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Exploring COVID-19 vaccination behavior: A cross-country study among pregnant and postpartum women in Brazil, Ghana, Kenya, and Pakistan☆

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ABSTRACT

Pregnant women infected with SARS-CoV2 are more likely to be hospitalized and require ventilation, compared to non-pregnant women. Although the development of the COVID-19 vaccine was regarded as a scientific breakthrough among many, the pace of development in combination with delayed and unclear recommendations for maternal vaccination led to slower vaccine uptake among this population. We explored the decision-making process for COVID-19 vaccination among pregnant and postpartum women in four countries: Brazil, Ghana, Kenya, and Pakistan through 201 in-depth interviews. A grounded theory approach was used for analysis, and a socio-ecological framework was used to synthesize emerging themes. Four levels of influence on vaccine-related attitudes and behaviors were identified: individual, interpersonal, community, and policy. Risk perception and beliefs about vaccines safety were the primary individual-level factors identified. Risk perception of the disease was a common reason for vaccine acceptance, whereas lower risk perception emerged as a reason to not vaccinate. Vaccine safety concerns, for the pregnant woman herself, her pregnancy, and her baby were common across all countries. At the interpersonal level, the influence of the male partner and peers emerged across all countries. While participants identified the partner or spouse was most influential, they also discussed the limited impact the male partner had on decision-making, particularly in Ghana, Kenya, and Pakistan. At the community-level, healthcare providers helped in allaying vaccine safety concerns, and women looked to them for their health expertise and recommendations. At the policy-level, the requirement — real or perceived — of vaccination to access services, travel, work, and education was an important factor in all countries. Vaccine decision-making is complex, multi-faceted, and context-specific. When promoting vaccination among pregnant and postpartum women, engaging influential individuals can support the successful uptake of maternal vaccination.

1. Introduction

The COVID-19 pandemic had a devastating negative impact on global public health, having caused more than 775,000,000 reported cases of illness and more than 7 million reported deaths as of July 2024 [1]. While COVID-19 affected large swaths of the global population,

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certain groups faced increased risks from the disease; pregnant women were disproportionately affected by COVID-19. A 2022 systematic review found that pregnant women with COVID-19 were significantly more likely to be hospitalized and require ventilation than non-pregnant women with COVID-19 [2]. Additionally, contracting COVID-19 during pregnancy is associated with an increased risk of adverse pregnancy outcomes, such as preterm birth, preeclampsia, stillbirth, and maternal mortality [3,4]. Risk factors for increased severity of COVID-19 disease and adverse pregnancy outcomes include comorbidities such as diabetes, hypertension, and HIV infection, as well as being underweight or having anemia during pregnancy [5]. Given the close link between COVID-19 and adverse outcomes of pregnancy, preventing COVID-19 is paramount to protect pregnant women; a key prevention method is COVID-19 vaccination [6–8].

While many high-income countries (HICs) were able to purchase doses for their populations, many low-and middle-income countries (LMICs) faced substantial barriers in purchasing doses directly. Many LMICs utilized the COVAX initiative to secure vaccines for their populations [9,10]. The COVAX initiative brought COVID-19 vaccines to many LMICs that would otherwise not have access to vaccines; yet there were initial challenges including delays in vaccine shipments and insufficient support for coverage goals [9,11]. There were inequities in vaccine uptake, comparing LMICs to HICs: approximately 71 % of the world's population received at least one COVID-19 vaccine dose, with the vast majority of doses going to high-income countries [[12].

Availability, access, and recommendations for vaccination varied around the globe, including for pregnant and postpartum women. This study focused on Brazil, Ghana, Kenya, and Pakistan. Each of these countries had diverse experiences related to initial COVID-19 vaccine shipments, vaccine brands received, and recommendations related to vaccination of pregnant and postpartum women. In addition, in some of these countries, there were key events that also influenced recommendations related to pregnant and postpartum women. We have included background information related to initial COVID-19 vaccine shipments, recommendations related to pregnant and lactating women, and other key events related to these countries in Table 1.

We conducted this qualitative study to better understand how and what factors influenced the decision-making process related to COVID-19 vaccination among pregnant and postpartum women.

2. Methods

2.1. Study design and setting

The data from this study are from a larger mixed methods study that included in-depth interviews and a survey. More details about the study design and facilities can be found in a published protocol manuscript [13].

This sub-analysis focuses on in-depth interviews with pregnant and postpartum women in Brazil, Ghana, Kenya, and Pakistan - countries that had varying policies related to COVID-19 vaccination for pregnant and postpartum women. We recognize that using the term pregnant people is more inclusive; however, in this manuscript we will use the term pregnant and/or postpartum women given cultural contexts. Table 2 outlines study facility information, including the date of data collection and date of recommendation for COVID-19 vaccination among pregnant and postpartum women by country.

2.2. Participants and recruitment

We sought to interview 25 pregnant and 25 postpartum women, for a total of 50 in-depth interviews per country and 200 interviews total. Recruitment strategy varied by country, with most sites using consecutive sampling. Study staff approached potentially eligible women in the waiting or reception areas of clinics, read a recruitment script, and then screened for study eligibility: 1) study interest; 2) age of 18 or older (or an emancipated minor - for Brazil only); 3) fluent in the local language (or English if applicable); and 4) knowledge of the COVID-19 vaccine. Participants who met eligibility criteria were invited to join and were consented in a private location. Interviews were conducted in private locations within the health facility. Countries provided transportation remuneration or thank you gifts, except Brazil as women were approached during routine health care visits.

2.3. Data collection

Data collection teams received a three-day training session with a standard agenda. This training included the basics of ethical research, such as informed consent, respect for the individual, privacy, and collecting and storing data. The training also included multiple scenarios for data collectors to work through that focused on ethical principles as well as content. Related to the data collection team, we engaged with individuals who were trained in qualitative research, had experience

Table 1
Initial COVID-19 vaccine shipments and recommendations in Brazil, Ghana, Kenya, and Pakistan.

Country	Date of COVAX shipment*	No. doses received	First brand received from COVAX	Pregnant and postpartum women recommendation during initial rollout	Date of recommendation for pregnant and postpartum women	Other key events
Brazil*	21 Mar 2021	1,000,000	AstraZeneca/ Oxford	No	March 2021 9 Jul 2021	AstraZeneca was suspended for pregnant and lactating women on 11 May 2021, after the death of two pregnant women a few days after receiving the vaccine.
Ghana	24 Feb 2021	600,000	AstraZeneca/ Oxford	No	20 Jan 2022	
Kenya	6 Mar 2021	1,000,000	AstraZeneca/ Oxford	No	24 Dec 2021	
Pakistan*	8 May 2021	1,200,000	AstraZeneca/ Oxford	No	8 May 2021	In Aug 2021, the Prime Minister of Health strongly urged all pregnant and lactating women to receive the vaccine following the deaths of two unvaccinated pregnant women from COVID-19.

* Brazil and Pakistan received their first shipments outside of the COVAX facility. Brazil's first COVID vaccine shipment was in January 2021; Pakistan's first COVID vaccine shipment was Feb 2021.

Table 2
Study facilities and dates of data collection and pregnant and postpartum women recommendations by country.

Country & Facilities	Primary population (s) served	Facility type	Facility category	Location	Date of data collection	Date of pregnant and postpartum women recommendation
São Paulo, Brazil						
CAISM/Unicamp Hospital, Campinas	● Urban ● Higher-risk pregnancies	Public	Referral	Campinas, São Paulo	August 21, 2023-December 4, 2023	July 7, 2021
Hospital Universitario de Jundiaí	● Urban ● General population	Public	Referral	Jundiaí, São Paulo		
Greater Accra Region, Ghana						
Ga West Municipal Hospital	● Rural/urban mix ● General population	Public	Referral	Amasaman, Greater Accra	October 25, 2023-November 2023	January 20, 2022
Shai-Osudoku District Hospital	● Rural ● General population	Public	Referral	Dodowa, Greater Accra		
Nairobi, Kenya						
Aga Khan University Hospital	● Urban ● General population	Private	Referral	Parklands, Nairobi	October 13, 2023-March 8, 2024	January 29, 2022
Pumwani Maternity Hospital	● Urban ● General population	Public	Referral	Pumwani, Nairobi		
Karachi, Pakistan						
Aga Khan Hospital for Women and Children, Kharadar	● Urban ● General population	Private	Secondary and tertiary	Karachi	February 26, 2024-May 25, 2024	May 8, 2021
Jinnah Postgraduate Medical Center	● Urban ● General population	Public	Tertiary	Karachi		

working in the communities where recruitment was occurring, and spent extensive time during the training on issues related to bias and reflexivity. Data collection teams also pre-tested the guides extensively among members in their communities to ensure that questions were clear and understood by participants. Semi-structured interview guides were reviewed and pretested before finalization. The guides included questions on the decision-making processes related to SARS-CoV-2 vaccines and are publicly available [14]. Interviews were audio recorded and all teams followed standardized procedures for audio transcription to ensure anonymization of all transcripts. All study data were managed and stored using REDCap electronic data capture tools hosted at the Johns Hopkins Bloomberg School of Public Health. Data collection was done in Brazilian Portuguese in Brazil; Ga, Twi, or English in Ghana; Kiswahili or English in Kenya; and Urdu in Pakistan. In-depth interviews lasted between 30 and 60 min. Ethical review and approval for the overall study was sought from the Johns Hopkins Bloomberg School of Public Health Institutional Review Board and World Health Organization's Research Ethics Review Committee. Individual country teams sought and obtained approvals from the appropriate entities: Committee of Research Ethics, University of Campinas (Brazil); Jundiai University Institutional Review Board (Brazil); Ghana Health Service Ethics Review Committee (Ghana); The Aga Khan University's Institutional Scientific and Ethics Committee (Kenya); Pumwani Maternity Hospital Ethics Review Committee (Kenya); National Council for Science, Technology, and Innovation (Kenya); Nairobi County Research and Development Committee (Kenya); The Aga Khan University Institutional Ethics Review Committee (Pakistan); Institutional Review Board at Jinnah Postgraduate Medical Center (Pakistan).

2.4. Data analysis

For Brazil, Kenya, and Pakistan, audio files from in-depth interviews were transcribed in the language they were conducted in and then translated into English. For Ghana, transcripts were transcribed into English from Ga or Twi. All transcriptions and translations were reviewed by an independent study team member fluent in both languages.

We conducted a thematic analysis. Each country went through an independent and iterative open coding process with representatives from each team. A minimum of two open coding sessions per country were conducted to develop, refine, and finalize a codebook. Study team members participating in the open coding sessions reviewed the same random selection of transcripts and through an iterative approach, a final codebook was generated. A team of 5 who have extensive experience in qualitative research (RJL, JLS, BF, PS, ESM) coded all transcripts using Atlas.ti software and met with the broader team with representatives from each country to discuss emerging themes. 10 % of transcripts were randomly chosen (5 transcripts per country, for a total of 20 transcripts) and a researcher who did not code any of the transcripts chosen conducted interrater reliability testing, which was 89 %.

3. Results

A total of 201 pregnant women were interviewed, with approximately half of interviews in each country conducted among postpartum women and half among pregnant women. Across the 201 participants, 132 (65.7 %) participants indicated that they had been vaccinated against COVID-19 at any time (98 % of Brazilian participants (49/50); 39 % (20/51) of participants in Ghana, 74 % (37/50) in Kenya, and 52 % (26/50) in Pakistan). Only 15 (30 %) participants in Brazil, 0 participants in Ghana, 7 (14 %) participants in Kenya, and 4 (8 %) participants in Pakistan indicated that they had received at least one COVID-19 dose during pregnancy. See Fig. 1 for study participant information and Table 3 for sociodemographic characteristics of the sample.

We used a socio-ecological model to organize our data, and facilitate a structured understanding of how and what factors influence participants' decision-making process. The socioecological model is a multilevel model which conceptualizes a given health behavior as being influenced by different factors ranging from personal to policy (see Fig. 2). Our analysis identified several levels of influences that affect vaccine-related attitudes and behaviors among pregnant and postpartum women: individual, interpersonal, community, and policy. While there were many influences that emerged from the data, we sought to categorize the most influential factors within each level,

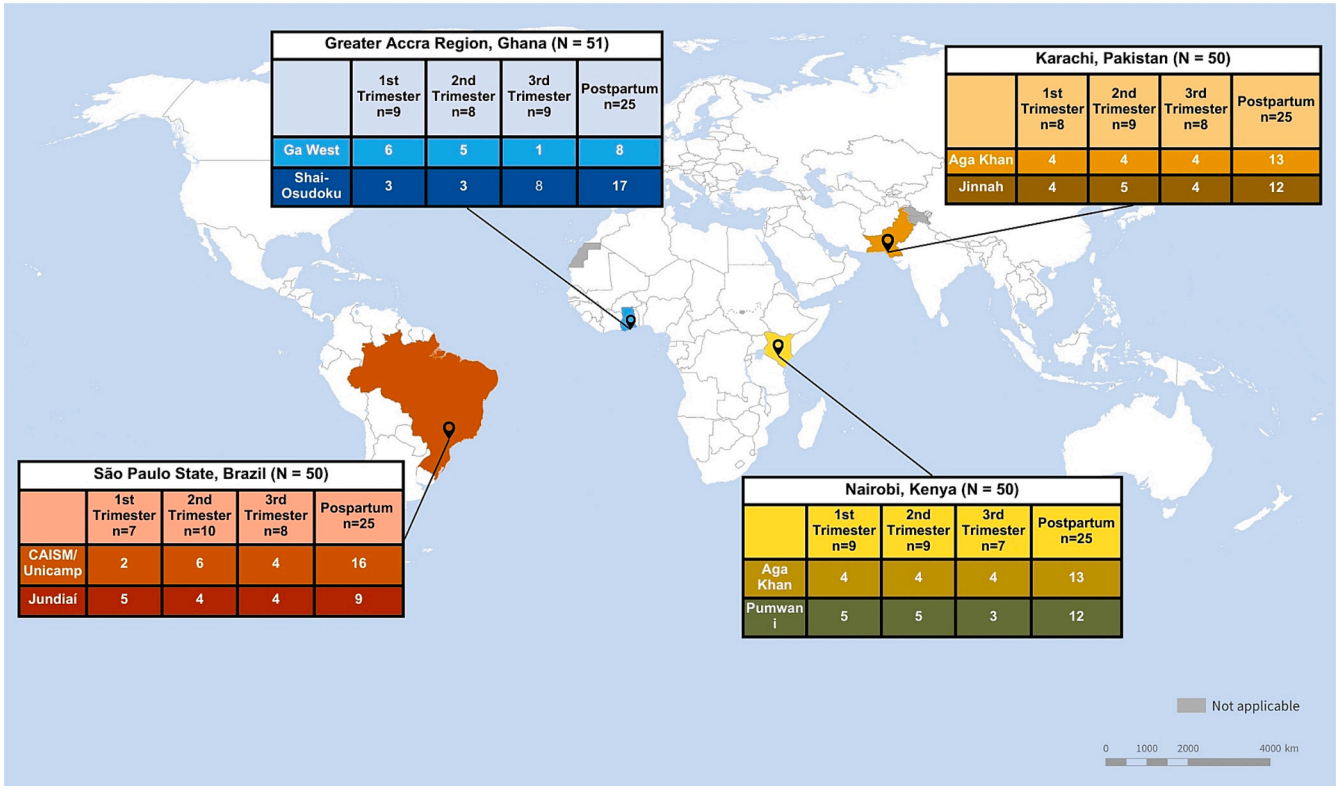

Fig. 1. Study participants by location and pregnancy status.

Table 3
Sociodemographic characteristics of the study sample.

	Overall (*N* = 201)	Brazil (*N* = 50)	Ghana (*N* = 51)	Kenya (N = 50)	Pakistan (N = 50)
Age, n(%)					
18–24	62 (30.8)	19 (38.0)	9 (17.6)	14 (28.0)	20 (40.0)
25–34	95 (47.3)	16 (32.0)	30 (58.8)	25 (50.0)	24 (48.0)
35–49	43 (21.4)	15 (30.0)	11 (21.6)	11 (22.0)	6 (12.0)
Unknown (older than 18)	1 (0.5)	0 (0)	1 (2.0)	0 (0)	0 (0)
Pregnancy Trimester, n(%)					
First (1–12 weeks)	33 (16.4)	7 (14.0)	9 (17.6)	9 (18.0)	8 (16.0)
Second (13–26 weeks)	36 (17.9)	10 (20.0)	8 (15.7)	9 (18.0)	9 (18.0)
Third (from 27 weeks)	32 (15.9)	8 (16.0)	9 (17.6)	7 (14.0)	8 (16.0)
Postpartum	100 (49.8)	25 (50.0)	25 (49.0)	25 (50.0)	25 (50.0)
Living children under 18 years of age, n(%)					
None	39 (19.4)	11 (22.0)	7 (13.7)	10 (20.0)	11 (22.0)
One	73 (36.3)	19 (38.0)	16 (31.4)	19 (38.0)	18 (36.0)
Two	35 (17.4)	9 (18.0)	9 (17.6)	14 (28.0)	4 (8.0)
Three	32 (15.9)	6 (12.0)	10 (19.6)	5 (10.0)	11 (22.0)
Four or more	22 (10.9)	5 (10.0)	9 (17.6)	2 (4.0)	6 (12.0)
Ever vaccinated for COVID-19, n(%)					
	132 (65.7)	49 (98.0)	20 (39.2)	37 (74.0)	26 (52.0)

comparing and contrasting findings by country as appropriate. See Fig. 2 for key influences that emerged through a socio-ecological lens.

3.1. Individual-level vaccine influences: risk perception of COVID-19 - susceptibility and severity, vaccine safety concerns

While women across the four countries had varying risk perception and attitudes toward COVID-19 disease and COVID-19 vaccination, the overwhelming individual-level influence that emerged related to vaccine acceptance was protection from disease and its consequences. This included protection of the mother, the baby, and the community. On the other hand, the primary individual-level factor that emerged related to not accepting the vaccine was also risk perception - with women believing they were not at risk, and if they were at risk, the severity of the disease was not strong enough to warrant them getting a vaccine. Finally, participants raised various vaccine safety concerns.

3.1.1. Individual-level vaccine influences: risk perception of COVID-19 - susceptibility

Several women mentioned that pregnant women were at higher risk of COVID-19 outcomes as a reason to receive the vaccine, such as this pregnant woman from Brazil:

> "We're already vulnerable. My experience with COVID, if I were pregnant, I wouldn't even be able to feed myself. I stayed like that for two days. So, for pregnant women, COVID would be much worse." *(pregnant, 26, vaccinated, Brazil)*.

This vulnerability extended to the fetus, as this same pregnant woman continued:

> "I believe pregnant women are more exposed - it is a sensitive period for pregnant women. They can get anything more easily, including Covid. Covid may harm the baby." *(pregnant, 26, vaccinated, Brazil)*.

This postpartum woman from Kenya expressed similar concerns:

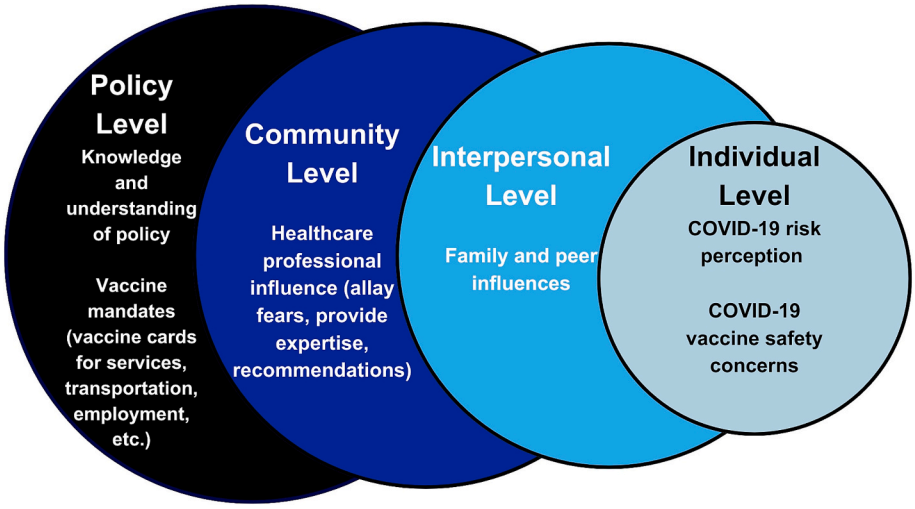

Fig. 2. Key influences of COVID-19 vaccination behaviors among pregnant and postpartum women through a socio-ecological lens.

"I think that if you get very sick when you are pregnant there is not much anyone can do and it presents a big risk to yourself and your baby if you get severely ill. So having a vaccine is something that we should recommend - especially the pregnant women…your immune system is more vulnerable to a bad case of a COVID if you are pregnant." *(postpartum, 41, vaccinated, Kenya)*.

3.1.2. Individual-level vaccine influences: risk perception of COVID-19 – severity and vaccine effectiveness

There were varying beliefs related to how the vaccine could prevent COVID-19 and/or reduce the severity of disease. These beliefs were primarily related to the person getting the vaccine (the pregnant woman) but also included the fetus. Women in all four countries articulated that they felt that the vaccine prevented COVID-19, such as this postpartum woman from Ghana who articulated that she got the vaccine for protection:

"I got the vaccine so that I don't catch the virus. I don't want to sit there and get the virus if I can take the vaccine to protect myself." *(postpartum, 32, unvaccinated, Ghana)*.

This postpartum woman in Brazil expressed that she received the vaccine to prevent her fetus from getting COVID-19:

"I received the vaccine to prevent the child before he/she comes into this world - to protect the child. Pregnant women should take the vaccine because there is still time. I think it protects us a lot before we give birth." *(postpartum, 34, vaccinated, Brazil)*.

This postpartum woman from Pakistan highlighted how the vaccine protected against COVID-19 disease:

"These vaccines are given for protection, for safety from COVID-19. If you get them, it's beneficial for you. You won't get a fever, won't cough, and the disease won't spread. You will be protected." (postpartum, 43, vaccinated, Pakistan).

Reducing the severity of COVID-19 emerged as a factor for vaccination, as illustrated by this postpartum woman from Kenya:

"If you get COVID-19 — if you haven't been given the vaccine it was affecting you a lot… but if you get COVID-19 after you are given the vaccine it helps a little to prevent the effects of COVID-19 if it was to hit you like a thousand times (without the vaccine) now it hits like fifty times." *(postpartum, 31, vaccinated, Kenya)*.

This also included preventing death, as many women raised the concept of COVID-19 as a death sentence, including this postpartum woman from Kenya:

"You see that time when COVID-19 was coming we were being told people are falling down and dying and then when we see on the television people were falling down and dying…so we were being injected so that we don't die." *(postpartum, 31, vaccinated, Kenya)*.

COVID-19 as a death sentence arose commonly among participants from Kenya, including this postpartum woman:

"To prevent myself from getting it, there was a panic. What I saw on television was scary honestly. A lot of people were dying and just a thought of it was scaring me. So, I made a quick decision to go for the vaccine. At the time I didn't ask anything - I just went for it to prevent myself from getting infected with COVID-19. Just the thought of getting infected was really scary, I mean did you see how people were dying?" *(postpartum, 37, vaccinated, Kenya)*.

Many Kenyan participants were motivated by fear of death from COVID-19, including this postpartum woman:

"Because it was said [COVID-19] is bad, it kills, so I decided let me now go get [the vaccine]." *(postpartum, 23, vaccinated, Kenya)*.

Additionally, women expressed the need to protect others in their communities as a reason to accept the vaccine, such as this pregnant woman from Kenya that teaches at a university:

"Because I did not want to die, but also, we were working in these areas where you are serving people. So, you are coming into contact with many people. So that you also don't spread and if it crosses you do not get it." *(pregnant, 36, vaccinated, Kenya)*.

This pregnant woman from Brazil noted:

"I'm going to take it because it is necessary to protect the life of someone I already care about, and that is going to be good for my neighbor, it's going to be good for me as well. I'm not just doing good for myself, I'm doing it for those who will come close to me as well, not just thinking about "me," but thinking about others." *(pregnant, 26, vaccinated, Brazil)*.

Risk perception was also a driving influence for women to not get vaccinated primarily among women in Ghana. Many women in Ghana did not believe COVID-19 was a real concern, and in fact, many believed it was not real, as described by this postpartum woman:

"We thought, it's a forged disease that doesn't exist and from the look of things, the symptoms of coronavirus are more or less like malaria and any other diseases or sickness. So people say it's just

similar to malaria so it makes it difficult to understand that this sickness exists. People find it difficult to be convinced. People were not convinced to get the vaccine because it's a forged sickness. If it doesn't exist why do I have to go and boost or go in for the vaccine?" *(postpartum, 35, vaccinated, Ghana)*.

This pregnant woman was convinced that COVID-19 was no longer an issue:

"It was very difficult (for me to get the vaccine) because I didn't believe there was any virus. The virus is not in existence anymore so why are they still giving it to us?" *(pregnant, 32, vaccinated, Ghana)*.

This postpartum woman from Kenya referred to few cases of COVID-19 as a reason why she did not need to get a booster:

"I don't think I would take another vaccine right now. I just feel like the Covid infections have really gone down tremendously and we don't need another jab since I have had two and I think it's enough. I don't need the booster - too much vaccine into our bodies might react with your hormones, you know for us women, it's too much. Anything that will tamper with my hormones I am careful. I think it will affect my immunity and this can bring long-term effects in future." *(postpartum, 37, vaccinated, Kenya)*.

In addition to not believing COVID-19 was real, some participants in Ghana did not perceive the effects of a natural infection as severe enough to warrant getting a vaccine, such as this postpartum woman:

"I have not come into contact with someone who is infected and there is no symptom showing that I am infected with the disease so I see no reason to take the vaccine. When you are not sick, you won't go to the hospital to see the doctor unless you are sick." *(postpartum, 29, unvaccinated, Ghana)*.

3.1.3. Individual-level vaccine influences: vaccine safety concerns

Participants also raised safety concerns, and the emergent concerns were found across countries. Table 4 summarizes the prevalent individual-level concerns raised by participants or what they heard in their communities.

3.2. Interpersonal-level vaccine influences: family, peers

Influence of the partner or spouse emerged as the most prevalent interpersonal-level influence. While male partners were critical in vaccine decision-making, the concept of a woman's autonomy also arose quite strongly in Ghana, Kenya, and Pakistan. Across all four countries, peers were used to learn from others' experiences in getting the vaccine to inform an individual's vaccine decision-making, especially because the vaccine was new.

Many participants relied on approval from their partners to get the vaccine, and this was especially prevalent in Ghana and Pakistan, while there was less influence of the male partner among participants from Kenya and Brazil. Many women in Ghana mentioned the need to consult their partners, as their opinion was critical, as per this postpartum woman in Ghana:

"Based on what they are saying I need to tell my husband before I can vaccinate. I have to tell my husband that I want to take the coronavirus vaccine and what he will say will take effect. In our setting, if you want to do anything you have to tell your husband. Whatever your husband says, your family will have no objection to it. If he says I should go and vaccinate, that is final. If he says otherwise, that is also final. If my husband says I should go and vaccinate but my family says I shouldn't, I can't go against my husband's decision." *(postpartum, 23, unvaccinated, Ghana)*.

This postpartum woman concurred:

Table 4
Individual-level vaccine influences: Vaccine safety concerns heard in communities.

Complications related to the mother	"For pregnant women I do not recommend it because of the stories of the abortions *(pregnant, 33, vaccinated, Brazil)*
	"They said they will get miscarriage." *(postpartum, 26, vaccinated, Ghana)*
	"Someone said when the person takes the vaccine, the child will die, and she too will die." *(pregnant, 27, unvaccinated, Ghana)*
	"She went and was vaccinated, but soon after vaccination, coming back home she passed away, so they said she was injected with the vaccine and it came with all other illnesses so she died." *(postpartum, 31, vaccinated, Kenya)*
	"People fear complications in pregnancy and introducing new things into your body is a big problem." *(pregnant, 22, unvaccinated, Kenya)*
	"The women from the neighbourhood, and whenever I visited the hospital, the female patients sitting next to me, all used to say these things that getting vaccinated leads to death." (*pregnant, 27, unvaccinated, Pakistan*)
	"The doubt is: if you are pregnant and take this vaccine now, will your child be born impaired or not." *(pregnant, 41, vaccinated, Brazil)*
	"Pregnant women who took it, their fetuses would be born with some heart-related complications." *(postpartum, 29, vaccinated, Brazil)*
	"The information we used to receive was: 'my son was ok, then he took the vaccine and was paralyzed here'. How can a person that is a mother take the vaccine or take her child to get it, a child who is fine and that you know that after the vaccine instead of helping him it could cause him some harm? So, it's quite complicated." *(pregnant, 26, vaccinated, Brazil)*
Complications related to the baby	"My concern is that drugs have different ways it works in our system. The same thing applies to the Coronavirus, there might be side effects and it may affect my child if I go and take it because I am breastfeeding him and he will suck it through my breast. Personally, I don't think pregnant people and nursing mothers should be included." *(postpartum, 29, unvaccinated, Ghana)*
	"Some said your child might lose his memory when born or won't have a sound mind. Some said your child cannot walk after you give birth." *(pregnant, 27, unvaccinated, Ghana)*
	"But I won't do it because my child might be infected or die, and I won't know what to do, so I won't accept it." *(postpartum, 38, unvaccinated, Ghana)*
	"I know some people are still reserved because they don't know what it will do to the child." *(postpartum, 31, vaccinated, Kenya)*
	"The doctors advised to take the vaccine, but said it might have side effects on her baby. The vaccination could be heavy (strong). It could cause a miscarriage or the baby might be affected by other diseases." (*pregnant, 22, unvaccinated, Pakistan*)

(*continued on next page*)

Table 4 (*continued*)

	"The reason is that it could harm the child (if vaccinated). Just because it could harm the baby. It's because heavy tablets (medications perceived to be strong and/or high dosage) cannot be taken, and if it is taken, it can harm the child more." (*pregnant, 31, vaccinated, Pakistan*)
	"Because whatever we eat, everything comes in the mother's milk. Now, if injections like these come, obviously when something happens to the mother, the baby will also be affected." (*postpartum, 30, unvaccinated, Pakistan*)
	"Many people said if you're a man, you'll not be able to give birth like you will become, your penis will be weak." *(pregnant, 26, vaccinated, Ghana)*
	"It can cause women to be infertile and they will not conceive again. Maybe it could cause death. People say that we will become zombies." *(pregnant, 34, vaccinated, Kenya)*
	"Men will be infertile because of the vaccine." *(pregnant, 34, vaccinated, Kenya)*
Infertility concerns	"People were saying if you are injected and you have never given birth, you won't ever give birth." *(pregnant, 29, unvaccinated, Kenya)*
	"They say it's a COVID-19 vaccine for protection. People came to our madrassa to administer it, but our madrassa teacher forbade us to get it because it causes infertility in the future." (*pregnant,18, vaccinated, Pakistan*)
	"With the vaccine, there was a lot of fear and rumors that it might cause infertility or other issues. People were scared and believed that those who got the vaccine would die within two years. Such rumors were widespread, so people were scared of Corona and those who already got vaccinated were afraid of what would happen." (*pregnant, 29, unvaccinated, Pakistan)*
	"They said after 5 years we that have been vaccinated will have strokes and others, is it true?" *(pregnant, 32, vaccinated, Ghana)*
	"Some said they won't take the vaccine because it's in the system as 666." *(postpartum, 34, vaccinated, Ghana)*
	"The misconception about the COVID is "666", then people are saying if you take it, you won't be able to conceive and that stuff. That's what [X president] and his people will use to get their money." *(pregnant, 26, vaccinated, Ghana)*
Unknown short- or long-term effects	"I heard (about) the magnet reaction so it scares me." *(postpartum, 37, unvaccinated, Ghana)*
	"They said it can damage your hand and can even light up a bulb." *(pregnant, 32, vaccinated, Ghana)*
	"The COVID vaccines are the ones that are causing cancer." *(postpartum, 35, vaccinated, Kenya)*
	"I heard that people get blood clots and they die." *(pregnant, 35, unvaccinated, Kenya)*
	"You hear someone has been injected and gotten paralyzed. Another one says the fingers got paralyzed." *(postpartum, 27, vaccinated, Kenya)*

Table 4 (*continued*)

	"Most people, especially the elderly had more severe side effects after getting the COVID vaccine. My mum and dad suffered severe headaches, sweating, and hands were numb for days. My mum had to be admitted to the hospital because of the headaches." *(postpartum, 23, unvaccinated, Kenya)*
	"(I have concerns) about this one because of the short production time, limited in terms of following up with people and seeing how the vaccine has affected their life." *(pregnant, 33, vaccinated, Kenya)*
	"After getting the vaccine, a family member had a stroke. A blood vessel in their brain was damaged, part of the brain was damaged. The same issue happened to two or three others in the family. They got the vaccine at night, and by morning their health deteriorated. They started foaming from the mouth and collapsed." (*pregnant, 24, unvaccinated, Pakistan*)
	"The white men want the Africans also to die, so that's why they brought this vaccine in to kill the Blacks." *(pregnant, 35, vaccinated, Ghana)*
	"I'm scared because people claim you'll die if you take the vaccine. The vaccine can kill. It is strong. It is rather the vaccine that is killing us. [Mr. President] is lying to us. You'll die if you follow his words. A lot of ranting on the radio claiming they're going to kill us through the vaccines. So, I decided not to take the vaccine if it's going to kill us. Even my husband hasn't taken the jab." *(postpartum, 38, unvaccinated, Ghana)*
	"Others are saying it is a way of controlling the African population." *(pregnant, 34, vaccinated, Kenya)*
Population control or experimentation	"Yeah, people fear that the vaccines may cause more harm to them than COVID itself so most of them were not keen on getting the vaccine. It's for whites not Africans. They are coming to test (the vaccine) on Africans so they were not keen on it." *(pregnant, 33, vaccinated, Kenya)*
	"It's a way of the government reducing population. It's just a government target to finish the population." *(pregnant, 22, unvaccinated, Kenya)*
	"Yes, (the vaccine will) create infertility because it's a conspiracy. Overall, this is to control the world's population. This is because Muslim countries don't have this thing of controlling population. So, these are being targeted toward Muslim countries specifically." (*pregnant, 28, vaccinated, Pakistan*)
	"Just (trust) herbal medicines (not non-herbal medications)." *(pregnant, 26, vaccinated, Ghana)*
Distrust in non-traditional medicine or organizations	"I don't believe these pharmaceuticals, I believe they look at the sales not the health, So, Pfizer and all those others… I think they are more about pushing productivity and profits." *(pregnant, 35, unvaccinated, Kenya)*
	"Because they paid money to get the (vaccine immunization card) made, it was also a way to earn money from the vaccine." (*pregnant, 28, unvaccinated, Pakistan*)

"My husband's opinion affects me most." *(postpartum, 38, unvaccinated, Ghana)*.

This woman from Pakistan said she would listen to what her husband told her to do about getting a vaccine:

"Yes, I will listen to him. (If he forbids), then I won't get vaccinated." (*pregnant, 27, vaccinated, Pakistan*).

Similarly, this woman from Pakistan commented:

"It all depends on my husband. If he agrees, then I'll get vaccinated." (*pregnant, 18, vaccinated, Pakistan*).

Another woman from Pakistan relayed that her husband's opinion was most critical:

"My decision would be influenced by my husband. I would do what my husband says." (*postpartum, 30, vaccinated, Pakistan*).

These women in Brazil and Kenya relayed how their husbands advised them to take the vaccine:

"My husband said it's a means of prevention, of protection. Actually, I was in doubt, and he said that I had to take it, that it was a means of protection, of prevention." *(postpartum, 29, vaccinated, Brazil)*. "Because COVID cases were on the rise. I used to travel for work and my husband was scared that I could get the virus out there and infect the children and him. So, he used to emphasize the importance of the vaccine." *(pregnant, 34, vaccinated, Kenya)*.

On the other hand, other women discussed how the influence of a male partner would be limited when making a decision to vaccinate, such as this postpartum woman from Ghana:

"My husband has his family, I also have mine even though we are married. He can't refuse me from taking the vaccine, it's my body and if something happens to me when I die, I will die alone." *(postpartum, 34, unvaccinated, Ghana)*.

Similarly, this pregnant woman from Ghana raised the importance of protecting herself:

"I am protecting myself. If he had even stopped me, I would still go to vaccinate." *(pregnant, 32, vaccinated, Ghana)*.

This was also evident among participants from Pakistan:

"I will (get the vaccine) according to my own will. I will get it on my own will." (*pregnant, 22, unvaccinated, Pakistan*).

There was less evidence of limiting the influence of the male partner in Kenya, but there were a few women who raised this, including this postpartum woman from Kenya: "When I got that vaccine he was angry and he told me, 'when you went to get that vaccine you didn't tell me when you get sick don't tell me,' I told him, 'The body is mine there is no problem even if I get a headache I won't tell you,' but God helped me – I felt nothing." *(postpartum, 25, vaccinated, Kenya)*.

Related to limited male partner influence, several participants received the vaccine without their husband's knowledge, such as this pregnant woman from Ghana:

"(My husband) didn't know I had gone to vaccinate. Before I went to vaccinate I didn't tell him." *(pregnant, 39, vaccinated, Ghana)*.

This was also raised in Brazil, as communicated by this pregnant woman:

"I heard pregnant women who said, '*Oh, I need to take the vaccine, my husband doesn't want me to take it because of political position, because of various issues, but I'm going to take it anyway, hidden from him, because I want to protect my baby*'. Her baby, she puts that as a priority, so I thought that was interesting in the sense that she didn't want to get into a fight with her husband. She at the same time didn't want to go against him, but she also didn't want to stop protecting her baby." *(pregnant, 39, vaccinated, Brazil)*.

This woman from Ghana received her first dose without her husband knowing:

"My husband wasn't around when I went for the vaccine. He came to meet my swollen hand (reaction from the vaccine) and got angry. So he hasn't taken the vaccine until now. He wasn't happy with it (me getting the vaccine)." *(pregnant, 32, vaccinated, Ghana)*.

Peers also influenced the decision-making process. Several participants had heard or knew of someone that took the vaccine and later experienced a severe adverse consequence which they believe was caused by the vaccine, like this pregnant woman from Brazil:

"There were more cases of close people. One woman's friend who lost her baby after the vaccine was from my praying group. She had taken the COVID vaccine at 35 weeks, then she lost her baby when she was 37 weeks. It was quite nerve-wracking! My other friend, at 24 weeks, her womb was perfect! She started to develop placental abruption. Then she had a miscarriage. She even got pregnant again and now she is already at thirty-eight weeks of pregnancy and she hasn't taken the COVID vaccine. She got the vaccine and that happened." *(pregnant, 33, vaccinated, Brazil)*.

The idea that the vaccine could cause miscarriage was also raised by this postpartum woman from Brazil:

"People were saying that many people lost their babies due to taking the Covid vaccine. Then I got scared. Then I didn't take it." *(postpartum, 24, vaccinated, Brazil)*.

A pregnant woman from Pakistan also heard negative things about the vaccine:

"I also got influenced by what people were saying, and hearing those things makes a person afraid. So, that's why I didn't get it." (*pregnant, 27, unvaccinated, Pakistan*).

More broadly, participants relied on the experience of their peers to decide whether or not to get the vaccine, especially because it was a new vaccine, as illustrated by this woman in Ghana:

"Well, I thought, at first, I thought those going for vaccines will die. So, I was waiting for them. I was waiting for them to come out with any good news. So, when they came, nothing happened to them. And then I also went for it." *(pregnant, 29, vaccinated, Ghana)*.

This was also evident in Kenya, per this pregnant woman:

"You know that vaccine was new and you had to look for advice from others. You hear this one is like this and I also used it and saw it was okay. Because something new you will only hear about it from people since you have not been where it was made from, so you depend on what others say." *(pregnant, 39, vaccinated, Kenya)*.

Similarly, this woman from Pakistan, when asked why she got the vaccine, responded:

"There was no reason I got the vaccine, everyone was getting it, so I got it too." (*pregnant, 31, vaccinated, Pakistan*).

3.3. Community-level vaccine influences: healthcare professionals, religion

At the community-level, the primary influence that emerged was healthcare professionals – including traditional and non-traditional providers at various levels of the healthcare system, including those that were formally trained and those that were not formally trained. There were two main roles healthcare professionals played in affecting acceptance: allaying vaccine fears, and providing their medical expertise

and personal recommendations related to receiving the vaccine. Table 5 provides illustrative quotes related to these two main roles. Related to allaying vaccine fears, women who had concerns about receiving the vaccine sought and/or received advice from healthcare professionals that helped address these fears and nudge women toward acceptance. Finally, in Pakistan only, a religion as a key influence emerged.

Additionally, in Pakistan only, women referenced religion as an influential factor, per this woman from Pakistan:

"I trust my Allah. I don't rely on the vaccine." *(pregnant, 28, unvaccinated, Pakistan)*.

At the same time, there were beliefs that the disease was brought by Allah:

"The more precautions we take, the more cleanliness and hygiene we maintain, the more we will stay safe. But diseases are ultimately from Allah." (*pregnant, 25, vaccinated, Pakistan*).

This woman felt similarly:

"Look, if a disease comes from Allah, it's a different matter. Illness comes from God, and if God wants to teach us something, He gives us illness. If God doesn't want to give us anything, then we won't get sick either." (*postpartum, 30, unvaccinated, Pakistan*).

Table 5
Community-level vaccine influences: Healthcare professionals' roles in vaccine acceptance.

	"I was afraid to take it. So, I went to the (health center) and the worker said, 'Pregnant women must take it. You must take it! It's important.' But I said, 'It's going to be bad for the baby.' She said, 'No, it won't. So far I've never seen anything like that.'" *(postpartum, 38, vaccinated, Brazil)*
Allay fears about vaccine	"The doctors and nurses who are providing prenatal care, antenatal care for women who are pregnant - they proactively tell their patients that it's important to get vaccinated…She reassured me that it was a good thing to do and that the risks were low that anything would happen to the baby and that in fact it would be worse if I got sick." *(postpartum, 41, vaccinated, Kenya)* "Because we were advised by the doctor, we should get it to maintain our health. (To prevent) from being infected by Covid. To protect my baby inside the womb." *(postpartum, 23, vaccinated, Kenya)*
Providing personal recommendation	"I've heard from my doctor and in reading about it that it's important to get the vaccine because even if you were pregnant because even if you feel a bit bad after you've taken the vaccine it can be dangerous to get a really bad case of COVID while you are pregnant." *(postpartum, 41, vaccinated, Kenya)* "Because you really have to take the vaccine, and when you come to the follow-up, the gynecologist says 'you have to take it' and I did it." *(postpartum, 30, vaccinated, Brazil)* "If the doctor recommends it, then I would get it." (*pregnant, 32, vaccinated, Pakistan*)
Providing expertise	"The hospital staff might have been convincing people at that time that you should get it, otherwise, you might face problems in future procedures." (postpartum, 30, vaccinated, Pakistan) "Mashallah, the doctors who trained us very well, explained everything very well." (*pregnant, 23, vaccinated, Pakistan*) "I believe a lot in doctors and scientists, and if it's good, we have to obey, we have to take it, because they studied for it, we didn't. I prefer to listen to the opinion of a person who understands the subject." *(postpartum, 30, vaccinated, Brazil)* "Now that the doctors have spoken to me, I'm convinced so I can now think about it and decide whether I'll take it or not. I also have to talk to my husband and let him know that what people are saying isn't true." *(postpartum, 37, unvaccinated, Ghana)*

3.4. Policy-level vaccine influences: vaccine card required for accessing services, transportation, employment

A key factor at the policy-level that influenced vaccine acceptance among participants across all countries was mandates and the requirement (or perceived requirement) of vaccination (indicated through a vaccine card) to access various services. This influence was very strong in pushing women to accept the vaccine. In Ghana, Kenya, and Pakistan, women indicated that they needed a vaccine card to be able to travel, and participants from all four countries indicated they needed a card for employment and education opportunities. In Kenya and Pakistan, women indicated that a vaccine card was needed to access basic services, including health care. Table 6 provides illustrative quotes related to policy-level influences.

4. Discussion

Vaccine uptake, especially among pregnant and postpartum women, is affected by a multitude of influences. On the individual level, knowledge and beliefs about COVID-19 vaccine safety, side effects, and effectiveness impact vaccine acceptance [15–17]. Our results also showed that risk perception for both the mother and the baby was a central individual influence. Specifically, lower disease risk perception was related to low vaccine uptake, while higher disease risk perception, including the belief that COVID-19 caused death, was associated with vaccine uptake. Similar to our results, another study found that lower COVID-19 disease risk perception among pregnant women in Sub-Saharan Africa was associated with lower COVID-19 vaccine acceptance [18]. Given that pregnant women are actually at higher risk of severe illness and outcomes from COVID-19 infection, addressing lower risk disease perception to increase vaccine acceptance is key [3,4,18,19].

Interpersonal influences including partners and peers can also influence vaccine acceptance, as seen in the present study. Norms among peers and community members have been shown to influence vaccine confidence among pregnant and lactating women in both Kenya and Bangladesh [20,21]. Previous research reports that partners, particularly male partners and husbands, serve as a major influence for many when considering the uptake of maternal vaccines given their role as decision-makers during their partner's pregnancy [20–23]. Despite the interpersonal influences that emerged in other studies as well as ours, participants also noted the importance of their own autonomy when making decisions about vaccination. Levels of personal autonomy for vaccination vary across settings and are affected by factors such as location, religion, and traditional values [22].

In our study findings, healthcare professionals emerged as the primary community-level influence for alleviating fears related to vaccine safety and providing a recommendation. Healthcare provider recommendation of a vaccine has been identified as one of the primary drivers of vaccine acceptance among pregnant women for maternal vaccines broadly [24,25]. This is largely driven by high levels of trust in healthcare providers by pregnant women in low- and middle-income countries [26,27]. For a new vaccine, such as the one for COVID-19, the established trust and relationships between healthcare providers and pregnant women greatly influence vaccine uptake during pregnancy

Table 6
Policy-level vaccine influences: Vaccine card required for accessing services, transportation, employment.

Perception that vaccine was mandatory/ needed the vaccine card	"When I took it now, they said it was a booster, that it was mandatory." *(pregnant, 35, vaccinated, Brazil)* "The first three shots I took because it was almost mandatory for everyone, right? The fourth shot I took because I was pregnant. Then the doctors, nurses told me to take it, that it'd be good for me, and I wanted to take it because I was pregnant." *(postpartum, 19, vaccinated, Brazil)* "I took the injection because I wanted the card - that's why I took the injection." *(postpartum, 28, vaccinated, Ghana)* "My reason was protecting myself and it was like we were supposed to take it if not you're not going to have the card. And the card behaves something like compulsory." *(pregnant, 24, vaccinated, Ghana).* "You couldn't go anywhere without it. They wouldn't even let you enter malls. You could only go if you showed your card, otherwise, you couldn't go. So, was that also a reason for getting vaccinated? Yes, if you wanted to be part of society and follow the system, you had to do it. So, that's why." *(postpartum, 30, vaccinated, Pakistan)* "People were getting vaccinated due to compulsion because wherever they were going whether it was the workplace, offices, or hospitals, the first thing they were asked for was the vaccination card. That's why everyone was getting vaccinated due to compulsion." *(pregnant, 22, unvaccinated, Pakistan).* "Yes, I have the vaccine because they said it will come to a time if you don't take the vaccine, you can't board a vehicle. And I'm not from this town, so I have to take it in order for me to be able to travel around in case I even want to go to my village." *(postpartum, 34, vaccinated, Ghana)* "I didn't want to vaccinate but they told us that if we don't vaccinate we won't be able to board cars or you can't travel. That is why I took the vaccine." *(pregnant, 32, vaccinated, Ghana)*
Vaccine card needed for travel	"I took the vaccine because I was scared I won't be able to pick a vehicle if I don't take the vaccine. During that week I even had a funeral at my village so that's why I went in for it." *(postpartum, 34, vaccinated, Ghana)* "My sister (took the vaccine) because she needed to travel." *(pregnant, 21, unvaccinated, Kenya).* "Wherever you go, whether it's a hotel or a hospital, everywhere they'll let you in after seeing your vaccination card." *(pregnant, 24, vaccinated, Pakistan)*
Vaccine card needed for employment	"People started getting vaccinated, if anyone was traveling by air, they must need to have the card (COVID vaccination card). Papa also went (by air) so he needed a card too whether he is vaccinated or not. People got vaccinated because they had to go. Earlier, there was a lot of strictness (about) whether the COVID vaccine was taken or not. That's why there's a separate small card made for it." *(pregnant, 35, vaccinated, Pakistan)* "Because people were saying that if I didn't take it, we wouldn't have a job, we wouldn't have anything, we would die of starvation [without anything]. So, I took it and went to see what it was, because people were saying '*oh, it will turn you into an alligator, it hurts, I don't know what*', so I went to see what it was. Because just like I said, I told my grandparents '*I'm young, you know. You don't, you, I don't. I'm back in the job market, I need to work. How am I going to work without a vaccine?*' It was right around the time I was looking for a job. And some companies were asking. I got a babysitter job, and the kid's mother asked for my booklet [Vaccination Booklet]. I wouldn't be able to take care of her if I didn't have the Covid vaccine certification." *(postpartum, 24, vaccinated, Brazil).* "Most people got vaccinated because of their job. Yes especially these private companies, it was strictly forced else they would fire you. Most people were vaccinated but I didn't get it." *(pregnant, 32, unvaccinated, Ghana)* "Mostly the government workers (had to take the vaccine). Yes, some of them it was compulsory so you don't have any choice, like the police, immigration, they took it." *(pregnant, 24, unvaccinated, Ghana)* "It was compulsory the first time. The first time I got the vaccine was when I was getting employed and it was a compulsory thing. So, I didn't have a choice." *(pregnant, 31, vaccinated, Kenya)* "You know…if you want to continue working here and all that it is a must you get the vaccine, there was you know you are looking at my job and getting a vaccine, so you just go and get the vaccine." *(postpartum, 35, vaccinated, Kenya).* "(If you get the vaccine), you get a card. Without the card, you can't do any work. Even jobs require it." *(pregnant, 28, unvaccinated, Pakistan)* "They were vaccinated due to compulsion (forcefully)- job-related issues were happening. I mean, the company administration was also saying that this vaccine is mandatory, and they weren't letting people in without it, and masks, so even the school people were getting vaccinated for this reason." *(pregnant, 27, unvaccinated, Pakistan)* "They were saying that if you show the vaccination card, they'll allow us to enter [university]. I said it was my final year of research work. Although my exams were already conducted. Only the research coursework submission was due. The jury was due, and I had to use the library, so it was all necessary for me to get vaccinated and show them the vaccination card." *(pregnant, 24, vaccinated, Pakistan)* "People were being injected for free that… vaccination for Corona. In fact, they said you can't enter the hospital if you haven't…you can't be treated if you haven't been vaccinated."*(pregnant, 20, vaccinated, Kenya)*
Vaccine card needed to access health services	"I went to the clinic when my child was three months old and we were told it's a must we receive the vaccine so that the children can be treated. We refused and went to a private hospital and got the services we needed." *(pregnant, 31, unvaccinated, Kenya)* "There is a woman a friend of mine who went to the rural area and found her child sick, the hospital she took the child that hospital they went and were told for the child to be treated or for the woman to be treated they must have gotten the COVID injection, she refused she didn't go and they came back. When they came back the child continued to be sick and the woman said she won't put her child's life at risk, she will go get vaccinated so we went with her and we were injected. Now from that woman when she

(*continued on next page*)

Table 6 (*continued*)

	explained to me you see this vaccine, now I've refused to be vaccinated, my child cannot be treated because I have not been vaccinated. I just saw, let me just go with her, we go get vaccinated because maybe tomorrow my own will be sick so I went." *(postpartum, 25, vaccinated, Kenya)*
	"When we used to go to the hospital when COVID-19 was widespread, the female doctors were saying that 'You will be treated when you get vaccinated. We won't do checkups until you have your vaccination card with you'." *(pregnant, 22, unvaccinated, Pakistan)*

due to patients' reliance on providers to give vaccine information and recommendations [28]. A 2023 review of 44 studies found that a lack of recommendation or an explicit recommendation against taking the COVID-19 vaccine during pregnancy from a healthcare provider influenced pregnant patients to not get the vaccine [29]. Given the importance of healthcare provider recommendation on maternal vaccine decision-making, ensuring that the policies are clearly disseminated to healthcare providers and that their own concerns about COVID-19 vaccines have been addressed is paramount to increasing uptake during pregnancy. This is particularly critical in situations where recommendations regarding inclusion of pregnant women evolve over time, as was the case for COVID-19 vaccines.

Mandates for vaccination were implemented across the world at various time points to encourage uptake [30]. Some participants in our study obliged with vaccine mandates, both real and perceived. Other studies have found that, while vaccine mandates have been utilized previously with other vaccines, the intense politicization of the COVID-19 pandemic introduced new obstacles for compliance [30–32]. Trust in government and other institutions is not only an outcome of mandates, but also a predictor of mandate support, with increased trust being associated with adherence in settings such as Uganda and Sierra Leone [32,33]. Additionally, COVID-19 vaccine mandates among healthcare providers had negative effects and led to fear, anxiety, diminished trust in policymakers, as well as increased vaccine hesitancy among healthcare providers [32,34].

There are limitations to this qualitative study. We conducted in-depth interviews as we believed this was the best method to glean information about vaccination behavior within the context of changing policy recommendations, but other qualitative methods could have assisted in triangulating the findings. Data were collected at least one year after permissive policies toward vaccination of pregnant and postpartum women were in effect. Data were collected from 2023 to 2024, well past the peak of the pandemic; study data collection timing likely influenced responses. Each country had varying policies and vaccine brands available, which could have also influenced responses.

Study participants were interviewed at health facilities while they were attending antenatal and postnatal appointments. Although the study staff conducting the interviews were not clinic staff, the location of the interviews can result in social desirability bias. There were also large differences in participation rates between the countries and even within countries at different study sites, this may have introduced selection bias to the study sample. Study sites within countries were selected to represent different populations within a country. All participants were pregnant or postpartum women, and although the interview topic is not explicitly gender-sensitive, there were male interviewers in two different country teams. The gender difference between interviewer and participant may have influenced the responses that participants gave. To mitigate many of the limitations listed above, all study staff were trained in qualitative and interviewing best practices and pilot testing was conducted prior to data collection start.

This study indicates that vaccine decision-making does not occur in a vacuum. In fact, across countries, women are likely affected by individual-, interpersonal-, community- and policy-level influences. While we acknowledge that there are other potential influences that could serve as facilitators and/or barriers to vaccine uptake, such as vaccine campaigns, for example, we have focused our discussion the data collected from this study. These influences at these various levels can be context- and vaccine-specific, which suggests the need for formative research to better understand how these influences may affect decision-making prior to when a vaccine is made available in a community. However, the lessons learned from COVID-19 vaccines could be valuable when planning for other new vaccine introductions. We were able to identify primary influences at each level, and these findings indicate the importance of including male partners and healthcare professionals in programs promoting vaccination during pregnancy. Additionally, given the array of vaccine safety concerns raised, ensuring that women and those who influence them are aware of the risks and the benefits of vaccines targeted toward pregnant or postpartum women is paramount. While maternal vaccination has substantially reduced maternal and neonatal morbidity and mortality, it is important to remember that vaccines do not save lives; vaccination does. As such, working with pregnant women, postpartum women, and those that influence them as partners in protecting their health will help nudge this important group toward accepting maternal vaccines.

CRediT authorship contribution statement

Rupali J. Limaye: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Berhaun Fesshaye:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Emily S. Miller:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Prachi Singh:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Saleem Jessani:** Writing – review & editing, Supervision, Project administration, Investigation. **Muhammad Asim:** Writing – review & editing, Project administration, Investigation. **Ferdinand Okwaro:** Writing – review & editing, Supervision, Project administration, Investigation. **Caroline Dinam Badzi:** Writing – review & editing, Supervision, Project administration, Investigation. **Emefa Modey Amoah:** Writing – review & editing, Project administration, Investigation. **Renato T. Souza:** Writing – review & editing, Supervision, Project administration, Investigation. **Maria Laura Costa:** Writing – review & editing, Project administration, Investigation. **Sarah Saleem:** Writing – review & editing, Project administration. **Marleen Temmerman:** Writing – review & editing, Project administration. **Kwasi Torpey:** Writing – review & editing, Project administration. **Jose G. Cecatti:** Writing – review & editing, Project administration. **Vanessa Brizuela:** Writing – review & editing, Supervision, Project administration, Methodology. **Jessica L. Schue:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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Data availability

Data will be made available on request.

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