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RESEARCH

Factors affecting the public's knowledge about COVID-19 vaccines and the influence of knowledge on their decision to get vaccinated

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ABSTRACT

Objective: An analysis was conducted to assess the factors affecting the public's knowledge about coronavirus disease (COVID-19) vaccines and the influence of that knowledge on their decision to get vaccinated.

Study Design: Cross-sectional survey.

Methods: An online, self-administered questionnaire was instrumentalized to assess the factors affecting the Jordanian public's knowledge about COVID-19 vaccines and the influence of that knowledge on their decision to get vaccinated. A multiple linear regression analysis was carried out to determine the variables that affected the participants' knowledge score regarding COVID-19 vaccines. The Mann–Whitney U test was used to evaluate the differences in knowledge scores among different groups. $P < 0.05$ was considered statistically significant. **Results:** Only 45.9% of the 468 participants reported being willing to receive the vaccine, and only 38.5% ($n = 180$) had registered on the Ministry of Health platform to get vaccinated. Moreover, very few of them (26/468, 5.6%) had received the vaccine. The participants showed inadequate knowledge, with a median knowledge score of 4 out of 8 (interquartile range = 4). The linear regression analysis showed that participants aged above 45 years, those with bachelor's or graduate degrees, and those with medical-related degrees had higher knowledge scores regarding COVID-19 vaccines than the others ($P < 0.001$). Participants who were willing to receive the vaccine, those who had registered to receive the vaccine, and those who had got vaccinated had higher knowledge scores than the others ($P < 0.001$ for all).

Conclusion: This cross-sectional analysis indicated that urgent education is needed to improve the public's knowledge and awareness about the COVID-19 vaccine to reduce the adverse impact of lack of knowledge on decision making for the COVID-19 vaccination.

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Background

The novel coronavirus, known as severe acute respiratory syndrome coronavirus 2, has been identified as the cause of coronavirus disease (COVID-19), which was first identified in December 2019 in China.¹ This novel virus is highly

transmittable,² and the World Health Organization has declared it a public health emergency of international concern, advising countries to adopt preventive measures to contain this serious disease.³ On March 2, 2020, Jordan confirmed its first case of COVID-19; subsequently, new cases continued to appear, and the total number of confirmed cases exceeded 747,501 by the end of June 2021, with 9683 deaths.⁴ Similar to other countries in the world, Jordan was heavily affected and devastated by the overwhelming impact of the COVID-19 pandemic, including mandatory stay-at-home orders.⁵ On March 15, 2020, several recommendations, including the avoidance of large gatherings and closure of schools and universities, were made.⁵

As repeatedly acknowledged, vaccinations have been seen as a major tool for reducing the burden of infectious diseases

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Data availability: The required information can be obtained from the author on request.

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Key Points**Background:**

- Vaccination have been seen as a major tool for reducing the burden of infectious diseases.
- Previous studies revealed several variables had significant impact on vaccines other than coronavirus disease vaccines.

Findings:

- The present study assessed the influence of knowledge of coronavirus disease vaccines on public decision to get vaccinated.
- The finding of the present study may help to direct plans and efforts of health authorities for better containment of the disease.

and decreasing their related mortality and morbidity, as well as health care costs.^{6,7} The COVID-19 vaccine is intended to help our bodies develop immunity to the virus that causes COVID-19 without falling ill. National regulatory authorities have approved 6 vaccines for public use: 2 RNA vaccines (tozinameran from Pfizer–BioNTech and mRNA-1273 from Moderna), 2 conventional inactivated vaccines (BBIBP-CorV from Sinopharm and CoronaVac from Sinovac), and 2 viral vector vaccines (Gam-COVID-Vac from the Gamaleya Research Institute and AZD1222 from the University of Oxford and AstraZeneca).⁸ Most of these vaccines require more than 1 dose.⁸ Besides getting vaccinated, people should take steps such as wearing masks and maintaining social distancing to protect themselves and others from COVID-19. Together, these steps will protect human beings from COVID-19.

Despite the availability of vaccines, vaccine compliance remains variable and inconsistent, and vaccine hesitancy is considered a vital obstacle to instituting preventive measures to combat infectious diseases.⁹ Conspiracy theories regarding the safety of COVID-19 vaccines, such as its supposed impact on fertility and the so-called implantation of microchips to control humans, have an impact on the public's attitude to vaccination.^{10,11} Thus, the availability of vaccines does not guarantee that a sufficient number of the population will get vaccinated.¹² Jordan, like other countries, has implemented phased vaccination distribution plans. The National Centre for Security and Crises Management and the Ministry of Health in Jordan at the beginning of 2021 announced the launch of the vaccination campaign. Up to June 2021, however, only 10.5% of the Jordanian population had been fully vaccinated compared with 44.9% of the U.S. population.¹³ Not surprisingly, this low vaccination rate could be attributed to vaccine hesitancy,¹⁴ in addition to the limited availability of the vaccines because the vaccination program prioritizes those at the highest risk of complications, such as older patients, and those at a high risk of exposure and transmission, such as health care workers.¹³

Enhancing public knowledge, willingness, and personal beliefs with regard to vaccination has the potential to notably affect both occupational and public health. A successful inoculation drive against COVID-19 will require widespread public

educational campaigns regarding the safety and efficacy of the vaccines. Pharmacists, as health professionals, can play a major role during the COVID-19 pandemic, acting hand in hand with other health professionals, continuing to care for patients with comorbidities, and providing pharmaceutical care for hospitalized patients with COVID-19.^{15–17} In addition, they may provide reliable information to dispel common concerns related to the adverse effects of the vaccines and improve the vaccination rates. Moreover, pharmacists can act as educators and advocates regarding vaccination.^{18,19}

A previous study from Jordan and other Middle Eastern countries exploring the factors that affect the public's willingness to receive the COVID-19 vaccine revealed several variables that had a significant impact: marital status, monthly income, having a medical degree, fears regarding COVID-19, and previous experience of the influenza vaccine.¹⁴ But, to our knowledge, no previous study has evaluated the influence of the public's knowledge of COVID-19 vaccines on their decision to get vaccinated. Thus, this study aimed to assess the factors affecting the public's knowledge about COVID-19 vaccines and the influence of that knowledge on their decision to get vaccinated. The findings of this study at these early stages of the COVID-19 vaccination campaign may help to direct the plans and efforts of public health authorities, physicians, and the media of our country for timely and better containment of the disease.

Methods*Study design, population, and ethics*

This is a cross-sectional survey-based study that was conducted between January 3, 2021, and January 17, 2021, to assess the public's knowledge about COVID-19 vaccines as well as the factors affecting their decision to get vaccinated. During the study period, an electronic-based survey was distributed to a convenience sample of Jordanian adults (aged ≥ 18 years) using 2 social media platforms (Facebook and WhatsApp). Before enrollment, the participants were provided a detailed explanation of the purpose of the study and a statement about voluntary participation and anonymity of the survey. The study protocol was approved by the institutional review board of Jordan University Hospital (decision no. 10/2021/1527).

Study instruments

The survey was developed by the authors of this manuscript in Arabic, after an extensive review of the literature.^{20,21} The questionnaire was reviewed by 2 authors (PhD holders) with experience in conducting this type of research. Subsequently, it was pilot tested on 18 adult participants from the general public of various ages and backgrounds to evaluate its structure, clarity, and length, as well as to assess the participants' overall impression of the questionnaire, which resulted in several minor amendments to the original questionnaire. The final version of the questionnaire was composed of 4 sections. The first section aimed to collect general information about the participants, such as age and gender. The second section featured the knowledge scale. The statements mentioned in this domain focused on knowledge of the types and doses of the vaccine, high-risk populations,

postvaccination clinical symptoms, and the impact of the COVID-19 vaccination. Regarding the knowledge score, 8 questions were asked; for each correct answer, the participants were assigned a score of 1, and a total knowledge score out of 8 was calculated for each participant. The third section inquired about the participants' willingness to receive the vaccine and the factors that encouraged their willingness (evaluated through 5 statements). One portion of this section was related to worries associated with the COVID-19 vaccines that the Jordanian population experiences, which include concerns regarding the efficacy and safety of the vaccines. The fourth section was related to the COVID-19 vaccination experience. Four questions were asked. Moreover, the survey also included 1 question regarding the participants' sources of information about COVID-19 vaccines.

Sample size calculation

The standard Cochran formula for sample size calculation with an infinite population— $n = P \times (1 - P) \times z^2/d^2$ —was used to calculate the minimal sample size required for this study.²² The sample size was determined using the most conservative proportion of the participants' willingness to receive the vaccine ($P = 50\%$), 5% desired precision, and 95% CIs. Using this formula, a minimum sample size of 385 participants was considered representative for inclusion in this study.

Statistical analysis

Data were entered and analyzed using SPSS version 22.0 (IBM Corp, Armonk, NY). Categorical variables were presented as frequencies and percentages. Continuous variables were presented as medians with interquartile range (IQR). The normality was tested using the Kolmogorov–Smirnov test (with $P > 0.05$ indicating a normally distributed continuous variable).

Simple linear regression was carried out to initially screen the independent variables that affected the participants' knowledge score regarding COVID-19 vaccines. Variables found to have $P < 0.25$ using univariate linear regression analysis were entered into multiple linear regression analysis. The variables were selected after checking their independence, where tolerance values greater than 0.1 and variance inflation factor values less than 5 were selected to indicate the absence of multicollinearity among the independent variables in regression analysis. In the multiple linear regression analysis, the variables that independently affected the participants' knowledge about COVID-19 vaccines were identified. Finally, the Mann–Whitney U test for nonparametric data was used to evaluate the differences in knowledge scores among different groups. $P < 0.05$ was considered statistically significant.

Results

During the study period, 468 individuals completed the survey; 57.9% ($n = 271$) were women, and 60.7% ($n = 284$) were aged 45 years or younger. Approximately two-thirds of the participants had bachelor's degrees ($n = 319$, 68.2%), and more than two-thirds (328, 70.1%) were married. Approximately 45% of the participants ($n = 210$) reported having

Table 1

Sociodemographic characteristics of the study participants ($N = 468$)

Variable	n (%)
Gender	
Female	271 (57.9)
Male	197 (42.1)
Age, y	
18–45	284 (60.7)
46–60	159 (34.0)
> 60	25 (5.3)
Educational status	
School level	42 (9.0)
Bachelor's degree	319 (68.2)
Graduate degree	107 (22.9)
Marital status	
Married	328 (70.1)
Other ^a	140 (29.9)
Having a medical-related profession ^b	
No	258 (55.1)
Yes	210 (44.9)

^a Other: single, divorced, or widowed.

^b Medical-related profession includes physicians, pharmacists, pharmacy technicians, nurses, surgeons, dentists, radiologists, and medical laboratory technicians.

medical-related degrees. The sociodemographic characteristics of the study participants are presented in [Table 1](#).

Regarding the participants' experiences with COVID-19 vaccines ([Table 2](#)), although 45.9% of the participants ($n = 215$) reported willingness to receive the vaccine, only 38.5% ($n = 180$) had registered on the Ministry of Health platform, and only 5.6% ($n = 26$) had received the vaccine. Regarding chronic diseases, approximately one-quarter of the participants ($n = 126$, 26.9%) reported having at least 1 chronic disease.

The participants who were willing to receive the vaccine ($n = 215$, 45.9%) were asked about the reasons for their willingness ([Figure 1](#)), and the main reason reported by them was that they wanted to return to a normal life ($n = 162$, 75.3%). Another reason was that they wanted protection from COVID-19 ($n = 160$, 74.4%).

In contrast, those who refused to receive the vaccine ($n = 253$, 54.1%; [Figure 2](#)), reported that the main reason behind

Table 2

Participants' experiences with COVID-19 vaccines and their clinical characteristics ($N = 468$)

Statement	n (%)
Are you willing to take COVID-19 vaccine?	
No	253 (54.1)
Yes	215 (45.9)
Did you register on the Ministry of Health platform to get the vaccine?	
No	288 (61.5)
Yes	180 (38.5)
Did you get vaccinated?	
No	442 (94.4)
Yes	26 (5.6)
Type of vaccine received ^a	
Sinopharm	17 (65.4)
Pfizer	9 (34.6)
Do you have any chronic diseases?	
No	342 (73.1)
Yes	126 (26.9)

Abbreviation used: COVID-19, coronavirus disease.

^a Percentage calculated for participants who were vaccinated ($n = 26$).

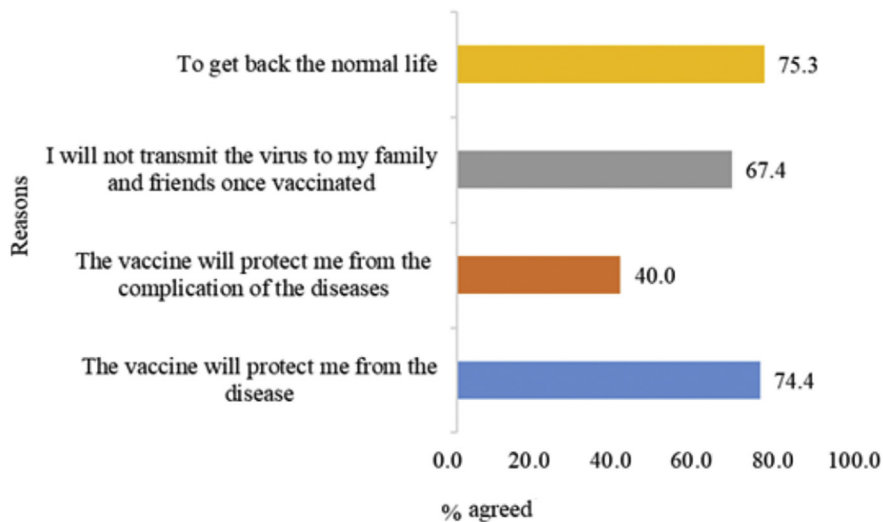


Figure 1. Reasons for the participants' willingness to receive the coronavirus disease vaccine. Percentage calculated for those who were willing to receive the vaccine ($n = 215$).

their refusal was that the vaccine had not undergone the required testing period ($n = 140$, 55.3%); they also feared any potential adverse effect associated with the vaccine ($n = 126$, 49.8%).

Regarding their knowledge about COVID-19 vaccines (Table 3), the participants showed inadequate knowledge, with a median knowledge score of 4 out of 8 (IQR = 4). Only 47.2% of the participants ($n = 212$) knew that the vaccine can be administered to older adults, and approximately two-thirds ($n = 306$, 65.4%) knew that the vaccine should be administered in 2 doses. Interestingly, only 39.1% of the participants ($n = 183$) knew that people who had been previously infected with COVID-19 still needed to get vaccinated. In addition, only 120 participants (25.6%) were aware that the COVID-19 vaccine should not be given to individuals in quarantine.

Regarding the sources of information about COVID-19 vaccines, the participants revealed that their main source of information was social media (72.2%), followed by television and radio (Figure 3).

Linear regression analysis (Table 4) showed that participants aged above 45 years, those with university or graduate degrees, and those with medical-related degrees had higher knowledge scores regarding COVID-19 vaccines than the others ($P < 0.001$).

Regarding the association between the participants' knowledge about COVID-19 vaccines and their vaccination behavior (Figure 4), those who were willing to receive the vaccine, those who had registered to receive the vaccine, and those who got vaccinated had higher knowledge scores than the others ($P < 0.001$ for all).

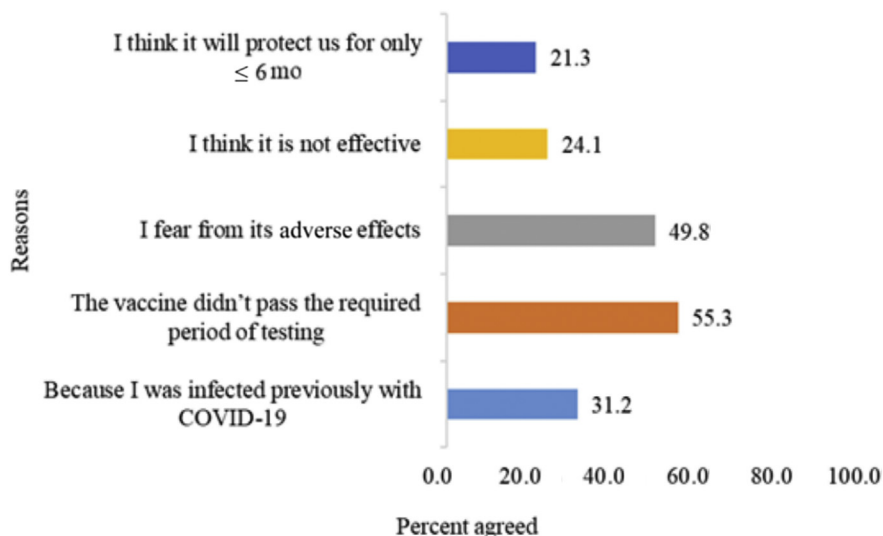


Figure 2. Reasons for the participants' refusal to receive the COVID-19 vaccine. Percentage calculated for those who were unwilling to receive the vaccine ($n = 253$). Abbreviation used: COVID-19, coronavirus disease.

Table 3
Assessment of participants' knowledge about COVID-19 vaccines (N = 468)

Statement	n (%)
COVID-19 vaccine should not be given to older patient	
Yes	49 (10.5)
No ^a	221 (47.2)
I don't know	198 (42.4)
COVID-19 vaccine will protect us from the disease	
Yes ^a	208 (44.4)
No	37 (7.9)
I don't know	223 (47.6)
COVID-19 vaccine can prevent the spreading of the disease	
Yes ^a	237 (50.6)
No	27 (5.8)
I don't know	204 (43.6)
Number of doses of the COVID-19 vaccine	
1 dose	9 (1.9)
2 doses ^a	306 (65.4)
I don't know	153 (32.7)
I should not get the vaccine because I was infected previously	
Yes	100 (21.4)
No ^a	183 (39.1)
I don't know	185 (39.5)
I can get the vaccine while I am in quarantine	
Yes	75 (16.0)
No ^a	120 (25.6)
I don't know	273 (58.3)
After vaccination, wearing masks and other preventive measures become unnecessary	
Yes	43 (9.2)
No ^a	335 (71.6)
I don't know	90 (19.2)
COVID-19 vaccine could be given safely to children	
Yes	44 (9.4)
No ^a	147 (31.4)
I don't know	277 (59.2)
Knowledge score out of 8, median (IQR)	4.0 (4.0)

Abbreviations used: IQR, interquartile range; COVID-19, coronavirus disease.

^a Correct answer.

Discussion

To the best of our knowledge, this is the first nationwide study to assess both the public's knowledge about COVID-19 vaccines and the factors that affect their knowledge. In addition, we aimed to study the association between their knowledge and their decision to get vaccinated after COVID-19 vaccine licensure in Jordan. Almost 1 month after the first vaccination approval and 1 week after the launch of the vaccination campaign in Jordan, the participants' knowledge score regarding COVID-19 vaccine was still inadequate. The Ministry of Health platform is the official platform for vaccine registration, and it was open to all to register to receive the vaccine. This website is user friendly and sends end users a short message service text message on their phones specifying whether they are eligible and where they can receive the vaccine. This process was advertised through several channels, including television and social media platforms. Nonetheless, although 45.9% of the study participants were willing to get vaccinated, only 38.5% had registered on the Ministry of Health

platform to receive the vaccine, and only a few (5.6%) got vaccinated.

As published previously, knowledge about vaccines is an important predictor of vaccination.²³⁻²⁶ The results of this study showed that knowledge about the COVID-19 vaccine was limited in the adult population, even about some basic aspects. This lack of knowledge might have an adverse impact on decision making regarding the COVID-19 vaccination and, accordingly, indicates an urgent need to educate the public to improve their knowledge and awareness about the COVID-19 vaccine. This result was inconsistent with what has been reported elsewhere. A study by Al-Hanawi et al.²⁷ revealed that the mean COVID-19 knowledge score among study participants was 17.96 (SD 2.24, range 3-22), indicating a high level of knowledge among the public in Saudi Arabia. An assessment of the factors affecting knowledge about the COVID-19 vaccine in this study revealed that higher education level and age above 45 years were associated with increased knowledge ($P < 0.05$). People with medical-related degrees were also found to have more knowledge about COVID-19 vaccines. This finding is consistent with other studies that have found that older people and health care providers are more knowledgeable about COVID-19 and the vaccines.²⁸⁻³⁰

It is worth mentioning that the rate of willingness to receive the COVID-19 vaccine in this study was generally much lower than what has been shown globally.^{31,32} This low rate of acceptability was shown previously with other vaccines, including seasonal influenza vaccines in 2016-2018.^{33,34} A study based on a sample from 19 countries that recruited 13,426 participants reported that the global acceptance of COVID-19 vaccines ranges from a high of 88.6% in China to a low of 54.8% in Russia. In addition, most western countries show relatively higher public acceptance rates (59%-75%).³¹ In contrast, a higher acceptance rate (64.7%) has been reported in Saudi Arabia, a country with demographic distributions similar to those of Jordan.³²

An assessment of the reasons behind the public's unwillingness to receive the COVID-19 vaccine revealed that almost half of the participants thought that the vaccine had not undergone the required testing period. Another reason was that they feared any potential adverse effect associated with the vaccine. Such beliefs may have affected the participants' vaccination behavior. Researchers have claimed that there are many factors that may explain the public's vaccination behavior, such as availability and cost of the vaccination.^{35,36} However, these factors are not applicable in this research because COVID-19 vaccines are available for free for both Jordanians and non-Jordanians in Jordan. Thus, the most frequently reported obstacle to vaccination in our study was concern about the safety of the vaccine. Besides concern about safety, the efficacy of the vaccine was another substantial obstacle to vaccination as indicated by this study. These findings were consistent with those of Pogue et al.,³⁷ who reported that most of the study participants (nearly two-thirds) in the United States reported that they were worried about the adverse effects of the COVID-19 vaccines. In addition, a previous study conducted in the United Arab Emirates reported similar findings, with 59% of the study sample expressing concerns regarding the vaccines and their safety.³⁸ According to the Centers for Disease Control and Prevention (CDC), COVID-19 vaccines are safe and effective, and the results from

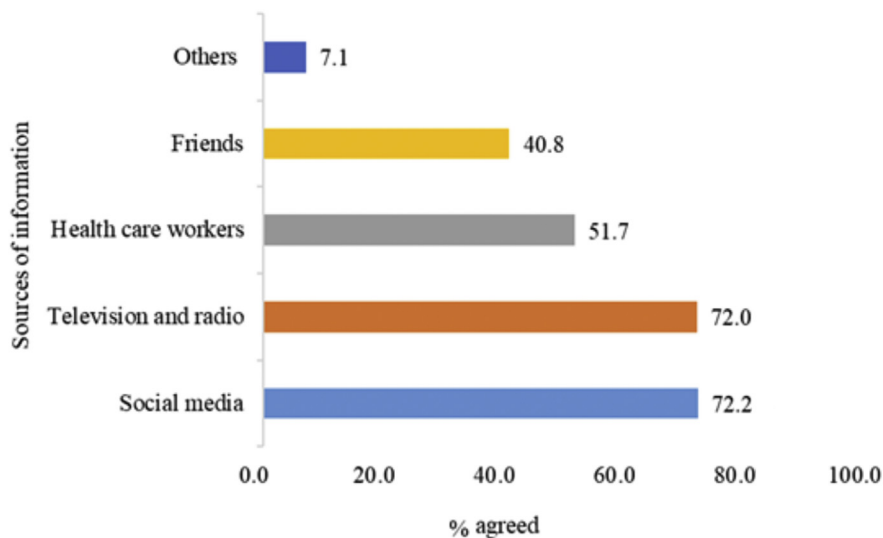


Figure 3. Sources of information about coronavirus disease vaccines among the study participants (N= 468).

the safety monitoring exercise are reassuring. In addition, CDC has reported that serious adverse effects after receiving the COVID-19 vaccine, such as anaphylaxis, venous thromboembolism, and myocarditis, are rare.³⁹

Although the number of study participants who got vaccinated is still very low, it is worth noting that of the vaccinated participants, approximately 65% chose the Sinopharm vaccine, which could be due to the fact that this vaccine was created using one of the classic vaccine techniques rather than using the genetic material technique. The new messenger RNA-based vaccines use novel technology; therefore, skepticism about them is a factor because no prior experience or successes with this approach have been reported.

As presented in this study, it is noteworthy that the main sources of COVID-19 vaccine information and recommendation were social media, television/radio, and health care providers. Social media represents a rapidly evolving global media environment; but, of note, it plays a vital role in disseminating misleading information. Supervision of these channels should be undertaken because misleading information could be distributed rapidly to the public through these channels.

The low level of knowledge presented in our study is troubling because knowledge is an important predictor of willingness regarding COVID-19 vaccine uptake. The low registration rate on the Ministry of Health platform to receive the vaccine at no cost reveals an urgent need for imperative action to improve vaccination acceptance. This underscores the need to design an effective educational intervention to tackle the problem of inadequate knowledge. Educational programs should also focus more on people with low education levels or people with nonmedical-related jobs. More information addressing people's concerns, outlining the consequences of a COVID-19 infection, the benefits of the COVID-19 vaccination, and the safety of the vaccine, should be delivered and emphasized. Setting up a trusted governmental channel for spreading accurate and easy-to-understand information should be considered.

Using health care providers, including pharmacists, to increase awareness by discussing the benefits and risks of vaccination and dispelling the common myths surrounding COVID-19 vaccinations may have a positive impact and increase vaccination rates, as reported in the literature.⁴⁰

Table 4
Assessment of factors affecting participants' knowledge about coronavirus disease vaccines (N = 468)

Parameter	Knowledge score			
	Beta	P value ^a	Beta	P value ^b
Gender (female)	0.093	0.045 ^c	0.070	0.083
Age, > 45 y	0.102	0.027 ^c	0.107	0.008 ^d
Educational status (bachelor's or graduate degrees)	0.161	< 0.001 ^c	0.092	0.025 ^d
Marital status (nonmarried ^e)	0.026	0.574	—	—
Having medical-related profession ^f	0.486	< 0.001 ^c	0.462	< 0.001 ^d
Having chronic diseases	-0.010	0.827	—	—

^a Using simple linear regression.

^b Using multiple linear regression.

^c Eligible for entry in multiple linear regression

^d Significant at 0.05 significance level.

^e Nonmarried: single, divorced, or widowed.

^f Medical-related profession includes physicians, pharmacists, pharmacy technicians, nurses, surgeons, dentists, radiologists, and medical laboratory technicians.

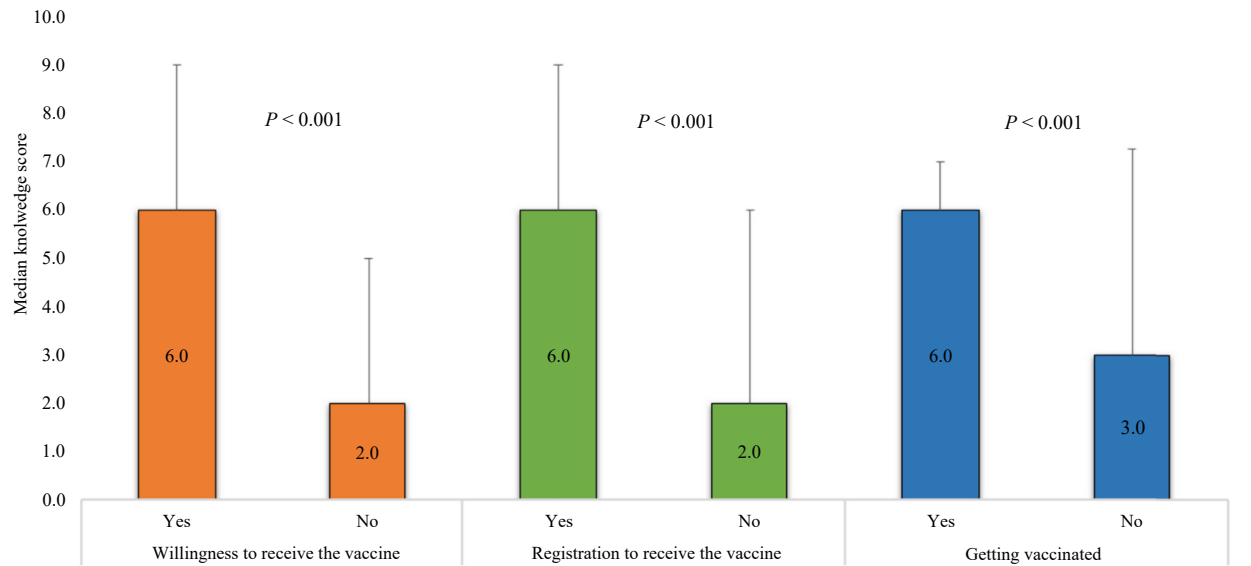


Figure 4. The association between the participants' knowledge about coronavirus disease vaccines and their willingness to receive the vaccine, registering to receive the vaccine, and actually getting vaccinated. Comparisons were performed using the Mann–Whitney U test.

Pharmacists, as reported previously, can take the initiative to discuss vaccination with patients and try to motivate the public to receive the recommended vaccines. Of note, people may shy away from vaccines owing to myths and misconceptions. Thus, pharmacists should encourage open discussions with the public to identify any concerns. Recently, researchers assessed the role of a pharmacist-led educational intervention on people's attitude to, and awareness and acceptance of, pneumococcal vaccines in Amman, Jordan.⁴¹ This interventional study recruited 916 randomly selected older adults.⁴¹ The enrollment of pharmacists in vaccination education and recommendation was associated with an improvement in pneumococcal vaccine coverage in this specific Jordanian population.⁴¹

There are some limitations to this study. First, data were collected using social media platforms because there was no other suitable method of data collection during the lockdown period. Thus, selection bias may exist because the online survey required participants to have access to, and the ability to handle, technology. In addition, approximately 45% of the participants reported holding a biomedical degree, which could have influenced the overall knowledge about COVID-19 vaccines, but this could not be avoided although we targeted general public groups on social media. This selection bias could limit the generalizability of our results to the general population. To add to this, there is the disadvantage of the relatively high nonresponse rate. Because participation in this survey was voluntary, nonresponse bias was hard to avoid. It is possible that people with a greater interest in COVID-19 vaccines or in health-related topics were more likely to respond to the survey. In addition, this study has an inherent limitation due to its design that implies only associations among the specific variables rather than a cause-and-effect relationship. Furthermore, our survey could not distinguish vaccine apathy (participants who did not register to receive the vaccine) from vaccine hesitancy (lack of knowledge).

Conclusion

Through this study, we concluded that the most frequently reported obstacle to vaccination was concern about the efficacy and safety of the vaccine. We also found that knowledge about the COVID-19 vaccine was limited in the adult population, even about some basic aspects. This lack of knowledge might have an adverse impact on decision making with regard to the COVID-19 vaccination and, therefore, indicates an urgent need to educate the public to improve their knowledge and awareness about the COVID-19 vaccine.

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