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# Pregnant women's perspectives on severe acute respiratory syndrome coronavirus 2 vaccine



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**BACKGROUND:** Since coronavirus disease 2019 vaccines have been distributed, a debate has raised on whether pregnant women should get the vaccine. No available data exist so far regarding the safety, efficacy, and toxicology of these vaccines when administered during pregnancy. Most of the Obstetrics and Gynecology societies suggested that pregnant could agree to be vaccinated, after a thorough counseling of risks and benefits with their gynecologists, thus leading to an autonomous decision.

**OBJECTIVE:** This study aimed to evaluate the attitude to coronavirus disease 2019 vaccination in pregnant and breastfeeding women in Italy.

**STUDY DESIGN:** A survey was made at the University of Naples Federico II and the Ospedale Cristo Re, Tor Vergata University of Rome, on pregnant and breastfeeding women asking their perspectives on the available vaccines after reading the recommendations issued by our national Obstetrics, Gynecology, and Neonatology societies. The questionnaire included 12 items finalized to evaluate general features of the women and 6 items specifically correlated to their attitudes toward the severe acute respiratory syndrome coronavirus 2 vaccination. Chi-square or Fisher's exact tests were used to compare group differences of categorical variables and Wilcoxon signed rank or Mann-Whitney *U* test for continuous

variables. The study was approved by the institutional review boards of the University of Naples Federico II (ref. no. 409/2020) and the Ospedale Cristo Re, Tor Vergata University of Rome (ref. #Ost4-2020).

**RESULTS:** Most of the included women did not agree to eventually receive severe acute respiratory syndrome coronavirus 2 vaccine during pregnancy (40 [28.2%] vs 102 [71.8%]). Being pregnant was considered a determinant factor to refuse the vaccine prophylaxis (99 [69.7%] vs 43 [30.3%]; chi-square test=24.187;  $P<.001$ ), even if a very large percentage declared to be generally in favor of vaccines (128 [90.1%] vs 14 [9.9%]; chi-square test=6.091;  $P=.014$ ) and most of them confirmed they received or would receive other recommended vaccines during pregnancy (75 [52.8%] vs 67 [47.2%]; chi-square test=10.996;  $P=.001$ ).

**CONCLUSION:** Urgent data are needed on the safety, efficacy, and toxicology of severe acute respiratory syndrome coronavirus 2 vaccines during pregnancy to modify this trend and to help obstetricians during the counseling. Furthermore, pregnant women should be included in future vaccine development trials to not incur again in such uncertainty.

**Key words:** COVID-19, SARS-CoV-2, survey, vaccine during pregnancy

## Introduction

Coronavirus disease 2019 (COVID-19) pandemic has determined an incredible burden on national health-care systems worldwide. In Obstetrics and Gynecology practice, all nonurgent clinical and surgical activities have been postponed during the most critical phases, also raising the debate on which conditions should be considered as urgent and how to reorganize obstetrical, gynecologic, and reproductive medicine units.<sup>1–8</sup>

Large multicenter cohort studies have found that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection during pregnancy was associated with a 0.8% rate of maternal

mortality and 11.1% rate of intensive care unit admissions, with increased rates of preterm deliveries (both spontaneous and iatrogenic) and cesarean deliveries.<sup>9,10</sup> The earlier the infection, the more the increase of the risk of adverse fetal outcomes,<sup>11</sup> even though the risk of vertical transmission seems to be negligible.<sup>9,10</sup> Actually, no general consensus exists on the optimal management for pregnant women with SARS-CoV-2 infection<sup>12–15</sup>; moreover, there is a huge heterogeneity among hospitals, and regarding therapy, combinations of azithromycin or other antibiotic agents, hydroxychloroquine, low-molecular-weight heparin, and a large variety of antiviral agents have been used, without any substantial difference among therapeutic regimes.<sup>9,16</sup>

Less than a year after the recognition of this new infection, vaccines against SARS-CoV-2 virus have been developed and open to worldwide distribution, to counteract the pandemic.

It has been widely proposed to include pregnant women into COVID-19 vaccine trials,<sup>17,18</sup> because they could be considered at higher risk, and the International Federation of Gynecology and Obstetrics endorsed this recommendation.<sup>19</sup>

On December 27, 2020, the vaccine against SARS-CoV-2 infection started to be administered in Italy and across Europe. Thereafter, the most important Italian Obstetrics and Gynecology societies released a position paper ad interim on COVID-19 vaccine and pregnancy, stating that it is not recommended but not contraindicated to receive SARS-CoV-2 vaccine during pregnancy and breastfeeding and in women with reproductive desire and that each woman should evaluate with her gynecologist risks and benefits of its administration.<sup>20</sup>

Therefore, the aim of the present survey is to understand which are the perspectives of pregnant and breastfeeding women regarding the possibility to receive COVID-19 vaccine during pregnancy.

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## AJOG MFM at a Glance

**Why was this study conducted?**

This study aimed to know the current perspectives of Italian pregnant women, during the first phase of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccine distribution, regarding its uptake.

**Key findings**

Italian pregnant women are still largely suspicious toward the SARS-CoV-2 vaccination program, independently from social, cultural, and pregnancy-related features.

**What does this add to what is known?**

These results are the first report from a patient's point of view that reinforce the need for urgent data from vaccine trials, in which women should be included since now on, to avoid the current uncertainty and denial. Counseling without data lacks power.

## Materials and Methods

### Study design and participants

This was a multicenter cross-sectional cohort study involving 2 centers in Italy (University of Naples Federico II and Ospedale Cristo Re, Tor Vergata University of Rome), conducted in January 2021.

Our study included pregnant women attending the 2 centers for outpatient visits and early postpartum inpatient women who were asked to participate to a survey on the possible uptake of the SARS-CoV-2 vaccine during pregnancy and puerperium. The exclusion criteria were inability to comprehend the text and to sign the informed consent.

After signing an informed consent and reading the position paper ad interim on "Pregnancy and COVID-19 vaccine,"<sup>20</sup> participants were given a questionnaire to fill. An anonymous online semistructured questionnaire was developed using google forms (<https://docs.google.com/forms>. Google Mountain View, CA).

**Outcome measures**

The questionnaire was structured in 2 sections: Part A was finalized to acquire data on maternal characteristics (socio-cultural and demographic variables, past and current obstetrical history, and maternal age and gestational age at the receipt of the questionnaire); Part B was structured to test women's knowledge

and concerns about vaccines (Supplemental Material).

We defined education as of a medium-low level in case of primary school or early secondary school and of a medium-high level in case of late secondary school or degree and more. Any work was considered to fill in the worker subgroup compared with women who were housewives or unemployed.

Women were specifically asked whether they were in favor or against the SARS-CoV-2 vaccine during pregnancy. Furthermore, questions were asked regarding general acceptance of vaccines, whether the acceptance of SARS-CoV-2 vaccine was dependent on the pregnant/breastfeeding status, and whether they would receive other vaccine recommended during pregnancy (referring to the trivalent—diphtheria, tetanus, and acellular pertussis [DTaP]—and the influenza vaccines).

Patients were then grouped according to their response to the survey (acceptance or decline of the SARS-CoV-2 vaccine during pregnancy or breastfeeding).

**Statistical analysis**

Descriptive statistics were calculated for the variables considered, and data were expressed as number and percentage for categorical variables and median and interquartile range for continuous variables. Chi-square ( $\chi^2$ ) or Fisher exact tests were used to compare group

differences of categorical variables and Wilcoxon signed rank or Mann-Whitney *U* test for continuous variables. Pearson correlation analysis was used to calculate the univariate associations variables. All hypotheses were tested at a significance level of  $P=.05$ . Statistical analysis was performed using SPSS Statistic 21.0 (IBM Corp, Armonk, NY).

**Ethical approval**

The study was approved by the institutional review boards of the University of Naples Federico II (ref. no. 409/2020) and the Ospedale Cristo Re, Tor Vergata University of Rome (ref. #Ost4-2020).

**Results**

A total of 168 women were asked to participate in the study, 26 of whom (15.5%) refused the invitation; therefore, 142 women (84.5%) were enrolled in the survey.

Of 142 women, 119 (83.8%) were pregnant and 23 (16.2%) were in the early postpartum period. Maternal and obstetrical characteristics of included women are described in Table 1.

The median age of the women was 34 years [31–37.25]. For pregnant women, the median gestational age during the survey was 29 weeks [19–35]. Most of the included patients were Italian (96.5%), 1 (0.7%) was from a European country, and 4 (2.8%) were non-European. In our cohort, 58 pregnant women (40.8%) were >35 years old, and 31 (21.8%) had pathologic conditions during pregnancy (pregnancy-induced hypertension, gestational diabetes, threatened miscarriage, and threatened preterm birth) (Table 1).

Most of the included women did not express their agreement to eventually receive SARS-CoV-2 vaccine during pregnancy (40 [28.2%] vs 102 [71.8%]). Interestingly, no patient affirmed to be totally sure about the safety of SARS-CoV-2 vaccine, only 39 patients (27.5%) were quite secure, 69 patients (48.6%) were quite insecure, and 34 patients (23.9%) were totally insecure about vaccine safety (Table 2). Furthermore, they affirmed that being pregnant was a determinant factor guiding the eventual choice to accept the vaccine

**TABLE 1**  
**General characteristics of the participants to the survey (Questionnaire Part A)**

Features	Options	Value
Age		34 [31–37.25]
Nationality	Italian	137 (96.5)
	European	1 (0.7)
	Non-European	4 (2.8)
Marital status	Unmarried	11 (7.7)
	Married	71 (50)
	Divorced	2 (1.4)
	No answer	58 (40.8)
Education	Medium-low	121 (85.2)
	Medium-high	21 (14.8)
Employment	Worker	90 (63.4)
	Housewife/unemployed	52 (36.6)
Smoke	Yes	12 (8.5)
	No	130 (81.5)
Preexisting diseases	Yes	108 (76.1)
	No	34 (23.9)
Previous pregnancy	Yes	91 (64.1)
	No	51 (35.9)
Previous children	Yes	58 (40.8)
	No	65 (45.8)
	No answer	19 (13.4)
Previous miscarriage	Yes	30 (21.1)
	No	93 (65.5)
	No answer	19 (13.4)
Conception	Spontaneous	120 (84.5)
	IVF	22 (15.5)
Gestational age during the survey		29 [19–35]
Trimester during the survey	1	18 (12.7)
	2	33 (23.2)
	3	68 (47.9)
	Postpartum	23 (16.2)
Still pregnant during the survey	Yes	119 (83.8)
	No	23 (16.2)
Disease during pregnancy	Yes	31 (21.8)
	No	111 (78.2)

Data are presented as median [interquartile range] or number (percentage).

IVF, in vitro fertilization.

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prophylaxis (99 [69.7%] vs 43 [30.3%];  $\chi^2=24.187$ ;  $P<.001$ ), even if a very large percentage declared to be generally in favor of vaccines (128 [90.1%] vs 14 [9.9%];  $\chi^2=6.091$ ;  $P=.014$ ) and most of them confirmed they received or would receive other recommended vaccines during pregnancy (75 [52.8%] vs 67 [47.2%];  $\chi^2=10.996$ ,  $P=.001$ ) (Table 3). When we

compared maternal characteristics and survey answers according to women's agreement to receive SARS-CoV-2 vaccine in pregnancy, no statistically significant differences were found in relation to nationality, marital status, education, employment, smoke, preexisting diseases, type of conception, pregnancy trimester during the survey, and pregnancy

complications during current pregnancy, between women who would undergo SARS-CoV-2 vaccine in pregnancy and women who would not (Table 3). Indeed, women who had a previous pregnancy (irrespective of defining it as a livebirth or a miscarriage) (91 [64.1%] vs 51 [35.9%];  $\chi^2=4.354$ ,  $P=.037$ ) and women who were still pregnant during the survey (119 [83.8%] vs 23 [16.2%];  $\chi^2=10.904$ ,  $P=.001$ ) would preferably decline the SARS-CoV-2 vaccine in a statistically significant manner (Table 3).

Performing a subgroup analysis, we evaluated women who were >35 years old who had previous diseases or had complications during pregnancy and were still pregnant during the survey, but there were no statistically significant differences in the eventual SARS-CoV-2 vaccine uptake for these subgroups (Table 3).

Finally, we asked women who did not want to receive the SARS-CoV-2 vaccine during pregnancy about the reasons for such refusal, and the 2 most frequent answers were “fear of baby's health consequences” in 61 of cases (59.8%) and “too short time from development to commercialization” in 41 of cases (40.2%) (Figure).

## Discussion

### Main findings

This survey analyzed the grade of acceptance of women during pregnancy and breastfeeding to eventually receive SARS-CoV-2 vaccine during pregnancy after being informed on the basis of actual evidence and recommendations from the main Italian Obstetrics, Gynecology, and Neonatology societies. Our data show that most women were not in favor to receive SARS-CoV-2 vaccine in pregnancy, being overall insecure about the safety of this vaccine, even if most of them were usually in favor to receive vaccines and almost half of them received or would receive other vaccines recommended during pregnancy. Indeed, the state of pregnancy itself has been largely considered as a determinant factor to refuse the SARS-CoV-2 vaccine, combined with the current lack of certainty.

TABLE 2

**Perspectives on SARS-CoV-2 vaccine of the included women (Questionnaire Part B)**

Questions	Answers	n (%)
Agreement to be vaccinated against SARS-CoV-2	Yes	40 (28.2)
	No	102 (71.8)
Feeling safe about SARS-CoV-2 vaccine	Totally insecure	34 (23.9)
	Rather insecure	69 (48.6)
	Safe enough	39 (27.5)
	Totally safe	0
Being pregnant influence the choice	Yes	99 (69.7)
	No	43 (30.3)
Usually in favor of vaccines	Yes	128 (90.1)
	No	14 (9.9)
Received or would receive other vaccine during pregnancy (DTaP and/or influenza)	Yes	75 (52.8)
	No	67 (47.2)

Data are presented as number (percentage).

DTaP, diphtheria, tetanus, and acellular pertussis; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

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### Results in the context of what is known

Although the absolute risk of SARS-CoV-2 severe infection is low, the Centers for Disease Control and Prevention (CDC) has included pregnancy as a risk factor for severe COVID-19 illness.<sup>21</sup> Unfortunately, clinical trials for the available vaccines excluded pregnant and lactating women. Therefore, because the safety and efficacy of the vaccines for pregnant women, the fetus, and the newborn remain unknown, there is no general consensus on whether pregnant women should be vaccinated against SARS-CoV-2. The last recommendations of the Royal College of Obstetricians and Gynaecologists in the United Kingdom on SARS-CoV-2 vaccine in pregnancy stated that although the available data do not indicate any safety concern or harm to pregnancy, there is insufficient evidence to recommend the routine use of COVID-19 vaccines during pregnancy, and pregnant women should undergo an individualized and autonomous evaluation with their obstetrician on whether they should receive the vaccine.<sup>22</sup>

### Clinical and research implications

The last recommendations of the United States CDC on SARS-CoV-2

vaccine in pregnancy, issued on February 12, 2021, stated that SARS-CoV-2 vaccine is a messenger RNA (mRNA)–based vaccine that, first, does not contain the live virus that causes COVID-19 and, therefore, cannot transmit COVID-19 to someone and, second, mRNA vaccines do not interact with a person's DNA because the mRNA does not enter the nucleus of the cell.<sup>23</sup> Nevertheless, the CDC stated that getting vaccinated is a personal choice for people who are pregnant.<sup>23</sup> In January 2021, the European Medicines Agency authorized the use of COVID-19 vaccines and issued a report<sup>24</sup> stating that no harmful effects with respect to pregnancy and lactation were observed during animal studies. However, it also declared that the decision to receive the vaccine during pregnancy and lactation should be based on a discussion with the healthcare provider and on a case-by-case basis, taking into consideration benefits and possible risks. Because currently there are no available data on the safety or possible established risks for SARS-CoV-2 vaccination in pregnancy, it seems to be difficult for women and for their doctors to perform and individualized counseling on the possible benefits and risks of the vaccination.

The lack of strong recommendations based on evidence for clear safety seems to explain the results of our survey, where 71.8% of women felt unsure on whether eventually undergo SARS-CoV-2 vaccination, 59.8% of women who did not agree for SARS-CoV-2 vaccine were afraid of possible baby's health consequences, and 40.2% of women were afraid of vaccine safety considering the short amount of time from development to commercialization compared with other vaccines.

Authors have pointed out how pregnancy is considered an emotional phase in women life and how it can impact women's mental health even in uneventful pregnancies. Recently, the concept of maternal anxiety has been described, distinct from general anxiety or depression.<sup>25</sup> Maternal anxiety is characterized by the fear of real or anticipated threat to pregnancy or its outcomes and low perceived control. Silva et al<sup>26</sup> found that 26.8% women with low-risk pregnancies scored a high grade of anxiety, with a greater incidence in the third trimester (42.9%). These results are in line with findings from Giardinelli et al,<sup>27</sup> who found that 21.9% of pregnant women in the study group had a high score at Edinburgh Postnatal Depression Scale.

SARS-CoV-2 pandemic, national lockdown, severe restrictions, and safety measures into hospitals and labor wards caused a great impact on pregnant women's emotional balance. Moyer et al<sup>28</sup> analyzed 2740 pregnant women and found that 93% of them reported increased stress about getting infected with COVID-19, and Saccone et al<sup>29</sup> reported that 68% of pregnant women included in a survey performed a high score of State-Trait Anxiety Inventory scale during the first months of the COVID-19 pandemic; Mappa et al<sup>30</sup> observed that 47% had fear of structural anomalies and 51% of preterm birth. These data are consistent with our findings of increased perception of risk of pregnancy or baby outcomes associated with SARS-CoV-2 vaccine in pregnancy, mostly because of the lack of adequate safety data and of strong clear recommendations from the main



TABLE 3

## Comparison of women characteristics according to their attitude to coronavirus disease 2019 vaccine

Items	Would get the SARS-CoV-2 vaccine		Chi-square test	P value
	Yes=40	No=102		
Nationality			189.347	.51
- Italian	38 (95)	99 (97.2)		
- European	0	1 (0.9)		
- Non-European	2 (5)	2 (1.9)		
Marital status			1.562	.81
- Unmarried	2 (5)	9 (8.9)		
- Married	20 (50)	51 (50)		
- Divorced	0	1 (0.9)		
- Separated	0	1 (0.9)		
- No answer	18 (45)	40 (39.3)		
Education			2.348	.125
- Medium-low	37 (92.5)	84 (82.3)		
- Medium-high	3 (7.5)	18 (17.7)		
Employment			1.995	.158
- Worker	29 (72.5)	61 (59.8)		
- Housewife/unemployed	11 (27.5)	41 (40.2)		
Smoke			0.857	.355
- Yes	2 (5)	10 (9.8)		
- No	38 (95)	92 (90.2)		
Preexisting diseases			0.064	.801
- Yes	9 (22.5)	25 (24.5)		
- No	31 (77.5)	77 (75.5)		
Previous pregnancy			4.354	.037 <sup>a</sup>
- Yes	31 (77.5)	60 (58.8)		
- No	9 (22.5)	42 (41.2)		
Previous children			3.215	.073
- Yes	22 (55)	36 (35.3)		
- No	15 (37.5)	50 (49)		
- No answer	3 (7.5)	16 (15.7)		
Previous miscarriage			0.2	.655
- Yes	10 (25)	20 (19.6)		
- No	27 (67.5)	66 (64.7)		
- No answer	3 (7.5)	16 (15.7)		
Conception			0.01	.919
- Spontaneous	34 (85)	86 (84.3)		
- IVF	6 (15)	16 (15.7)		
Trimester during the survey			4.732	.094
- 1	7 (17.5)	11 (10.8)		
- 2	9 (22.5)	24 (23.5)		
- 3	11 (27.5)	57 (55.9)		
- Postpartum	13 (32.5)	10 (9.8)		

(continued)

TABLE 3

Comparison of women characteristics according to their attitude to coronavirus disease 2019 vaccine (continued)

Items	Would get the SARS-CoV-2 vaccine		Chi-square test	P value
	Yes=40	No=102		
Still pregnant during the survey			10.904	.001 <sup>a</sup>
- Yes	27 (67.5)	92 (90.2)		
- No	13 (32.5)	10 (9.8)		
Disease during pregnancy			1.523	.217
- Yes	6 (15)	25 (24.5)		
- No	34 (85)	77 (75.5)		
Age of >35 y			0.278	.598
- Yes	20 (50)	46 (45)		
- No	20 (50)	56 (55)		
Preexisting diseases at the age of >35 y			0.2812	.59
- Yes	4 (10)	12 (11.7)		
- No	16 (40)	34 (33.3)		
Preexisting diseases in still pregnant >35-y-olds			0.3626	.547
- Yes	3 (7.5)	12 (11.7)		
- No	12 (30)	31 (30.4)		
Disease during pregnancy at the age of >35 y still pregnant during the survey			1.2899	.256
- Yes	2 (5)	12 (11.7)		
- No	13 (32.5)	31 (30.4)		
Being pregnant influence the choice			24.187	.000 <sup>a</sup>
- Yes	40 (100)	59 (57.8)		
- No	0	43 (42.1)		
Usually in favor of vaccines			6.091	.014 <sup>a</sup>
- Yes	40 (100)	88 (86.3)		
- No	0	14 (13.7)		
Received or would receive other vaccine during pregnancy (DTaP and/or influenza)			10.996	.001 <sup>a</sup>
- Yes	30 (75)	45 (44.1)		
- No	10 (25)	57 (55.9)		

Data are presented as number (percentage).

DTaP, diphtheria, tetanus, and acellular pertussis; IVF, in vitro fertilization; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

<sup>a</sup> Statistically significant for  $P < .05$ .Carbone. SARS-CoV-2 vaccine and pregnancy. *Am J Obstet Gynecol* MFM 2021.

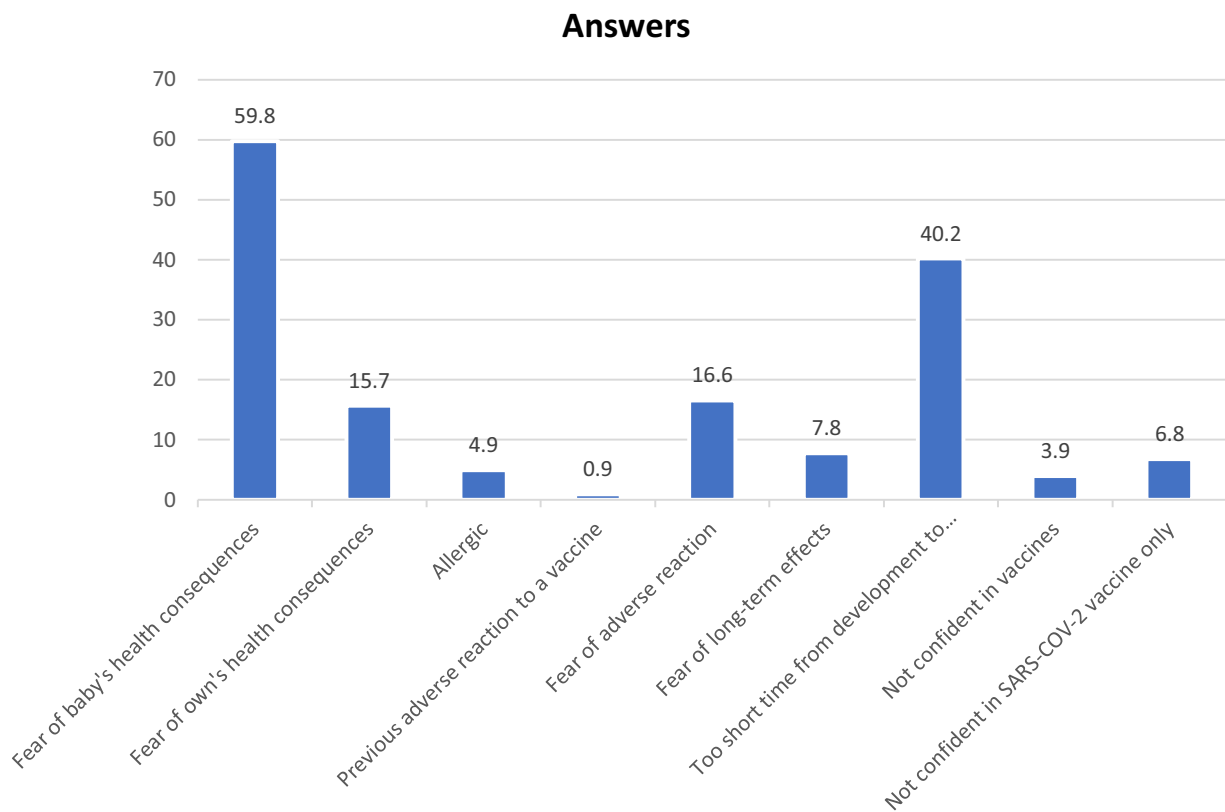
scientific societies and agencies. In this view, it is of utmost importance the evidence that, even if most women in the survey would not get vaccinated against SARS-CoV-2, 90.1% of them are generally in favor of vaccines and 52.8% of them received or would receive other vaccines strongly and clearly recommended in pregnancy (DTaP or influenza vaccine). Klein et al<sup>31</sup> affirmed that

it is not ethical to ask pregnant women or their providers to decide whether to get the COVID-19 vaccine or not, given the such limited evidence so far; in addition, they acknowledge the need to include them in phase III trials, especially if preclinical data on safety and toxicology seem encouraging.

Other authors urged to include pregnant and lactating women in future

clinical trials on SARS-CoV-2 vaccines in the development and deployment of COVID-19 vaccines and early investment in this field.<sup>32</sup> The inclusion of these women will ensure that pregnant women and their infants could benefit from vaccine candidates that prove successful and help ensure that they will ultimately be protected against COVID-19.<sup>33</sup> Furthermore, as soon as rigorously

**FIGURE**  
**Main reason reported by the women to decline SARS-CoV-2 vaccine**



Participants could indicate more than 1 reason. Data are presented as percentage.

SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

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designed studies with proactive data collection, recording both vaccine-related symptoms and obstetrical outcomes, will provide evidence-based recommendations regarding mRNA vaccination to reduce harms from COVID-19, expert opinion will be replaced.<sup>34</sup> As Heath et al<sup>32</sup> stated, to enable the inclusion of pregnant and lactating women in the development of COVID-19 vaccines, it is important to understand whether pregnant women wish to be vaccinated against COVID-19 and also participate in trials for vaccine development.

### Strength and limitations

This survey reports women's attitudes toward the vaccination against COVID-19, in the context of lack of definitive data regarding its safety during pregnancy, demonstrating with its results that counseling is fundamental, but data are a very strong added value to

reinforce it. A limitation of our analysis depends on the small sample size, which in part is caused by the short amount of time we decided to apply for the distribution of the survey. Another limitation is given by the survey method itself, because we gave the questionnaire after the administration of the abovementioned document produced by our national societies,<sup>20</sup> which could eventually be considered too technical by some women, resulting in a higher rate of negative answers.

### Conclusions

This survey describes current perspectives in pregnant and breastfeeding women about SARS-CoV-2 vaccine, of which the majority would opt to not get the vaccine, highlighting the need of evidence-based recommendations to guide pregnant women decision to get vaccinated. According to our results,

first safety reports on pregnant and lactating women who got vaccinated during these months and more clear indications on SARS-CoV-2 vaccine in pregnancy from scientific societies will increase women adherence rate to the vaccine during pregnancy and lactation, hence reducing maternal morbidity owing to SARS-CoV-2 infection. ■

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### Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.ajogmf.2021.100352](https://doi.org/10.1016/j.ajogmf.2021.100352).

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