



# Pregnant and Postpartum Patients' Views of COVID-19 Vaccination

Lily Huang<sup>1</sup> · Kirsten A Riggan<sup>2</sup> · Grayson B Ashby<sup>3</sup> · Enid Y Rivera-Chiauszi<sup>4</sup> · Megan A. Allyse<sup>1,2,4</sup>

Accepted: 21 June 2022 / Published online: 16 July 2022

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

## Abstract

Perinatal patients were faced with the decision to receive a COVID-19 vaccination in the absence of clinical trial data on COVID-19 vaccine safety and efficacy in pregnant and lactating patients. We used the Coronavirus Perinatal Experiences Impact Survey to explore the impact of the COVID-19 pandemic on the lives of perinatal patients. The mixed-method survey was distributed to all patients  $\geq 18$  years old who were pregnant between January 1st, 2020 – April 28, 2021 at a large academic health system in the upper Midwest. Open-ended responses were qualitatively analyzed. Of the 1182 respondents who completed the survey, 647 answered at least one open-ended question. Among these 647 participants, 85 discussed COVID-19 vaccination and were secondarily analyzed. The responses illustrated a wide range of perspectives regarding COVID-19 vaccination, with many citing concerns over the consequences of maternal vaccination on their child. Others highlighted the lack of information surrounding COVID-19 vaccination in perinatal women. Respondents also discussed challenges discussing their vaccination status with their healthcare provider and the impact of family member's vaccination decisions on postpartum support and childcare. The unprompted discussion of concerns about COVID-19 vaccination suggests this decision weighed on many participants, especially in the context of lack of information early in the pandemic. Our findings support the need for open discussion of perinatal patients with their providers on COVID-19 vaccination during the pregnancy and postpartum period.

**Keywords** Sars-Cov2 · Vaccination · Qualitative research · Pregnancy · Postnatal

## Introduction

In March 2020, the World Health Organization (WHO) declared the novel coronavirus infection (COVID-19) a pandemic. [1, 2] As of February 2022, over 900,000 people had died in the US due to COVID-19. [3] The first vaccines against SARS-CoV2 were granted an emergency use authorization by the Federal Drug Administration (FDA) on December 11, 2020, and were prioritized for the health-care and essential workforce. [4–7] Since Spring 2021,

three vaccines against COVID-19 have been widely available: two mRNA vaccines (Pfizer-BioNTech, Moderna) and a viral vector vaccine (Janssen (Johnson & Johnson)). The Pfizer-BioNTech and Moderna vaccines were the first mRNA vaccines to be tested in large phase III trials and approved by the FDA based on robust clinical and preclinical research. From April 13–23, 2021, the FDA and Centers for Disease Control recommended a temporary pause in the use of the Janssen COVID-19 vaccine due to risk of thrombosis with thrombocytopenia syndrome (TSS). The novelty of the mRNA vaccines and TSS risk of the Janssen vaccine has led to public concerns regarding COVID-19 vaccine safety. Additionally, members of the public have to weigh their decision about vaccination against a climate of COVID-19 vaccine misinformation and politicization. One study in the US showed that almost a fifth (22%) of respondents were hesitant to receive a COVID-19 vaccine due to a variety of factors, including sociodemographic characteristics, political affiliation, and perceived COVID-19 threat. [8].

✉ Megan A. Allyse  
Allyse.Megan@mayo.edu

<sup>1</sup> Department of Quantitative Health Sciences, Mayo Clinic, 4500 San Pablo Road, 32224 Jacksonville, FL, USA

<sup>2</sup> Biomedical Ethics Research Program, Mayo Clinic, Jacksonville, FL, USA

<sup>3</sup> Mayo Clinic Alix School of Medicine, Jacksonville, FL, USA

<sup>4</sup> Department of Obstetrics & Gynecology, Mayo Clinic, Jacksonville, FL, USA

Early evidence suggested that COVID-19 infection may increase maternal and fetal morbidity and mortality. [9] Recent evidence has confirmed that COVID-19 substantially increases clinical complications, including cesarean delivery, low birth weight, and preterm birth. [10] A meta-analysis of COVID-19 infection in pregnancy also found increased maternal death rates and neonatal intensive care unit admissions. [11] While the FDA permitted COVID-19 vaccination in pregnant and lactating women, the early clinical evaluation of COVID-19 vaccines did not include these groups, [12] leading obstetric patients to contend with the decision to be vaccinated amid limited data. In late July 2021, the American College of Obstetrics & Gynecology (ACOG) and the Society for Maternal Fetal Medicine (SMFM) recommended COVID-19 vaccination for pregnant individuals, and the Centers for Disease Control (CDC) issuing a similar recommendation on September 29, 2021. [13] Despite these recommendations, only 70.5% of pregnant individuals have been fully vaccinated against COVID-19 as of April 23rd, 2022. [14].

It is important to assess the perceptions of perinatal individuals about vaccination to understand vaccine hesitancy and improve uptake. Using a mixed-methods survey, we explored the pandemic experiences of pregnant and postpartum patients in a large Midwest healthcare system. Unprompted, a subset of respondents used their open-ended responses to discuss their views and perceptions of COVID-19 vaccination. Given the number of responses, we performed a secondary analysis of the cohort to understand their views and perceptions.

## Methods

### Survey Development

The Coronavirus Perinatal Experiences Impact Survey (COPE-IS) was developed by the COVGEN alliance [15] and electronically administered to participants at a large academic health system in the Upper Midwest. The survey includes assessments of personal or family diagnosis of COVID-19, changes to medical care, views on COVID-19 restrictions, impact of daily activities, and changes to support networks. The survey contained fixed single-answer, multiple-choice, and 7-point Likert Scale questions; open-ended questions on positive and negative life changes due to the pandemic; advice they would give to mothers during the COVID-19 pandemic; and questions or comments for the research team were included for additional context. An additional question was appended to the beginning of the survey to determine the where respondents received prenatal care.

### Recruitment and Data Collection

We conducted a search of Mayo Clinic's electronic health record database to determine eligible patients. Inclusion criteria are biologically female, pregnancy diagnosis between January 1st, 2020 – April 28, 2021, and age  $\geq 18$  years old. Exclusion criteria included  $\leq 18$  years old, documented miscarriage or stillbirth during the survey eligibility period, and no email address on file. All eligible patients were sent an email invitation to participate in the survey, with two additional reminder emails. The survey was fielded through REDCap, a secure web-based application for data collection. The survey was open from April 28, 2021 – June 28, 2021. Mayo Clinic's Institutional Review Board determined this study to be exempt.

### Data Analysis

All open-ended responses were analyzed according to standard qualitative methodology using NVivo 12, a qualitative data analysis software. [16] Two researchers (G.A., L.H.) formulated a preliminary codebook based on identified topics after an initial review of responses. Concurrent themes were grouped according to thematic content using the principles of grounded theory. [17].

Refinement of the codebook was based on initial application to 50 responses and feedback from the research team. A final codebook was applied to all open-ended responses. The responses were coded separately by the two reviewers, with 150 responses (21.7%) coded to consensus to maintain coding accuracy. Coded responses were reviewed weekly to resolve discrepancies and for research rigor. Here we present analysis on the codes 'Vaccination' and 'Vaccine effects'. Responses in these codes were further categorized as reflecting "positive," "negative," or "ambivalent" attitudes on vaccination to agreement by two researchers (K.R and L.H.). In accordance with published guidelines on reporting qualitative research, direct quotes are reported with minimal edits for readability. [18] Quantitative findings are reported separately.

## Results

Out of 6141 survey invitations, 1182 respondents completed the survey (19.1% response rate), with 647 respondents answering at least one open-ended question. Demographics were similar to the broader population of the geographic area and are provided in Table 1.

**Table 1** Demographics of Respondents Discussing COVID-19 Vaccines

Characteristic	Total
<b>Age (yrs)</b>	N = 71
Mean (SD)	33.1 (3.8)
Range	(24.1–44.8)
<b>Education</b>	N = 79
High School Degree/GED	1 (1.3%)
Partial College	1 (1.3%)
2-year College Degree	4 (5.1%)
4-year College Degree	41 (51.9%)
Graduate Degree	32 (40.5%)
<b>Relationship status</b>	N = 79
Partnered/Married	79 (100.0%)
<b>Race</b>	N = 79
Black or African American	1 (1.3%)
Asian	2 (2.5%)
White	73 (92.4%)
More than one	1 (1.3%)
Prefer not to answer	2 (2.5%)
<b>Ethnicity</b>	N = 76
Hispanic or Latino	1 (1.3%)
Not Hispanic or Latino	73 (96.1%)
Prefer not to answer	2 (2.6%)
<b>Household income in past year</b>	N = 78
Less than \$40,000	1 (1.3%)
\$40,000 to \$60,000	6 (7.7%)
\$60,000 to \$80,000	10 (12.8%)
\$80,000 to \$100,000	13 (16.7%)
\$100,000 to \$120,000	15 (19.2%)
\$120,000 to \$160,000	16 (20.5%)
\$160,000 to \$200,000	8 (10.3%)
\$200,000 to \$250,000	2 (2.6%)
Greater than \$250,000	7 (9.0%)

**Table 2** Attitudes toward COVID-19 Vaccines

Attitude	Total (N = 69)
Favorable	41 (59.4%)
Negative	6 (8.7%)
Ambivalent	22 (31.9%)

### Attitudes on COVID-19 Vaccination

Participants expressed a wide range of opinions regarding COVID-19 vaccines and willingness to be vaccinated. Of the 85 participants who discussed vaccines, 69 expressed an attitude towards vaccination. Attitudes were categorized into Favorable, Negative, and Ambivalent and are provided in Table 2. Among them, 41 (59.4%) expressed favorable views about COVID-19 vaccine stating that they had received the vaccine and/or encouraged others to become vaccinated. Pregnant women who decided to be vaccinated against COVID-19 indicated that they did so to protect their unborn child and family. Some reported feeling that vaccination helped decrease fears of contracting COVID-19.

“I feel better knowing I got my covid vaccine during pregnancy and am hopefully passing immunity to baby” (Respondent 286, Age Not Disclosed, Due August 2021)

“My opinion is to take precaution and get the vaccine when you can/are comfortable to protect yourself and your baby” (Respondent 478, Age 29, Delivered October 2020)

A few (n = 6, 8.7%) participants described negative attitudes towards vaccination, either explicitly stating that they were against COVID-19 vaccines or vaccination more generally. Others stated their belief that the vaccine was “experimental” or that post-infection immunity was preferable to vaccination.

“Live life and go on. Do not get vaccines of any kind.” (Respondent 426, Age 30, Delivered April 2020)

“The biggest stress I have with the pandemic is fearing people forcing or pressuring my family members to get vaccinated... I do not fear the disease, I actually wish I could get it naturally to get it over with, rather than people pressuring me to get an experimental vaccine” (Respondent 1141, Age 38, Delivered July 2020)

Other responses illustrate ambivalent attitudes towards vaccination (n = 22 (31.9%)), with these respondents indicating that they had concerns about vaccination or were still in the process of deciding whether to receive a vaccine for COVID-19. This includes respondents who indicated they had received a vaccine but were uncertain about this decision.

“Although I was able to be vaccinated prior to getting pregnant I do worry that COVID may impact my baby and their overall health” (Respondent 259, Age Not Disclosed, Due August 2021)

“There are so many unknowns about this. How much protection the baby will have from me getting the vaccine, how long it will last?” (Respondent 226, Age 34, Due July 2021)

The perception of the severity of COVID-19 infection often informed attitudes towards COVID-19 vaccination. Some participants stated that they were extremely concerned about the risks of COVID-19 infection and that this influenced their vaccination decision.

“The risks of COVID are monumentally higher than the risks of getting vaccinated while pregnant... trust the science and don't let the anxiety of getting a new

vaccine deter you from protecting you and your child.” (Respondent 1025, Age 31, Due August 2021)

“I am still glad that I [got] vaccinated [after experiencing a post-vaccine complication] because the virus would have possibly killed baby and I.” (Respondent 254, Age 35, Due August 2021)

Others, however, minimized the severity of the pandemic or stated that they were opposed to vaccine mandates.

“I have not changed my ways. This ‘pandemic’ has been blown out of proportion and I have been enjoying still seeing my family and friends. I have not been vaccinated and have not had covid.” (Respondent 466, Age 30, Delivered June 2020)

“What if we are forced to get an experimental vaccine?” (Respondent 1190, Age 24, Delivered January 2020).

### Concerns of Vaccine Effects During Pregnancy and Breastfeeding

An additional subset of women expressed hesitation about COVID-19 vaccination while pregnant or breastfeeding, stating that they planned to postpone vaccination until after pregnancy or after their child was weaned. These women described concerns about the effects of the vaccines on fetal and newborn health, including long-term morbidity.

“[I’m] worried about getting the immunization while breastfeeding and decided to wait. Not sure about long term effects on baby” (Respondent 1118, Age 35, Delivered June 2020)

“Long-term effects of COVID vaccine on developing fetus are unknown” (Respondent 468, Age Not Disclosed, Delivered August 2021)

These concerns were reported among women who were vaccinated during the prenatal period and while breastfeeding. Women described lingering worries about the long-term safety of COVID-19 vaccines, including potentially adverse side effects. These fears were primarily focused on the consequences of maternal vaccination on their child:

“I have been exposed to Covid-19 during week 5/6 of our pregnancy. I also received the vaccines during month 4 of pregnancy. I recognize that it may be a very long time into the future before we really know the effects of this.” (Respondent 811, Age 32, Due July 2021)

“I am most concerned about her becoming infected after birth and am concerned about how/if my covid vaccination had any long-term impacts on her health” (Respondent 323, Age 34, Due June 2021)

Many participants expressed a combination of uncertainty and hope for vertical transmission of COVID-19 immunity in utero or via breastfeeding. These respondents described concern that their infant was too young to be vaccinated and thus was at higher risk of infection.

“I got the COVID vaccine so I am hoping the baby is born with some level of immunity, but he will need to go to a childcare center starting at 12 weeks old and won’t be eligible for any vaccine until at least 6 months, if not longer” (Respondent 351, Age 32, Due July 2021)

“I worry that my baby could get COVID. I hope the vaccine provides immunity for my breastfed baby” (Respondent 175, Age 37, Delivered March 2020)

### Medical Decision-making and Vaccination

A few women expressed a wish that they had more information regarding the safety and efficacy of COVID-19 vaccinations during pregnancy.

“[I desire] frequent updates on the research being done regarding the safety of the COVID 19 vaccine in pregnancy and while nursing. The CDC has essentially stated from the release of the vaccine that they ‘don’t see any reason why it would cause harm in these populations or to the child’ but as a mother with a newborn, solid facts and statistics are reassuring. I know many pregnant and nursing mothers who are unvaccinated due to this concern.” (Respondent 76, Age 31, Delivered August 2020)

“[I desire] information on covid 19 and how it affects infants/babies/toddlers as they cannot get the vaccine as of now.” (Respondent 1083, Age 30, Delivered April 2020)

Some new and expectant patients described feeling embarrassed when discussing their vaccination status with their healthcare providers. They felt their choice not to be vaccinated made it difficult to communicate and ask medical questions of their obstetrician:

“I had so many more questions and concerns this time just about COVID-related items but also felt embarrassed like I couldn’t ask them since I decided not to

get the COVID vaccine.” (Respondent 403, Age 31, Due June 2021)

“The conversation with [the healthcare professional] about being vaccinated or not is super awkward” (Respondent 1056, Age 30, Delivered March 2020)

Others stated that their primary concern was the decision to vaccinate their children against COVID-19, especially infants and younger children for which long-term data was not available.

“[I feel] uneasiness with vaccinating/not vaccinating children” (Respondent 1004, Age 27, Delivered August 2020)

“No vaccine available for the age group and then would probably want longer term studies done before getting one for young children.” (Respondent 346, Age Not Disclosed, Delivered July 2020)

The vaccination decisions of others also weighed heavily on their experience, with participants stating that they did not allow their children to be around unvaccinated family members. This decision resulted in less postnatal and childcare support and increased family discord for some.

“Family are not taking this as seriously as we are. They don’t work in healthcare like I do. They have less of an understanding of what is going on and refuse the vaccine. I don’t feel like I can trust them around my kids who aren’t yet old enough to have the vaccine available to them.” (Respondent 226, Age 34, Due July 2021)

“[I received] limited postpartum support as a result of family refusing to vaccinate” (Respondent 1168, Age 35, Due June 2021)

## Discussion

In this study, perinatal patients described a spectrum of views on COVID-19 vaccination, although most expressed positive attitudes towards the availability of COVID-19 vaccines for adults. Concerns primarily centered on prenatal and longitudinal risks to children. The survey instrument, developed in Spring 2020, did not explicitly solicit views on vaccination but respondents voluntarily shared their views and concerns about COVID-19 vaccination in their open-ended responses, suggesting this was a pressing issue for many.

## Longitudinal Concerns about Vaccine Effects

Many of the respondents explained their decision to vaccinate in terms of protection from COVID-19 for themselves and their children. Most participants had completed some form of higher degree (92.4%), which may positively influence their health literacy. Additionally, some referenced working in the healthcare field and may have been vaccinated due to the risks associated with workplace exposure. Among those who were vaccinated during the prenatal and breastfeeding period, many expressed longitudinal concerns for the wellbeing of their children. A recent study by Townsel et al. investigated vaccine acceptance amongst reproductive aged female healthcare workers. Among the participants, pregnant women were six times more likely to delay vaccination and twice as likely to decline compared to other women of reproductive age. They found that 44.5% of pregnant participants expressed at least one concern regarding the COVID-19 vaccine. [19] Another study by Perez et al. found that healthcare workers who were trying to conceive, currently pregnant, or lactating perceived COVID-19 vaccines more negatively than healthcare workers who were not. The desire to vaccinate was also significantly lower in these populations compared to participants who were not pregnant or trying to conceive. [20] Other surveys also indicate that pregnant and breastfeeding women were more likely to delay or decline the vaccine, but our study highlights the specific concerns and attitudes surrounding vaccination. [21, 22].

## Information about Vaccination while Pregnant and Breastfeeding

A small number of respondents who indicated that they do not intend to be vaccinated cited concerns that vaccine was experimental or stated that they were opposed to vaccine mandates. Pregnant patients and those intending to become pregnant were particularly targeted by disinformation when vaccines first became available, [9, 23–27] including social media rumors that the COVID-19 vaccines caused sterility and/or that antibodies generated by the Pfizer vaccine attack the placenta. [28] ACOG and SMFM released their statement on July 30, 2021 officially recommending COVID-19 vaccination during pregnancy and breastfeeding. [29] Our survey was administered from April 28, 2021 – June 28, 2021, prior to the official recommendations by ACOG, SMFM, and the CDC regarding COVID-19 vaccination in pregnant and breastfeeding patients. Women were left with significant uncertainty about the impact of COVID-19 vaccination on pregnant individuals, fetuses, and newborns. Even respondents who made the decision to be vaccinated expressed decisional regret about potential negative impacts

to their fetus/child, suggesting that conflicting information caused uncertainty and distress. A few respondents minimized the risks of COVID-19. This study was conducted before the emergence of high rates of hospitalization associated with the Delta and Omicron variants and before the CDC findings that COVID-19 increases the risk of stillbirth. [30].

The lack of information on COVID-19 safety for pregnant and lactating people should be understood through lens of a historical hesitancy to include pregnant and breastfeeding women in vaccine trials given their status as a vulnerable/medically complex population and the additional research protections mandated by the Common Rule (45 CFR 46). [31] At the time our study was administered, longitudinal studies on the effects of COVID-19 infection or vaccination on pregnant women and infants had yet to be completed. There are currently no vaccines licensed or approved specifically for use in pregnancy. [32] Many pregnant women blame uncertainty about vaccination on the absence of evidence regarding the impact of COVID-19 vaccines on fetal and pediatric health. [28] Initial studies, including single institution studies, national v-safe health checker data, and pregnancy registry/Vaccine Adverse Event Reporting System data, report no increase in adverse pregnancy and neonatal outcomes following COVID-19 vaccination. [33–35] Currently, a randomized clinical trial is underway that investigates the effects of the BNT162b2 mRNA vaccine in pregnant women (ClinicalTrials.gov, NCT04754594). [36] Further research is needed to alleviate concerns about the impact of COVID-19 vaccination on pregnancy, especially vaccines are developed in response to emerging variants of concern.

### Clinical Recommendations

Respondents reported confusion about how to balance immediate protection from COVID-19 against concerns over long-term side-effects their children may experience. Many women expressed a desire for more information and guidance from their OB/GYN healthcare professionals regarding COVID-19 vaccination and its impact on infant health. Creating opportunities for discussion of patient concerns can allow healthcare professionals to communicate with patients more effectively on COVID-19 vaccines. Some patients indicated that they felt embarrassed to communicate with their healthcare professionals about other concerns related to COVID-19 because of their decision not to receive a COVID-19 vaccine. Healthcare professionals can help reduce the stigma and perceived shame surrounding unvaccinated individuals by engaging in proactive, non-judgmental, open-ended discussions during which patients can share their concerns and ask questions.

ACOG, SMFM, and the CDC provide educational materials for pregnant patients. [37, 38] Motivational interviewing-based strategies have also been successful in reducing vaccine hesitancy by fostering meaningful patient/healthcare professional relationships. [39] Questions and concerns surrounding the COVID-19 vaccine remain relevant as periodic boosters against COVID-19 will likely be required [40] in addition to current booster guidelines. [41] Since the FDA has authorized the use of BNT162b2 mRNA vaccines for use in children ages 5–11 [42] and will likely recommend COVID-19 vaccinations for younger children in the near future, building strong patient-healthcare professional relationships in order to understand parental concerns and hesitancy will be essential. [43] Healthcare professionals should also be aware that family divisions on vaccination decisions may lead to reduced postpartum support and childcare options. Coping strategies and alternative options should be addressed.

### Strengths and Limitations

Open-ended questions allowed this survey to capture participant views and concerns on vaccination, but because the survey was developed in Spring 2020, it was not designed to capture late-pandemic experiences. Standard survey limitations (e.g., reliance on self-reported behaviors, recall bias, socially desirable responses) may also have affected responses. In keeping with the overall demographic of the patient populations and local demographics, most respondents were non-Hispanic and White and were highly educated. The majority (61.5%) of participants reported high household income ( $\geq$ \$100,000 per year). Study findings may not be generalizable to more diverse populations. Vaccination status was self-reported and was not verified via the medical record given the anonymous survey design. Additional investigation on perceptions and uptake of COVID-19 vaccine in pregnant and lactating people is necessary to understand vaccine acceptance and hesitancy.

### Conclusions

The decision to receive a COVID-19 vaccine emerged as a source of uncertainty for perinatal patients, despite high levels of education and access to healthcare. Healthcare professionals should utilize an open-ended, sensitive approach when discussing COVID-19 vaccination with pregnant and postpartum women so that they can feel comfortable sharing their concerns about COVID-19 vaccines.

**Acknowledgements** Additional support was provided by CTSA Grant Number UL1TR002377 from the National Center for Advancing Translational Sciences (NCATS), a component of the National

Institutes of Health (NIH). Its contents are solely the responsibility of the authors and do not necessarily represent the official view of NIH.

**Funding** This study was supported by Mayo Clinic’s Department of Obstetrics & Gynecology.

**Data Availability** The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethics approval** Mayo Clinic’s Institutional Review Board determined this study to be exempt.

**Consent to participate** Implied informed consent was obtained for all individuals who voluntarily completed the online survey.

**Consent for publication** Not applicable.

## References

- Cucinotta, D., & Vanelli, M. (2020). WHO declares COVID-19 a pandemic. *Acta Bio Medica: Atenei Parmensis*, *91*(1), 157
- World Health Organization (2020). WHO Director-General’s opening remarks at the media briefing on COVID-19-11 March 2020
- Centers for Disease Control and Prevention (2022). COVID Data Tracker [Data set]. Retrieved from <https://covid.cdc.gov/covid-data-tracker/#datatracker-home>
- Oliver, S. E. (2020). The advisory committee on immunization practices’ interim recommendation for use of moderna COVID-19 vaccine—United States, December 2020. *MMWR. Morbidity and mortality weekly report*, *69*
- Oliver, S. E., Gargano, J. W., Marin, M., Wallace, M., Curran, K. G., Chamberland, M., ... Dooling, K. (2020). The advisory committee on immunization practices’ interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine—United States, December 2020. *Morbidity and Mortality Weekly Report*, *69*(50), 1922
- Craig, A. M., Hughes, B. L., & Swamy, G. K. (2020). COVID-19 vaccines in pregnancy. *American journal of obstetrics & gynecology MFM*, *100295*
- Food and Drug Administration (2020, December 20). *FDA Takes Key Action in Fight Against COVID-19 By Issuing Emergency Use Authorization for First COVID-19 Vaccine* [Press release]. <https://www.fda.gov/news-events/press-announcements/fda-takes-key-action-fight-against-covid-19-issuing-emergency-use-authorization-first-covid-19>
- Khubchandani, J., Sharma, S., Price, J. H., Wiblehauser, M. J., Sharma, M., & Webb, F. J. (2021). COVID-19 vaccination hesitancy in the United States: a rapid national assessment. *Journal of Community Health*, *46*(2), 270–277
- Qeadan, F., Mensah, N. A., Tingey, B., & Stanford, J. B. (2021). The risk of clinical complications and death among pregnant women with COVID-19 in the Cerner COVID-19 cohort: a retrospective analysis. *BMC pregnancy and childbirth*, *21*(1), 1–14
- Jafari, M., Pormohammad, A., Sheikh Neshin, S. A., Ghorbani, S., Bose, D., Alimohammadi, S., ... Zarei, M. (2021). Clinical characteristics and outcomes of pregnant women with COVID-19 and comparison with control patients: A systematic review and meta-analysis. *Reviews in medical virology*, e2208
- Allotey, J., Stallings, E., Bonet, M., Yap, M., Chatterjee, S., Kew, T., ... PregCOV-19 Living Systematic Review Consortium. (2020). Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *Bmj*, *370*
- Smith, D. D., Phippen, J. L., Adesomo, A. A., Rood, K. M., Landon, M. B., & Costantine, M. M. (2020). Exclusion of pregnant women from clinical trials during the coronavirus disease 2019 pandemic: a review of international registries. *American journal of perinatology*, *37*(08), 792–799
- Centers for Disease Control and Prevention (2021, September 29). *CDC Statement on Pregnancy Health Advisory* [Press release]. <https://www.cdc.gov/media/releases/2021/s0929-pregnancy-health-advisory.html>
- Centers for Disease Control and Prevention (2022). COVID-19 vaccination among pregnant people aged 18–49 years overall, by race/ethnicity, and date reported to CDC - Vaccine Safety Data-link, United States [Data set]. Retrieved from <https://covid.cdc.gov/covid-data-tracker/#vaccinations-pregnant-women>
- Thomason, M. E., Graham, A., & VanTieghem, M. R. (2020). COPE: Coronavirus Perinatal Experiences-Impact Survey... nd)
- Saldana, J. (2016). *The Coding Manual for Qualitative Researchers* (3rd ed.). SAGE Publications
- Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications
- O’Brien, B. C., Harris, I. B., Beckman, T. J., Reed, D. A., & Cook, D. A. (2014 Sep). Standards for reporting qualitative research: a synthesis of recommendations. *Academic Medicine*, *89*(9), 1245–1251
- Townsel, C., Moniz, M. H., Wagner, A. L., Zikmund-Fisher, B. J., Hawley, S., Jiang, L., & Stout, M. J. (2021). COVID-19 vaccine hesitancy among reproductive-aged female tier 1A healthcare workers in a United States Medical Center. *Journal of Perinatology*, *41*(10), 2549–2551
- Perez, M. J., Paul, R., Raghuraman, N., Carter, E. B., Odibo, A. O., Kelly, J. C., & Foeller, M. E. (2022). Characterizing initial COVID-19 vaccine attitudes among pregnancy-capable healthcare workers. *American journal of obstetrics & gynecology MFM*, *4*(2), 100557
- Sutton, D., D’Alton, M., Zhang, Y., Kahe, K., Cepin, A., Goffman, D., ... Gyamfi-Bannerman, C. (2021). COVID-19 vaccine acceptance among pregnant, breastfeeding, and nonpregnant reproductive-aged women. *American journal of obstetrics & gynecology MFM*, *3*(5), 100403
- Turocy, J., Robles, A., Reshef, E., D’Alton, M., Forman, E., & Williams, Z. (2021). *A survey of fertility patients’ attitudes towards the COVID-19 vaccine*. Fertility & Sterility
- Dror, A. A., Eisenbach, N., Taiber, S., Morozov, N. G., Mizrahi, M., Zigran, A., ... Sela, E. (2020). Vaccine hesitancy: the next challenge in the fight against COVID-19. *European journal of epidemiology*, *35*(8), 775–779
- Ball, P. (2020). Anti-vaccine movement could undermine efforts to end coronavirus pandemic, researchers warn. *Nature*, *581*(7808), 251–252
- McAteer, J., Yildirim, I., & Chahroudi, A. (2020). The VACCINES Act: Deciphering vaccine hesitancy in the time of COVID19. *Clinical Infectious Diseases*, *71*(15), 703–705
- World Health Organizations (2019). Ten threats to global health in 2019. Retrieved from <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>

27. Harrison, E. A., & Wu, J. W. (2020). Vaccine confidence in the time of COVID-19. *European Journal of Epidemiology*, 35(4), 325–330
28. Male, V. (2021). Are COVID-19 vaccines safe in pregnancy? *Nature Reviews Immunology*, 21(4), 200–201
29. American College of Obstetricians and Gynecologists (2021, July 30). *ACOG and SMFM Recommend COVID-19 Vaccination for Pregnant Individuals* [Press release]. <https://www.acog.org/news/news-releases/2021/07/acog-smfm-recommend-covid-19-vaccination-for-pregnant-individuals>
30. DeSisto, C. L., Wallace, B., Simeone, R. M., Polen, K., Ko, J. Y., Meaney-Delman, D., & Ellington, S. R. (2021). Risk for stillbirth among women with and without COVID-19 at delivery hospitalization—United States, March 2020–September 2021. *Morbidity and Mortality Weekly Report*, 70(47), 1640
31. Krubiner, C. B., Faden, R. R., Karron, R. A., Little, M. O., Lyerly, A. D., Abramson, J. S., ... PREVENT Working Group. (2021). Pregnant women & vaccines against emerging epidemic threats: ethics guidance for preparedness, research, and response. *Vaccine*, 39(1), 85–120
32. Munoz, F. M. (2018). Current challenges and achievements in maternal immunization research. *Frontiers in Immunology*, 9, 436
33. Lipkind, H. S., Vazquez-Benitez, G., DeSilva, M., et al. (2022). Receipt of COVID-19 Vaccine During Pregnancy and Preterm or Small-for-Gestational-Age at Birth - Eight Integrated Health Care Organizations, United States, December 15, 2020–July 22, 2021. *Mmwr. Morbidity And Mortality Weekly Report*, 71, 26–30
34. Shimabukuro, T. T., Kim, S. Y., Myers, T. R., et al. (2021). Preliminary Findings of mRNA Covid-19 Vaccine Safety in Pregnant Persons. *New England Journal Of Medicine*, 384, 2273–2282
35. Theiler, R. N., Wick, M., Mehta, R., Weaver, A. L., Virk, A., & Swift, M. (2021). Pregnancy and birth outcomes after SARS-CoV-2 vaccination in pregnancy. *Am J Obstet Gynecol MFM*, 3, 100467
36. Riley, L. E., & mRNA (2021). COVID-19 Vaccines in Pregnant Women. *N. Engl. J. Med.* 384,2342–2343
37. American College of Obstetricians and Gynecologists (2021). ACOG and SMFM recommend COVID-19 vaccination for pregnant individuals. *Published July, 30*
38. Centers for Disease Control and Prevention. (2021). *COVID-19 vaccines while pregnant or breastfeeding*. Centers for Disease Control and Prevention
39. Gagneur, A., Lemaître, T., Gosselin, V., Farrands, A., Carrier, N., Petit, G., ... De Wals, P. (2018). A postpartum vaccination promotion intervention using motivational interviewing techniques improves short-term vaccine coverage: PromoVac study. *BMC Public Health*, 18(1), 1–8
40. Mahase, E. (2021). *Covid-19 booster vaccines*:. What we know and who's doing what
41. Mbaeyi, S., Oliver, S. E., Collins, J. P., Godfrey, M., Goswami, N. D., Hadler, S.C., ... Dooling, K. (2021). The Advisory Committee on Immunization Practices' Interim Recommendations for Additional Primary and Booster Doses of COVID-19 Vaccines—United States, 2021. *Morbidity and Mortality Weekly Report*, 70(44), 1545
42. Food and Drug Administration (2021). FDA authorizes Pfizer-BioNTech COVID-19 vaccine for emergency use in children 5 through 11 years of age
43. Olusanya, O. A., Bednarczyk, R. A., Davis, R. L., & Shaban-Nejad, A. (2021). Addressing parental vaccine hesitancy and other barriers to childhood/adolescent vaccination uptake during the coronavirus (COVID-19) pandemic. *Frontiers in immunology*, 12, 855

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.