CLINICAL AND EXPERIMENTAL VACCINE RESEARCH

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Pregnant women's knowledge about and beliefs toward COVID-19 vaccine: a cross-sectional study

Osman Samet Gunkaya[1],
Arzu Bilge Tekin[1], Murat Yassa[2],
Oguz Arslan[1], Kübra Karakoç[1],
Nesibe Demirtaş[1], Canberk Usta[1],
Çiğdem Künt İşgüder[1], Niyazi Tuğ[1]

[1]Department of Obstetrics and Gynecology,
Sehit Prof. Dr. Ilhan Varank Sancaktepe Training
and Research Hospital, University of Health
Sciences Turkey, Istanbul; [2]Clinic of Obstetrics and
Gynecology, VM Medical Park Maltepe Hospital,
Istanbul, Turkey

Corresponding author: Osman Samet Gunkaya, MD
Department of Obstetrics and Gynecology, Sehit
Prof. Dr. Ilhan Varank Sancaktepe Training and
Research Hospital, University of Health Sciences
Turkey, Namik Kemal Cd. No:7, 34785 Sancaktepe,
Istanbul, Turkey
Tel: +90-507-650-3540, Fax: +90-216-606-3300
E-mail: dr.sametgunkaya@hotmail.com

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Purpose: The aim of this study was to determine the scope of knowledge, attitudes, and be-haviors of pregnant women about the coronavirus disease 2019 (COVID-19) vaccine.
Materials and Methods: A total of 886 pregnant women were recruited for the study. A cross-sectional questionnaire was conducted on these selected participants. Data about past infec-tion with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), SARS-CoV-2 infection of closely related people, and deaths due to COVID-19 among their relatives were questioned.
Results: The rate of vaccination was higher (64.1%) in pregnant women with higher education levels. Informing about the vaccine, especially by health professionals, showed that the rates of vaccination (25%) increased (p<0.001). In addition, a significant increase was observed in vaccination rates with increasing age and financial income (p<0.001).
Conclusion: The main limitation of our study is that the vaccine, which was approved for "emergency use", was just started to be administered to pregnant women during the study. Our findings show that our target audience, low-income, low-education, younger pregnant women should be given more attention than those who apply to the doctor for routine follow-up.

Keywords: COVID-19 vaccine, Pandemics, Pregnant

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has quarantined billions of peo-ple, exacerbating pre-existing psychological and health problems and affecting vari-ous aspects of life, and it has caused a challenge to health systems, the economy, and education [1-4]. The effectiveness of vaccines against viral infections is known [5]. As-suming the baseline reproduction number is 4, the population immunity level needs to reach at least 70% to stop the COVID-19 pandemic [6]. Therefore, vaccines cannot prevent epidemics without widespread acceptance. The World Health Organization has listed vaccine hesitancy as one of the top ten threats to global health [7]. Vaccine hesitancy is one of the most significant public health challenges facing efforts to man-age the coronavirus disease 2019 (COVID-19) pandemic globally [8].

Pregnant women are considered a vulnerable and at-risk population for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection [9]. If infected, they have more risk of developing complications such as intensive care unit admission, mechanical ventilation, and death [10,11]. In addition, increased risk of miscarriage, iatrogenic preterm delivery, preeclampsia, cesarean section, and postpartum hemor-

rhage, have also been reported [12-14].

The results and reliability of vaccine studies in pregnant women started to become clear in the second half of 2021 [15,16]. Pregnant women are the ones who can influence a decision on vaccine acceptance of children and other family members. Understanding the factors that influence vaccination acceptance across diverse socioeconomic groups, particularly pregnant women, is critical to restoring society to pre-pandemic conditions [17].

In this context, we aimed to investigate the scope of knowledge, attitudes, and behaviors of pregnant women about the COVID-19 vaccine in our study.

Materials and Methods

Study design
This study was conducted by simple random sampling from pregnant women who applied to the gynecology outpatient clinic in a tertiary center in Istanbul, Turkey, between October 1, 2021, and December 1, 2021. The study included those who are currently pregnant (without distinction of trimester), have no contraindications to the vaccine, have access to the vaccine, and want to participate voluntarily. Survey questions were taken from previous studies conducted for similar purposes [18]. A cross-sectional questionnaire was conducted on these selected participants. Before the interviews, the participants were informed about the study and the confidentiality of the interview, and for those who did not want to answer only one question of the survey, the other questions of the survey were not continued. In the first part of the questionnaire, the socio-demographic characteristics of the pregnant women (age, educational status, pregnancy history, current gestational week, and monthly income levels, data about past infection with SARS-CoV-2, SARS-CoV-2 infection of closely related people, and deaths due to COVID-19 among their relatives) were questioned. While the illiterates read and answered the questionnaires, the participants were informed about the purpose of the study and data privacy.

Studies measuring vaccination hesitancy were sought for the purpose of calculating sample size. A study conducted on pregnant women in the United States found that the vaccination delay rate was 8.2% [19], and in a study of pregnant women in Malaysia, it was 11.6% [20]. The study sample size was calculated using the sampling method. This led to an unknown population [21] and an accepted 11% vaccine skepticism.

$$n = \frac{t^2 \times (p \times q)}{d^2}$$

n: sample size

p: frequency of incidence of the event under consideration (expected prevalence)

q: frequency of absence of the event under consideration (expected non-prevalence)

t: the standard normal deviate (usually set at 1.96, which corresponds to the 95% confidence interval)

d: relative desired precision [13].

$$\frac{(1.96)^2 \times (0.11 \times 0.89)}{(0.05)^2} = 150$$

It was determined that at least 150 pregnant women should be included in the study.

Surveys
The questionnaire was developed based on the content of questionnaire tools used in pregnant women vaccinated against influenza by some of us recording different populations [18]. The questionnaire was tested among 10 unselected women to assess comprehension of the questions and answers. Pretest participants were not included in the results.

Level of knowledge about the COVID-19 vaccine
Survey questions: "COVID-19 is severe during pregnancy." "The vaccine also protects pregnant women from COVID-19." "All COVID-19 vaccines can be applied to pregnant women." "The COVID-19 vaccine during pregnancy causes disease in the fetus." "The COVID-19 vaccine during pregnancy causes preterm delivery/abortus." The answer options are "yes," "no," and "don't know."

Information source about COVID-19 and the vaccine
Survey questions: "Were you informed about COVID-19 during pregnancy?" "Were you informed about the COVID-19 vaccine during pregnancy?" The answers of these questions are "no," "doctor/nurse," "media," "friends," "family," and "others." The remaining survey questions are "Would you like to receive information about COVID-19?" "Would you like to learn about the COVID-19 vaccine?" The answers to these questions are "yes" and "no."

The reason for getting or not getting vaccinated against COVID-19
Those who answered "no": "I do not have risk." "The vaccine

can be harmful to my health." "I do not believe in the benefit." "My doctor was against." "Other." Those who answered "yes": "I belong to the risk group." "The vaccine is not harmful to my health." "The vaccine is not harmful to the health of my baby." "I believe in the benefit." "My doctor recommended." "Other."

Claims causing vaccine rejection

Survey questions: "The vaccines contain mercury, aluminum, ether and many chemicals that can cause different diseases." "The vaccine-producing companies have created a malicious market to generate revenue." "A better immunity can be gained by undergoing the disease rather than being vaccinated." "Complementary and alternative medicine is more effective and has fewer side effects." "There are no studies proving the efficacy and safety of vaccines." "There are studies reporting the side effects of vaccines." "Some people who have gained religious and philosophical activity and doctors explain that the vaccine is harmful and they do not have it done." All answer options are "yes," "no," and "don't know."

Ethical considerations

All patients gave written informed consent and were approved for publication before data collection. All procedures were in accordance with the 1964 Helsinki Declaration and its later amendments. This study followed the principles of the Declaration of Helsinki and the local institutional administration board approved the study (meeting 08/09/2021; registry no., 2021/190).

Statistical analysis

Data analysis was performed with IBM SPSS ver. 26.0 (IBM Corp., Armonk, NY, USA). Normal distributions for continuous variables were checked using P-P plots and single-sample Kolmogorov-Smirnov tests. Comparisons between pregnant women who received the COVID-19 vaccine and those who refused the vaccine were made using chi-square tests for categorical variables, independent samples chi-square test, and Mann-Whitney U tests for continuous variables. The significant statistical difference was determined as 0.05.

Results

A total of 900 pregnant women were invited to participate in this survey, 868 met the study entry criteria and volunteered to be evaluated, and the participation rate was 96.4%. Of the

Table 1. Demographic characteristics of pregnant women with and without COVID-19 vaccine

Characteristic	Unvaccinated	Vaccinated	p-value
No. of participants	779 (89.7)	89 (10.3)	
Age (yr)			**<0.001**
Mean±SD	27.4±5.3	29.8±5.6	
Median±IQR (min–max)	27±7 (16–44)	29±7 (19–42)	
Gestational age (wk)			**0.016**
Mean±SD	31.6±9.2	30.0±8.8	
Median±IQR (min–max)	36±2 (5–42)	33±13 (7–40)	
Parity			0.246
Median±IQR (min–max)	1±2 (0–6)	1±1 (0–4)	
Trimester			1
1 Trimester	58 (7.4)	6 (6.7)	
2 Trimester	143 (18.4)	21 (23.6)	
3 Trimester	578 (74.2)	62 (69.7)	
Education			**<0.001**
Secondary education	418 (53.7)	32 (35.9)	
High school and higher education	361 (46.3)	57 (64.1)	
Income			**<0.002**
Low-medium wages	750 (96.3)	78 (87.6)	
High wages	29 (3.7)	11 (12.4)	
Infected with SARS-CoV-2 before the vaccine recommendation			0.488
Yes	201 (25.8)	26 (29.2)	
No	578 (74.2)	63 (70.8)	
Relative infected with SARS-CoV-2			0.6772
Yes	499 (64.1)	59 (66.3)	
No	280 (35.9)	30 (33.7)	
Relative died due to COVID-19			0.200
Yes	671 (86.1)	81 (91.1)	
No	108 (13.9)	8 (8.9)	
Had routine vaccinations other than the COVID-19 vaccine			**<0.001**
Yes	151 (19.4)	38 (42.7)	
No	628 (80.6)	51 (57.3)	

Values are presented as number (%), mean±SD, or median±IQR (min–max). Statistically significant results are marked in bold.
SD, standard deviation; IQR, interquartile range; COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

participants, 89.7% (n=779) were unvaccinated and 10.3% (n=89) were vaccinated. The age, gestational age, and parity of all pregnant women were 27±7 years, 36±11 weeks, and 1±2 (median±interquartile range), respectively. The demographic characteristics of the participants who were separated according to their COVID-19 vaccination status are presented in Table 1. Thirty-seven (4.3%) illiterate pregnant women did not want to be vaccinated and were not vaccinated.

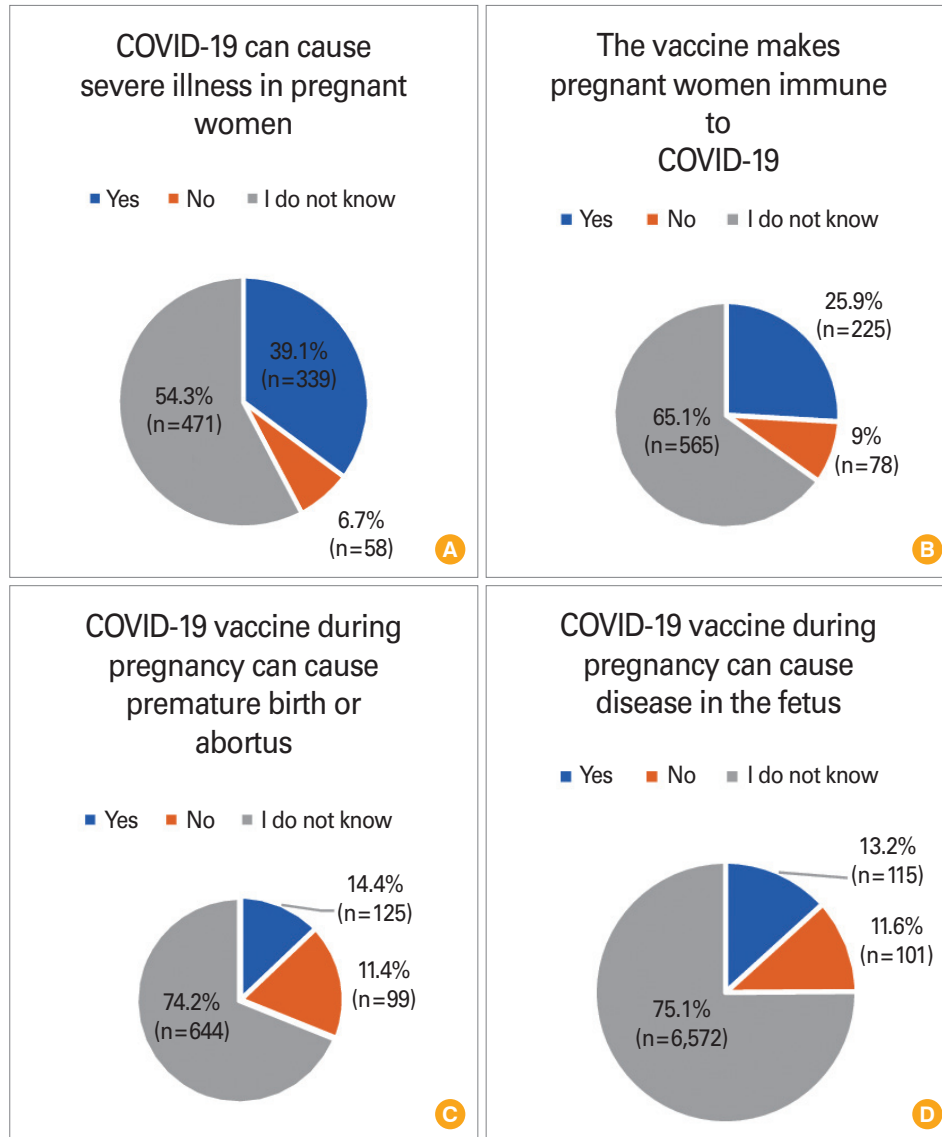Knowledge level of pregnant women about COVID-19 and

Fig. 1. (A–D) Knowledge level of pregnant women about coronavirus disease 2019 (COVID-19) and COVID-19 vaccine.

COVID-19 vaccine is summarized in Fig. 1. Reasons for COVID-19 vaccine acceptance and refusal are summarized in Fig. 2. Pregnant women's knowledge and willingness towards COVID-19 vaccine is summarized in Fig. 3. The rate of vaccination for the pregnant women who received information from health professionals (doctor, nurse) was 25% (39/156) and for the pregnant women who received information other than health professionals was 6.4% (34/532) (p<0.001). The distribution of claims that caused vaccine rejection is given in Table 2.

Discussion

This study found significant gaps in the knowledge of preg-

nant women about vaccination. The main concern was that the vaccine may have adverse effects on the fetus, it is important in terms of correcting the hesitations and disinformation of the pregnant women who did not get vaccinated. Almost only one woman in ten women was vaccinated in this study.

The rate of vaccination was higher (64.1%) in pregnant women with higher education levels, who had the potential to have more information about the risk level and the right source from the participants. Informing about the vaccine, especially by health professionals, showed that the rates of vaccination (25%) increased (p<0.001). In addition, a significant increase was observed in vaccination rates with increasing age and financial income (p<0.001).
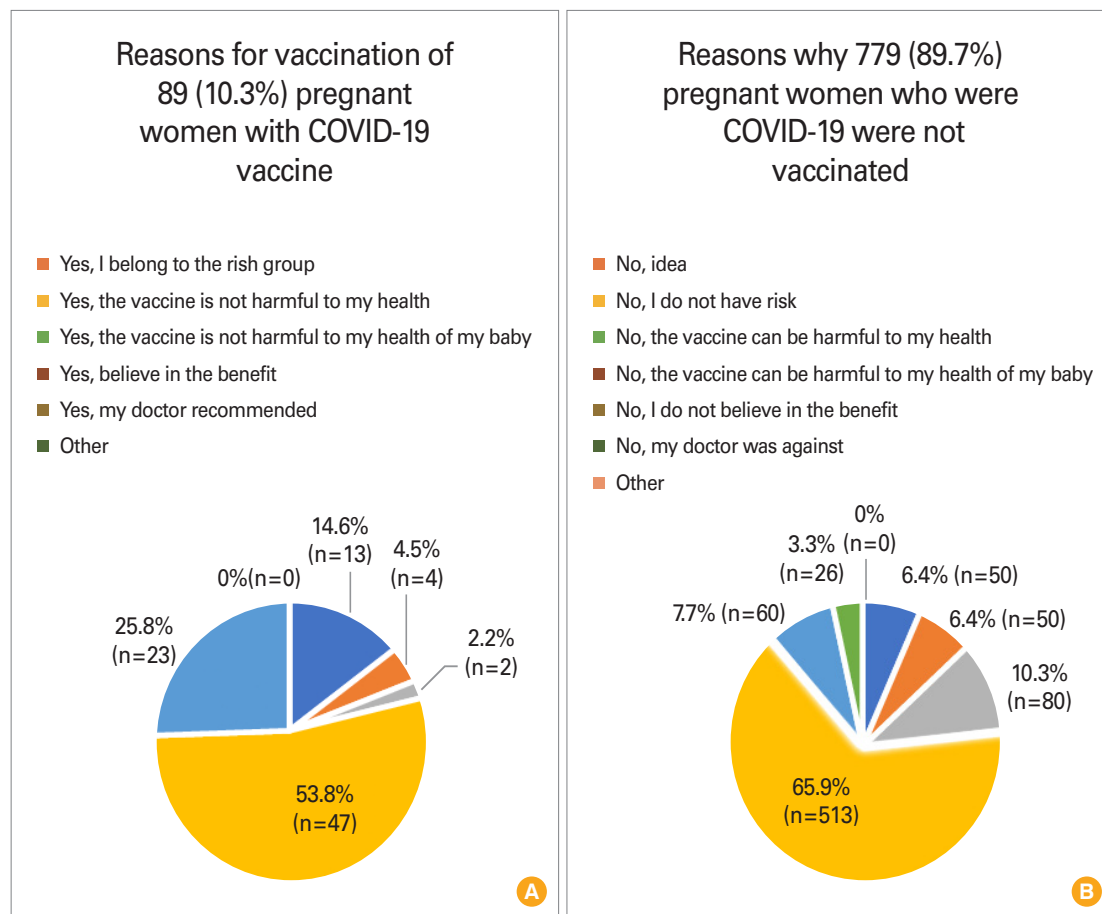
The safety of the COVID-19 vaccine was proven and al-

Fig. 2. (A, B) Reasons of coronavirus disease 2019 (COVID-19) vaccine acceptance and opposition.

Table 2. Allegations leading to vaccine denial

	Yes	No	I do not know
Vaccines contain mercury, aluminum, ether, and many chemicals that can cause different diseases.	172 (22.1)	67 (8.65)	540 (69.3)
Vaccine-producing companies have created a malicious market to generate revenue.	171 (22.0)	129 (16.6)	479 (61.5)
A better immunity can be provided by passing the disease rather than being vaccinated.	148 (19.0)	162 (20.8)	469 (60.2)
Complementary and alternative medicine is more effective and has fewer side effects.	98 (12.6)	118 (15.1)	563 (72.3)
There are no studies proving the efficacy and safety of vaccines	199 (25.5)	107 (13.7)	473 (60.7)
There are studies reporting the side effects of vaccines.	263 (33.8)	67 (8.6)	449 (57.6)
Some "people who have gained religious and philosophical activity" and "doctors" explain that the vaccine is harmful and they do not have it done.	166 (21.3)	131 (16.8)	482 (61.9)

Values are presented as number (%).

though it was recommended to pregnant women, acceptance of the COVID-19 vaccine was similar to other vaccines (influenza vaccine, tetanus vaccine, etc.) [22,23]. This indicates that vaccine hesitancy is a growing public health problem in the world in the last 10 years [24].

The first encounter of pregnant women with a pandemic that affects the whole world as well as the use of the COVID-19 vaccine for the first time in the world might have caused con-

cerns about the vaccine in pregnant women. While 65.9% (n=513) of unvaccinated pregnant women think that the vaccine is harmful to the baby, 53.8% (n=47) of vaccinated pregnant women believe that the vaccine is protective against COVID-19, only 14.6% (n=13) know that they are in the risky group. These rates show that they do not have enough information about the vaccine and that the information is learned from the wrong source. Information pollution in the visual
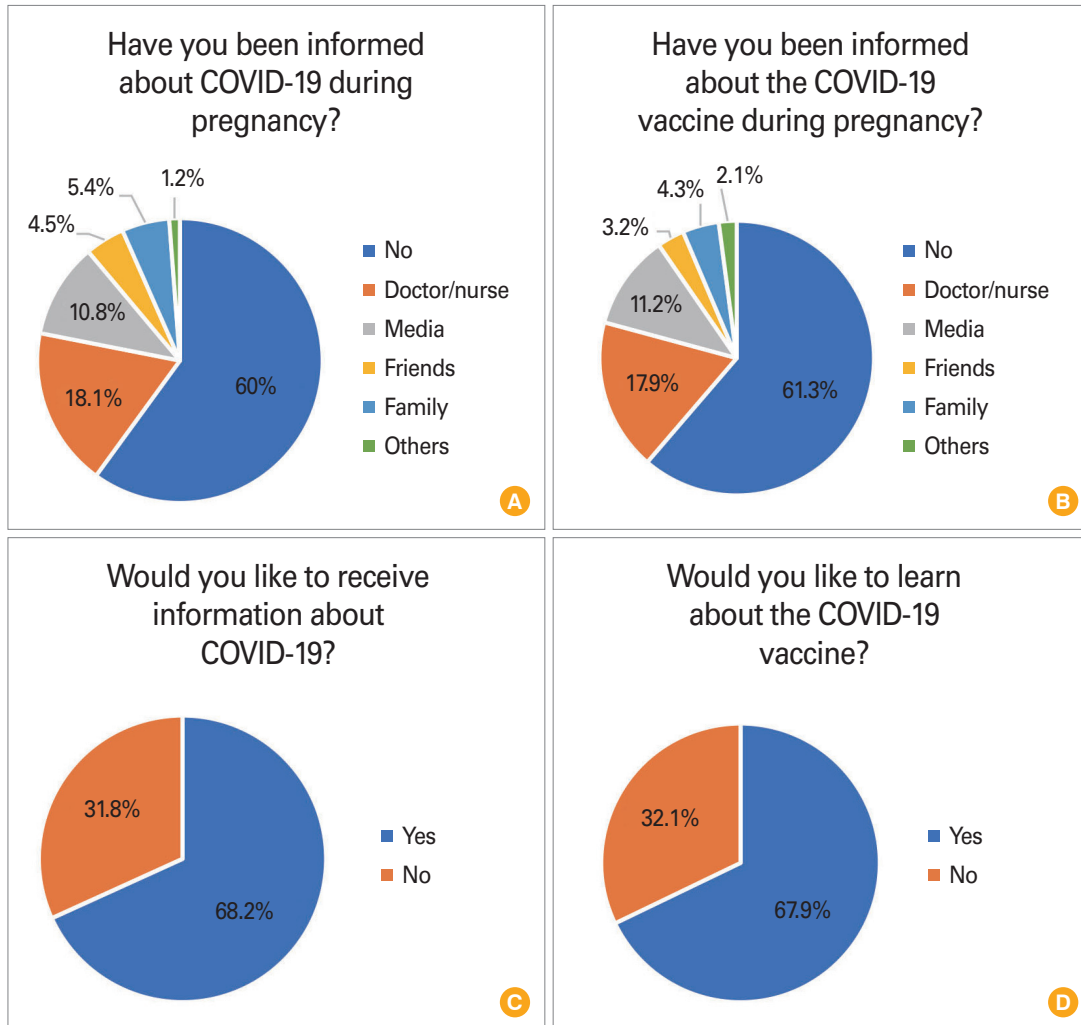
Fig. 3. (A–D) Pregnant women knowledge and willingness towards coronavirus disease 2019 (COVID-19) vaccine.

and written media on the SARS-CoV-2 epidemic should be avoided, and it was recommended that only health professionals should provide information [25,26].

The higher the education level, the less likely they are to refuse the vaccine, as they have more information about disease risk, side effects, and efficacy [27]. In our study, vaccination rates increase with the increase in education levels. Likewise, pregnant women with a higher level of education are more likely to reach the right source of information, so the level of knowledge depends on many factors, however, the results of the survey revealed that the sources of information have an important role. It is worrying that 54.3% (n=472) of pregnant women do not have information about the severity of COVID-19, while 65.1% (n=565) do not have any information about vaccines. It is quite interesting that the majority of pregnant women did not see health professionals, the most frequently consulted source, as an important source of informa-

tion. Whereas health professionals are in the best position to answer questions, they have the responsibility to recommend vaccines and answer questions that come to mind. It is supported by the results that obtaining information from doctors or other health professionals is positively associated with vaccination. Pregnant women with incorrect and insufficient information are more likely to think that the COVID-19 vaccines recommended during pregnancy during the SARS-CoV-2 pandemic are dangerous for them and the unborn child. In particular, physicians informing the public about vaccination within the scope of their preventive medicine responsibilities also create an opportunity to reduce health costs. The vaccine was free at the time of study and in our country, the rate of vaccination in pregnant women in our study was found to be very low, at 10.3% (n=89). In addition, although the vaccine is free, the vaccination rate of young and low-income people was low. The reason for this may be the positive relationship be-

tween income status and education status or access to sufficient and correct information. Skirrow et al. reported that lower-income women were less likely to prefer vaccination and lower income can link to lower education levels as well as vaccine hesitancy has been linked to lower education levels [28].

COVID-19 vaccine hesitancy is a multifaceted phenomenon [29]. In another study, the main reasons participants did not want to receive the COVID-19 vaccine were the initiation of vaccination with the Emergency Use Authorization and a significant proportion of pregnant women expressed additional safety concerns due to insufficient clinical evidence [30]. In a study, Hosokawa et al. [31] reported 13.4% vaccine acceptance in pregnant women and they stated that to reduce vaccine hesitancy, accurate information transmission and increased trust in the government may be necessary. In our study, 69.3% (n=540) of pregnant women who refused the vaccine did not show any reason, while 25.5% (n=199) of them expressed that vaccine studies were insufficient and they want to see more safety and efficacy data. Although, the data about the vaccine effectiveness and safety were relatively clear at the time of the current study when compared to the beginning of the pandemic, there may still be suspicion about vaccine usage in pregnancy or a failure to transmit information about vaccine safety to the public [15,16]. As more data become available and if the transfer of this data to the public is more effective, there will be more opportunities for pregnant women to rely on scientific validation of vaccines, which may positively impact pregnant women with vaccine hesitancy and reluctance.

The time frame of the study was the main limitation of our study, lack of information about the use of vaccines for pregnant women led to the lack of confidence in policymakers, health workers, and vaccine providers and our country has given "emergency clearance" to vaccine use at the beginning of January 2021. Moreover, the methodological limitations of this research are primarily that this survey was conducted using a cross-sectional design and therefore this precludes any conclusions about causality in the relationships found between the estimators and the outcomes of interest. Second, the findings of the survey cannot be fully generalized for the Turkish pregnant female population as it was conducted in only one geographic region. Third, participants may have responded in a socially desirable manner regarding a positive attitude towards the vaccine, even though they were informed that the interview was fully confidential. Therefore, the findings are likely to be true. Despite these limitations,

the survey provides useful data on this sensitive issue for policymakers and healthcare professionals.

Vaccination rates among pregnant women in the research group were found to be extremely low. Lack of knowledge about the safety of the vaccine is the biggest obstacle to vaccination. Our findings show that the recommendations of health professionals and other authorities are widespread and that low-income, low-education, young pregnant women, who are our target audience, should be given more attention than those who apply to a doctor for routine follow-up. Public awareness of the COVID-19 pandemic and vaccines should be increased through focused interventions to increase vaccine acceptance in pregnant women.

ORCID

Osman Samet Gunkaya *https://orcid.org/0000-0002-2188-2503*
Arzu Bilge Tekin *https://orcid.org/0000-0001-8054-2624*
Murat Yassa *https://orcid.org/0000-0001-8661-1192*
Oguz Arslan *https://orcid.org/0000-0003-4014-4511*
Kübra Karakoç *https://orcid.org/0000-0003-2916-4538*
Nesibe Demirtaş *https://orcid.org/0000-0001-8182-4412*
Canberk Usta *https://orcid.org/0000-0002-0825-2355*
Çiğdem Künt İşgüder *https://orcid.org/0000-0002-0420-1913*
Niyazi Tuğ https://orcid.org/0000-0001-7442-834X

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