



Trust, emotions and risks: Pregnant women's perceptions, confidence and decision-making practices around maternal vaccination in France



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ABSTRACT

Maternal vaccination is an important strategy to reduce maternal and newborn mortality and morbidity. Yet, vaccination uptake is suboptimal in many countries, including France. This mixed-method study aimed to identify factors influencing maternal vaccination, exploring pregnant women's perceptions, confidence, and decision-making processes in France. Maternal vaccination uptake was positively associated with awareness of maternal vaccines, confidence in vaccine effectiveness and receiving a recommendation from a healthcare professional. A trusting relationship with healthcare professionals was observed as crucial for women during pregnancy. Even if women considered themselves as sole decision-makers, healthcare professionals' role in decision-making was viewed as substantial. Pregnancy can be a complex time for assessing risks, which was evident in the strong emotional reactions to maternal vaccination and anxieties about safety. As new maternal vaccines are developed, it is crucial to consider women's values, risk perceptions and emotions in the development of strategies to support acceptance of maternal vaccination.

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1. Introduction

Maternal vaccination has become an increasingly important component of global strategies to reduce maternal and newborn mortality and morbidity [1]. Recommendations vary by country, in part due to differences in disease burden, but commonly include vaccination against influenza, tetanus and pertussis [2].

Since 2012, the inactivated influenza vaccine is officially recommended for pregnant women in France, while tetanus vaccination is only given to women considered at high-risk of infection and pertussis vaccination is given before or after pregnancy as part of a cocooning strategy [3]. The benefits of vaccinating pregnant women against influenza are two-fold; preventing influenza complications for the mother, and providing indirect protection to newborns, who are at higher risk of severe and sometimes fatal infection [4,5].

Despite official recommendations to vaccinate pregnant women against influenza, coverage for influenza vaccination among pregnant women in France was estimated at around 7% in 2016 [6,7]. This reflects a decrease in influenza vaccination coverage among all high-risk groups in France, in part explained by the spread of controversies since the 2009 AH1N1 pandemic [6]. Other factors

have been proposed to explain this decreasing trend, including low awareness of influenza vaccination among pregnant women, insufficient promotional campaigns and recommendations by healthcare professionals (HCPs), as well as concerns about vaccine side effects [6,8]. These results also reflect the overall and historical context of mistrust and low confidence in vaccination in the country. France was identified as the country with the lowest confidence in the safety and effectiveness of vaccines globally in a 2016 study [9]. The effects of this generalised vaccine mistrust on pregnant women's attitudes towards and confidence in maternal vaccination are unclear.

While a growing body of research contributes to the understanding of factors influencing uptake of maternal vaccination globally [10], evidence remains sparse in France. This mixed-method study aimed to explore the perceptions, confidence levels and decision-making practices around maternal vaccination among pregnant women in France. Such evidence can be crucial to inform strategies aimed at increasing current and future maternal vaccine uptake within the French national immunisation programme.

2. Methods

This study is part of a larger mixed-method research project investigating attitudes towards maternal vaccination worldwide.

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We collaborated with WIN/Gallup International Association (WIN/GIA) to recruit pregnant women and conduct surveys, interviews and focus groups in France. WIN/GIA collaborated with their local partner to obtain access to a panel of participants from which pregnant and recently pregnant women were selected. All study materials were developed in English and translated into French by local translators.

2.1. Quantitative methodology

2.1.1. Survey and data collection

A representative sample of pregnant and recently pregnant women (last child < 2 years old) were invited to participate in internet surveys in January 2019. These women were recruited from a nationwide panel of participants with relevant demographic information maintained by WIN/GIA's local partner in France. A quota-based sampling methodology was used to ensure that the sample of women was representative of the population distribution in the different regions of France (Supplemental Table 1). Most women included in the study had a recent pregnancy ($n = 386$, 77%), potentially influencing their recall of previous maternal vaccinations. The survey questionnaire included questions on women's attitudes towards vaccines in general (*not focusing on specific childhood, adolescent or adult vaccines*) and vaccination during pregnancy (both collected on a 5-point Likert scale), sources of information for maternal vaccination decisions, previous vaccination (self-reported), future maternal vaccination intentions, and socio-demographic characteristics.

2.1.2. Study variables

The outcomes, dichotomized as “yes” and “no” (no or don't know) for the analyses, were: 1) ever receiving a vaccination during pregnancy (also called “maternal vaccination uptake”) and 2) intention to be vaccinated in a future pregnancy. All participant characteristics were considered as potential explanatory factors in the analyses. Women's attitudes towards the importance, safety, effectiveness, and religious compatibility of vaccines during pregnancy were dichotomized as “agree” (strongly agree or tend to agree) or “not agree” (strongly disagree, tend to disagree, neither agree nor disagree or don't know). Women's concerns about illness during pregnancy, awareness about maternal vaccination, and whether they received an HCP recommendation for vaccination during pregnancy were also dichotomized. The socio-demographic variables investigated were age, relationship status, pregnancy status, employment, annual household income, educational attainment, and religious affiliation. The missing data (“prefer not to say”) percentage was low for marital status (1%), educational attainment (1%), employment status (1%) and household income (3%). Since the missing data percentage for religious affiliation was higher (14%), the “prefer not to say” responses were added as a separate category in the analyses.

2.1.3. Statistical analysis

Descriptive analyses were performed using means, standard deviations, and proportions for the study variables. Univariate analyses were conducted to assess the strength of association between the outcomes and each of the participant characteristics using the chi-square or Fisher's exact test as appropriate. Characteristics with an uncorrected $p < 0.25$ in the univariate analyses were included in the multivariate models using previously described methods [11]. Multivariate logistic regression was used to assess the participant characteristics independently associated with maternal vaccination uptake and future vaccination intentions. A backward stepwise method was used to retain variables with an uncorrected $p < 0.10$ in the final multivariate models. We used a parsimonious modelling strategy, accounting for marginally

significant associations between the explanatory variables and outcomes [12]. Hosmer and Lemeshow's goodness-of-fit test was used to evaluate the performance of the individual regression models. Multicollinearity between independent variables in the models was assessed using the variable inflation factor (VIF). Results of the logistic regression models were measured using crude and adjusted odds ratios (ORs) and presented with their 95% confidence intervals (CIs). We reported Holm-Bonferroni corrected p -values for the estimates from the multivariate logistic regression models as stepwise methods are known to inflate the probability of Type I errors (false positive results) [13]. Holm-Bonferroni corrected p -values below the 0.05 threshold were considered statistically significant. We also conducted sensitivity analyses to assess the impact of combining the “don't know” responses to the “no” categories for the outcomes of interest. All analyses were conducted in Stata 16 (StataCorp LP, College Station, TX, USA).

2.2. Qualitative methodology

2.2.1. Data collection

Semi-structured interviews and focus group discussions were conducted with pregnant women in their first, second or third trimester (<18 years old). Participants were recruited from two cities, Paris and Toulouse, selected to include different urban environments. Participants were purposively selected to include women with positive and negative attitudes towards maternal vaccination by including the following screening question in the recruitment phase: “On a scale of 1–10, could you tell me how strongly you agree or disagree with this statement, where 10 is agree completely and 1 is disagree completely: ‘I would take any vaccine recommended to me by a doctor’”. Recruiters were asked to include a mix of women who responded 1–3, 4–7 and 8+. Data was collected in French in February 2019 by local experienced professionals briefed on the objectives of the study. We aimed to conduct 20 semi-structured interviews (10 per city) and four focus groups with eight participants each. Two focus groups were conducted in each city: one for first time pregnancies, and a second group of women previously pregnant.

Topic guides were designed to collect data on awareness, experiences, perceptions, attitudes and decision-making factors influencing vaccination in pregnancy, while encouraging participants to share their views and opinions freely. While questions addressed maternal vaccination in general, discussions focused on influenza vaccination, the only vaccine officially recommended for pregnant women in France. Participants were compensated for travel and participation in the research.

2.2.2. Data analysis

Anonymised transcripts were translated into English and imported into Nvivo® for analysis. An initial coding framework was developed by deductively drawing codes from the topic guides, research objectives and analytical memos. Five transcripts were coded using the initial coding framework, using a more inductive process to derive additional codes from close readings of the data. The final coding framework was reviewed and used for the remaining transcripts and key themes were derived from a thematic analysis.

2.3. Data management and ethical approval

Data was collected by WIN/GIA following strict industry standards laid down by the professional bodies they subscribe to, such as the World Association for Public Opinion Research (WAPOR). Ethical approval was received to conduct secondary data analysis from the London School of Hygiene & Tropical Medicine (LSHTM) Ethics Committee in May 2019 (LSHTM ethics ref: 17100).

Participants were informed that their participation was entirely voluntary, and that they could withdraw from the study or refuse to answer any questions during data collection. Verbal or written informed consent was required to take part in the study. All participants included in the qualitative study approved audio recording of the discussions.

To ensure confidentiality, all data files were anonymised. Additional care was taken to remove personal identifiers from the anonymous quotations used in this paper, with codes assigned to participants (T for Toulouse and P for Paris). Data files were stored on an LSHTM secure server on password-protected computers. Data will be stored for ten years, and the records documenting the management of the project will be stored for six years following the completion of the research study, as per LSHTM's Records Retention and Disposal Schedule guidance.

3. Results

3.1. Participant characteristics

A total of 500 pregnant and recently pregnant women were surveyed across 13 regions in France. The majority of women were from the Ile-de-France ($n = 98$, 20%), Auvergne Rhone Alpes ($n = 63$, 13%) and Hauts-de-France ($n = 59$, 12%) regions (Supplemental Table 1). The mean age of women in the survey was 32 years. Over half the women had a university education or higher ($n = 307$, 62%) and a similar proportion were employed during the survey ($n = 304$, 62%) (Table 1). About a third of the women were Roman Catholic ($n = 174$, 35%) and just under a third were Atheist/Agnostic ($n = 146$, 29%).

The qualitative research included 53 pregnant women aged between 24 and 41 years, 20 of which took part in interviews and 33 in focus groups. Overall, 12 women responded 1–3 to the screening question on their views on vaccination (classified as negative views towards vaccination); 21 women responded 4–7 (neither negative nor positive), and 19 women responded 8+ (positive views towards vaccination). Data was missing for one woman. Focus groups included either one (P11, T11), two (P12), or three women (T12) with negative views towards vaccination.

3.2. Factors influencing maternal vaccination uptake and future vaccination intentions

Just over a fifth of the women surveyed ($n = 113$, 23%) reported ever receiving a vaccination during pregnancy and a quarter ($n = 126$, 25%) intended to be vaccinated in future pregnancies. In the univariate analyses, awareness about maternal vaccines, agreeing that vaccines during pregnancy are important, safe and effective, receipt of an HCP recommendation for vaccination, deciding on vaccination for self, being currently pregnant and having a higher household income were positively associated with both maternal vaccination uptake and future vaccination intentions (Table 1).

In the multivariate analyses, receipt of an HCP recommendation for vaccination during pregnancy was one of the strongest predictors of maternal vaccination uptake (Adjusted odds ratio (aOR): 11.10, 95% CI: 6.06–20.34) and women's future vaccination intentions (aOR: 3.27, 95% CI: 1.80–5.93) (Table 2). Women who agreed that vaccines during pregnancy are effective were more likely (than women who disagreed that vaccines during pregnancy are effective) to have received a maternal vaccination previously (aOR: 3.44, 95% CI: 1.96–6.05) and were more likely to be willing to be vaccinated in a future pregnancy (aOR: 3.83, 95% CI: 2.25–6.50). Awareness of currently available maternal vaccines was positively associated with maternal vaccination uptake (aOR: 3.65,

95% CI: 2.06–6.44) (Table 2). Women who had reported ever being vaccinated during pregnancy were four times more likely to be willing to be vaccinated in future pregnancies than those who had not been vaccinated previously (aOR: 4.26, 95% CI: 2.29–7.94) (Table 2). The findings of the sensitivity analyses excluding the “don't know” responses for the study outcomes were generally consistent with the results for the unrestricted analytical sample (Supplemental Table 2). In addition to positive associations between ever being vaccinated and receiving an HCP recommendation, there was some evidence to support associations between confidence in the importance of maternal vaccines and trust in information provided by HCPs and future vaccination intentions in the sensitivity analysis (Supplemental Table 2).

3.3. Accepting vaccines while taking on a new nurturing role: A change in perception

Women expressed more positive perceptions of vaccines in general than maternal vaccines. Compared to vaccines in pregnancy, women were specifically more likely to agree (strongly agree or tend to agree) that vaccines in general are important (78% vs 35%), effective (72% vs 34%) and safe (28% vs 18%) (Fig. 1-A-C). These differences were confirmed in the qualitative interviews, with women expressing strong fears around maternal vaccination: “I get the impression that I'm scared more now because I'm pregnant” (P11). Both women who support vaccination and those with pre-existing doubts about vaccines used particularly strong emotive language around the risks for their babies: “No. No, I really don't agree. Because during the pregnancy it is forbidden to take any medicine (...). So, no, no immunisation. We have a baby inside of us that is immunised against nothing so no. Not during pregnancy.” (P2) The difference in attitudes came together with a shift in the role and responsibility that women must assume when they become pregnant. In her new nurturing role, one woman described maternal vaccination as a disruptor of peace: “I'm creating a baby, I would rather create him peacefully and when he's going to be out, I will do all the vaccines peacefully” (P9).

3.4. Mistrust stemming from concerns about missing information

Just under a third of women surveyed ($n = 157$, 31%) reported being aware of vaccines currently administered during pregnancy (Table 1). Pregnant women questioned the need for maternal vaccination in the qualitative interviews and raised concerns about not having received information or recommendations from official sources, such as their HCPs or social security: “Unfortunately we are not informed enough about vaccines and I think that's why a lot of people don't get vaccinated, or don't dare to do it” (T1). This seemed to trigger worry and discontent with the general lack of health information provided during pregnancy in France: “As a pregnant woman, I do not believe we are sensitized enough about all the things we could do during pregnancy” (P6).

In the survey, the most frequently reported sources of information for vaccination decisions during pregnancy were HCPs (75%), family members (29%) and the internet (26%) (Fig. 2). While HCPs (74%) and family members (24%) were also listed as the most trusted sources of information, the proportion of women who trusted the internet for vaccination-related information was lower (12%) (Fig. 2). During the interviews, women seemed to justify their use of the internet, indicating a general acceptance that information online is not trustworthy. Mistrust of information was also raised more generally, with women repetitively asking for “proof”: proof that vaccines are well tested, safe, effective and important. Some discussed the trustworthiness of information provided in the media as well as the possible influence of the pharmaceutical industry: “How do you know that you're getting the right informa-

Table 1

Characteristics of study participants and their associations with previous vaccination and future vaccination intention among pregnant and recently pregnant women in France: 2019.

Characteristics	Categories	Total, N (%)	Ever vaccinated during pregnancy		Intend to be vaccinated in a future pregnancy	
			n (%)	P-value [‡]	n (%)	P-value [‡]
Concerned about illness during pregnancy	No or Don't know	157 (31.4)	27 (17.2)	0.051	32 (20.4)	0.093
	Yes	343 (68.6)	86 (25.1)		94 (27.4)	
Aware of vaccines currently available for pregnant women	No or Don't know	343 (68.6)	36 (10.5)	<0.001	56 (16.3)	<0.001
	Yes	157 (31.4)	77 (49.1)		70 (44.6)	
Vaccines during pregnancy are important	Not agree	325 (65.0)	34 (10.5)	<0.001	39 (12.0)	<0.001
	Agree	175 (35.0)	79 (45.1)		87 (49.7)	
Vaccines during pregnancy are safe	Not agree	409 (81.8)	68 (16.6)	<0.001	76 (18.6)	<0.001
	Agree	91 (18.2)	45 (49.4)		50 (54.9)	
Vaccines during pregnancy are effective	Not agree	332 (66.4)	36 (10.8)	<0.001	39 (11.8)	<0.001
	Agree	168 (33.6)	77 (45.8)		87 (51.8)	
Vaccines during pregnancy are compatible with my religious beliefs	Not agree	266 (53.2)	44 (16.5)	0.001	46 (17.3)	<0.001
	Agree	234 (46.8)	69 (29.5)		80 (34.2)	
Trust in information provided by health care workers	No	129 (25.8)	27 (20.9)	0.599	23 (17.8)	0.025
	Yes	371 (74.2)	86 (23.2)		103 (27.8)	
Health care worker recommended a vaccine during pregnancy	No or Don't know	331 (66.2)	19 (5.7)	<0.001	37 (11.2)	<0.001
	Yes	169 (33.8)	94 (55.6)		89 (52.7)	
Decide on vaccination for self	No	145 (29.0)	19 (5.7)	<0.001	37 (11.2)	<0.001
	Yes	355 (71.0)	94 (55.6)		89 (52.7)	
Pregnancy status	Previously pregnant	386 (77.2)	75 (19.4)	0.002	91 (23.6)	0.124
Respondent age	Currently pregnant	114 (22.8)	38 (33.3)		35 (30.7)	
	18–24 years	40 (8.0)	11 (27.5)	0.093	7 (17.5)	0.205
	25–34 years	305 (61.0)	59 (19.3)		73 (23.9)	
	35+ years	155 (31.0)	43 (27.7)		46 (29.7)	
Marital status (n = 496)	Not living with a partner or single	24 (4.8)	3 (12.5)	0.163*	6 (25.0)	0.981
	Married or living with a partner	472 (95.2)	110 (23.2)		119 (25.2)	
Annual household income (n = 484)	Up to 20,000 €	121 (25.0)	24 (19.8)	0.026	33 (27.3)	<0.001
	20,000–39,999 €	196 (40.5)	40 (20.4)		38 (19.4)	
	40,000–59,999 €	103 (21.3)	22 (21.4)		23 (22.3)	
	60,000 € and above	64 (13.2)	24 (37.5)		29 (45.3)	
Education (n = 493)	Primary or others	24 (4.9)	7 (29.2)	0.010	5 (20.8)	0.318
	Secondary	162 (32.9)	23 (14.2)		34 (21.0)	
	University or higher	307 (62.3)	80 (26.1)		83 (27.1)	
Employment (n = 494)	Not working	41 (8.3)	9 (21.9)	0.694	7 (17.1)	0.337
	On maternity leave	149 (30.2)	30 (20.1)		35 (23.5)	
	Working (full or part-time)	304 (61.5)	72 (23.7)		82 (27.0)	
Religion	Atheist or Agnostic	146 (29.2)	33 (22.6)	0.925	37 (25.3)	0.956
	Christian (Roman Catholic)	174 (34.8)	41 (23.6)		44 (25.3)	
	Christian (Protestant/Others)	26 (5.2)	7 (26.9)		8 (30.8)	
	Other religions (Muslim/Hindu/Buddhist etc.)	83 (16.6)	16 (19.3)		19 (22.9)	
	Prefer not to say	71 (14.2)	16 (22.5)		18 (25.4)	

*Uncorrected *p*-value from Fisher's exact test.

‡ Uncorrected *p*-values from chi-square test.

tion? The problem with vaccines is that there is huge lobbying behind all it" (P11).

3.5. My body, my choice: decision-making during pregnancy

The majority of women surveyed (*n* = 355, 71%) reported making decisions for vaccination during pregnancy by themselves, with women in the qualitative interviews reporting the importance of remaining in control of their pregnancy. While some mentioned the role of their partner, it was often limited. Overall, women expressed high confidence in listening to their own bodies, and not being easily influenced by others: "When I ask a question, I already have the answer, I already know what I must do, but [asking others] validates my opinion" (P2). This confidence in one's own decision was particularly strong among women who refused vaccination, while vaccinated pregnant women were more divided: some remained uncertain about their decision, concerned about the vaccine's safety or effectiveness and others described accepting the vaccine straight away, without any doubt.

3.6. HCPs and pregnant women: A relationship of trust

Women in interviews expressed strong trust in their HCPs, particularly during their pregnancy. Many women talked about the fear of being treated like a number in a factory, and the importance of HCPs taking a reassuring role, with a focus on personalised and attentive care. For some, this meant placing their trust in midwives, while others placed their trust in the perceived expertise of gynaecologists. Having a trusting relationship with HCPs was seen as a crucial component of a stress-free pregnancy: "I have no medical notions, so I trust them (...). Maybe that's why I don't have those fears that other mothers can have, because I have all those doctors and I trust them." (T5). While only a couple of women expressed mistrust of HCPs, many expressed discontent about HCPs not taking the time to discuss vaccination: "I have not yet met a specialist, doctor, health professional that would be ready or willing to speak about it in detail with me" (P8).

This strong and trusting relationship led some women to reject maternal vaccination as a result of their HCP not recommending

Table 2
 Characteristics associated with maternal vaccination uptake and future vaccination intentions among pregnant and recently pregnant women in France: 2019.

Characteristics	Categories	Total, N (%)	Ever vaccinated during pregnancy (N = 477)		Intend to be vaccinated in a future pregnancy (N = 484)	
			Crude OR (95% CI) ‡	Adjusted OR (95% CI) †	Crude OR (95% CI) ‡	Adjusted OR (95% CI) †
Aware of vaccines currently available for pregnant women	No or Don't know	343 (68.6)	Ref	Ref	–	–
	Yes	157 (31.4)	8.21 (5.15–13.08) ***	3.65 (2.06–6.44) ***	–	–
Vaccines during pregnancy are effective	Not agree	332 (66.4)	Ref	Ref	Ref	Ref
	Agree	168 (33.6)	6.96 (4.39–11.02) ***	3.44 (1.96–6.05) ***	8.07 (5.14–12.67) ***	3.83 (2.25–6.50) ***
Trust in information provided by health care workers	No	129 (25.8)	–	–	Ref	Ref
	Yes	371 (74.2)	–	–	1.77 (1.07–2.94)*	2.03 (1.07–3.83)
Health care worker recommended a vaccine during pregnancy	No or Don't know	331 (66.2)	Ref	Ref	Ref	Ref
	Yes	169 (33.8)	20.58 (11.83–35.80) ***	11.10 (6.06–20.34) ***	8.84 (5.60–13.95) ***	3.27 (1.80–5.93) **
Ever vaccinated during pregnancy	No or Don't know	387 (77.4)	–	–	Ref	Ref
	Yes	113 (22.6)	–	–	12.22 (7.52–19.86) ***	4.26 (2.29–7.93) ***
Annual household income	Up to 20,000 €	121 (25.0)	–	–	Ref	Ref
	20,000–39,999 €	196 (40.5)	–	–	0.64 (0.38–1.09)	0.53 (0.27–1.01)
	40,000–59,999 €	103 (21.3)	–	–	0.76 (0.42–1.41)	0.49 (0.23–1.04)
	60,000 € and above	64 (13.2)	–	–	2.21 (1.17–4.17)*	1.17 (0.53–2.60)

‡ Uncorrected p-values: * Significant at $p < 0.05$, ** Significant at $p < 0.01$, ***Significant at $p < 0.001$.
 † olm-Bonferroni corrected p-values: * Significant at $p < 0.05$, ** Significant at $p < 0.01$, ***Significant at $p < 0.001$.

vaccination or recommending against it: “I had planned to go to the pharmacy to pick up the vaccine and to get vaccinated on the same day by the doctor. (...) [But] I wanted to follow his opinion, so I didn't do it.” (T5). Only just over a third of women surveyed ($n = 169$, 34%) reported receiving an HCP recommendation for vaccination during their pregnancy (Table 1). Reports of doctors questioning the need, reliability or risk of maternal vaccination were influential on women's decisions in interviews.

Even in a context of high trust, doctors' recommendations were not always sufficient to convince women to receive a maternal vaccine, pointing to the influence of other factors in decision-making. The approach taken by HCPs also played a role, with women trusting their doctors more if they advised rather than pressured them to vaccinate.

3.7. Why vaccinate if you still have a risk of being sick?

Interviewed pregnant women who had refused influenza vaccination raised questions about the need for the vaccine, together with the perception that they would still be at risk of catching influenza after vaccination. Some referred to their personal experiences of catching the flu after getting vaccinated, while others relied on testimonies from the internet: “I heard a lot of things around me and on the internet about people who have been vaccinated and who still had the flu. (...) Why do it if it's to have the flu after it” (T1).

3.8. The importance of avoiding illnesses during pregnancy

Susceptibility to influenza was discussed as an influential factor for accepting as well as refusing vaccination during pregnancy. Vaccinated women showed a perceived high risk of catching the flu linked to past infection, working in a high-risk environment,

or the belief that pregnancy makes women more at risk of catching the flu. On the other hand, some women refused the flu vaccine because they did not feel at particular risk (e.g., not pregnant during winter, not an “at-risk” person, not exposed to flu).

Over two-thirds of the women surveyed ($n = 343$, 69%) indicated that they were concerned about illnesses during pregnancy (Table 1). While flu was rarely described as a severe disease in the qualitative interviews, women discussed the importance of preventing any type of illness during their pregnancy, even the more benign ones: “There have been many cases of flu (...) and I see in my Facebook group that the mums are all very worried about catching it.” (P6). While some women worried about their personal risk of complications from infections during their pregnancy (i.e., because they would not be able to take medicines, or care for their other children if sick), most referred to risks for their babies, such as miscarriages. Many women agreed they would vaccinate themselves against extremely dangerous diseases to protect their babies. The importance of vaccination to protect communities and those around them was also raised.

3.9. Emotional reactions to invisible risks

Concerns about safety were raised by women during interviews regardless of their vaccination status, with mentions of “risk” and “danger” for their babies. Specific side effects, apart from malformation and miscarriages, were not commonly discussed. Women instead expressed strong uncertainty surrounding the safety of vaccines: “R: I don't want to inject a product like this to a human being who lives inside me. I: What are you afraid of? R: The unknown, we do not know what the final result is and we will never know!” (P1). The thought that women cannot see what happens to their baby created the feeling of an “invisible” risk, which made them even more anxious: “if something goes wrong in my womb it's going to

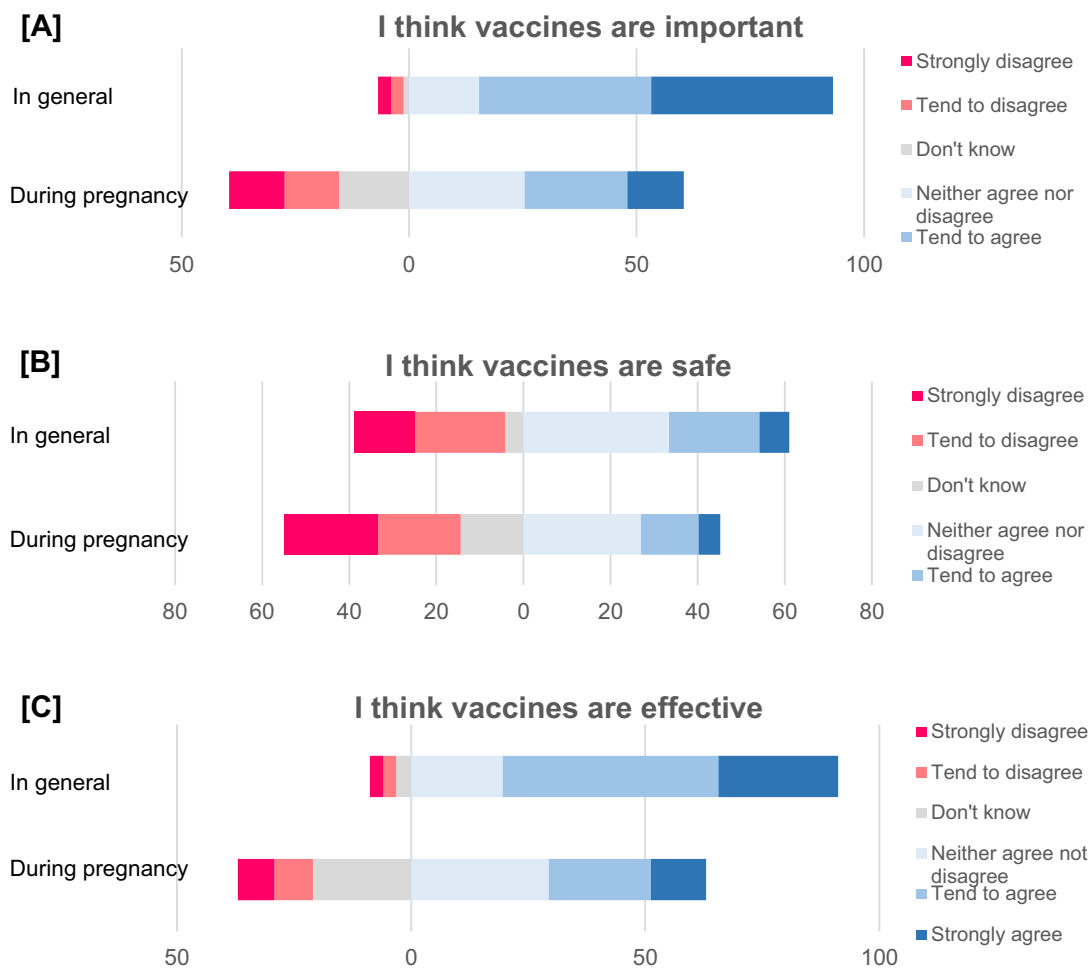


Fig. 1. A–C: Women’s perceptions toward the importance, safety, and effectiveness of vaccines in general and during pregnancy in the survey (N = 500).

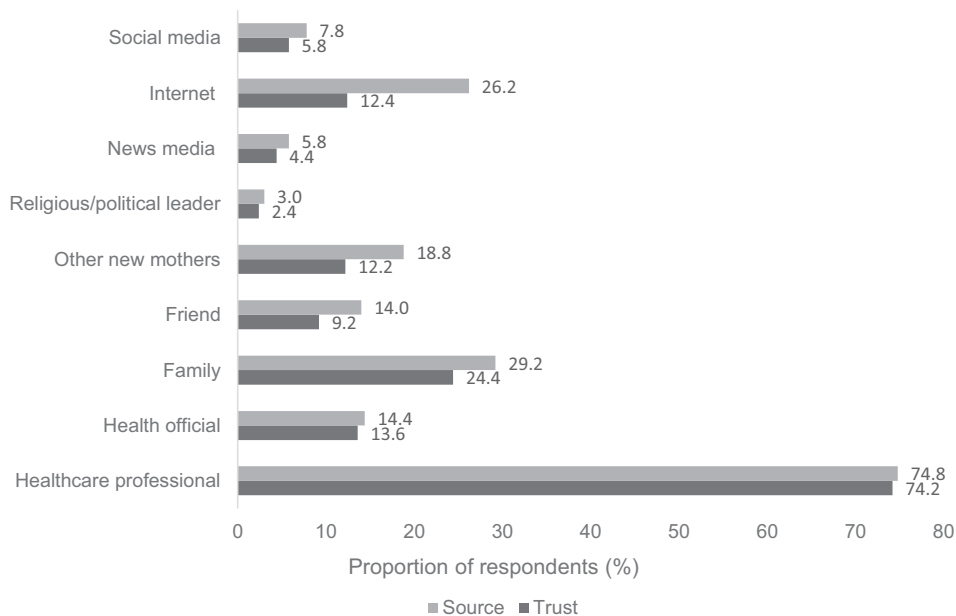


Fig. 2. Women’s sources of information and trust in these sources when making decisions on vaccination during pregnancy. Data from the survey (N = 500). Multiple responses were allowed.

be my fault and I won't see it" (P11). Women also described their doubts about vaccine safety as unlikely to change. They did not question vaccine safety, but how long it would take for risks to be exposed. In fact, few women showed high confidence in vaccine safety, with those who did expressing trust in science or HCPs: "if it was risky, they would not propose it" (T11).

Vaccine safety was an emotional topic for pregnant women. Women reacted strongly to the thought of receiving a vaccine during pregnancy, using emotive language ("brutal", "enormous"), repetitions and exclamations: "No way he's touching me!" (P12). Some women also discussed their responsibility and guilt if something bad were to happen: "You don't know how to proceed afterwards. What do you do if it goes wrong for the baby?" (P2). Emotional responses were reinforced when the discussion concerned their babies ("I'm afraid for the health of the baby, not for myself (...) I don't care about myself;" (T7)), with some discussing a maternal instinct that would be difficult to change.

Being pregnant also changed some women's tolerance for risks: the notion that you should avoid taking any risk during pregnancy, from smoking to drinking alcohol was very important: "You have to avoid taking certain medications, even if they say you can. You have to be careful" (P11). Medications were also perceived as risky, which made some women question maternal vaccination: "They tell us that small medicines are forbidden, even cough syrup is forbidden, so I don't really understand why this would be authorised" (P2).

4. Discussion

This study has found that vaccine uptake among pregnant women is low in France, with just over a fifth (23%) of women reporting ever being vaccinated during pregnancy and a similar proportion (25%) intending to be vaccinated in future pregnancies. While this compares to previous studies [6,14,15], understanding the reasons behind this low uptake is key to informing strategies to support maternal vaccination. Our study found that having a general awareness of maternal vaccines, being confident about the effectiveness of vaccines during pregnancy and receiving an HCP recommendation for vaccination were positively associated with maternal vaccination uptake. The strongest predictor of women's future vaccination intentions was having received a vaccination during a previous pregnancy. These findings are comparable to previous studies conducted in France and across the world [6,8,10,16–19].

By combining quantitative and qualitative data, our study was able to provide more in-depth understanding of the scope and scale of pregnant women's beliefs, emotions and decision-making. While no strong association was identified between vaccine safety and maternal vaccination uptake in the quantitative analysis, in-depth conversations revealed a more generalised consensus that vaccines may be unsafe, consistent with existing evidence [6,8,10]. When making decisions about vaccination, pregnant women did not question whether vaccines are safe, but whether - and when - the real risks would be exposed. This mirrors confidence issues observed in the general population, with global studies showing that a high proportion of adults in France question the safety of vaccines [9,20,21]. Women's tolerance for risk was also shown to decrease during pregnancy, especially when considering "invisible risks" related to the uncertainty of not seeing what might happen to their babies during pregnancy. This could in part be due to an "omission bias" and individuals' preference for risks related to non-vaccination over risks related to the active act of vaccination [22].

Pregnant women in this study were much less likely to perceive maternal vaccines as important, effective and safe than childhood vaccines; and when compared to the 2018 EU Vaccine Confidence

survey, we also found to be less confident than the French general population (Supplementary Fig. 1) [20]. This could be explained by pregnancy being a relatively complex and emotional period for women to reason about risks, as their responsibility shifts from making decisions and assessing risks for themselves to thinking about both their own and their baby's health [24]. These emotional changes could impact vaccination intentions, supporting the concept of "emotional determinants of health" [25]. Our study showed that women often used very emotive language when talking about maternal vaccination, particularly risks. Chapman and colleagues have shown that emotions can mediate risk perceptions, with worry about the risk and severity of diseases prompting preventive action [23]. This protective emotional reaction was observed in this study, with women taking on a nurturing role and discussing the importance of protecting their children against any type of diseases.

Both the qualitative and quantitative findings from our study revealed a paradox in maternal vaccination decision-making: while pregnant women expressed the conviction that maternal vaccination should remain a personal decision, the influence of HCPs on their decision was evident. The "my body, my choice" narrative has been central to discussions around women and reproductive health, including vaccination [26,27]. In this study, pregnant women reflected on the importance of being in control of their pregnancies and listening to their own voice. This points to the need for communication campaigns to shift their focus from imposing maternal vaccination to engaging with and empowering pregnant women. Shared-decision making can help reduce anxiety, lower decision conflict and increase knowledge and satisfaction [28,29].

Healthcare professionals can play a key role in facilitating dialogue, as part of a trustworthy yet informed relationship. This study has shown the powerful impact HCPs can have when they offer a reassuring, compassionate and attentive presence. Unfortunately, studies have shown that HCPs themselves might be losing confidence in vaccination in France [30,31], which has been reflected in this study with some women reporting that HCPs were not recommending or recommending against maternal vaccination. The influence of hesitant HCPs, particularly midwives and gynaecologists who might be less commonly involved in vaccination communications, comes at a crucial time when women are forming their opinions about vaccination as pregnant women, and as future mothers.

The major strength of this study has been the use of a mixed method approach to provide a comprehensive picture of pregnant women's beliefs, perceptions, emotions, and confidence in maternal vaccination in France. Some limitations should be highlighted. Participants in the quantitative survey were recruited using quota sampling, a type of non-probability sampling, to form a study sample that were approximately representative of the regional population distribution in France. Non-probability sampling may not offer the same level of population representativeness as probability-based sampling. It is important to note that less than a quarter of the women (n = 114, 23%) were pregnant during the survey, suggesting that the potential for recall bias around previous maternal vaccinations may be high. While we were unable to verify these self-reported data by reviewing medical records, we assessed women's intention to be vaccinated in future pregnancies as a supplemental indicator of maternal vaccination acceptance in our study. Weighting of study proportions and regression estimates was not possible due to lack of national data on the distribution of currently and previously pregnant women. We used a parsimonious modelling approach employing stepwise regression, which can sometimes yield biased regression coefficients in addition to the increased probability of Type I errors [13]. We compared the stepwise models with the full models (with no variable selection

performed) for each of the study outcomes using Likelihood Ratio Tests (LRTs), there was no evidence to suggest an improved fit for the full models (Supplemental Table 3). It is also important to consider the cross-sectional nature of the surveys, which limits causal inference from the observed associations. Furthermore, while the impact of the interviewer on participant responses in the qualitative study is non-negligible, bias was limited by using a trained French speaking female researcher and reliability was guaranteed by using good fieldwork and analysis practices as well as comprehensive analysis of the entire data set. French interviews were translated and transcribed into English, which could have contributed to some concepts being lost in translation. This was mitigated by close listening to the audio-recordings by the French-speaking researcher analysing the data.

Many of the factors explaining low maternal vaccination uptake in France are similar to those found in other parts of the world, but they are complex and need to be understood as part of a period of change for pregnant women. While the importance of HCPs in pregnant women's decisions is not unique to France, the strong relationship based on trust could be detrimental if HCPs in France are losing confidence in vaccination. The patient-doctor relationship also needs to be explored further, especially looking at changes throughout women's lives, from adolescence to pregnancy and parenthood, as opinions, values and trust evolve with time. Women's low awareness about maternal vaccination represents a missed opportunity to shape positive attitudes towards vaccination in the mothers of tomorrow. We highlight the importance of the role of emotions in decision-making around vaccines during pregnancy. More studies should be conducted to explore the evolution of beliefs and emotions from pregnancy to motherhood. Perceptions of risk are complex and HCPs need to take the time to listen to concerns rather than dismiss them. This will be crucial in the context of new vaccines being developed for pregnancy, especially with the threat of pandemics from the emergence of new diseases.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: [The Vaccine Confidence Project has collaborative grant with GlaxoSmithKline (HJL, EK, MRF, PP), Merck (HJL, EK), and Johnson and Johnson (HJL, EK, PP). HJL and EK have also received other support for participating in Merck meetings and GlaxoSmithKline advisory roundtables. HJL is a member of the Merck Vaccine Confidence Advisory Board.]

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Author contributions

EK, PP and HJL participated in the conception and design of this study. EK analysed and interpreted the qualitative data and led the writing of this article. MRF designed and implemented the statistical analyses and created the figures. EK and MRF drafted the first version of the manuscript. All authors contributed to data interpretation, and finalised and approved the manuscript. All authors attest they meet the ICMJE criteria for authorship.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2021.05.096>.

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