Published online 2023 April 20 **Original Article**

Medical Students' Views and Attitudes toward Vaccine Refusal during the COVID-19 Pandemic: A Multicenter Study

Esra Çınar Tanrıverdi[1], Ezgi Ağadayı[2], M.Emin Layık[3], Mehmet Akif Nas[1*], Seher Karahan[2] and Elif Okşan Çalıkoğlu[4]

[1]Atatürk University Faculty of Medicine, Department of Medical Education, Erzurum, Turkey
[2]Cumhuriyet University Faculty of Medicine, Department of Medical Education, Sivas, Turkey
[3]Yüzüncü Yıl University Faculty of Medicine, Department of Medical Education, Van, Turkey
[4]Atatürk University Faculty of Medicine, Department of Public Health, Erzurum, Turkey

*** *Corresponding author:*** Mehmet Akif Nas, Atatürk University Faculty of Medicine, Department of Medical Education, Erzurum, Turkey. Email: mehmetakifnas@gmail.com

Received 2022 January 20; **Revised** 2023 February 15; **Accepted** 2023 March 04.

Abstract

Background: The rapid development and production of COVID-19 vaccines have raised concerns about their safety and efficacy, which have contributed to vaccine hesitancy among some people.
Objectives: This study aimed to determine the opinions and attitudes of medical students about COVID-19 vaccines and vaccine hesitancy.
Methods: Nine hundred seventy-seven volunteer students from three medical faculties participated in this study, and data were collected via an online survey. A questionnaire consisting of 40 items and four parts, including sociodemographic information, COVID-19 vaccines, vaccine rejection, and vaccine hesitancy was used for data collection. In the questionnaire, the students were asked about their desire to be vaccinated, whether they want to be vaccinated for their families, vaccination indecision or rejection, and the reasons for not wanting to be vaccinated.
Results: Among the students, the rate of vaccine rejection was 15.4% (n=150), and the rate of vaccine hesitancy was 18.9% (n=185). While 65.7% (n=642) wanted to be vaccinated against COVID-19, the rate of those who wanted their families to be vaccinated was 54.1% (n=529). Age and being in the preclinical period positively affected the vaccination decision, while a history of COVID-19 and being affected by vaccine technology negatively influenced the decision to be vaccinated. The vaccine acceptance rate was significantly higher in men than in women (P=0.002), in preclinical students than in clinical year students (P=0.049), and in those without a history of COVID-19 than in those who had COVID-19 (P<0.001).
Conclusion: The attitudes of medical students toward COVID-19 vaccines were positive. However, considering that some students were hesitant to be vaccinated or against vaccination, we think it would be beneficial to integrate positive attitude development programs into the medical education curriculum.

Keywords: COVID-19, Medical student, Vaccine refusal

1. Background

The primary purpose of health services is to protect individuals' health and prevent diseases (1). Vaccination is a crucial tool serving to protect public health (1, 2). Vaccination first leads to individual immunity and protects the vaccinated person from contracting diseases. As the number of vaccinated individuals increases, the contact of the unvaccinated individuals with the infectious agent decreases, leading to a decrease in the disease prevalence and, finally, herd immunity (3). Vaccination has prevented many disease sequelae and millions of deaths. Despite this, vaccine rejection and hesitancy have been increasing in recent years (4).

In 2019, before the COVID-19 pandemic, the World Health Organization (WHO) recognized vaccine rejection as one of the ten global threats (4, 5). The WHO defined vaccine hesitancy as "delaying or not accepting the administration of some vaccines even though the vaccine is available" and vaccine refusal as "rejecting or not having all vaccines voluntarily" (6).

At the time this study was written (November 2021), COVID-19 had infected millions of people and caused the death of approximately 5 million people (7). Many countries have taken measures to combat the disease, and these measures have brought enormous economic burdens to the states. Nevertheless, the COVID-19 vaccine has given humanity hope to end the devastating effects of the pandemic (8).

Studies have shown that the rapid development of vaccines for COVID-19 infection and concerns about their safety cause hesitations against vaccination (9). Although many complex reasons cause vaccine hesitancy or rejection (6, 10), it is necessary to understand whether people are willing to be vaccinated, why they want or do not want to be vaccinated, and the sources of information that influence their vaccination decision to encourage vaccination (9).

Healthcare professionals are one of the most reliable sources of COVID-19 vaccines (11). Messages of healthcare professionals emphasizing

vaccine efficacy and safety may change the public's attitude toward vaccines (12, 13). Considering the role of medical students in society, peer, and family education, it is essential to understand their thoughts on vaccine rejection. Today's medical students are tomorrow's doctors. Determining the possible negative attitudes of students toward vaccine rejection will provide an opportunity to plan training to turn these attitudes into positive attitudes (13).

2. Objectives

The present study aimed to determine the perceptions of medical students about COVID-19 vaccines and their attitudes toward vaccine rejection in the era of the COVID-19 vaccination campaign.

3. Methods

3.1. Study design, sample size, and participants

A cross-sectional study was conducted between 01 and 16 March 2021 on medical students from faculties of medicine of Atatürk University, Van Yüzüncü Yıl University, and Cumhuriyet University. Preclinical students of Agri Ibrahim Çeçen University and University of Erzurum Health Sciences, who were educated at Ataturk University Faculty of Medicine, were also included in the study.

The scope of the research consists of 4,476 students studying medicine at Atatürk University (n=2236), Cumhuriyet University (n=1151), and Van Yüzüncü Yıl University (n=1089). The targeted sample size was calculated as 354 with a 95% confidence interval and a 5% margin of error. The criteria for inclusion in the study were determined as being over the age of 18, being a student at the specified medical faculties, and being a volunteer for participation. Non-volunteers and those under the age of 18 were excluded from the study.

Printed materials were not used, and face-to-face meetings could not be held due to pandemic conditions. Instead, an online questionnaire was created by the researchers via Google Forms.

Although a sample calculation was made, it aimed to reach all the students. Therefore, the questionnaire was sent to all of them. Students were informed about the purpose and scope of the study via e-mail and were invited to participate. Next, the questionnaire link was shared with the students via WhatsApp class groups. Participation in the research was voluntary. Information about the purpose and scope of the study was also included at the beginning of the survey. Participants could access the questions after they marked the option "I voluntarily accept to participate in the research," providing online consent. Students were given 15 days to respond. Three reminder messages were sent during this time.

In March 2021, when the research was conducted, public vaccination services against COVID-19 had not started. Therefore, this context should be considered when evaluating the results of the study.

3.2. Data Collection Tools

A questionnaire composed of four parts was used for data collection: 1) sociodemographic characteristics, 2) views and attitudes about COVID-19 and the COVID-19 vaccine, 3) opinions about getting vaccinated, and 4) items about reasons and factors affecting vaccine refusal. The questionnaire, which includes 40 items, was first applied to a pilot sample of 20 students, and some items were modified. It could be answered in approximately 15 min.

3.2.1. Sociodemographic Characteristics

Age, sex, study year, university, nationality, residence, and geographical region of origin were asked (7 items).

3.2.2. Views and Attitudes about COVID-19 and the COVID-19 Vaccine

Various items were related to opinions on COVID-19 vaccines, such as "COVID-19 vaccination service should be encouraged by community leaders" and "Healthcare workers should be prioritized in COVID-19 vaccination" (24 items).

3.2.3. Opinions about Vaccination

In this section, the students were asked questions such as a history of COVID-19, vaccination willingness of their own and their families, factors affecting vaccination acceptance, such as production technology, protective proportions, local/international origin, and whether they would volunteer in a new vaccine phase study (7 items).

3.2.4. Items about Vaccine Rejection Reasons and Affecting Factors

In this section, reasons for vaccine rejection and affecting factors were queried (2 items).

3.2.5. Ethical Consent

Ethical permissions were obtained from the Turkish Health Ministry Health Services General Directorate Scientific Research Platform and the Van Yüzüncü Yıl University Clinical Research Ethical Committee (Decision No: 2021/03-04, Date: 19.02.2021). The study was carried out following the rules of the Helsinki Declaration. Informed consent of the participants was obtained.

3.3. Statistical Methods

Data were analyzed using the SPSS (version 25.0, SPSS Inc., Chicago, IL, USA) statistical package program. Categorical data are presented as numbers (n) and percentages (%). Measures of central distribution and spread (Mean ± Standard

deviation) were calculated for the numerical data. One-way analysis of variance (ANOVA) was used to determine whether the means of normally distributed numerical data differed significantly between three independent groups. Post hoc analysis of the nonhomogeneous variances was analyzed by the Tamhane T2 test. The chi-squared test was used to compare categorical data.

Binary logistic regression analysis was used to investigate the factors affecting students' intention to be vaccinated. The outcome variable "Attitude toward getting vaccinated" consisted of two categories (vaccination willingness and rejection/hesitation). The Wald Chi-squared test was performed to determine the significance of the model coefficients using logistic regression. The continuous variable in the model was age. Categorical variables in the model were being female (vs. being male), receiving basic medical education (vs. studying clinical sciences), having a history of COVID-19 infection (vs. no COVID-19 history), recommending vaccination (vs. not recommending/not sure), being affected by vaccine protection rate (vs. not being affected/not sure), perceived significance of vaccine technology (vs. being unaffected/not sure), being impressed by the nativeness of the vaccine (vs. unaffected/not sure), and willingness to volunteer for a vaccine trial (vs. unwilling/not sure). The results were presented using estimated coefficients, standard errors, Wald Chi-square, *P*-values, odds ratios, and confidence intervals. A *P*-value of less than 0.05 with a 95% CI was considered statistically significant.

4. Results

After excluding 80 incorrectly completed or incomplete questionnaires, the complete data of 977 participants were analyzed. The response rate was 21.8%.

4.1. Sociodemographic Characteristics of the Participants

The demographic characteristics of the participants are presented in Table 1.

4.2. Responses to Statements about COVID-19 and the COVID-19 Vaccine

The students' views on COVID-19 and the COVID-19 vaccine are shown in Table 2. Of the students, 932 (95.4%) thought some people would refuse the COVID-19 vaccine, and 376 (38.5%) proposed that all vaccination services, including the COVID-19 vaccine, should be compulsory.

Table 1. Sociodemographic characteristics of the participants (n=977)

Variables	n (%)
Sex	
Female	553 (56.6)
Male	424 (43.4)
Faculty	
Atatürk University, Ağrı İbrahim Çeçen University, and Erzurum Health Sciences University	459 (47.0)
Van Yüzüncü Yıl University	226 (23.1)
Cumhuriyet University	292 (29.9)
Study year	
1	208 (21.3)
2	370 (37.9)
3	104 (10.6)
4	152 (15.6)
5	111 (11.4)
6	32 (3.3)
Nationality	
Turkish	930 (95.2)
Other	47 (4.8)
Region of permanent residence	
Marmara	90 (9.2)
Aegean	46 (4.7)
Mediterranean	90 (8.7)
Central Anatolia	200 (20.5)
Black Sea	125 (12.8)
Eastern Anatolia	306 (31.3)
Southeastern Anatolia	103 (10.5)
Outside Turkey	22 (2.3)
Residence type	
City Center	733 (75.0)
County	193 (19.9)
Village	51 (5.2)
	Mean (±SD) (min-max)
Age (years)	20.9±2.0 (18-36)

Table 2. Responses of the medical students to statements about COVID-19 and the COVID-19 vaccine

Questions about COVID-19	Yes n (%)	Not sure n (%)	No n (%)
COVID-19 vaccination services will completely end the pandemic in the community.	181 (18.5)	273 (27.9)	523 (53.5)
All immunization services, including COVID-19 vaccination, should be required by law.	376 (38.5)	159 (16.3)	442 (45.2)
COVID-19 vaccine should be administered free of charge in Turkey.	694 (71.0)	171 (17.5)	112 (11.5)
To ensure herd immunity, 100% vaccination rates should be achieved in the community.	447 (45.8)	126 (12.9)	404 (41.4)
There will be people who refuse the COVID-19 vaccine.	932 (95.4)	24 (2.5)	21 (2.1)
COVID-19 vaccination services should be encouraged by community leaders.	748 (76.6)	139 (14.2)	90 (9.2)
It is the right decision to apply the COVID-19 vaccine to healthcare professionals first.	687 (70.3)	124 (12.7)	166 (17.0)
I believe that I will easily survive the COVID-19 disease without a vaccine.	350 (35.8)	263 (26.9)	364 (37.3)
People who had the COVID-19 infection do not need to be vaccinated.	159 (16.3)	158 (16.2)	660 (67.6)
The COVID-19 vaccine should not be administered to the population over 65 years of age.	68 (7.0)	162 (16.6)	747 (76.5)
Infants and children should be a priority for the COVID-19 vaccine.	159 (16.3)	206 (21.1)	612 (62.6)
Protection starts immediately after the COVID-19 vaccine shot.	72 (7.4)	250 (25.6)	655 (67.0)
The vaccine is ineffective, as those who had the disease can acquire it again.	111 (11.4)	238 (24.4)	628 (64.3)
Vaccination will increase the mutation rate of the virus.	131 (13.4)	314 (32.1)	532 (54.5)
The vaccine can have serious health risks.	289 (29.6)	251 (25.7)	437 (44.7)
The vaccine has not passed adequate safety tests.	467 (47.8)	233 (23.8)	277 (28.4)
The pandemic has increased people's interest in vaccines.	739 (75.6)	123 (12.6)	115 (11.8)
The childhood vaccination rates have increased with the pandemic.	405 (41.5)	371 (38.0)	201 (20.6)
The adult vaccination rates have increased with the pandemic.	540 (55.3)	319 (32.7)	118 (12.1)
The COVID-19 vaccine should be required by law.	119 (12.2)	196 (20.1)	662 (67.8)
Like the flu vaccine, I think the COVID-19 vaccine will be repeated every year.	408 (41.8)	362 (37.1)	207 (21.2)
The COVID-19 vaccine rejection rates will be low in Turkey.	132 (13.5)	202 (20.7)	643 (65.8)
Those who are not vaccinated for COVID-19 should be penalized, similar to those who do not wear masks.	217 (22.2)	194 (19.9)	566 (57.9)
Social restrictions should be imposed on those who are not vaccinated against COVID-19.	435 (44.5)	167 (17.1)	375 (38.4)

Of the students, 26.1% (n=255) had COVID-19 infection, 65.7% (n=642) wanted to be vaccinated against COVID-19, 18.9% (n=185) were not sure, and 15.4% (n=150) did not want to be vaccinated. The rate of those who wanted their families vaccinated against COVID-19 was 54.1% (n=529). Furthermore, 24.2% (n=236) were unsure about this issue, and 21.7% (n=212) did not want their family to be vaccinated against COVID-19. Factors affecting students' willingness to be vaccinated against COVID-19 are presented in Table 3.

Of the students, 20.9% (n=204) were ready to participate in a newly produced COVID-19 vaccine phase study. Furthermore, in 77.4% (n=756), the protection rate of the vaccine, in 52.7% (n=515), the production technology of the vaccine, and in 52.4% (n=512), the domestic production of the vaccine was indicated to affect their decision to be vaccinated. Of the participants, 60.9% (n=595) thought that vaccination would reduce the use of other protective measures (masks, distance, and hygiene).

Of the students, 78.2% (n=764) thought that the reason for vaccine rejection among the public was the unwanted side effects of the vaccines. The opinions of the participants about vaccine rejection are shown in Table 4.

Factors affecting students' attitudes toward wanting to be vaccinated (the group who wanted to be vaccinated and those who did not want to or were hesitant) were analyzed with the binary logistic regression model. The regression analysis results are shown in Table 5.

According to the regression analysis results, age had a 1.132-fold (P=0.017), and being a preclinical phase student had a 1.696-fold (P=0.017) positive effect on requesting to be vaccinated. On the other hand, having a COVID-19 infection had a 0.458-fold (P<0.001) negative effect, and being influenced by vaccine production technology had a 0.721-fold negative effect (P=0.040).

Table 3. Association of medical students' willingness to be vaccinated against COVID-19 with some factors

	Thoughts against getting vaccinated			*P*
	Positive n (%)	Hesitant n (%)	Negative n (%)	
Sex				
Female	344 (62.2)	123 (22.2)	86 (15.6)	0.002
Male	298 (70.3)	62 (14.6)	64 (15.1)	
Age (M±SD)	21.0±2.0	20.9±2.3	20.5±1.8	0.025†
Study period				
Preclinical years	455 (66.7)	116 (17.0)	111 (16.3)	0.049
Clinical years	187 (63.4)	69 (23.4)	39 (13.2)	
Nationality				
Turkish	603 (64.8)	180 (19.4)	147 (15.8)	0.023
International	39 (83.0)	5 (10.6)	3 (6.4)	
History of COVID-19				
Yes	147 (57.6)	70 (7.2)	38 (25.2)	<0.001
No	495 (68.6)	115 (15.9)	112 (15.5)	

Table 3. Continue

Does the production technology of the vaccine affect your decision?				
Yes	316 (61.4)	109 (21.1)	90 (17.5)	
Not sure	103 (68.7)	29 (19.3)	18 (12.0)	0.038
No	223 (71.5)	47 (15.0)	42 (13.5)	
Does the protection rate of the vaccine affect your decision?				
Yes	478 (63.2)	155 (20.5)	123 (16.3)	
Not sure	50 (71.4)	15 (21.4)	5 (7.2)	0.002
No	114 (75.5)	15 (9.9)	22 (14.6)	
If the vaccine was produced locally, would it affect your decision?				
Yes	325 (63.5)	105 (20.5)	82 (16.0)	
Not sure	158 (66.9)	52 (22.0)	26 (11.1)	0.009
No	159 (69.5)	28 (12.2)	42 (18.3)	
Would you like to volunteer in the phase study of a new vaccine?				
Yes	204 (100)	0 (0)	0 (0)	
Not sure	142 (67.0)	70 (33.0)	0 (0)	<0.001
No	296 (52.8)	115 (20.5)	150 (26.7)	
Are your childhood vaccinations complete?				
Yes	596 (65.6)	172 (18.9)	141 (15.5)	
Not Sure	43 (67.2)	12 (18.8)	9 (14.1)	0.855
No	3 (75.0)	1 (25.0)	0 (0)	

† ANOVA test was applied for the line. Tamhane post hoc analysis was then used to detect the difference between groups. Tamhane post hoc analysis; There is a significant difference between positive and negative groups. The Chi-square test was used in the remainder of the Table

Table 4. Students' views on why the public rejects the vaccine

Student opinions on reasons for vaccine rejection	n (%)
Occurrence of unwanted vaccine-related side effects	764 (78.2)
Financial interests of companies producing vaccines	627 (64.2)
Believing that the vaccine will cause infertility	455 (46.6)
Believing that the vaccine will cause autism	290 (29.7)
Religious reasons (such as the belief that vaccines contain pork)	275 (28.1)
Believing that the disease should be cured	197 (20.2)
Low health literacy and various conspiracy theories	58 (5.9)†
Not trusting the effectiveness of the vaccine or not trusting the producing company	42 (4.3)†
Student views on the factors affecting vaccine refusal	
Social Media (TV, Internet, etc.)	846 (86.6)
Anti-vaccine healthcare workers	173 (17.7)
Anti-vaccine community leaders	378 (38.7)
Anti-vaccine groups	632 (64.7)
Circle of friends and relatives	653 (66.8)

†These choices were categorized from the answers given by the students to the "other" option

Table 5. Examination of the factors affecting students' attitudes toward vaccination willingness (compared to those against or hesitant) with a binary logistic regression model

	Coefficient (β)	SE (β)	W	*P*	OR	95% CI	
						Lower	Upper
Being female (compared to being male)	-0.036	0.156	0.052	0.819	0.965	0.711	1.310
Age	0.124	0.052	5.685	0.017	1.132	1.022	1.254
Studying basic medical education (compared to being at the clinical phase)	0.528	0.222	5.649	0.017	1.696	1.097	2.622
History of a Covid-19 infection (compared to no history)	-0.781	0.177	19.39	<0.001	0.458	0.324	0.648
Suggesting getting vaccinated (vs. not recommending/not sure)	0.210	0.156	1.819	0.177	0.811	0.597	1.100
Being affected by vaccine protection (vs. unaffected/not sure)	-0.034	0.205	0.027	0.868	0.967	0.646	1.446
Being affected by vaccine technology (compared to being unaffected/not sure)	-0.327	0.159	4.223	0.040	0.721	0.527	0.985
Being affected whether the vaccine is local (compared to being unaffected/not sure)	-0.249	0.153	2.648	0.104	0.779	0.577	1.052
Willingness to volunteer for vaccine trials (compared to not wanting/not sure)	0.193	0.631	0.094	0.760	1.213	0.352	2.656

N = 977. Nagelkerke R^2 = 0.304
SE: Standard error; W: Wald Chi-square; OR: Odds ratio; CI: Confidence interval

5. Discussion

The results of this study, which investigated medical students' desire to be vaccinated, vaccine refusal, and vaccine indecision for COVID-19 vaccines, showed that more than half of the students were considering getting vaccinated. One out of five students participating in the study was undecided about vaccination, and less than one in five does not want to be vaccinated.

A study on medical school students in Egypt in January 2021 reported that 35.9% of the students agreed to be vaccinated, 17.3% refused the vaccine, and 46.8% were hesitant (14). Compared to the study

conducted in Egypt, the proportion of students considering vaccination was higher in our study. In a survey conducted in the USA in December 2020, 75% of medical school students, and in a study in Italy, 86.1% of university students stated that they would be vaccinated (13, 15). Although vaccine hesitation and rejection rates are expected to be higher in countries with low socioeconomic status, such as Egypt (12), our findings are in a position between the USA, Italy, and Egypt. In studies conducted in Turkey, it has been observed that the vaccine acceptance rate among medical school students varies between 29% and 81% (16, 17). Studies have revealed that vaccine rejection rates are higher in the Southeast and East regions of the country (18, 19). The universities where the study was conducted were in Eastern Anatolia, except Cumhuriyet University. Of the students participating in our study, 70.1% were from the Eastern Anatolia region. This may explain why our vaccine acceptance rate is lower than that of a university (81%) in a metropolitan city in Western Turkey (17). In another study, the vaccine acceptance rate among medical faculty students was 29% (16).

In our study, vaccine rejection and hesitancy were higher in Turkish students than in foreign students. In a study carried out by Taneri, the percentage of Turkish-citizen students who wanted to be vaccinated was significantly higher than that of international students (17).

Similarly, in a study conducted in Jordan, it was shown that non-Jordanian students were more willing to get vaccinated (20). It is thought that reasons such as being abroad, problems with health insurance, and financial burden during possible hospitalizations may cause foreign students to feel more inclined to accept the vaccine as a preventive measure (20).

Thus, the level of volunteering for vaccine phase studies was low in our research. Twenty-nine percent of the students stated that they would volunteer in the phase studies of a new COVID-19 vaccine. However, all these students accepted the vaccine. On the other hand, even in the group that accepted the vaccine, the rate of volunteering for the phase study was 31.7%. In the study of Lucia et al. in the USA, 53% of participants volunteered for phase studies (13). Teaching students about phase studies can be effective in this regard.

According to the results of our research, the rate of students' families wanting to be vaccinated was lower than their desire to be vaccinated themselves. However, two out of ten students did not want their family vaccinated, while two were hesitant. Similar to our results, in studies conducted in Turkey, lower proportions of students wanted their families to be vaccinated, and fewer parents wanted their children to be immunized against COVID-19 when compared to themselves (16). More comprehensive studies are needed on why people are reluctant to vaccinate their family members.

Although social media is frequently used today, false information about vaccines is commonly encountered (4,20). On the other hand, anti-vaccine news spreads more quickly, and anti-vaccine people use social media and the Internet more to seek information (21). Students saw social media (TV, Internet, etc.) as the most important factor ~~(86.6%)~~ affecting vaccine rejection. Similar results were obtained in a study from Turkey, and medical school students blamed the media as the most influential factor in vaccine hesitancy (17).

The need for a vaccine during the COVID-19 epidemic led to rapid vaccine production initiatives. The shorter phase studies of the vaccine compared to previous productions were covered in the media, and vaccine opponents frequently expressed this situation on social media against the vaccine's safety. In addition, people are hesitant to accept newly developed vaccines (22). Learning about vaccines through the press has a nonnegligible place in society (16, 17). Participants may have been heavily influenced by exposure to topics related to the COVID-19 vaccine in the media. Accordingly, the perception that vaccines did not pass adequate safety tests may have settled in students.

Furthermore, a significant number of students considered factors such as the undesirable side effects related to vaccines, the commercial interests of the vaccine-producing companies, and the thought that the vaccine would cause infertility among the critical reasons for vaccine rejection.

According to the results of our research, preclinical students were more inclined to vaccinate than those in the clinical years. We predicted that clinical students would be more prone to be vaccinated because they are more likely to see COVID-19 patients during the clinical study years. In fact, studies have also shown a higher rate of vaccine acceptance in healthcare workers following exposure to COVID-19 patients (21).

While 12.2% of the students in our study thought that vaccination should be mandatory, more people (67.9%) considered vaccination compulsory in a survey conducted in the USA (13). In another study in Turkey, one-third of the population defended that COVID-19 vaccinations must be mandatory (19). In our study, 95.4% of the participants believed that there would be people who would reject the COVID-19 vaccine, and 67.8% believed that the COVID-19 vaccine rejetion rates would be high. However, despite all of this, very few of the participants thought that vaccinations should be mandatory. Together with the anxiety about potential side effects of vaccines and concerns that they did not undergo adequate safety processes, negative messages against vaccination on social media may push the students into indecisiveness or rejection and may create the opinion that vaccination should not be mandatory.

The vaccination intentions of the male students were significantly greater than those of the female students in our study. In addition, two studies conducted on health workers and the community in Turkey support our results (18, 19). Again, in a study from Turkey, male medical school students preferred the option "I will get the COVID-19 vaccine immediately" more than women; however, there was no statistically significant difference in attitudes against the vaccine regarding sex (16). Although studies worldwide have suggested a relationship between the female sex and COVID-19 vaccination rejection or hesitation (20, 23-28), others have published higher vaccine rejection or hesitation proportions among males (29). With the study data, no clear conclusion can be made concerning the effects of sex on vaccine rejection or hesitation.

To the question "If the vaccine was produced locally, would it affect your decision? "the groups that were hesitant and against vaccination gave "yes" answers at rates of 56.7% and 54.7%, respectively. In a Turkish sample, "Which country's vaccine do you trust most?" the answer was Turkey by 64.3%, followed by Germany (51.3%) (19). Thus, a safe and effective local vaccine can significantly increase the vaccine acceptance rate in the hesitant and vaccine-reluctant groups.

Courses aiming to develop positive attitudes about vaccine rejection and hesitancy in medical students should be integrated into the curriculum and started at the earliest stages of medical education. In addition, medical students can be given an active role in community education by providing the public with correct information.

5.1. Study Strengths and Limitations

The strength of our study is that it provides data on the views and attitudes of future doctors. Furthermore, it is the first study to investigate the attitudes and hesitancy of medical students concerning COVID-19 vaccination in Eastern Turkey. However, this study has some limitations. Firstly, it is primarily a cross-sectional study, and causal inferences are difficult to draw. Secondly, since the data are collected online, the inability to reach those without an interface device or Internet connection may have affected the results. Thirdly, the faculties where the study was conducted were located in the country's eastern and central Anatolian regions. Thus, the results do not reflect all countrywide medical schools. Therefore, caution is warranted in generalizing the findings. Finally, no face-to-face interviews were conducted. Consequently, it is not possible to avoid recall or response bias.

6. Conclusion

The findings of this study showed that more than half of medical students were considering receiving the COVID-19 vaccine. One-fifth of the participants were undecided about getting vaccinated, and fewer did not want to be vaccinated. In the current study, it was determined that the most critical reason for vaccine rejection was the unwanted side effects of vaccines, and the most important factor affecting vaccine rejection was social media. It would be beneficial to integrate the training that will enable medical students, who are the health service providers of the future, to develop positive attitudes into the medical education curriculum at the earliest stage.

Acknowledgments

We thank the medical students who participated in the study.

Footnotes

Conflicts of Interest: The authors declare no conflict of interest.
Author Contribution: ECT, MEL, SK, EOD designed the research, ECT, MEL, SK, EA participated in data collection, EA data analysis, EA, MAN data interpretation, ECT, MAN, MEL, EA, SK, EOD wrote the manuscript, read and approved the final manuscript.
Informed Consent: Informed consent was obtained from all participants included in the study.
Funding: This study was not funded by any organization.
Ethical statements: Ethical permissions were obtained from the Turkish Health Ministry Health Services General Directorate Scientific Research Platform and the Van Yüzüncü Yıl University Clinical Research Ethical Committee (Decision No: 2021/03-04, Date: 19.02.2021). The study was carried out per the rules of the Helsinki Declaration.

References

1. Yüksel GH, Topuzoğlu A. Factors affecting anti-vaccination. *ESTÜDAM Halk Sağlığı Dergisi*. 2019;**4**(2):244-58. doi: 10.35232/estudamhsd.525983.
2. Bozkurt HB. An overview of vaccine rejection and review of literature. *Kafkas J Med Sci*. 2018;**8**(1):71-6. doi: 10.5505/kjms.2018.12754.
3. Gür E. Vaccine hesitancy - vaccine refusal. *Turk Pediatri Ars*. 2019;**54**:1-2. doi: 10.14744/TurkPediatriArs.2019.79990.
4. Nas MA, Atabay G, Şakiroğlu F, Cayir Y. Vaccine rejection in a university's training family health centers. *Konuralp tıp derg*. 2020;**12**(3):430-4. doi: 10.18521/ktd.744687
5. World Health Organization. Ten threats to global health in 2019.
6. World Health Organization. Report of the sage working group on vaccine hesitancy; 2014.
7. World Health Organization. WHO Coronavirus (COVID-19) dashboard 2021.
8. Malik AA, McFadden SM, Elharake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. *EClinicalMedicine*. 2020;**26**:100495. doi: 10.1016/j.eclinm.2020.100495. [PubMed: 32838242]
9. Machingaidze S, Wiysonge CS. Understanding COVID-19

vaccine hesitancy. *Nat Med*. 2021;**27**(8):1338-9. doi: 10.1038/s41591-021-01459-7. [PubMed: 34272500]
10. MacDonald NE. Vaccine hesitancy: definition, scope and determinants. *Vaccine*. 2015;**33**(34):4161-4. doi: 10.1016/j.vaccine.2015.04.036. [PubMed: 25896383]
11. Lau M, Lin H, Flores G. Factors associated with human Papillomavirus vaccine-series initiation and healthcare provider recommendation in US adolescent females: 2007 national survey of children's health. *Vaccine*. 2012;**30**(20):3112-8. doi: 10.1016/j.vaccine.2012.02.034. [PubMed: 22425179]
12. Solís Arce JS, Warren SS, Meriggi NF, Scacco A, McMurry N, Voors M, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med*. 2021;**27**(8):1385-94. doi: 10.1038/s41591-021-01454-y. [PubMed: 34272499]
13. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. *J Public Health*. 2021;**43**(3):445-9. doi: 10.1093/pubmed/fdaa230. [PubMed: 33367857]
14. Saied SM, Saied EM, Kabbash IA, Abdo SAEF. Vaccine hesitancy: beliefs and barriers associated with Covid-19 vaccination among Egyptian medical students. *J Med Virol*. 2021;**93**(7):4280-91. doi: 10.1002/jmv.26910. [PubMed: 33644891]
15. Barello S, Nania T, Dellafiore F, Graffigna G, Caruso R. 'Vaccine hesitancy' among university students in Italy during the Covid-19 pandemic. *Eur J Epidemiol*. 2020;**35**(8):781-3. doi: 10.1007/s10654-020-00670-z. [PubMed: 32761440]
16. Özbalıkçı E, Aydın ES, İpek İ, Özen N, Yüceler M, Ateş O, et al. The knowledge and opinions of the faculty of medicine students about vaccination, immunization, vaccine hesitation and COVID-19 vaccine in Turkey. *Turk Hij Den Biyol Derg*. 2021;**78**(3):317-32. doi: 10.5505/TurkHijyen.2021.39205.
17. Taneri PE. An evaluation of the knowledge and attitudes of medical students in Istanbul towards COVID-19 at the beginning of the outbreak. *Turk J Public Health*. 2020;**18**:78-85. doi: 10.20518/tjph.727723.
18. Kurtuluş Ş, Remziye C. What do health care professionals think about Covid-19 vaccine applications: a university example. *Harran Univ Tıp Fak Derg*. 2021;**18**(1):29-34. doi: 10.35440/hutfd.908043.
19. Oğulcan M. Türkiye'de İnsanların COVID-19 Aşısına Bakışı. *Dicle Tıp Derg*. 2021;**48**(3):583-94. doi: 10.5798/dicletip.988080
20. Sallam M, Dababseh D, Eid H, Hasan H, Taim D, Al-Mahzoum K, et al. Low COVID-19 vaccine acceptance is correlated with conspiracy beliefs among university students in Jordan. *Int J Environ Res Public Health*. 2021;**18**(5):2407. doi: 10.3390/ijerph18052407. [PubMed: 33804558]
21. Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrachi M, Zigron A, et al. Vaccine hesitancy: the next challenge in the fight against COVID-19. *Eur J Epidemiol*. 2020;**35**(8):775-9. doi: 10.1007/s10654-020-00671-y. [PubMed: 32785815]
22. Akarsu B, Canbay Özdemir D, Ayhan Baser D, Aksoy H, Fidancı İ, Cankurtaran M. While studies on COVID-19 vaccine is ongoing, the public's thoughts and attitudes to the future COVID-19 vaccine. *Int J Clin Pract*. 2021;**75**(4):e13891. doi: 10.1111/ijcp.13891. [PubMed: 33278857]
23. Reno C, Maietti E, Fantini MP, Savoia E, Manzoli L, Montalti M, et al. Enhancing COVID-19 vaccines acceptance: results from a survey on vaccine hesitancy in northern Italy. *Vaccines*. 2021;**9**(4):378. doi: 10.3390/vaccines9040378. [PubMed: 33924534]
24. Schwarzinger M, Watson V, Arwidson P, Alla F, Luchini S. COVID-19 vaccine hesitancy in a representative working-age population in France: a survey experiment based on vaccine characteristics. *Lancet Public Health*. 2021;**6**(4):e210-e21. doi: 10.1016/S2468-2667(21)00012-8. [PubMed: 33556325]
25. Allington D, McAndrew S, Moxham-Hall V, Duffy B. Coronavirus conspiracy suspicions, general vaccine attitudes, trust and coronavirus information source as predictors of vaccine hesitancy among UK residents during the COVID-19 pandemic. *Psychol Med*. 2021:1-12. doi: 10.1017/S0033291721001434. [PubMed: 33843509]
26. Van Duong T, Lin C-Y, Chen S-C, Huang Y-K, Okan O, Dadaczynski K, et al. Oxford COVID-19 vaccine hesitancy in school principals: impacts of gender, well-being, and Coronavirus-related health literacy. *Vaccines*. 2021;**9**(9):985. doi: 10.3390/vaccines9090985. [PubMed: 34579222]
27. Holeva V, Parlapani E, Nikopoulou V, Nouskas I, Diakogiannis I. COVID-19 vaccine hesitancy in a sample of Greek adults. *Psychol Health Med*. 2021;**27**(1):113-9. doi: 10.1080/13548506.2021.1948579. [PubMed: 34233532]
28. Aw J, Seng JJB, Seah SSY, Low LL. COVID-19 vaccine hesitancy—a scoping review of literature in high-income countries. *Vaccines*. 2021;**9**(8):900. doi: 10.3390/vaccines9080900. [PubMed: 34452026]
29. Soares P, Rocha JV, Moniz M, Gama A, Laires PA, Pedro AR, et al. Factors associated with COVID-19 vaccine hesitancy. *Vaccines*. 2021;**9**(3):300. doi: 10.3390/vaccines9030300. [PubMed: 33810131]