COVID-19 vaccine uptake and reasons for hesitancy in Canadian pregnant individuals

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Funding statement: This work was supported by grant no. 30962 of the Fonds de recherche du Québec–Santé (FRQS) granted to Dr Anick Bérard; and by a grant from the Cercle du Doyen of the Faculty of Pharmacy, University of Montreal granted to Dr Anick Bérard.

Declaration of authors competing interests: None to declare.

Acknowledgement: The authors wish to thank the participants of the CONCEPTION study.

Key words: COVID-19 Vaccine prevalence, COVID-19 vaccine hesitancy, Pregnancy, Perceived risk

Word account: Abstract: **248**; Text: **2500**; Tables: **3**; Figure: **3**; Supplement files: Figure: **1**, Table **1**.

Abstract

Background: With vaccines now recommended to pregnant persons, our aim was to quantify vaccination uptake, describe hesitancy levels and behavioral attitudes surrounding the COVID-19 vaccine in pregnancy in Canada.

Methods: The CONCEPTION study is an on-going international study started in June 2020, looking at the impact of the COVID-19 pandemic on the health of pregnant persons and their children. For this study, pregnant persons recruited from 03/15-07/25/2021, and residing in Canada were eligible. In addition to all CONCEPTION variables, data on vaccine uptake as well as personal knowledge of COVID-19 severity in pregnancy and of COVID-19 vaccine safety and efficacy were collected. Determinants of COVID-19 vaccination during pregnancy were identified using logistic regression models.

Results: From 03/15/2021-07/25/2021, 485 pregnant women were recruited and gave consent, of which 79.4% (385) were vaccinated, 6.4% (31) had the intention to get vaccinated and 14.2% (69) refused the vaccination. Uptake of the influenza vaccine in 2020-2021 was a significant predictor of COVID-19 vaccination status or intention to be vaccinated (aOR 3.03, 95%CI 1.56-6.33); living in suburban compared to rural areas (aORs 2.84, 95%CI 1.20-6.65), and being employed (aOR 3.66, 95%CI 1.67-7.81) were increasing the likelihood of being vaccinated for COVID-19. Knowledge of COVID-19 severity and COVID-19 vaccine efficacy in pregnancy were positively associated with vaccine uptake.

Interpretation: The current study shows that most Canadian pregnant persons are willing to get vaccinated against COVID-19. However, it underscores the importance of improving knowledge transfer of COVID-19 vaccines efficacy in pregnancy to guide vaccination efforts.

Introduction

To date, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic has led to devastating societal impacts. Several COVID-19 vaccines have emerged and been approved at an unparalleled speed, while maintaining rigorous regulatory processes.(1-4) There is limited data available on the efficacy of COVID-19 vaccines in pregnancy, mostly due to the fact that pregnant persons were excluded from preauthorization clinical trials, and only limited human data on safety during pregnancy were available at the time of authorization. However, we know that pregnant persons with COVID-19 are at increased risk for severe illness (e.g., resulting in admission to an intensive care unit (ICU), extracorporeal membrane oxygenation, or mechanical ventilation) and death, as compared with non-pregnant persons of reproductive age.(5) In a recent systematic review, preterm birth was 3 times more common in individuals with COVID-19 than those uninfected.(6) Moreover, the rate of stillbirths was reportedly 2-to-3 times higher among pregnant persons compared to the pre-pandemic period.(6) Following the PREVENT working group recommendations,(5) both the Society for Maternal-Fetal Medicine and other women's health organizations have included pregnancy as a risk factor for severe COVID-19.

Thus far, the vaccines appear to be equally effective in pregnant and non-pregnant individuals.(7) Indeed, data from developmental and reproductive toxicity animal-model studies for the Pfizer-BioNtech, Moderna, and Janssen (Johnson & Johnson) COVID-19 vaccines did not demonstrate any safety concerns in pregnancy,(7, 8) and efficacy data of the Pfizer-BioNtech and Moderna vaccines in pregnancy showed that no fully vaccinated pregnant persons were admitted to ICUs between 01/02/2021 when vaccination data collection commenced and 07/11/2021.(9)

On April 20th, 2021, the Society of Obstetricians and Gynecologists of Canada (SOGC) declared supporting the use of all available COVID-19 vaccines approved in Canada in any

trimester of pregnancy. (10)Recommendations for COVID-19 vaccination in pregnant individuals were further revised and approved on May 13th, 2021 by authorities, (11) and the SOGC statement related to vaccination in Canada was later updated on May 25th 2021 approving COVID-19 vaccine in pregnant individuals.(8) The Comité d'immunisation du Québec later recommended that the messenger RNA vaccines such as those from Moderna or Pfizer-BioNtech should be preferred for pregnant women as there is more safety data with these vaccines during pregnancy.(12)

Data on COVID-19 vaccine acceptance among pregnant individuals are critical, as vaccine hesitancy is a major threat to global health described by the World Health Organization (WHO).(13) Vaccine acceptance has been shown to depend on several factors, such as sociodemographic characteristics, confidence in vaccine safety and efficacy, available information on disease severity, as well as trust in the health system and healthcare providers.(8, 14-17) Additionally, the KFF COVID-19 Vaccine Monitor report noticed that about 27% of the public would probably not or definitely would not get a COVID-19 vaccine if available.(18) As of July 2021, the two age brackets with the lowest vaccination rate among Canadian adult females are the 18-29 and 30-39 years old (73% and 76% of one dose vaccination, respectively),(19) which would include the majority of persons of childbearing age.

In the context of this pandemic, we aimed to quantify vaccine uptake in pregnancy, and describe the level of and reasons for hesitancy and behavioral attitudes surrounding the COVID-19 vaccine among pregnant persons in Canada.

Methods

Study Design and Cohort

The CONCEPTION cohort started on June-26th, 2020 and is on-going. Since March 2021, CONCEPTION started collecting data on vaccine uptake prevalence, side effects, and vaccine hesitancy. The study obtains patient consent and collects data online using SurveyMonkey®, which is a secure platform that enabled recruitment worldwide, and facilitates the validation of double entry/participation by deleting questionnaires filled using the same IP address. Recruitment uses diverse methodologies based on the WHO's recent efforts to reach younger persons where they get their information, namely social media. Recruitment is done on social media, on the Internet but also through OB/GYN departments across Canada. Furthermore, recruitment is done in-person across Canada in community associations of recent immigrants, which allows for the recruitment of women from lower socio-economic status; computer terminals are also made available to pregnant women in all clinics where in-person recruitment is done. Finally, Quick Response (QR) codes are displayed on posters where in-person recruitment is done, in order for women to directly access the questionnaire with their mobile device, without having to be members of any of the social media platforms. Our study is by far the most representative of all studies performed in pregnant women during the COVID-19 pandemic(8, 15, 18, 20) With regards to our Web-based recruitment of pregnant women, it uses a combination of social media platforms (Facebook, Instagram, Twitter, Linkden, and TikTok). Recruitment strategies and data intake questionnaires are available in French, English, Spanish, Portuguese, and Mandarin, and postings are refreshed daily. Development of the questionnaire was done in English; translated in all other languages afterwards; and back translated in English to ensure validity. In order to reach the most diverse group of pregnant women, two team members (JG, YHG) actively work on promoting the cohort on social media platforms via information segments (all platforms), mother/child and pregnancy support groups, and

outpatient and community clinics, established hashtag strategies (Instagram, Twitter, LinkedIn), and through communication specialists affiliated with our team's respective universities. Social media combined with in-person recruitment in times of crises are appropriate methodologies given the rapidity with which we need answers to pressing questions, such as how are pregnant women doing during the COVID-19 pandemic. Social media recruitment with anonymized data (survey, cross-sectional samples) has been used in other similar studies.(8, 20, 21) Of all the studies published on this topic thus far, the CONCEPTION study is the only one that collects non-anonymized data. Our study is still recruiting pregnant women, and collects longitudinal data.

Study eligibility, consent, and baseline data collection are completed electronically; the information is thereafter downloaded on a secure server at CHU Sainte-Justine, Montreal, Quebec. All data collected are in a centralized database at CHU Ste-Justine in Montreal, Quebec, Canada. The consent obtained from study subjects does not include open access.

For this study on COVID-19 vaccination, participants had to be recruited in the CONCEPTION study after March 15, 2021; be pregnant, and reside in Canada at the time of recruitment; they also had to be 18 years or older, and able to read French, English, Spanish, Portuguese or Mandarin.

Study variables:

A) Maternal characteristics and physical health (history and since the first day of pregnancy): 1) age, gestational age, pre-pregnancy weight, ethnicity; 2) socio-demographic characteristics: education, household annual income, and marital status, place of residence (urban, rural), current employment status (type of work, working from home, still working on-site and at which frequency); 3) lifestyles during pregnancy including smoking, multivitamin use; 4) health status and medication use such as prescribed medication use, comorbidity history

(asthma, hypertension, diabetes, hyperthyroidism, hypothyroidism, dyslipidemia, depression, anxiety); 5) pregnancy history including parity; 6) COVID-19 diagnoses or symptoms.

B) Vaccine variables: Participants were asked whether they had been vaccinated against COVID-19 since the beginning of their pregnancy, and when they received the vaccine (gestational age); which vaccine and how many doses they had received; as well as the side effects were reported. Participants were also asked whether they had received the influenza vaccine during the 2020-2021 season, which was analysed as a proxy for pre-pandemic public health measures. Additionally, participants were questioned about their knowledge on COVID-19 severity in pregnancy and on the safety and efficacy of the COVID-19 vaccine in general and in pregnancy specifically; acceptability of the COVID-19 vaccine administration during pregnancy was measured using a Likert scales ranging from 1 (no knowledge) to 5 (excellent knowledge). Each participant was further asked about their personal history of COVID-19 disease. Finally, in case of vaccine refusal, the participant documented the reason(s) for their decision.

The questionnaire was pretested with 10 French-speaking and 10 English-speaking pregnant persons and took an average of 25 minutes to complete.

This study was approved by the CHU Ste-Justine's Research Ethics Committee (Institutional ethical review approval number: #**2021-2973).**

Data analyses

Comparisons were performed according to vaccination status and intention (vaccinated, intention to be vaccinated, no intention to be vaccinated). For all variables, comparisons using means with standard deviations or proportions with ranges were performed, depending on whether the variables were continuous or categorical, using one-way ANOVA or chi-square statistics.

We quantified the determinants of COVID-19 vaccination or intention to be vaccinated during pregnancy with crude and adjusted logistic regression models, considering maternal age, annual household income and years of education. Persons that expressed their intention to get vaccinated were considered in the vaccinated group for multivariate statistical analyses. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. All statistical analyses were performed using R Statistical Software (version 4.1.0).

Results

We recruited 556 participants into CONCEPTION from March 15th to July 25th, 2021 (**Figure 1**). Among these participants, 31 exited before providing consent, 1 refused consent, and 39 exited the survey without answering the sociodemographic questions. A total of 485 participants were considered for analysis, of which 79.38% (385/485) were vaccinated, 6.39% (31/485) had the intention to get vaccinated, and 14.22% (69/485) refused the vaccination. Among those who received the COVID-19 vaccines (n, 385), the majority had the Pfizer-BioNtech vaccine (311, 80.78%), and close to 50% already had received the 2 doses (50.48% Pfizer-BioNtech, 47.30% Moderna) (**Supplementary Table ST1)**. The majority of those vaccinated at the time of recruitment were in their second or third trimester of pregnancy (93.54%, Table 1). Reported side effects among vaccinated participants were pain and swelling at injection site, tiredness, and headache, which were both observed more frequently following the second dose (**Supplementary Figure SF1).**

Population characteristics

Participants were on average 33.00 ± 4.06 (Standard deviation, SD) years old at recruitment (Table 1). The mean gestational age at inclusion was 22.94 ± 9.22 (SD) gestational weeks. Analyses revealed significant statistical differences in maternal and gestational age at inclusion according to vaccination status. Vaccinated individuals were recruited earlier in their pregnancy than non-vaccinated participants (22.33 weeks gestation (WG) vs. 26.87 WG, p<.001) (Table 1). The prevalence of influenza vaccination for the 2020-2021 season was significantly higher among COVID-19-vaccinated individuals (42.60%) compared with individuals intending to be vaccinated or not vaccinated (22.58% and 15.94%, respectively, p<0.001). Furthermore, vaccinated individuals were more educated compared to those intending to be vaccinated or non-vaccinated participants (17.65 years vs. 16.02 and 14.67 years, respectively, p<0.001).

Vaccinated pregnant persons also had higher annual family income than the other 2 study groups (p<0.001) (**Table 1**).

Personal knowledge assessment of COVID-19 and predictors of vaccination status

Personal knowledge of COVID-19 severity in pregnancy was stratified by vaccination status and presented in **Figure 2A**. Vaccinated participants or those intending to get vaccinated reported a higher prevalence of good (4/5) or excellent knowledge (5/5) on COVID-19 severity in pregnancy than participants refusing the vaccine.

When considering personal knowledge assessment of COVID-19 vaccination in general (**Figure 2B**), vaccine acceptance differed in those with a reported good (4/5) knowledge (44.95% acceptance vs 36.23% refusal), while remaining largely similar in others (knowledge of 2-3-5/5). Furthermore, **Figure 2C** shows that vaccination acceptance did not vary significantly according to self-assessment level of personal knowledge of COVID-19 vaccination in pregnancy.

Personal experiences with COVID-19 stratified by vaccination status are shown in **Table 2**. Despite the absence of statistical significance, vaccinated participants reported more frequent COVID-19 testings.

Reception of an influenza vaccine within the most recent flu season was considered a significant predictor of vaccination status or intention to be vaccinated (adjusted odds ratio (aOR) 3.03, 95% CI 1.56-6.33) (**Table 3**). Area of residence (suburban area) and employment status were significantly associated with vaccination status after adjustment for the other predictors (**Table 3**). Self-assessment of knowledge of the COVID-19 vaccine in general was not a significant predictor of vaccination status or intention to be vaccinated, regardless of the level of self-assigned personal knowledge. However, controlling for maternal age, years of education, and annual household income, self-estimated knowledge of COVID-19 severity in pregnancy and

knowledge of COVID-19 vaccination in pregnancy were significant predictors of vaccination status (**Table 3**). The more personal knowledge a participant believed they had; the more participants were likely to accept vaccination (**Table 3**).

The main reasons stated for refusal of COVID-19 vaccines were lack of safety and efficacy data in pregnancy, the speed of vaccine creation and approval, as well as lack of information on vaccines in pregnancy (**Figure 3)**. Submitted personal reasons for refusal included incomplete clinical trials and adverse outcomes with fertility and pregnancy, which highlights the impact of misinformation. Respondents also stated that public health, their obstetrician, family doctor and/or doula had advised against vaccination (**Figure 3).**

Interpretation

Main findings

The present study is the first to report on the COVID-19 vaccine hesitation, and acceptance of COVID-19 vaccination in a sample of pregnant persons in Canada. The majority of pregnant persons included in our study were vaccinated (79.38%), and the Pfizer-BioNtech vaccine was the most frequently used; close to 50% of pregnant participants had received the 2 doses at the time of recruitment. After adjustments for maternal age, years of education and annual household income, self-estimated knowledge of COVID-19 severity in pregnancy, and of COVID-19 vaccination efficacy and safety in pregnancy were significant predictors of vaccination status. Previous influenza vaccination uptake was a significant predictor of COVID-19 vaccination among participants. The main reasons provided among individuals refusing to be vaccinated were lack of safety and efficacy data in pregnancy, and hasty approval of the vaccine. Among vaccinated persons, pain and swelling at the injection sites, tiredness, and headaches were the most frequent reported side effects.

Explanation of the findings

This study emphasizes the impact of educational strategies on behavioral public health determinant. Our finding suggested that the involvement of the patient in the preventive strategy and the knowledge of the benefits and risks of the therapeutic plan generate better compliance and adherence to the personalized care project in accordance with the national public health recommendations. Since women's health authorities have recommended that pregnant persons discuss vaccination decisions with their healthcare providers,(22, 23) these findings underline the need for public health messaging and pedagogical approaches to improve COVID-19 vaccination acceptance adapted to each distinct population. Healthcare providers are the most frequently trusted source of vaccine information and play a key role in shaping maternal

attitudes towards vaccination.(24) While COVID-19 vaccine safety education in pregnancy is essential, our results show that an alternative approach may be necessary to increase COVID-19 vaccine acceptance, especially for those who experience mistrust in the healthcare system.

Influenza vaccination acceptance was considered a predictor of COVID-19 vaccination among the participants. Indeed, the refusal group reported lower influenza vaccination during the previous flu season. This result is consistent with vaccine hesitancy, a growing problem in public health over the last decade.(25) In Canada, a vaccination survey tracks every 2 years coverage for all vaccines recommended by the National Advisory Committee on Immunization. Among pregnant persons, only 45% were vaccinated against the flu, 44% against pertussis, and 3 to 10% of mothers did not know if they had been vaccinated.(26) With a prevalence of COVID-19 vaccine of 79.38% in addition to 6.39% who accept vaccination but hadn't yet and a prevalence of flu vaccination of 37.53%, our reported vaccination acceptance is consistent with Canadian and international observations.(27, 28) This said, in a report by BORN Ontario, they reported a vaccination rate among pregnant persons of 23.9% between December 14th 2020 and May 31st 2021.(29) This discrepancy with our results stems from the fact that vaccination rolled out at different times in Canada, with earlier access grated to pregnant persons in Quebec compared to Ontario.

Underestimation of vaccine efficacy and lack of trust were previously reported as two main reasons for vaccine hesitancy.(30, 31) In our study, mistrust of the vaccine safety and efficacy were the most frequent reasons for vaccine refusal. The population expressing a vaccination refusal denounced a precipitous approval of vaccines, which denotes a lack of understanding of the approval process, lack of confidence in the procedures for validating vaccination in pregnant individuals, and a mistrust of national recommendations. The exclusion of pregnant individuals from vaccine safety trials(32) did not prevent the Society of Obstetricians and Gynecologists of Canada recommending the use of the COVID-19 vaccine for pregnant persons.(8) A recent

surveillance review of the safety of mRNA COVID-19 vaccines during pregnancy indicated no significant outcome among pregnant persons who received the vaccine.(33) Vaccine refusal associated with a good to excellent self-assessment of knowledge level highlights the priority to answer remaining knowledge gaps and confront the existing misinformation towards COVID-19 vaccine. Indeed, while the vaccine validation trials were completed and many studies have provided reassuring COVID-19 vaccine safety data,(1, 33, 34) many patients mentioned inconsistent arguments to justify their vaccine hesitation, which may denote the limited access to evidence-based medicine in a constantly evolving and learning science.

Strengths and limitations

This study has several strengths, including a well-established recruitment strategy tailored to our study population and a significant sample size. Additionally, the study was ready for recruitment at the same time as vaccination approvals for pregnant persons. Data intake was performed electronically, which allowed us to collect data in real-time. We ensured the quality of data through complete data cataloguing. Limitations of the study include enrollment, in part, through social media which may limit generalizability to those less familiar with social media and exclude those with lower socioeconomic status. However, the 2018 Canadian Internet Use Survey showed that more than 80% of Canadian adults aged 18-44 years old use social media regularly (and >90% adults between 18-34 years old), women predominantly.(35) We acknowledge that the study design may have biased the selection of participants, preferentially recruiting individuals who were interested in the topic or favorable to vaccination and who are more concerned with COVID-19, however our methods did not target influencers or news sources who are necessarily pro-vaccination more than others. Also, the multivariate analysis combined into a same group, individuals who were vaccinated with those who intended to be vaccinated. This was done as recruitment began the same week as vaccination was open to

pregnant persons in the province of Quebec and because a majority of those intending to be vaccinated completed the survey prior to their scheduled vaccination appointment.

Our study described the vaccine acceptance rate around the time that the mRNA vaccines were promoted. Given that the primary concern was safety, this acceptance rate may change over time as more data are accrued.

Conclusion and future directions

To date, no study has provided strong evidence of fetal and neonatal safety with the COVID-19 vaccine.[24] While prolonged monitoring is needed to evaluate late-onset neonatal and childhood outcomes associated with maternal COVID-19 vaccination, vaccination against COVID-19 in pregnancy is vital to controlling disease burden and decreasing morbidity in pregnancy. As vaccine efficacy ranges between 70 and more than 90% for severe disease and COVID-19-related-hospitalization prevention,(36) we are increasingly facing a "pandemic of the unvaccinated", as warned by the Pan American Health Organization. Given the economic, political, social and industrial repercussions, it seems essential to consider the epidemiological factors influencing vaccine acceptance and prioritize their impact in public health and knowledge translation strategies. This study underscored the importance of adapted educational approaches to guide public health and research efforts, as a key to improve vaccine acceptance in pregnant individuals.

Contributor statement

AA and JG wrote the first draft of the manuscript; JG and YHG actively recruited via social media and traditional media; AB obtained funding; AB obtained data as well as ethics approval; JG performed the statistical analyses. All authors wrote the study protocol, interpreted results, and critically reviewed the manuscript.

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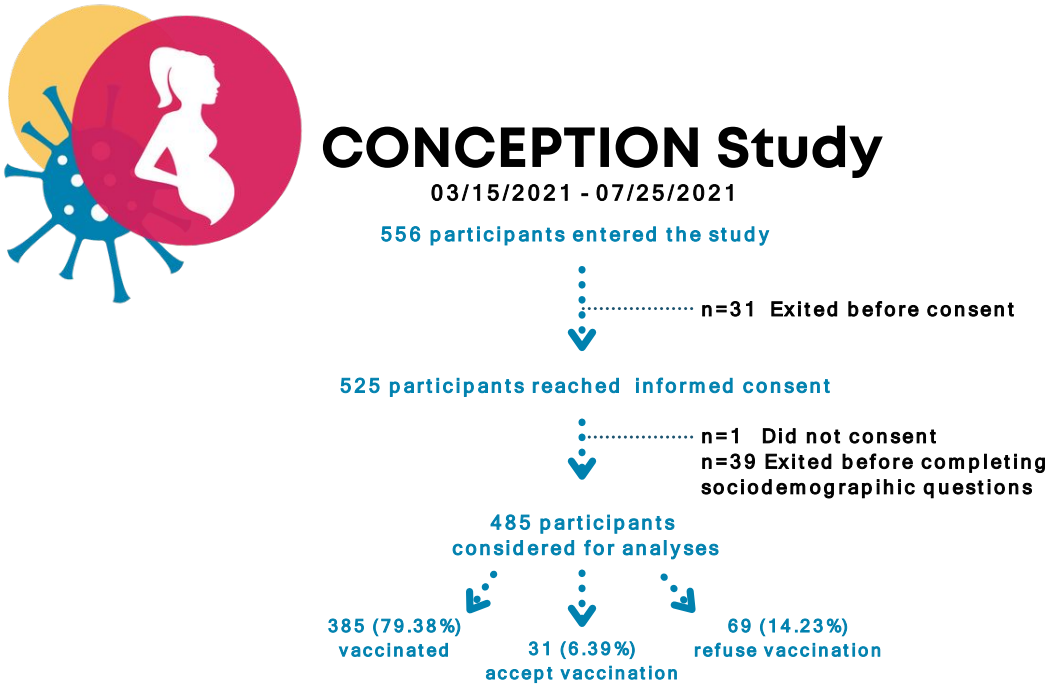


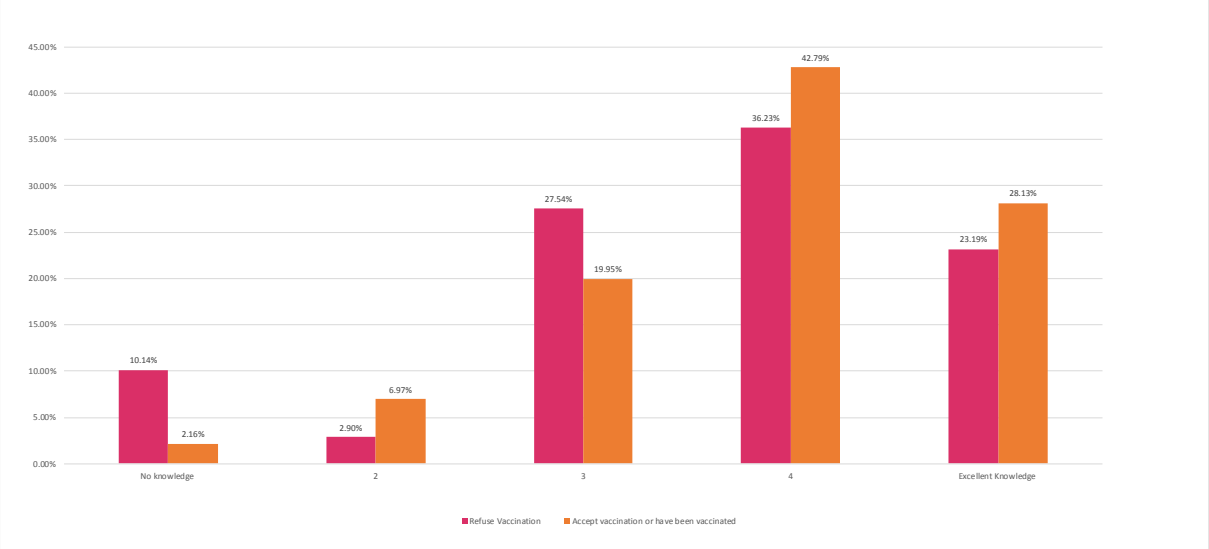
Figure 1. CONCEPTION Study flow-chart.

Table 1. Sociodemographics of study participants stratified based on their vaccination status.

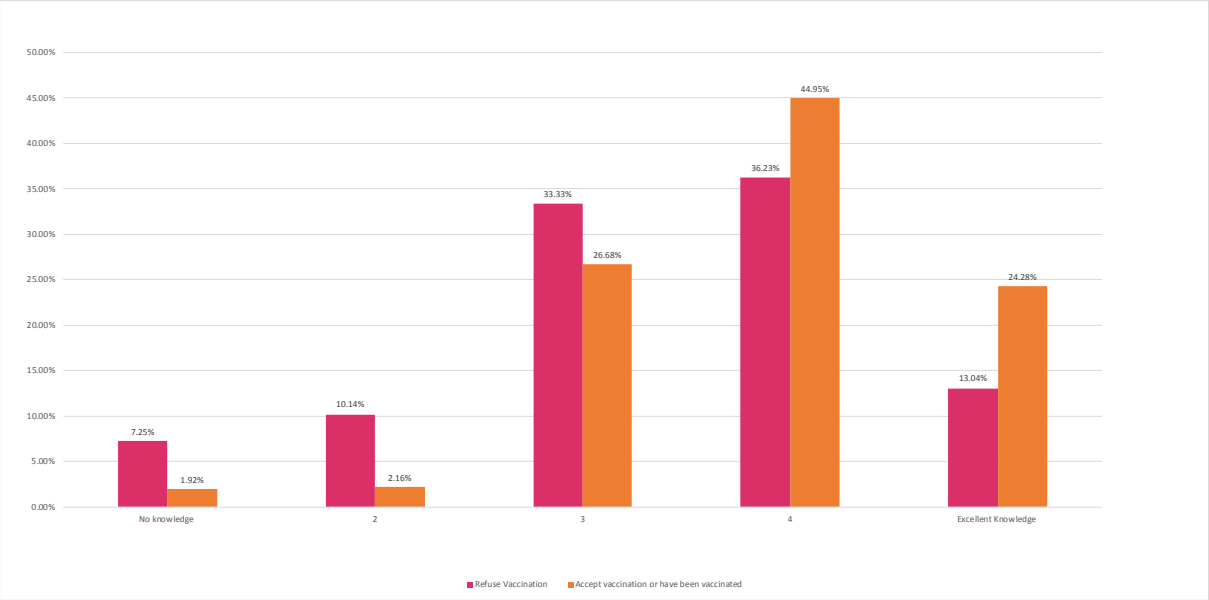
	Overall n=485	Vaccination or intention to vaccinate n=416		Refuse vaccination n=69	P-value**
		Vaccinated n=385	Accept vaccination n=31		
Age, years – mean±SD	33.00 ± 4.06	32.91 ± 3.96	30.80 ± 4.25	33.00 ± 4.33	**<0.001**
Gestational age, weeks – mean±SD	22.94 ± 9.22	22.33 ± 9.35	25.10 ± 7.84	26.87 ± 8.25	**<0.01**
Body mass index**, kg/m^2 – mean±SD	24.61 ± 6.60	24.41 ± 5.40	24.08 ± 5.11	25.98 ± 11.37	**0.02**
Trimester of pregnancy at the time of survey completion – n(%)					
1st trimester	72 (14.85%)	66 (17.14%)	2 (6.45%)	4 (5.80%)	
2nd trimester	184 (37.94%)	149 (38.70%)	12 (38.71%)	23 (33.33%)	
3rd trimester	229 (47.21%)	170 (44.16%)	17 (54.84%)	42 (60.87%)	**0.023**
Received influenza vaccine in 2020-2021 – n(%)	182 (37.53%)	164 (42.60%)	7 (22.58%)	11(15.94%)	**<0.001**
Healthcare professional ensuring pregnancy follow-up***– n(%)					
Family physician	152 (31.34%)	126 (31.90%)	6 (19.35%)	20 (28.99%)	
Obstetrician	310 (63.92%)	241 (61.01%)	22 (70.97%)	47 (68.12%)	
Midwife	46 (9.48%)	35 (8.86%)	4 (12.90%)	7 (10.14%)	
Nurse Practitioner	28 (5.73%)	23 (5.82%)	1 (3.23%)	4 (5.80%)	
Years of education - mean±SD	17.20±3.86	17.65 ± 3.60	16.02 ± 4.40	14.67 ± 5.17	**<0.001**
Employment status – n(%)					
Employed	368 (75.88%)	293 (76.10%)	26 (83.87%)	49 (71.01%)	
Self-employed	42 (8.66%)	39 (10.13%)	-	3 (4.35%)	
Student or Intern	32 (6.60%)	23 (5.97%)	3 (9.68%)	6 (8.70%)	
Unemployed	11 (2.27%)	6 (1.56%)	1 (3.23%)	4 (5.80%)	
On welfare	18 (3.71%)	16 (4.16%)	-	2 (2.90%)	
Prefer not to answer	14 (2.89%)	7 (1.82%)	1 (3.23%)	5 (7.25%)	-
Ethnic background					
Aboriginal (North American Indians, Métis or Inuit [Inuk])	2 (0.41%)	2 (0.52%)	-	-	
Asian	9 (1.86%)	4 (1.04%)	1 (3.23%)	4 (5.80%)	
Black	6 (1.24%)	6 (1.56%)	-	-	
Caucasian/white	434 (89.48%)	354 (91.95%)	27 (87.10%)	53 (76.81%)	
Hispanic	13 (2.68%)	9 (2.34%)	2 (6.45%)	2 (2.90%)	
Other	12 (2.47%)	6 (1.56%)	-	6 (8.70%)	
Prefer not to answer	9 (1.86%)	4 (1.04%)	1 (3.20%)	4 (5.80%)	-
Living situation					
Living alone or single mother	8 (1.65%)	6 (1.56%)	1 (3.23%)	1 (1.45%)	
Living with a partner or married	470 (96.91%)	374 (97.14%)	30 (96.77%)	66 (95.65%)	
Living with parents or family	7 (1.44%)	5 (1.30%)	-	2 (2.90%)	-
Area of residence					
Urban	214 (44.12%)	174 (45.19%)	11 (35.48%)	29 (42.03%)	
Suburban	211 (43.51%)	167 (43.38%)	18 (58.06%)	26 (37.68%)	
Rural	60 (12.37%)	44 (11.43%)	2 (6.45%)	14 (20.29%)	0.12
Household income, CAD					
<$60,000	53 (10.93%)	29 (7.53%)	6 (19.35%)	18 (26.09%)	
$60,001-$90,000	68 (14.02%)	55 (14.29%)	2 (6.45%)	11 (15.94%)	
$90,001-$120,000	103 (21.24%)	82 (21.30%)	7 (22.58%)	14 (20.29%)	
$120,001-$150,000	85 (17.53%)	68 (17.66%)	7 (22.58%)	10 (14.49%)	
>$150,001	147 (30.31%)	132 (34.29%)	7 (22.58%)	8 (11.59%)	
Prefer not to answer	29 (5.98%)	19 (4.94%)	2 (6.45%)	8 (11.59%)	**<0.001**

Legend: CAD – Canadian dollar, SD – standard deviation.
* P values compare the three vaccination status categories and were considered significant if they were <0.05. ** Measured using pre-pregnancy weight. ***Not mutually exclusive categories.

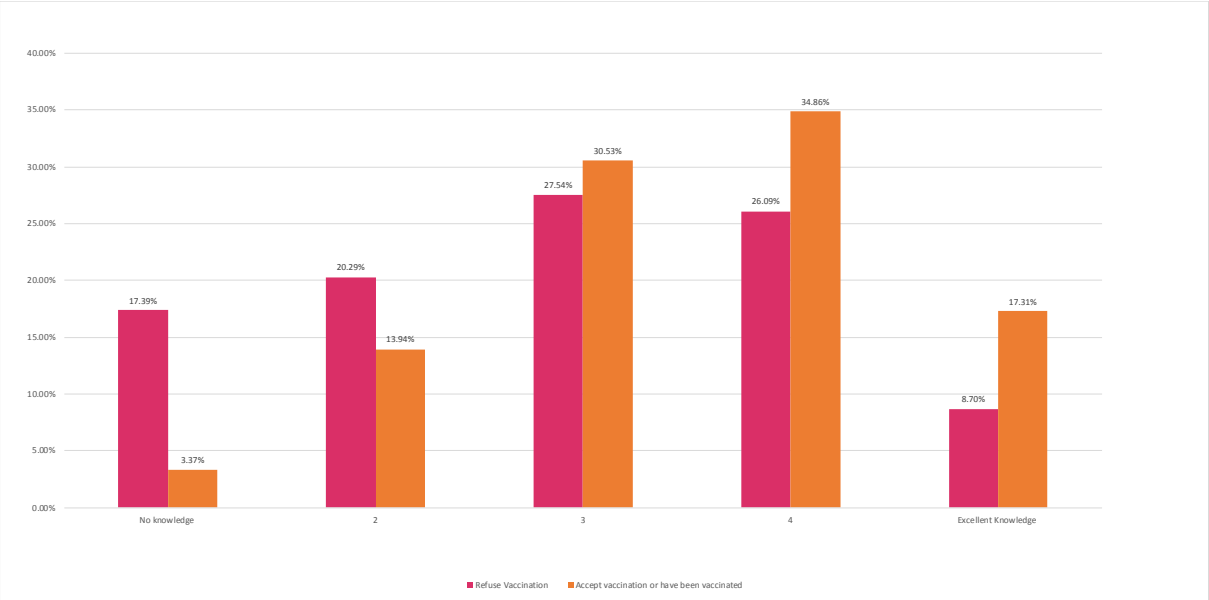
Figure 2 – Personal knowledge assessment of COVID-19 stratified by vaccination/vaccination intention status.



A. Personal knowledge assessment of COVID-19 severity in pregnancy stratified by vaccination/vaccination intention status.



B. Personal knowledge assessment of COVID-19 vaccination in general stratified by vaccination/vaccination intention status.



C. Personal knowledge assessment of COVID-19 vaccination in pregnancy stratified by vaccination/vaccination intention status.

Table 2. Personal experience with COVID-19

	Vaccination or intention to vaccinate n=416		Refuse vaccination n=69	P-value*
	Vaccinated n=385	Accept vaccination n=31		
Tested for COVID-19 – n(%)	235 (61.04%)	18 (58.06%)	35 (50.72%)	0.27
Prevalence of Negative test	217 (56.36%)	15 (48.39%)	32 (40.38%)	0.24
Prevalence of COVID-19	18 (4.68%)	3 (9.68%)	3 (4.35%)	0.45
Prevalence of positivity among those tested	18 (7.66%)	3 (16.67%)	3 (8.57%)	0.41
Number of immediate family members infected with COVID-19 – n(%)				
None	343 (89.09%)	28 (90.32%)	61 (88.41%)	
1-5	42 (10.91%)	3 (9.68%)	4 (11.59%)	0.50
Number of extended family members and/or friends infected with COVID-19 – n(%)				
None	195 (50.86%)	16 (51.61%)	33 (47.38%)	
1-5	165 (42.86%)	12 (38.71%)	35 (50.72%)	
6 or more	25 (6.48%)	3 (9.68%)	1 (1.45%)	0.36

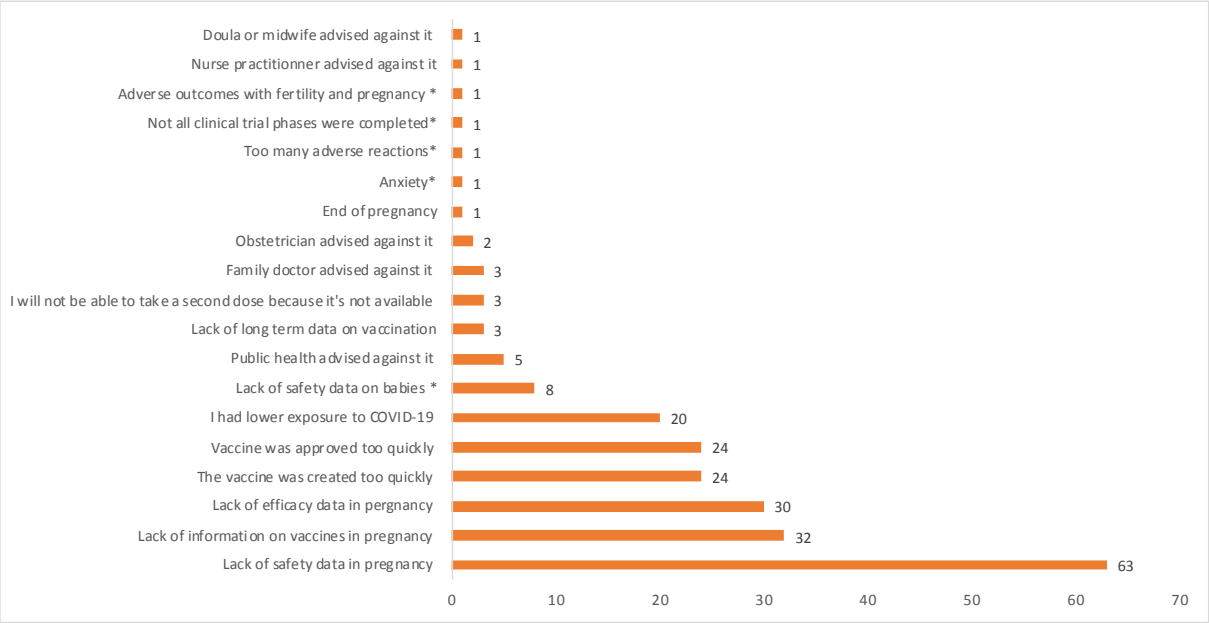
* P values compare the three vaccination status categories and were considered significant if they were <0.05.

Table 3. Predictors of vaccination status or intention to be vaccinated.

	Crude Odds Ratio (95%CI)	Adjusted* Odds Ratio (95%CI)
Received an influenza vaccine within the last flu season	3.07 (1.68-6.01)	3.03 (1.56-6.33)
Area of residence		
Rural	1.00	1.00
Suburban	2.56 (1.19-5.35)	2.84 (1.20-6.65)
Urban	1.71 (0.82-3.40)	1.51 (0.67-3.28)
Employment status		
On welfare or unemployed	1.00	1.00
Employed	3.75 (1.89-7.24)	3.66 (1.67-7.81)
Self-assessment of knowledge of COVID-19 severity in pregnancy		
No knowledge	1.00	1.00
2	3.40 (1.09-10.31)	2.60 (0.76-8.42)
3	5.57 (1.84-16.31)	3.73 (1.12-11.70)
4	5.64 (1.80-17.35)	3.72 (1.06-12.42)
Very Knowledgeable	11.28 (2.27-85.57)	8.13 (1.50-64.77)
Self-assessment of knowledge of COVID-19 vaccine in general		
No knowledge	1.00	1.00
2	0.80 (0.17-3.57)	0.52 (0.08-2.81)
3	3.01 (0.85-9.90)	1.40 (0.27-5.58)
4	4.68 (1.33-15.17)	2.15 (0.43-8.50)
Very Knowledgeable	7.01 (1.81-26.07)	2.94 (0.54-13.28)
Self-assessment of knowledge of COVID-19 vaccine in pregnancy		
No knowledge	1.00	1.00
2	3.55 (2.35-9.47)	2.39 (0.80-7.00)
3	5.73 (2.30-14.36)	4.09 (1.45-11.29)
4	6.90 (2.76-17.39)	4.47 (1.56-12.51)
Very Knowledgeable	10.29 (3.43-34.12)	7.62 (2.19-28.71)

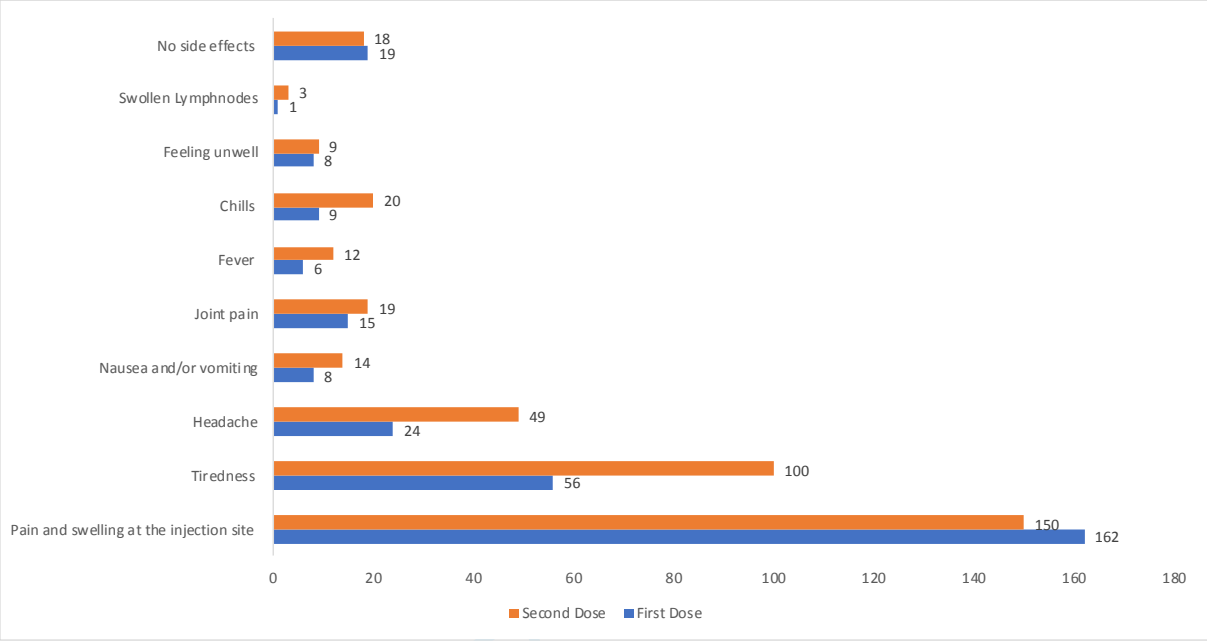
*Adjusted for maternal age, pre-pregnancy body mass index, years of education as well as annual household income.

Figure 3. Reasons (%) provided for refusal among those refusing to get vaccinated (n=69).



* Reasons reported by participants in addition to those suggested.

Supplementary Figure SF1. Reported side effects among those vaccinated with the first and second dose (n=385).



Supplementary Table ST1. Doses received among those vaccinated (n=385).

	Pfizer/BioNTech (n=311)	Moderna (n=74)
One dose received	154 (49.52%)	39 (52.70%)
Two doses received	157 (50.48%)	35 (47.30%)