pregnant women reported that their physician discussed influenza vaccination with them during their pregnancy.[13] In non-pandemic years, data from the United States indicate a background influenza vaccination rate of 14.4% among pregnant women.[8] Although neither Alberta data nor Canadian data on influenza vaccination during pregnancy in non-pandemic years appear to be available, Kwong et al.[12] reported that the influenza vaccination rate of Canadian women aged 12 and older was 36% in 2005 (28% in the province of Alberta) and has been steadily increasing since 1996. While our study is unable to assess causality, it is suspected that the almost 2.5-fold increase in vaccination uptake in our sample compared to national estimates in non-pandemic years and the 1.5-fold increase compared to pregnant women across the country during the 2009 H1N1 pandemic could be due to intensive media coverage surrounding the 2009–2010 pandemic. This resulted in a heightened awareness of the reassuring safety profile of 2009 H1N1 vaccine and of the increased health risks for pregnant women who became ill with 2009 H1N1. The increased uptake of influenza vaccination in our sample could also be due to differences in underlying sociodemographic factors or health-seeking behaviours between pregnant women and the general population of women in Alberta.

Although the participants in this study had high levels of household income and education, these levels were comparable to the income levels of Canadian families with children under six years of age and to the level of educational attainment of Canadian women giving birth[14,15] and reflect the pregnant and parenting population in Canada. Both characteristics were significantly associated with vaccination status in the univariable analysis, and education remained a significant predictor in the multivariable analysis. Because there is no charge for obtaining the vaccine in the province of Alberta, income level should not have affected uptake; but it can be speculated that more highly educated women better understood the associated risks of acquiring influenza during pregnancy than less educated women, and therefore responded to the call to be vaccinated. Other sociodemographic factors such as partner status, ethnicity, and age were not associated with vaccination status. Interestingly, even in the second trimester (when most women were vaccinated), initial contentment about pregnancy and pregnancy planning were still significantly associated with receiving the vaccine. This suggests that investment in pregnancy from the time of conception or before conception may positively affect health promotion behaviours throughout pregnancy. These findings contrast with the findings of de Zwart et al.[16] in a 2006–2007 survey examining risk perception and precautionary behaviour regarding avian influenza in the Netherlands. In this survey, older age, lower level of education, and non-Dutch ethnicity were predictive of taking protective measures.[16] These differences may be explained by the proximity of the risk; the authors surveyed the general population rather than a specific high risk group (pregnant women).[17] Further, avian influenza had not yet reached the Netherlands at the time of the survey, while our study coincided with the 2009–2010 pandemic. Between April 2009 and April 2010 there were 1278 hospitalized confirmed cases of H1N1 influenza in Alberta (393 in Calgary), and 71 deaths.[9] In Calgary, two pregnant women were hospitalized in intensive care units with confirmed H1N1 in 2009.[18] Few women in our sample would have been unaware of these confirmed cases because they were given a high media profile, which may have highlighted the disease risk and impact.

Many external factors complicated the results of this analysis. Delivery of seasonal influenza vaccine was suspended in the study area early in the influenza season to

re-direct resources to the 2009 H1N1 vaccination program. As such, it is not possible to determine what proportion of women would have received both vaccines, or who would have chosen only the seasonal influenza vaccine. However, because the 2009 H1N1 vaccine and the seasonal influenza vaccine were not available at the same time, self-reporting of the vaccine received could be checked for accuracy based on the trimester in which the vaccine was received and which vaccine was available at that time. Therefore, although the vaccination rates are self-reported, they nevertheless correlate with the vaccination program as it was rolled out in Calgary. Additionally, due to the time associated with manufacturing and distributing the 2009 H1N1 vaccine, this vaccine was not available throughout the entire influenza season; this is reflected in the fact that the majority of our sample received the 2009 H1N1 vaccine during their second trimester. Almost 30% of this sample reported contracting influenza during their pregnancy, but because influenza was self-reported, it is possible that many of these flu-like illnesses were not due to the influenza virus. Thirty-one women (10.7% of the total sample) reported contracting influenza after receiving the 2009 H1N1 influenza vaccine, which may have influenced public perception of vaccine efficacy. The reliance on self-reported influenza status, the likelihood that influenza-like symptoms could be erroneously attributed to influenza, and the limited availability of vaccine could explain the lack of association found between receiving the vaccine and acquiring influenza.

Motivations for receiving the influenza vaccines and the perception of risk were not assessed in this sample, limiting our ability to identify effective promotional strategies for vaccine uptake. However, Gilmour et al. found that the most common reasons for women not to receive the 2009 H1N1 vaccine were that they did not feel it was necessary (72.5%; 95% CI 70.6% to 74.4%), they had "not gotten around to it" (11.4%; 95% CI 10.0% to 12.7%), and fear (8.5%; 95% CI 7.4% to 9.6%).[12] As the women in our study had already chosen to participate in health research, they may have been more engaged than the general population, and consequently the vaccine uptake may have been higher in this sample.

CONCLUSION

During the 2009–2010 pandemic, over 70% of a community-based cohort of pregnant women chose to receive the 2009 H1N1 vaccine. Pregnant women become ill due to influenza every year, and ultimately many of these illnesses are preventable. Health care providers have an obligation to promote the uptake of influenza vaccines

Table 3. Associations between sociodemographic variables and 2009 H1N1 vaccination status (n = 395)

Variable	OR	95% CI	*P*
Annual household income			0.004
< $60 000	Ref		
≥ $60 000	2.12	1.27 to 3.53	
Graduated from trade school/ college/university			0.003
No	Ref		
Yes	2.03	1.28 to 3.23	
Currently working or attending school			0.02
No	Ref		
Yes	1.70	1.09 to 2.64	
Maternal age			0.32
Continuous	1.02	0.98 to 1.08	
Born in Canada			0.58
No	Ref		
Yes	1.16	0.69 to 1.94	
Ethnicity			0.48
Caucasian	Ref		
Non-Caucasian	1.23	0.69 to 2.18	
Currently has a partner			0.26
No	Ref		
Yes	2.53	0.50 to 12.71	
Has other children in the home			0.71
No	Ref		
Yes	0.92	0.60 to 1.43	
Planned pregnancy			< 0.001
No	Ref		
Yes	2.53	1.55 to 4.14	
Feelings about becoming pregnant			0.001
Not sure/unhappy	Ref		
Very happy/happy	2.66	1.51 to 4.68	
Influenza during pregnancy (self-report)			0.40
No	Ref		
Yes	0.81	0.50 to 1.31	
Of those who worked or attended school and had influenza, took time off due to influenza			0.22
No	Ref		
Yes	0.64	0.31 to 1.31	

Table 4. Multivariable logistic regression predicting uptake of the 2009 H1N1 influenza vaccine

Variable	Odds ratio	95% CI	*P*
Graduated from trade school/ college/university			0.02
No	Ref		
Yes	1.78	1.11 to 2.87	
Planned pregnancy			0.001
No	Ref		
Yes	2.28	1.38 to 3.77	

to their pregnant patients *every* year. Media coverage may be useful to improve public awareness of the benefits of influenza vaccination and to support care providers' efforts, increasing annual compliance with vaccination recommendations.

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Appendix.

Questions asked in survey 1 (gestational age < 24) and survey 2 (34 to 36 weeks' gestation) that were used for this study

1. How did you feel when you found out that you were pregnant?
   - ☐ Very happy
   - ☐ Happy
   - ☐ Not sure
   - ☐ Unhappy
   - ☐ Very unhappy
2. When you became pregnant, were you trying to get pregnant?
   - ☐ Yes
   - ☐ No
3. Do you currently have a partner?
   - ☐ Yes
   - ☐ No
4. What is your birth date?

   _____
5. What is the highest level of education you have completed?
   - ☐ Some elementary or high school (grades 1–12)
   - ☐ Graduated high school
   - ☐ Some college, trade, university
   - ☐ Some graduate school
   - ☐ Completed graduate school

Appendix. *continued*

6. Were you born in Canada?

- ☐ Yes
- ☐ No

7. How would you describe your ethnic background?

- ☐ White or Caucasian
- ☐ Black or African North American
- ☐ First Nations person registered under the Indian Act of Canada
- ☐ First Nations person not registered
- ☐ Inuit
- ☐ Métis
- ☐ Chinese
- ☐ South Asian
- ☐ Filipino
- ☐ Latin American
- ☐ Southeast Asian
- ☐ Arab
- ☐ West Asian
- ☐ Korean
- ☐ Japanese
- ☐ Mixed
- ☐ Other

8. What is the total income, before taxes and deductions of all household members from all sources in the past 12 months?

- ☐ Less than $10,000
- ☐ $10,000–$19,999
- ☐ $20,000–$29,999
- ☐ $30,000–$39,999
- ☐ $40,000–$49,999
- ☐ $50,000–$59,999
- ☐ $60,000–$69,999
- ☐ $70,000–$79,999
- ☐ $80,000–$89,999
- ☐ $90,000–$99,999
- ☐ $100,000 or more

9. Which of the following best describes your MAIN activity? Please select only one.

- ☐ Working at a job or business (self-employed, part-time, full-time)
- ☐ A homemaker
- ☐ Looking for a job
- ☐ On maternity leave
- ☐ A student
- ☐ On medical leave
- ☐ Other

10. Did you receive a seasonal flu immunization during this pregnancy?

- ☐ Yes
- ☐ No (if no, please skip to Question 12)

11. Which trimester were in you at the time of your seasonal flu immunization?

- ☐ First (0–12 weeks)
- ☐ Second (13–24 weeks)
- ☐ Third (25 weeks-birth)
- ☐ Don't know

12. Did you receive the H1N1 flu immunization during this pregnancy?

- ☐ Yes
- ☐ No (if no, please skip to question 14)

13. Which trimester were you in at the time of your H1N1 flu immunization?

- ☐ First (0–12 weeks)
- ☐ Second (13–24 weeks)
- ☐ Third (25 weeks-birth)
- ☐ Don't know

14. Did you have the flu at any time during your pregnancy?

- ☐ Yes
- ☐ No (if no, please skip to question 16)
- ☐ Don't know

15. During which trimester(s) did you have the flu?

- ☐ First (0–12 weeks)
- ☐ Second (13–24 weeks)
- ☐ Third (25 weeks-birth)
- ☐ Don't know

16. Did you take time off work due to flu symptoms during your pregnancy?

- ☐ Yes
- ☐ No