

BMJ Open Influence of the COVID-19 pandemic and social media on the behaviour of pregnant and lactating women towards vaccination: a scoping review

Larissa De Brabandere ¹, Greet Hendrickx ¹, Karolien Poels ²,
Walter Daelemans ³, Pierre Van Damme ¹, Kirsten Maertens ¹

To cite: De Brabandere L, Hendrickx G, Poels K, *et al*. Influence of the COVID-19 pandemic and social media on the behaviour of pregnant and lactating women towards vaccination: a scoping review. *BMJ Open* 2023;**13**:e066367. doi:10.1136/bmjopen-2022-066367

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-066367>).

Received 09 August 2022
Accepted 30 January 2023



© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Centre for the Evaluation of Vaccination, Vaccine & Infectious Diseases Institute, University of Antwerp, Wilrijk, Belgium

²Department of Communication Studies, University of Antwerp, Antwerpen, Belgium

³Department of Linguistics, Computational Linguistics and Psycholinguistics Research Centre, University of Antwerp, Antwerpen, Belgium

Correspondence to

Professor Kirsten Maertens; kirsten.maertens@uantwerpen.be

ABSTRACT

Background Pregnant women, foetuses and infants are at risk of infectious disease-related complications. Maternal vaccination is a strategy developed to better protect pregnant women and their offspring against infectious disease-related morbidity and mortality. Vaccines against influenza, pertussis and recently also COVID-19 are widely recommended for pregnant women. Yet, there is still a significant amount of hesitation towards maternal vaccination policies. Furthermore, contradictory messages circulating social media impact vaccine confidence.

Objectives This scoping review aims to reveal how COVID-19 and COVID-19 vaccination impacted vaccine confidence in pregnant and lactating women. Additionally, this review studied the role social media plays in creating opinions towards vaccination in these target groups.

Eligibility criteria Articles published between 23 November 2018 and 18 July 2022 that are linked to the objectives of this review were included. Reviews, articles not focusing on the target group, abstracts, articles describing outcomes of COVID-19 infection/COVID-19 vaccination were excluded.

Sources of evidence The PubMed database was searched to select articles. Search terms used were linked to pregnancy, lactation, vaccination, vaccine hesitancy, COVID-19 and social media.

Charting methods Included articles were abstracted and synthesised by one reviewer. Verification was done by a second reviewer. Disagreements were addressed through discussion between reviewers and other researchers.

Results Pregnant and lactating women are generally less likely to accept a COVID-19 vaccine compared with non-pregnant and non-nursing women. The main reason to refuse maternal vaccination is safety concerns. A positive link was detected between COVID-19 vaccine willingness and acceptance of other vaccines during pregnancy. The internet and social media are identified as important information sources for maternal vaccination.

Discussion and conclusion Vaccine hesitancy in pregnant and lactating women remains an important issue, expressing the need for effective interventions to increase vaccine confidence and coverage. The role social media plays in vaccine uptake remains unclear.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ A concrete research question with targeted search terms was used to complete this review.
- ⇒ The search was limited to one database (PubMed), which could have led to missing out on important studies not included in the searched database.
- ⇒ The search was not systematic since timing to perform the review was limited (within the Vaccine Confidence Project).
- ⇒ This scoping review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines for scoping reviews.

INTRODUCTION

Several infectious diseases are associated with adverse outcomes in pregnant women, foetuses and infants. Therefore, a strategy that has gained interest in recent years is vaccination during pregnancy as well as during lactation, as a means to reduce infectious disease-related morbidity and mortality in these target populations.¹⁻³

Pregnant women who contract influenza have an increased risk of influenza-related complications and hospitalisation compared with non-pregnant women.^{2 4} In addition, influenza infections during pregnancy are linked to an increased risk of preterm delivery and small-for-gestational-age infants. Infants younger than 6 months are at high risk of having severe influenza-related complications, often associated with hospitalisation and mortality.²

Another infectious disease that forms a serious threat for neonates is pertussis, of which the disease burden and case fatality rate is highest in the first year of life.^{5 6}

A COVID-19 infection during pregnancy is linked to an increased risk of hospitalisation, admission to an intensive care unit and death in pregnant women.^{7 8} Several studies have also found that there is a higher risk

of preterm delivery, stillbirth and pre-eclampsia.^{7 9 10} Furthermore, low birth weight, foetal distress and other respiratory symptoms are more frequent in neonates born to a mother who experienced a COVID-19 infection.^{7 10} Infants infected with COVID-19 in the postpartum period can become critically ill.¹¹

To better protect pregnant women, foetuses and infants against infectious disease-related complications, vaccination during pregnancy is an important strategy. Public health authorities worldwide have already implemented this approach for influenza and pertussis, while recently also adding vaccination against COVID-19.^{5 12–15}

Vaccination during pregnancy induces vaccine-specific antibodies that protect pregnant women against severe illness. Subsequently, these vaccine-induced antibodies are transferred from mother to baby across the placenta during pregnancy and via breastfeeding after birth.¹² Therefore, if women did not receive a pertussis and/or influenza vaccine during pregnancy or are not yet fully vaccinated against COVID-19 with the advised vaccine doses, it is recommended to vaccinate in the postpartum period.^{16 17}

Despite the proven benefits of vaccination during pregnancy and lactation and the implementation of the vaccination strategy on a broad scale, there is still a significant amount of hesitation towards maternal vaccination policies. This is reflected by poor vaccine uptake in different regions and varying or lacking maternal vaccination programmes and recommendations in various countries.^{12 13 18 19} A previous systematic review,²⁰ conducted before the start of the COVID-19 pandemic, defined factors that could possibly influence vaccination decision-making among pregnant women. The most important factor was found to be the recommendation from a healthcare provider (HCP) to vaccinate during pregnancy. However, other determinants such as previous vaccination behaviour and vaccine-specific factors could negate the recommendation from a HCP. This work also found that pregnant women used the internet or other media to search for information about vaccination, but these women did not perceive these channels to be the most trustworthy sources.²⁰

With the COVID-19 pandemic and the licensing of COVID-19 vaccines, debates around vaccination flared up again. Pregnant and lactating women were initially excluded from premarketing clinical trials for licensing of COVID-19 vaccines, which resulted in doubts about safety, immunogenicity and the efficacy of the vaccines in these target groups. However, based on evidence from other vaccines already administered to pregnant and lactating women, no safety or efficacy issues were expected. After weighing the benefits of vaccination against the complications of disease, different countries immediately started to approve COVID-19 vaccination for these groups. Different opinions, scientifically based or not, were shared via all sorts of social media, both by the general public and by HCPs. The aim of this scoping review is to give an update of the pre-pandemic

systematic review mentioned above²⁰ by trying to reveal how COVID-19 and its accompanying vaccination campaign impacted vaccine confidence in pregnant and lactating women. Also, this review intends to identify additional factors related to vaccine decision-making in lactating women. Furthermore, the role social media plays in creating opinions towards vaccination during pregnancy and/or lactation is studied.

METHODS

This scoping review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (online supplemental file 1). First, a research protocol was written and grey literature was searched (online supplemental file 2). Scientific literature was found by searching the PubMed database, without language restrictions. Keywords were identified based on the previous systematic review²⁰ and additional search terms linked to social media and COVID-19 were added:

vaccin*, immuniz*, immunis*, antibodies, immune response, confidence, awareness, attitude*, anxiety, trust*, intent*, dilemma, perception*, misconception*, behaviour, behavior, anti-vaccin*, decision-making, vaccination refusal, fear*, distrust, mistrust, hesitancy, controvers*, belief*, criticis*, misinformation, intent*, choice*, concern*, knowledge, acceptance, willingness, uptake, barrier*, disinformation, complacency, fake news, pregnan*, maternal, prenatal, antenatal, parent*, lactating*, lactation, breast milk, breastfeeding, social media, internet, website*, communication*, social network*, social behavior, social behaviour, message*, forum, fora, blog*, discussion group*, online, Facebook, Twitter, Pinterest, LinkedIn, Instagram, Reddit, YouTube, Messenger, WhatsApp, Telegram, COVID*, SARS-CoV-2, COVID*, corona*.

Publication dates were limited starting from 23 November 2018 since the pre-pandemic systematic review²⁰ covered articles published to 22 November 2018. The search was done on 18 July 2022 (online supplemental file 3).

Overall, 477 records were identified in the PubMed search. All records were screened by title and abstract, from which 46 were retained to screen by full text. Articles that did not mention pregnant and/or lactating women, the COVID-19 pandemic or vaccination and/or social media were excluded. Also, reviews and abstracts without full text were not included. If the article focused on outcomes of a COVID-19 infection or COVID-19 vaccination during pregnancy/lactation, the article was rejected. Finally, after screening by full text, 37 records were selected to be included in this scoping review. Screening the references of the selected records—known as ‘the snowball search method’ or ‘snowballing’—yielded two additional articles.

Patient and public involvement

Patients/the public were not involved in the design or conduct of the study.

RESULTS

COVID-19 vaccine acceptance in pregnant and lactating women and women planning to be pregnant

In total, 32 articles about willingness to get vaccinated against COVID-19 during pregnancy, lactation and when planning to get pregnant were identified and included in this review. A summary of the selected articles can be found in [table 1](#).

COVID-19 vaccine confidence in pregnant women and women planning to be pregnant

Several studies were conducted on vaccine willingness in pregnant women before the availability of COVID-19 vaccines (N=12). In four of these studies, pregnant women were less likely to accept a future COVID-19 vaccine (29.7%–62.1%) compared with breastfeeding women (38.6%–69.0%) and non-pregnant women (73.4%–81.2%).^{21–24} In contrast, one study found that more pregnant women (65.9%) were willing to get vaccinated against COVID-19 compared with non-pregnant women (59.6%), although the difference was not significant.²⁵ In addition, a high COVID-19 vaccine acceptance rate in pregnant women in China was detected (77.4%).²⁶ Furthermore, willingness to get vaccinated during pregnancy varied greatly by country: COVID-19 vaccine readiness level was above 80.0% for pregnant women in India and Mexico and lower than 45.0% in Russia, Australia and the USA.²² In a study where six European countries were compared, the highest COVID-19 vaccine willingness during pregnancy was seen in Belgium (78.1%), whereas the lowest rate was found in Switzerland (29.7%).²¹

Twenty surveys were performed after licensure of COVID-19 vaccines, but some were conducted before the WHO and/or national authorities officially recommended vaccinating all pregnant women against COVID-19. A survey study conducted at the New York Presbyterian Hospital (USA) concluded that pregnant women—at that moment—were still less likely to accept a COVID-19 vaccine (44.3%) compared with breastfeeding (55.2%) and non-pregnant women (76.2%).²⁷ Another survey study conducted in Saudi Arabia made the same significant conclusion for pregnant women and women planning to get pregnant compared with non-pregnant women and women not planning to get pregnant.²⁸ A study performed in January 2021 in the USA divided the responders into two groups: that is (1) female HCPs preventing pregnancy and (2) female HCPs who are pregnant/lactating/attempting pregnancy. The research found a significant difference in vaccine willingness between both groups where group (1) significantly desired more to receive the vaccine compared with group (2).²⁹ Thirteen studies also mentioned COVID-19 vaccine coverage rates in pregnant women. Two studies measured

the COVID-19 vaccine coverage in pregnant women during the same time period (March–April 2021) in two different countries: Germany³⁰ and the USA.³¹ A remarkable difference in coverage between both studies was observed: 2.4% in Germany versus 21.7% in the USA.^{30 31}

COVID-19 vaccine confidence in lactating women

Fifteen studies included lactating/postpartum women in their study population of which three studies found that lactating women were more likely to accept a COVID-19 vaccine (39.4%–69.0%) compared with pregnant women (13.8%–61.0%).^{21 27 30} Nevertheless, lactating women remain less willing to receive a COVID-19 vaccine than non-pregnant and non-nursing women.²⁷ In an American follow-up study, 35.0% of postpartum women were willing to be vaccinated compared with only 14.0% of pregnant women. However, the breastfeeding status of the postpartum women was not clear.³² Another study from the USA found that women currently nursing or planning to breastfeed were less willing to receive a COVID-19 vaccine compared with women who were not.³³ As for pregnant women, the acceptance rate widely varies among different countries with a 79.2% acceptance rate in Belgium compared with 38.6% in Switzerland.²¹

COVID-19 vaccine confidence in HCP

The perception of French HCPs towards COVID-19 vaccination during pregnancy was investigated via an anonymous survey distributed from January to March 2021. Overall, midwives were less likely to recommend COVID-19 vaccination during pregnancy (37.5%), compared with general practitioners (50.7%) and obstetricians (58.8%).³⁴

To study how HCPs view COVID-19 vaccination during pregnancy, a survey of women (including pregnant and lactating women), midwives, doctors providing maternity care and midwifery students was conducted in Australia in early 2021. The study found that doctors and midwifery students were significantly more likely to advise COVID-19 vaccination during pregnancy compared with midwives. Unfortunately, in this study, pregnant and lactating women were not asked if a recommendation from a HCP was a motivational factor or not when looking at influential factors that determined pregnant and lactating women's decision to be vaccinated.³⁵

Determinants predicting COVID-19 vaccine acceptance

Most of the surveys (N=26) included in this review not only measured readiness to get vaccinated against COVID-19 during pregnancy or lactation but also described determinants linked with COVID-19 vaccine acceptance.

Factors influencing COVID-19 vaccine acceptance during pregnancy

The most important reason for refusing COVID-19 vaccination during pregnancy is safety concerns, as described in 19 studies.^{22 24–27 30–32 36–46} These safety concerns include the assumption of potential harm to the baby

Table 1 Overview of studies analysing vaccine confidence in COVID-19 vaccines of pregnant/lactating women

Authors (year of publication)	Reference	Study period	Country	Study design	Participants, n	COVID-19 vaccine coverage	COVID-19 vaccine willingness
Abuhammad (2022)	⁶¹	September 2021 to October 2021	Jordan	Survey	414 participants: 195 pregnant women 218 lactating women	50.8% of pregnant and lactating women	NA
Ceulemans <i>et al</i> (2021)	²¹	16 June 2020 to 14 July 2020	Ireland, Norway, Switzerland, Netherlands, UK	Survey	16063 participants: 6661 pregnant women 9402 lactating women	NA	61.0% of pregnant women 69.0% of lactating women
		10 April 2020 to 31 May 2020	Belgium				
Citu <i>et al</i> (2022)	⁴⁷	1 October 2021 to 1 December 2021	Romania	Survey	345 participants: 184 pregnant women 161 non-pregnant women of reproductive age	NA	47.8% of pregnant women 59.7% of non-pregnant women of reproductive age
Citu <i>et al</i> (2022)	⁴⁸	1 January 2022 to 1 May 2022	Romania	Survey	345 pregnant women	53.3% of pregnant women	NA
Egloff <i>et al</i> (2022)	³⁶	18 February 2021 to 5 April 2021	France	Survey	664 pregnant women	NA	29.5% of pregnant women
Erchick <i>et al</i> (2022)	²⁵	15 December 2020 to 23 December 2020	USA	Survey	8481 participants: 233 pregnant women 8248 non-pregnant women	NA	65.9% of pregnant women 59.6% of non-pregnant women
Geoghegan <i>et al</i> (2021)	³⁷	4 December 2020 to 14 January 2021	Ireland	Survey	300 pregnant women	NA	38.0% during pregnancy 63.0% after pregnancy
Germain <i>et al</i> (2022)	³²	22 March 2021 to 2 April 2021	USA	Survey	456 participants: 435 pregnant women 21 postpartum women	NA	60.0% of pregnant and postpartum women
		29 June 2021 to 20 November 2021		Follow-up survey	290 participants: 68 pregnant women 222 postpartum women	52.0% of pregnant and postpartum women	14.0% of pregnant women 35.0% of postpartum women
Gutierrez <i>et al</i> (2022)	³³	January 2021	USA	Survey	5269 participants: 1190 pregnant and postpartum women	NA	53.4% of pregnant and postpartum women 57.1% of other participants
Hosokawa <i>et al</i> (2022)	³⁸	24 July 2021 to 30 August 2021	Japan	Survey	1621 pregnant women	13.4% of pregnant women	49.1% of pregnant women
Kuciel <i>et al</i> (2022)	⁶²	1 July 2021 to 30 August 2021	Poland	Survey	118 participants: 28 pregnant women 60 lactating women 109 mothers	NA	NA
Levy <i>et al</i> (2021)	³⁹	14 December 2020 to 14 January 2021	USA	Survey	662 pregnant women	NA	58.3% of pregnant women

Continued

Table 1 Continued

Authors (year of publication)	Reference	Study period	Country	Study design	Participants, n	COVID-19 vaccine coverage	COVID-19 vaccine willingness
Mappa <i>et al</i> (2021)	⁴⁰	27 December 2020	Italy	Survey	161 pregnant women	NA	52.9% of pregnant women
Mohan <i>et al</i> (2021)	⁴¹	15 October 2020 to 15 November 2020	Qatar	Survey	341 pregnant and lactating women	NA	49.1% of participants
Nguyen <i>et al</i> (2021)	⁶³	January 2021 to February 2021	Vietnam	Survey	651 participants: pregnant women or postpartum	NA	60.4% of all participants
Oluklu <i>et al</i> (2021)	⁵⁰	11 February 2021 to 21 March 2021	Turkey	Survey	412 postpartum women: 363 lactating women	NA	33.3% of postpartum women
Perez <i>et al</i> (2021)	²⁹	8 January 2021 to 31 January 2021	USA	Survey	11 405 female healthcare provider of reproductive age: 955 women attempting pregnancy 2196 pregnant women 2250 lactating women 67 lactating women attempting pregnancy 91 women pregnant and lactating 5846 preventing pregnancy	73.6% of all participants	75.3% of all participants strongly desire or desired vaccination—1.5% are strongly adverse
Perrotta <i>et al</i> (2022)	⁴²	1 March 2021 to 23 July 2021	USA	Survey	299 pregnant women	20.7% of pregnant women	42.8% of pregnant women
Pisula <i>et al</i> (2022)	⁴³	24 October 2021 to 9 November 2021	Poland	Survey	515 pregnant women	58.1% of pregnant women	6.2% of pregnant women
Razzaghi <i>et al</i> (2022)	³¹	31 March 2021 to 16 April 2021	USA	Survey	1561 pregnant women	21.7% of pregnant women	24.0% of pregnant women
Redmond <i>et al</i> (2022)	⁴⁴	June 2020 to August 2020	USA	Survey	26 pregnant women 1 postpartum woman	NA	63.0% of pregnant and postpartum women
Riad <i>et al</i> (2021)	⁴⁵	August 2021 to October 2021	Czechia	Survey	362 participants: 278 pregnant women 84 lactating women	NA	66.6% of pregnant and lactating women
Saleh and Halperin (2022)	⁴⁹	End September 2020 to mid-January 2021	Israel	Survey	410 participants: 293 pregnant women 117 postpartum women of whom 84 were lactating	NA	40.0% of postpartum participants

Continued

Table 1 Continued

Authors (year of publication)	Reference	Study period	Country	Study design	Participants, n	COVID-19 vaccine coverage	COVID-19 vaccine willingness
Samannodi (2021)	28	12 June 2021 to 1 August 2021	Saudi Arabia	Survey	431 women: 214 women pregnant or planning to be pregnant	57.1% of all participants	NA
Schaal <i>et al</i> (2021)	30	30 March 2021 to 19 April 2021	Germany	Survey	2339 participants: 1043 pregnant women 1296 lactating women	2.4% of pregnant women 13.7% of lactating women	13.8% of pregnant women 39.4% of lactating women
Skirrow <i>et al</i> (2022)	24	3 August 2020 to 11 October 2020	UK	Survey	1181 pregnant women	NA	62.1% during current pregnancy
Skjette <i>et al</i> (2021)	22	7 December 2020 to 16 December 2020		Semistructured interviews	10 pregnant women		81.2% after delivery
Skjette <i>et al</i> (2021)	22	28 October 2020 to 18 November 2020	Italy, Chile, Peru, New Zealand, Russia, Australia, Colombia, Brazil, Spain, South Africa, India, Mexico, Philippines, Argentina, USA, UK	Survey	17 871 participants: 5294 pregnant women 12 562 non- pregnant women	NA	52.0% of pregnant women 73.4% of non-pregnant women
Stuckelberger <i>et al</i> (2021)	23	18 June 2020 to 12 July 2020	Switzerland	Survey	1551 participants: 515 pregnant women 1036 lactating women	NA	29.7% of pregnant women 38.6% of lactating women
Sutton <i>et al</i> (2021)	27	7 January 2021 to 29 January 2021	USA	Survey	1012 participants: 216 pregnant women 122 lactating women 656 non-pregnant women	1.9% of pregnant women 3.3% of lactating women 13.3% of non-pregnant women	44.3% of pregnant women 55.2% of lactating women 76.2% of non-pregnant women
Tao <i>et al</i> (2021)	26	13 November 2020 to 27 November 2020	China	Survey	1392 pregnant women	NA	77.0% of pregnant women
Ward <i>et al</i> (2022)	46	NA	Australia	Survey	218 pregnant women	44.0% of pregnant women	7.4% of pregnant women
Waring <i>et al</i> (2022)	64	Mid-February 2021 to mid-March 2021	USA	Survey	203 women: 15 pregnant women 188 non-pregnant women (mothers)	47.3% of pregnant and non-pregnant women	66.0% of pregnant women 73.0% of non-pregnant women

and to the mother, both in the short and long term. Other concerns include that there is not yet enough clinical trial data on COVID-19 vaccination during pregnancy^{22 24 27 30 32 42} and that COVID-19 vaccines are seen as not being trustworthy because they were developed and approved rapidly.^{22 24 31 38} In Japan, mistrust in the government was determined as the only significant factor linked to vaccine hesitancy among pregnant women.³⁸ Not believing in vaccines and in the existence of the SARS-CoV-2 virus, not being afraid of COVID-19, and trusting rumours on social media were also described as statistically independent risk factors for vaccine hesitancy among pregnant women.⁴⁷

Receiving an influenza vaccine^{23 27 31 32 36} and/or pertussis vaccine during pregnancy^{24 32} are positive determinants for accepting COVID-19 vaccination among pregnant women. Other positive factors are a recommendation by a HCP or having a discussion with a HCP about COVID-19 vaccines,^{31 32 36 37 44 46} believing to be at high risk of or concerns about contracting COVID-19,^{22 29 32} being aware of having an increased risk of severe illness due to COVID-19,⁴⁶ and living with individuals with or themselves suffering from comorbidities/high-risk conditions.³¹

Demographic factors associated with better COVID-19 vaccine willingness are a higher level of education,^{22 23 32 33 36 38–40 42 43 45 48 49} being employed,^{31 32 40 49} having a higher income,^{22 24 33 42 43 47 48} older age,^{22–25 32 33 36 39 42 45} being in the third trimester of gestation,^{23 26 37 45 48} multiparity^{36 45} and living in an urban area.^{43 47–49} Other demographic factors linked to COVID-19 vaccine willingness are race and ethnicity.^{24 29 31 39 41 49} Interestingly, pregnant Chinese women of younger age and with a lower level of education were more likely to accept COVID-19 vaccination.²⁶

Factors influencing COVID-19 vaccine acceptance during lactation

Lactating/postpartum women were found to have similar safety concerns to pregnant women.^{27 30 32 45 50} One of the reasons for refusing the vaccine or being hesitant about getting it is the lack of reliable data on the administration and effectiveness of a COVID-19 vaccine during lactation.^{30 50} Additionally, there were concerns in this target group that the COVID-19 vaccine could cause infertility.²⁷

Two studies described several demographic factors in pregnant and lactating/postpartum women associated with a lower likelihood of vaccination: younger age,^{23 33} lower level of education^{23 33} and lower income.³³ However, both studies did not distinguish between pregnant and lactating/postpartum women.^{23 33} Another study found that there was no significant difference in age and educational level in the group of lactating women willing to accept the vaccine and the group of lactating women resistant to the vaccine. However, lactating healthcare workers had a significantly higher COVID-19 vaccine acceptance level compared with non-healthcare workers.⁴⁵

The impact of the COVID-19 pandemic on other vaccinations

Several studies also discussed vaccine willingness for other diseases in pregnancy during the COVID-19 pandemic. Two studies focused on influenza, one focused on pertussis while the other focused on vaccines during pregnancy in general.^{43 49 51 52} A study conducted in Turkey found that 77.0% of the interviewed pregnant women received or intended to receive vaccination during pregnancy. For 50.6% of these women, the COVID-19 pandemic had not affected their views on being vaccinated in the future.⁵¹

Another study analysed the effect of the COVID-19 pandemic on seasonal influenza vaccine compliance among pregnant and postpartum women in Israel from September 2020 to mid-January 2021. The research found that, despite the high incidence of COVID-19, vaccine uptake was similar to prepandemic times with 54.4% of the women studied being vaccinated against influenza.⁴⁹

The knowledge and attitudes of Polish pregnant women towards influenza vaccination was searched in 2021. In total, 21.0% had been vaccinated against influenza during pregnancy and 17.5% were planning to get vaccinated. The study stated that there is a link between influenza vaccine uptake and COVID-19 vaccine uptake in pregnant women. Women who refused COVID-19 vaccination did not intend to get an influenza vaccine and vice versa.⁴³

Furthermore, the experience of women getting vaccinated against pertussis during pregnancy in COVID-19 times was explored in the UK. The study used an online survey, which was spread from 3 August 2020 to 11 October 2020. The survey was completed by 922 pregnant women and 482 postpartum women who had been pregnant at some point after the first lockdown. The study found that 72.1% of pregnant women and 84.0% of postpartum women had received a pertussis vaccine during pregnancy even when access was hampered due to COVID-19 restrictions.⁵²

The impact of social media on COVID-19 vaccine confidence

Social media is an important source of information on COVID-19 vaccines for pregnant and lactating women. However, only 8.3% of the pregnant and lactating women in a Czech study reported that media/social media was an important factor when deciding to receive or not receive COVID-19 vaccination.⁴⁵

Three surveys conducted in remote Alaskan communities between November 2020 and September 2021 focused on the impact of COVID-19 on the daily life and attitude towards COVID-19 vaccination of adults, including pregnant women, living in these communities. By September 2021, misunderstandings about vaccine recommendations during pregnancy and the effects of COVID-19 vaccination on fertility and DNA were present in participants where social media was identified as the primary source of information.⁵³

The changes in Google Search interest on vaccination during pregnancy after the introduction of COVID-19 vaccination in Italy were investigated by using Google

Trends. The data covered searches from 1 January 2019 to 31 October 2021. This made it possible to monitor the changes over two years from before the introduction of COVID-19 vaccination starting before the introduction of COVID-19 vaccination. The analysis of Google Trends indicated that the search interest for 'vaccination in pregnancy' was increased significantly (both qualitative and quantitative) compared with the predicted trend after the start of the Italian COVID-19 vaccination campaign. Moreover, further qualitative analysis showed that the increase was most likely due to concerns about COVID-19 vaccination.⁵⁴

Among pregnant Romanian women, trusting rumours on social media had the greatest impact on vaccine hesitancy according to a study performed from 1 October 2021 to 1 December 2021. Compared with non-pregnant women (63.0%), significantly more pregnant women (78.1%) answered 'yes' to the question if they trusted social media rumours.⁴⁷ In a survey conducted a few months later, Romanian unvaccinated pregnant women (44.7%) were significantly more likely to select social media as a trustworthy decision-making factor compared with vaccinated pregnant women (25.0%).⁴⁸

A social media campaign called 'One Vax Two Lives' was set up in Washington to encourage the spread of scientifically based information about the risks of COVID-19 and benefits of COVID-19 vaccination during pregnancy. The campaign reached a lot of people through ads on Facebook and Instagram, but the number of visitors to the informative website linked to the project remained rather low. It is not clear what the actual impact of the campaign was on vaccine confidence and uptake in pregnant women.⁵⁵

DISCUSSION

Maternal vaccination has already proven to be an effective means to prevent infectious disease-related morbidity and mortality in pregnant women, fetuses and infants. During the COVID-19 pandemic, the topic of vaccination during pregnancy and lactation received a lot of attention. In many countries, HCPs were one of the priority groups to receive vaccination against COVID-19. A lot of these HCPs were of fertile age, pregnant and/or lactating. These women were among the first fertile/pregnant/lactating women to be vaccinated against COVID-19. The vaccine was assumed to be safe for these target groups, based on previous research which generated reassuring evidence on the use of inactivated vaccines during pregnancy/lactation. However, lack of robust data on the safety, immunogenicity and efficacy of the COVID-19 vaccines and the existence of varying recommendations concerning COVID-19 vaccination during pregnancy and lactation in different areas of the world started an important debate on COVID-19 vaccination during pregnancy and lactation.

Even before the start of the COVID-19 pandemic, the WHO defined vaccine hesitancy as one of the top 10 threats

to global health.⁵⁶ Therefore, insights into factors influencing willingness to get vaccinated are crucial to plan effective interventions to increase vaccine coverage, especially in high-risk groups (such as pregnant and lactating women). Surveys performed during the COVID-19 pandemic—both before and after licensure of COVID-19 vaccines—demonstrated that willingness to get vaccinated against COVID-19 is generally lower in pregnant and lactating women than in non-pregnant and non-nursing women, which was not a surprising finding. On a global scale, vaccine hesitancy is more common in pregnant and lactating women. Many studies have reported that there are low coverage rates for influenza and Tdap vaccines in pregnant and lactating women. This population also shows low vaccine confidence. However, the overall reluctance towards COVID-19 vaccination is even higher compared with other vaccines recommended to be administered during pregnancy and/or lactation. This is possibly caused by the belief that COVID-19 vaccines were tested and approved too quickly and that in the initial premarketing trials no data were collected on pregnant and lactating women.

Safety concerns are reported as the main reason for refusal of COVID-19 vaccination during pregnancy and lactation. The belief that COVID-19 vaccines could cause harm to the reproductive system, fetus/baby and/or to the women themselves is the most commonly cited driver for vaccine hesitancy. This is not a new observation; before the COVID-19 pandemic, similar concerns were mentioned as the most frequently cited barrier to being vaccinated during pregnancy.⁵⁷

The reasons for vaccine hesitancy towards COVID-19 vaccination in pregnant and lactating women are comparable to those in the general population, where concerns about safety, efficacy and the rapid development and approval of the vaccines are also the key determinants for COVID-19 vaccine refusal.⁵⁸ These observations highlight the importance of high-quality clinical trials that include pregnant and lactating women. Furthermore, it is important to clearly and transparently communicate the findings from these trials to all population groups to increase vaccine coverage rates.

Before the start of the pandemic, a systematic review defined a HCP recommendation as the most important factor affecting vaccine confidence during pregnancy²⁰; later studies found the same for COVID-19 vaccination. Recommendations from HCPs were pinpointed as the most influential strategy to increase vaccine willingness.⁴⁴ However, these recommendations are often still overshadowed by anxiety about side effects and messages circulating social media. Another worrying factor is that not all HCPs support COVID-19 vaccination during pregnancy. Especially, midwives seem to be less likely to recommend COVID-19 vaccination during pregnancy, which is in line with studies on other vaccines before the pandemic.⁵⁹ Therefore, it is crucial to provide HCPs access to tailored information on vaccination. Moreover, proper education of HCPs concerning the effects and importance of vaccines during pregnancy and lactation is needed.

Besides clear formulation of vaccination recommendations during pregnancy/lactation, it is of equal importance that correct information on these recommendations reaches the target groups. In a survey conducted in remote Alaskan communities, 22.8% of the participants were not aware that COVID-19 vaccination was recommended during pregnancy, 26.5% of the participants were unsure about a recommendation for pregnant women and 28.1% of the participants were uncertain if COVID-19 vaccination would affect fertility or not. Furthermore, participants often cited pregnancy and lactation as reasons to postpone COVID-19 vaccination.⁵³ Additionally, in a questionnaire in Saudi Arabia on public knowledge regarding COVID-19 vaccination, 46.2% of males and 24.2% of females did not know if COVID-19 vaccination was recommended for pregnant women or not. Also, 72.4% of female participants stated that COVID-19 vaccination was not preferred during pregnancy.⁶⁰

To avoid the misconceptions mentioned above and to make sure that target groups are made aware of the most recent recommendations, specific programmes and tools need to be developed—each adapted according to region, language and accessibility. Here, proper education of HCPs is again key to support these programmes and tools to make these interventions effective.

Since social media has become an integral part of our lives, these platforms can be used to inform women who are pregnant, lactating or planning to be pregnant about vaccine recommendations. For many, it has become an important source of information and it is used to form an opinion about all kinds of topics, including COVID-19 and COVID-19 vaccination. In Italy, research showed that Google Search interest for ‘vaccination in pregnancy’ increased significantly after Italy’s COVID-19 vaccination campaign had started.⁵⁴ Further research is still needed to accurately define the relation between social media and internet searches and actual vaccine uptake during pregnancy or lactation.

A 6-month follow-up study comparing COVID-19 vaccine hesitancy and actual vaccine uptake in pregnant and postpartum women concluded that being hesitant towards COVID-19 vaccines at baseline persisted, with only 10% of individuals transitioning from being vaccine hesitant to being vaccinated.³² This highlights that efficient interventions and educational strategies need to be developed to increase vaccine confidence, which subsequently increases vaccine coverage rates in pregnant and postpartum women. Therefore, a project was started at the University of Antwerp funded by the Vaccine Confidence Fund to identify which factors linked to social media influence vaccine confidence and in the long run the uptake of pertussis, influenza and COVID-19 vaccines in women of childbearing age, and pregnant and lactating women. The overall aim of this project—which this review is also part of—is to identify which interventions are efficient in increasing vaccine confidence in pregnant and lactating women.

CONCLUSION

Vaccine hesitancy during pregnancy and lactation remains an important topic to study, especially in times of a pandemic and with the fast development of new vaccines. To improve vaccine confidence in these target groups, the inclusion of pregnant and lactating women in clinical trials could reduce safety concerns, as this was identified as the main reason to refuse vaccination. In addition, proper education of HCPs and clear, universal recommendations can also contribute to increase vaccine willingness. Further research is necessary to define the role social media plays in actual vaccine uptake. However, from our findings, it can be concluded that social media messages can influence vaccine confidence in pregnant and lactating women.

Contributors LDB and KM conducted the review. PVD, GH, KP and WD read the review and provided input and comments. All authors contributed to the article and approved the submitted version. Kirsten Maertens is the author responsible for the overall content as the guarantor.

Funding This review was funded by a grant (VCF—010) from the Vaccine Confidence Fund, a philanthropic and charitable fund of Global Impact.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Larissa De Brabandere <http://orcid.org/0000-0003-2757-2490>

Greet Hendrickx <http://orcid.org/0000-0002-0099-272X>

Karolien Poels <http://orcid.org/0000-0002-5276-0293>

Walter Daelemans <http://orcid.org/0000-0002-9832-7890>

Pierre Van Damme <http://orcid.org/0000-0002-8642-1249>

Kirsten Maertens <http://orcid.org/0000-0002-2880-441X>

REFERENCES

- 1 Jamieson DJ, Rasmussen SA. An update on COVID-19 and pregnancy. *American journal of obstetrics and gynecology*. *Elsevier Inc* 2022;226:177–86.
- 2 Omer SB, Bednarczyk R, Madhi SA, et al. Benefits to mother and child of influenza vaccination during pregnancy. *Hum Vaccin Immunother* 2012;8:130–7.
- 3 Kandeil W, van den Ende C, Bunge EM, et al. A systematic review of the burden of pertussis disease in infants and the effectiveness of maternal immunization against pertussis. *Expert Rev Vaccines* 2020;19:621–38.

- 4 Mertz D, Geraci J, Winkup J, *et al.* Pregnancy as A risk factor for severe outcomes from influenza virus infection: A systematic review and meta-analysis of observational studies. *Vaccine* 2017;35:521–8.
- 5 WHO. WHO recommendation pertussis. n.d. Available: https://www.who.int/health-topics/pertussis#tab=tab_2
- 6 Masseria C, Martin CK, Krishnarajah G, *et al.* Incidence and burden of pertussis among infants less than 1 year of age. *Pediatr Infect Dis J* 2017;36:e54–61.
- 7 Allotey J, Stallings E, Bonet M, *et al.* Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ* 2020;370:m3320.
- 8 Lokken EM, Huebner EM, Taylor GG, *et al.* Disease severity, pregnancy outcomes, and maternal deaths among pregnant patients with severe acute respiratory syndrome coronavirus 2 infection in washington state. *Am J Obstet Gynecol* 2021;225:77.
- 9 Wei SQ, Bilodeau-Bertrand M, Liu S, *et al.* The impact of COVID-19 on pregnancy outcomes: A systematic review and meta-analysis. *CMAJ* 2021;193:E540–8.
- 10 Smith V, Seo D, Warty R, *et al.* Maternal and neonatal outcomes associated with COVID-19 infection: A systematic review. *PLoS One* 2020;15:e0234187.
- 11 Cui X, Zhao Z, Zhang T, *et al.* A systematic review and meta-analysis of children with coronavirus disease 2019 (COVID-19). *J Med Virol* 2021;93:1057–69.
- 12 Sebghati M, Khalil A. Uptake of vaccination in pregnancy. vol. 76, best practice and research: clinical obstetrics and gynaecology. *Bailliere Tindall Ltd* 2021:53–65.
- 13 Maltezou HC, Effraimidou E, Cassimos DC, *et al.* Vaccination programs for pregnant women in europe, 2021. *Vaccine* 2021;39:6137–43.
- 14 WHO. WHO recommendation COVID-19. Available: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines/advice> [Accessed 15 Jul 2022].
- 15 WHO. WHO recommendation influenza. Available: <https://www.who.int/teams/global-influenza-programme/vaccines/vaccine-use> [Accessed 15 Jul 2022].
- 16 Lajos GJ, Fialho SCAV, Kfourir R de Á, *et al.* Vaccination in pregnant and postpartum women. *Rev Bras Ginecol Obstet* 2020;42:851–6.
- 17 Luxi N, Giovanazzi A, Capuano A, *et al.* COVID-19 vaccination in pregnancy, paediatrics, immunocompromised patients, and persons with history of allergy or prior SARS-cov-2 infection: overview of current recommendations and pre- and post-marketing evidence for vaccine efficacy and safety. *Drug Saf* 2021;44:1247–69.
- 18 Giles ML, Gunatilaka A, Palmer K, *et al.* Alignment of national COVID-19 vaccine recommendations for pregnant and lactating women. *Bull World Health Organ* 2021;99:739–46.
- 19 Drezner D, Youngster M, Klainer H, *et al.* Maternal vaccinations coverage and reasons for non-compliance - A cross-sectional observational study. *BMC Pregnancy Childbirth* 2020;20:541.
- 20 Kilich E, Dada S, Francis MR, *et al.* Factors that influence vaccination decision-making among pregnant women: A systematic review and meta-analysis. *PLoS One* 2020;15:e0234827.
- 21 Ceulemans M, Foulon V, Panchaud A, *et al.* Vaccine willingness and impact of the covid-19 pandemic on women's perinatal experiences and practices-a multinational, cross-sectional study covering the first wave of the pandemic. *Int J Environ Res Public Health* 2021;18:3367.
- 22 Skjette M, Ngirbabul M, Akeju O, *et al.* COVID-19 vaccine acceptance among pregnant women and mothers of young children: results of a survey in 16 countries. *Eur J Epidemiol* 2021;36:197–211.
- 23 Stuckelberger S, Favre G, Ceulemans M, *et al.* SARS-cov-2 vaccine willingness among pregnant and breastfeeding women during the first pandemic wave: A cross-sectional study in switzerland. *Viruses* 2021;13:1199.
- 24 Skirrow H, Barnett S, Bell S, *et al.* Women's views on accepting COVID-19 vaccination during and after pregnancy, and for their babies: a multi-methods study in the UK. *BMC Pregnancy Childbirth* 2022;22:33.
- 25 Erchick DJ, Agarwal S, Kaysin A, *et al.* Changes in prenatal care and vaccine willingness among pregnant women during the COVID-19 pandemic. *BMC Pregnancy Childbirth* 2022;22:558.
- 26 Tao L, Wang R, Han N, *et al.* Acceptance of a COVID-19 vaccine and associated factors among pregnant women in china: a multi-center cross-sectional study based on health belief model. *Hum Vaccin Immunother* 2021;17:2378–88.
- 27 Sutton D, D'Alton M, Zhang Y, *et al.* COVID-19 vaccine acceptance among pregnant, breastfeeding, and nonpregnant reproductive-aged women. *Am J Obstet Gynecol MFM* 2021;3:100403.
- 28 Samannodi M. COVID-19 vaccine acceptability among women who are pregnant or planning for pregnancy in saudi arabia: A cross-sectional study. *Patient Prefer Adherence* 2021;15:2609–18.
- 29 Perez MJ, Paul R, Raghuraman N, *et al.* Characterizing initial COVID-19 vaccine attitudes among pregnancy-capable healthcare workers. *Am J Obstet Gynecol MFM* 2022;4:100557.
- 30 Schaal NK, Zöllkau J, Hepp P, *et al.* Pregnant and breastfeeding women's attitudes and fears regarding the COVID-19 vaccination. *Arch Gynecol Obstet* 2022;306:365–72.
- 31 Razzaghi H, Kahn KE, Masalovich S, *et al.* COVID-19 vaccination and intent among pregnant women. *Public Health Reports* 2021;14:003335492210992.
- 32 Germann K, Kiefer MK, Rood KM, *et al.* Association of initial COVID-19 vaccine hesitancy with subsequent vaccination among pregnant and postpartum individuals. *BJOG* 2022;129:1352–60.
- 33 Gutierrez S, Logan R, Marshall C, *et al.* Predictors of COVID-19 vaccination likelihood among reproductive-aged women in the united states. *Public Health Rep* 2022;137:588–96.
- 34 Deruelle P, Couffignal C, Sibiude J, *et al.* Prenatal care providers' perceptions of the SARS-cov-2 vaccine for themselves and for pregnant women. *PLoS One* 2021;16:e0256080.
- 35 Bradfield Z, Wynter K, Hauck Y, *et al.* COVID-19 vaccination perceptions and intentions of maternity care consumers and providers in australia. *PLoS One* 2021;16:e0260049.
- 36 Egloff C, Couffignal C, Cordier AG, *et al.* Pregnant women's perceptions of the COVID-19 vaccine: A french survey. *PLoS One* 2022;17:e0263512.
- 37 Geoghegan S, Stephens LC, Feemster KA, *et al.* "This choice does not just affect me." attitudes of pregnant women toward COVID-19 vaccines: a mixed-methods study. *Hum Vaccin Immunother* 2021;17:3371–6.
- 38 Hosokawa Y, Okawa S, Hori A, *et al.* The prevalence of COVID-19 vaccination and vaccine hesitancy in pregnant women: an internet-based cross-sectional study in japan. *J Epidemiol* 2022;32:188–94.
- 39 Levy AT, Singh S, Riley LE, *et al.* Acceptance of COVID-19 vaccination in pregnancy: a survey study. *Am J Obstet Gynecol MFM* 2021;3:100399.
- 40 Mappa I, Luviso M, Distefano FA, *et al.* Women perception of SARS-cov-2 vaccination during pregnancy and subsequent maternal anxiety: a prospective observational study. *J Matern Fetal Neonatal Med* 2022;35:6302–5.
- 41 Mohan S, Reagu S, Lindow S, *et al.* COVID-19 vaccine hesitancy in perinatal women: A cross sectional survey. *J Perinat Med* 2021;49:678–85.
- 42 Perrotta K, Messer A, Alvarado S, *et al.* COVID-19 vaccine hesitancy and acceptance among pregnant people contacting a teratogen information service. *J Genet Couns* 2022;31:1341–8.
- 43 Pisula A, Sienicka A, Pawlik KK, *et al.* Pregnant women's knowledge of and attitudes towards influenza vaccination during the COVID-19 pandemic in poland. *Int J Environ Res Public Health* 2022;19:4504.
- 44 Redmond ML, Mayes P, Morris K, *et al.* Learning from maternal voices on COVID-19 vaccine uptake: perspectives from pregnant women living in the midwest on the COVID-19 pandemic and vaccine. *J Community Psychol* 2022;50:2630–43.
- 45 Riad A, Jouzová A, Üstün B, *et al.* COVID-19 vaccine acceptance of pregnant and lactating women (PLW) in czechia: an analytical cross-sectional study. *Int J Environ Res Public Health* 2021;18:13373.
- 46 Ward C, Megaw L, White S, *et al.* COVID-19 vaccination rates in an antenatal population: A survey of women's perceptions, factors influencing vaccine uptake and potential contributors to vaccine hesitancy. *Aust N Z J Obstet Gynaecol* 2022;62:695–700.
- 47 Citu IM, Citu C, Gorun F, *et al.* Determinants of COVID-19 vaccination hesitancy among romanian pregnant women. *Vaccines (Basel)* 2022;10:275.
- 48 Citu C, Chiriac VD, Citu IM, *et al.* Appraisal of COVID-19 vaccination acceptance in the romanian pregnant population. *Vaccines (Basel)* 2022;10:952.
- 49 Saleh OA, Halperin O. Influenza virus vaccine compliance among pregnant women during the COVID-19 pandemic (pre-vaccine era) in israel and future intention to uptake bnt162b2 mrna COVID-19 vaccine. *Vaccine* 2022;40:2099–106.
- 50 Oluklu D, Goncu Ayhan S, Menekse Beser D, *et al.* Factors affecting the acceptability of COVID-19 vaccine in the postpartum period. *Hum Vaccin Immunother* 2021;17:4043–7.
- 51 Gencer H, Özkan S, Vardar O, *et al.* The effects of the COVID 19 pandemic on vaccine decisions in pregnant women. *Women Birth* 2022;35:317–23.
- 52 Skirrow H, Barnett S, Bell S, *et al.* Women's views and experiences of accessing pertussis vaccination in pregnancy and infant vaccinations during the COVID-19 pandemic: A multi-methods study in the UK. *Vaccine* 2022;40:4942–54.
- 53 Hahn MB, Fried RL, Cochran P, *et al.* Evolving perceptions of COVID-19 vaccines among remote alaskan communities. *Int J Circumpolar Health* 2022;81:2021684.

- 54 Maugeri A, Barchitta M, Agodi A. Using google trends to predict COVID-19 vaccinations and monitor search behaviours about vaccines: A retrospective analysis of italian data. *Vaccines (Basel)* 2022;10:119.
- 55 Marcell L, Dokania E, Navia I, *et al.* One vax two lives: A social media campaign and research program to address COVID-19 vaccine hesitancy in pregnancy. *Am J Obstet Gynecol* 2022;227:685–95.
- 56 WHO. WHO ten threats for global health. n.d. Available: <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>
- 57 Wilson RJ, Paterson P, Jarrett C, *et al.* Understanding factors influencing vaccination acceptance during pregnancy globally: A literature review. *Vaccine* 2015;33:6420–9.
- 58 Troiano G, Nardi A. Vaccine hesitancy in the era of COVID-19. *Public Health* 2021;194:245–51.
- 59 Dubé E, Gagnon D, Kaminsky K, *et al.* Vaccination during pregnancy: canadian maternity care providers' opinions and practices. *Hum Vaccin Immunother* 2020;16:2789–99.
- 60 Al-Zalfawi SM, Rabbani SI, Asdaq SMB, *et al.* Public knowledge, attitude, and perception towards COVID-19 vaccination in saudi arabia. *Int J Environ Res Public Health* 2021;18:10081.
- 61 Abuhammad S. Attitude of pregnant and lactating women toward COVID-19 vaccination in jordan: a cross-sectional study. *J Perinat Med* 2022;50:896–903.
- 62 Kuciel N, Mazurek J, Hap K, *et al.* COVID-19 vaccine acceptance in pregnant and lactating women and mothers of young children in poland. *Int J Womens Health* 2022;14:415–24.
- 63 Nguyen LH, Hoang MT, Nguyen LD, *et al.* Acceptance and willingness to pay for COVID-19 vaccines among pregnant women in vietnam. *Trop Med Int Health* 2021;26:1303–13.
- 64 Waring ME, Pagoto SL, Rudin LR, *et al.* Factors associated with mothers' hesitancy to receive a COVID-19 vaccine. *J Behav Med* 2022:1–6.