

## COVID-19 Vaccination Acceptance in Iran, a Nationwide Survey on Factors Associated with the Willingness toward Getting Vaccinated

### Abstract

**Background:** In the name of extensive vaccine uptake, understanding the public's attitude, perception, and intent toward COVID-19 vaccination is a significant challenge for public health officials. **Methods:** A cross-sectional survey via an online questionnaire rooted in the Health Belief Model and Integrated Behavioral Model was conducted to evaluate COVID-19 vaccination intent and its associated factors. Factor analysis and multivariate logistic regression were operated to be satisfactory. **Results:** Among the 4,933 respondents, 24.7% were health care workers, and 64.2% intended to accept COVID-19 vaccination. The adjusted odds (aOR) of COVID-19 vaccination intent was higher for individuals with greater exposure to social norms supportive of COVID-19 vaccination (aOR = 3.07, 95% Confidence Interval (CI) = 2.71, 3.47) and higher perceived benefits of COVID-19 vaccination (aOR = 2.9, 95% CI = 2.49, 3.38). The adjusted odds of vaccination intent were lower for individuals with greater COVID-19 vaccine safety concerns (aOR = 0.28, 95%CI = 0.25, 0.31). Lower vaccination intent was also associated with increasing age ((aOR = 0.99, 95% CI = 0.98, 0.999), female sex (aOR = 0.76, 95% CI = 0.65, 0.88), and working in the health care field (aOR = 0.75, 95% CI = 0.63, 0.9). **Conclusions:** The odds of COVID-19 vaccination intent were higher three or more times among those with a greater belief in vaccine effectiveness, lower concerns about vaccine safety, and greater exposure to cues to vaccinate, including from doctors. This last finding is concerning as vaccine acceptance was surprisingly lower among health care workers compared to others. The remarkable results of factor analysis and reliability of the questionnaire may encourage local health authorities to apply it to their regional population.

**Keywords:** Attitudes and beliefs, COVID-19 vaccine, knowledge, social norms, vaccination

### Introduction

As of December 2020, the World Health Organization (WHO) has cataloged more than 150 candidate vaccines for coronavirus disease 2019 (COVID-19) with 48 in clinical trials, and several approved for early use in some countries raising hopes that a safe and effective vaccine may soon be widely available to curtail the worst of the pandemic.<sup>[1]</sup>

Rapidly vaccinating the majority of the world's population with a COVID-19 vaccine is an unprecedented, daunting undertaking. In addition to the logistical challenges of vaccine distribution, convincing billions of people across the planet regarding the benefits and safety of the novel COVID-19 vaccine is of significant importance. Public health officials in each district must lift cultural and perceptual barriers of vaccine

acceptance among their citizens because a high prevalence of vaccine refusal will reduce infection, control speed, and impede the return to normalcy.

Vaccine refusal due to specific concerns is not a recent phenomenon, and the prevalence of concerns about vaccine safety is becoming increasingly common, precisely for newer vaccines.<sup>[2]</sup> In 2009, an online survey of Italian mothers' attitudes toward pandemic influenza A (H1N1) vaccination found that 87.2% of the respondents either would not or were doubtful that they would vaccinate their children.<sup>[3]</sup> Low vaccine acceptance has also been reported among health care workers.<sup>[4]</sup> In the case of influenza vaccination, the most common reasons health care workers refuse vaccination include misconceptions about vaccine efficacy, adverse effects, and vaccinations causing disease.<sup>[4-8]</sup>

In contrast, the most common reasons health care workers choose to accept influenza

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vaccination include prior influenza illness, effective use of influenza vaccination seen for seasonal influenza,<sup>[4,5,8]</sup> desire to protect themselves and their family and friends,<sup>[6]</sup> and vaccination recommendation from a family member or close friend.<sup>[9]</sup> Amongst the general public for all vaccines, receiving a vaccination recommendation by a trusted medical provider has a significant influence on vaccination acceptance.<sup>[9,10]</sup>

In this study, we aimed to assess the rate of COVID-19 vaccination acceptance among Iranians, identify factors associated with their willingness, and create an internal validity and factor analysis of the questionnaire.

## Materials and Methods

A cross-sectional survey was conducted using an online questionnaire to assess COVID-19 vaccination acceptance among Iranian adults and determine the factors that may affect their willingness. The survey was distributed to a convenience sample via social media (WhatsApp and Telegram) over 6 days, from August 18 to 23, 2020 with no exclusion criteria except the age <18. No incentives were provided for survey completion. This study was approved by the institutional review board and ethics committee at Shiraz University of Sciences (SUMS) with the ethical code IR.sums.med.rec. 1399.276.

## Measures

The survey consisted of three sections. The first section assessed sociodemographic and health characteristics including age, gender, province of residence, marital status, health care occupation status, the highest level of educational attainment, chronic disease, personal history of COVID-19 disease, and family history of COVID-19 disease. The chronic diseases assessed were those associated with risk for a more severe COVID-19 disease course including diabetes mellitus, hypertension, lung disease, renal disease, cardiovascular disease, and any condition requiring chronic oral corticosteroid use.

The second survey section consisted of 27 items. These items were adapted from the study conducted by Painter *et al.*,<sup>[11]</sup> which operationalized the Health Beliefs Model (HBM) and Integrated Behavioral Model (IBM) to assess intent to receive an influenza vaccine. Items were included to assess the following dimensions: *perceived severity of COVID-19 disease* (one item), *perceived susceptibility to COVID-19 disease* (two items), *perceived benefits of COVID-19 vaccination* (four items), *perceived barriers to COVID-19 vaccination* (eight items), *perceived self-efficacy to be able to get the COVID-19 vaccine* (one item), *prosocial norms for COVID-19 vaccination* (seven items), and *COVID-19 risk-reduction habits* (four items). All items were scored using a five-point Likert scale ranging from one (“strongly disagree”) to five (“strongly agree”) except the habits items, which were dichotomous variables and used “yes” or “no” response options. The

third section was the primary outcome measure, intent to receive COVID-19 vaccination. This section had one item, “Will you get the COVID-19 vaccine as soon as it is accessible?” which was a dichotomous variable (“yes” and “no/I don’t know”).

## Data analysis

The data were analyzed using SPSS version 16.0 (IBM, Armonk, NY, USA). Means  $\pm$  standard deviations were reported for scale items and frequencies of responses for dichotomous variables. Principal components exploratory factor analysis using varimax rotation was conducted on the HBM and IBM scale items. Rotated factor loadings of  $\geq 0.4$  were accepted. Construct scales were tested for internal reliability using Cronbach’s alphas. T-tests and Chi-square tests were used to assess the bivariate association of continuous and categorical variables, respectively, with COVID-19 vaccination intent. A backward stepwise process was used to build a multivariate logistic regression model to examine the association of Health Beliefs Model tenets and the COVID-19 vaccination intent. All sociodemographic variables and all six factors identified in exploratory factor analysis were candidates for model building. The significance level for variable entry was set at  $P < 0.05$  and elimination at  $P < 0.1$ .

## Results

### Participant characteristics

The survey was disseminated to 12,093 adults. Of those, 4,933 (40.8%) individuals completed it. Most of the participants lived in Fars Province (29.3%), followed by Tehran Province (28.1%). The mean age of the respondents was 40 years (standard deviation (SD) of 12 years) and ranged from 18 to 86 years old. Most of the respondents were female (56.1%) and married (74.9%) [Table 1]. Seven hundred twenty-eight participants (14.8%) reported that they suffered from at least one of the chronic diseases assessed, and 520 (10.5%) individuals claimed to have been diagnosed with COVID-19 disease during the pandemic. When asked whether they intend to get the COVID-19 vaccine or not, 3168 participants (64.2%) responded “yes,” whereas 175 (35.8%) responded “No/I don’t know.” As compared to those who did not intend to get the vaccine or were unsure, those who intended to be vaccinated were, on average, younger, and a greater proportion was male and working outside of the health care field ( $P < .05$  for all comparisons).

### Health beliefs dimension exploratory factor analysis

Two tests were conducted to determine the data’s suitability on participants’ health beliefs for structure detection. The Kaiser-Meyer-Olkin (KMO) test statistic was 0.91, indicating sampling adequacy. Besides, Bartlett’s test of sphericity was significant ( $P < 0.001$ ) suggesting factor analysis would compress the data in a meaningful way.

**Table 1: Sociodemographic and health characteristics of individuals who did and did not intend to receive COVID-19 vaccination**

	Intent to receive COVID-19 vaccination			P
	Overall n=4, 933	Yes n (%) n=3168	No/Don't know n (%) n=1765	
Age in years				0.01
18-49	3825 (77.5)	2491 (78.6)	1334 (75.6)	
50-64	993 (20.1)	597 (18.8)	396 (22.4)	
≥65	115 (2.3)	80 (2.5)	35 (2.0)	
Female	2767 (56.1)	1688 (53.3)	1079 (61.1)	<0.001
Married	3694 (74.9)	2385 (75.3)	1309 (74.2)	0.38
Health care worker	1219 (24.7)	708 (22.3)	511 (29.0)	<0.001
Education				<0.001
<High school degree	139 (2.8)	88 (2.8)	51 (2.9)	
High school degree	766 (15.5)	522 (16.5)	244 (13.8)	
Technical degree	330 (6.7)	230 (7.3)	100 (5.7)	
Bachelors degree	1888 (38.3)	1238 (39.1)	650 (36.8)	
Graduate degree	1810 (36.4)	1090 (34.4)	720 (40.8)	
History of chronic disease*	728 (14.7)	469 (14.8)	259 (14.7)	0.90
History of COVID-19 disease	520 (10.5)	334 (10.5)	186 (10.5)	0.99
Family history of COVID-19 disease	3215 (65.2)	2084 (65.8)	1131 (64.1)	0.23

\*Chronic diseases assessed were diabetes mellitus, hypertension, lung disease, renal disease, cardiovascular disease, and corticosteroid consumption

The eigenvalues and scree plot generated in exploratory factor analysis indicated that a six-factor solution (61.2% cumulative variance) best fit the data with items generally loading onto expected factors with only a few exceptions [Table 2]. The eight items initially considered to be part of the *perceived barriers to COVID-19 vaccination* dimension loaded onto two factors which we subsequently treated as two scales: *COVID-19 vaccine safety/cost concerns* and *preference for COVID-19 vaccine alternatives*. Also, items that initially were used to describe *perceived COVID-19 disease severity* and *perceived COVID-19 disease susceptibility* were loaded onto a single factor which we subsequently treated as a singular construct and combined into *perceptions of COVID-19 disease* scale. Two items “I don’t think that COVID-19 is dangerous to my health,” and “Have you ever gotten a flu vaccine?” did not load onto any factors and were not included in subsequent model building. As assessed using the Cronbach’s alpha statistic, the constructs’ overall reliability was 0.73, which seems to be adequate.

### Multivariable logistic regression

Respondents’ age, sex, health care worker status, and education, as well as social norms for COVID-19 vaccination, perceived benefits of COVID-19 vaccination, and COVID-19 risk-reduction habits, were included in the final model [Table 3]. The Hosmer Lemeshow Goodness of Fit statistic was 0.94, suggesting a good fit of data to the model. The Nagelkerke R<sup>2</sup> was 0.48. Age, sex, and health care employment status were significantly associated with vaccination intent in the multivariable analysis. With each year increase in age, the odds of intent to receive a COVID-19 vaccination decreased 1% (adjusted odds

ratio (aOR) = 0.99, 95% confidence interval (CI)= 0.98, 0.999). The odds of intent to receive a vaccination among females was 24% less than males (aOR = 0.76, 95% CI = 0.65, 0.88). Lastly, the odds among health care workers was 24% less than among nonhealth workers (aOR = 0.75, 95% CI = 0.63, 0.9).

Of note, the adjusted odds of intent to receive a COVID-19 vaccination was approximately three times higher with every 1 point increase in score for the scales assessing prosocial norms for COVID-19 vaccination and perceived benefits of COVID-19 vaccination, (aOR = 3.07, 95% CI = 2.71, 3.47 and aOR = 2.9, 95% CI = 2.49, 3.38, respectively). The odds of intent to receive the vaccine was 72% lower with every 1 point increase in score for the scale assessing safety concerns about the COVID-19 vaccine (aOR = 0.28, 95%CI = 0.25, 0.31).

### Discussion

One of the most critical components to controlling the COVID-19 pandemic will be achieving high uptake of a safe and effective vaccine. Depending on levels of adherence to recommended COVID-19 prevention and mitigation strategies among individuals in a population, the threshold for achieving herd immunity may be between 55% and 82%.<sup>[12]</sup> The percentage will vary across a country based on regional differences in socio-behavioural practices and susceptibility of residents. In the current survey, only 64.3% of the participants across Iran intended to accept a COVID-19 vaccination. Suppose low intent will eventually manifest as low uptake once a COVID-19 vaccine is widely available. In that case, this inadequate level of public enthusiasm for COVID-19 vaccination

**Table 2: Factor loadings based on principal components factoring with varimax rotation for 28 items designed to predict intent to accept COVID-19 testing (n=4,933)**

		SN*	Ben*	Hab*	Saf*	Pref*	Dis*
Eigen value		7.80	2.64	1.97	1.86	1.41	1.04
% of Variance		19.7	14.19	9.16	8.30	7.09	5.82
Cronbach's $\alpha$		0.91	0.96	0.83	0.70	0.52	0.51
Item	Item mean						
<b>Factor 1: Prosocial norms for COVID-19 vaccination</b>							
I will get the vaccine because I heard about its benefits from national TV programs.	3.44	0.842					
I will get the vaccine because I read about its benefits on the internet and social media	3.56	0.839					
I will get the vaccine because my trusted doctor told me about its benefits.	3.52	0.814					
Most people important to me think I should get the vaccine.	3.62	0.813					
My trusted doctor thinks I should get the vaccine.	3.56	0.712					
My parents think I should get the vaccine.	3.78	0.693					
My friends think I should get the vaccine.	3.71	0.688					
I know other people my age who will get the vaccine.	3.73	0.629					
<b>Factor 2: Perceived benefits of COVID-19 vaccination</b>							
If I know COVID-19 vaccination can protect myself, I will do it.	4.60		0.901				
If I know COVID-19 vaccination can protect my family and my friends, I will do it.	4.66		0.893				
If I know COVID-19 vaccination can protect other community members, I will do it	4.63		0.875				
If I know COVID-19 vaccination can lead public to normalcy, I will do it.	4.68		0.865				
<b>Factor 3: COVID-19 risk-reduction habits</b>							
I obey protocols of health system for wearing a facemask for COVID-19.	4.75			0.818			
I obey protocols of health system for social distancing for COVID-19.	4.62			0.855			
I obey protocols of health system for hand hygiene for COVID-19.	4.68			0.837			
<b>Factor 4: COVID-19 vaccine safety/cost concerns</b>							
I am concerned about potential side effects of COVID-19 vaccine.	3.78				0.801		
I think COVID-19 vaccine may not be safe.	2.99				0.790		
I have concerns about getting COVID-19 from the vaccine.	2.43				0.659		
Vaccination has some cost for me.	2.96				0.460		
<b>Factor 5: Preference for COVID-19 vaccine alternatives</b>							
I am afraid of injections.	1.80					0.512	
I believe in natural or traditional remedies.	2.30					0.581	
Due to religious beliefs, I will reject COVID-19 vaccination.	1.29					0.749	
I am not in a high-risk group.	1.56					0.577	
<b>Factor 6: Perceptions of COVID-19 disease</b>							
COVID-19 is an important and serious disease.	4.59						0.416
I am very likely to get COVID-19.	3.16						0.763
If I get COVID-19, those who are in close contact with me will be more susceptible	4.20						0.721

\*SN=Social norms for COVID-19 vaccination, Ben=Perceived benefits of COVID-19 vaccination, Hab=COVID-19 risk-reduction habits, Saf=COVID-19 vaccine safety/cost concerns, Pref=preference for COVID-19 vaccine alternatives, and Dis=perceptions of COVID-19

will preclude the possibility of herd immunity in some communities.

On the bright side, the percentage of Iranian participants in this survey who had the intention was higher than the percentage of Iranian health care workers or high-risk individuals who reported having received seasonal influenza vaccination in a survey from 2018 (30.7% and 21.3%, respectively).<sup>[13]</sup> The current survey was completed before any information was available on candidate COVID-19 vaccines' safety and effectiveness profiles compared to the seasonal influenza vaccine for which similar data has been available for many years. Perhaps now that at least three COVID-19 vaccine manufacturers have announced

their candidate vaccines to be associated with at least 90% efficacy and no serious side effects in clinical trials, it is possible that public enthusiasm for COVID-19 vaccine is higher than when we conducted this survey.<sup>[14-16]</sup> Once vaccine safety and efficacy data are made available for peer review, health educational campaigns should move swiftly to build public enthusiasm for COVID-19 vaccines by ensuring this information is understandable in layperson terms. In the current study, high perceived benefits of vaccination, low safety concerns, and high exposure to provaccination social norms were all associated with approximately three times or higher odds of COVID-19 vaccination intent. Thus, these should be areas of focus for health education initiatives.

**Table 3: Summary of Logistic Regression Analysis for Variables Predicting COVID-19 Vaccination Intent (n=4,933)**

Predictor variable	OR (95% CI)*	aOR (95% CI)**
Age	0.99 (0.90, 1.00)	0.99 (0.98, 0.999)
Female	0.73 (0.64, 0.82)	0.76 (0.65, 0.88)
Married	1.06 (0.93, 1.21)	-
Health care worker	0.71 (0.62, 0.81)	0.75 (0.63, 0.90)
History of chronic disease	1.01 (0.86, 1.20)	-
History of COVID-19	1.00 (0.83, 1.21)	-
Family history of COVID-19	1.08 (0.95, 1.22)	-
Education		
<High school degree	reference	reference
High school degree	1.24 (0.85, 1.81)	1.01 (0.62, 1.63)
Technical degree	1.33 (0.88, 2.02)	1.38 (0.81, 2.36)
Bachelors degree	1.10 (0.77, 1.58)	0.90 (0.57, 1.42)
Graduate degree	0.88 (0.61, 1.25)	0.67 (0.42, 1.07)
Prosocial norms for COVID-19 vaccination	5.11 (4.58, 5.70)	3.07 (2.71, 3.47)
Perceived benefits of COVID-19 vaccination	5.60 (4.89, 6.41)	2.90 (2.49, 3.38)
COVID-19 vaccine safety/cost concerns	0.23 (0.21, 0.25)	0.28 (0.25, 0.31)
Perceived barriers to COVID-19 vaccination-safety concerns	0.23 (0.21, 0.25)	-
Perceived barriers to COVID-19 vaccination-other	0.44 (0.39, 0.48)	-
Perceived severity of/susceptibility to COVID-19 disease	1.62 (1.47, 1.78)	-

\*OR=odds ratio; CI=confidence interval, \*\*aOR=adjusted odds ratio. A multivariable model was built using a backwards stepwise selection process with significance criteria for variable entry and elimination set at  $P<0.05$  and  $P<0.1$ , respectively

Because our study suggests that exposure to prosocial norms transmitted by trusted doctors, family members, and friends, as well as social and traditional media, are all correlated, it is important for public health efforts to harness each of these sources to promote COVID-19 vaccine acceptance. The importance of receiving cues to vaccinate is strongly supported in the literature. For instance, previous studies have consistently shown that parents follow the vaccination recommendations of their health care providers.<sup>[17-19]</sup> Therefore, it is critical that health care providers must be well educated about the COVID-19 vaccine so that they can make a strong vaccination recommendation to their patients. Other studies have demonstrated that individuals also trust their friends and family members for vaccine advice. That greater vaccine hesitancy among social network members is associated with greater hesitancy in individuals, underscoring the importance of not relying solely on medical providers to transmit provaccination messages.<sup>[19-21]</sup> Individuals even trust vaccine messengers whom they do not know personally if they feel the messengers are similar to them and have a similar outlook on life.<sup>[20,22,23]</sup> This means individuals may be particularly susceptible to believing vaccine misinformation transmitted via nonmedical interest groups on social media. It is improbable that social media platforms will ever be able to keep up with the unremitting task of finding, flagging, and demoting all misleading posts before they are disseminated; thus, it is also critical to empower individuals to rebut any COVID-19 vaccine misinformation encountered online by teaching them to reply by linking to corrective data on reputable websites

as studies suggest this tactic is effective at improving health attitudes and beliefs among viewers.<sup>[24,25]</sup>

In terms of demographic factors associated with COVID-19 vaccination intent, the current study found that men had higher odds than women of COVID-19 vaccination intent (aOR = 1.32, 95% CI = 1.13, 1.54). This finding is similar to that of other studies. In a survey of Malaysian respondents, males had a higher odds of COVID-19 vaccination intent than females (OR = 1.44, 95% CI = 1.11, 1.87).<sup>[26]</sup> Likewise, in a study of French respondents, more men than women intended to receive COVID-19 vaccine and/or participate in a COVID-19 vaccine clinical trial.<sup>[27]</sup> Nonetheless, the finding of a gender difference in COVID-19 vaccination intent has not been universal. Two studies of the US respondents and a third of Chinese health care workers found no statistically significant difference between men and women in their COVID-19 vaccination intent.<sup>[28-30]</sup> Part of the explanation why male gender has only sometimes been associated with higher COVID-19 vaccination intent when comparing results from around the world may be differences in the social and cultural characteristics of the population studied; for example, in countries where men spend more time than women out of the house for both work and nonwork-related activities, men may be more concerned about their risk of contracting the virus causing COVID-19 disease and therefore more eager for vaccination. In addition, in countries where men have greater access to health care services and the means to pay for vaccination than women, men may be more interested in COVID-19 vaccination. Multiple studies have found that vaccination intent varies by country suggesting

the need for each country to establish an understanding of their national context to develop culturally-informed strategies to promote vaccine confidence.<sup>[31,32]</sup>

The current study also found that individuals with jobs in the health care field had lower odds of COVID-19 vaccination intent than those not working in health care (aOR = 0.75, 95% CI = 0.63, 0.9). This finding was unexpected and contrary to the results from a prior study in which health care workers reported greater willingness to be vaccinated against COVID-19.<sup>[27]</sup> Further, the current study's finding of an association of lower COVID-19 vaccination intent with working in a health care field cannot be attributed to greater vaccine hesitancy among individuals of higher socioeconomic status, as has been reported previously,<sup>[33-35]</sup> as in the current study, level of education was not associated with COVID-19 vaccine intent in multivariable analysis. One would imagine that health care workers are more concerned about COVID-19 due to their greater potential for work-related exposure and for witnessing severe sequelae in some cases. One would also imagine that health care workers have greater access to information about vaccination and a better understanding of the clinical trial process, leading to more confidence about the safety and efficacy of candidate COVID-19 vaccines. Despite reasons to the contrary, other researchers have also found vaccine hesitancy among health care workers. In an Italian study, families in which at least one parent worked in the health care field had lower odds of the child being vaccinated on time. However, this relationship was not significant on the multivariable analysis.<sup>[36]</sup> If the finding that working in the health profession is associated with decreased vaccine intent, this is very concerning given the public's trust of physicians for vaccine advice is so robust, as described earlier. As the current study did not ask respondents to specify their health care job, it would be helpful for future studies to determine whether COVID-19 vaccine intent differs by health care job type (e.g., physician, nurse, home health care worker, nursing assistant, etc.). In addition, it would be useful to delve further into the COVID-19 vaccination attitudes and beliefs of individuals who do and do not work in the health care field using qualitative methods.

The current study has several limitations. The most important limitation is that the study only evaluated COVID-19 vaccination intent, not uptake; thus, the results should be treated with caution as the intent is never completely predictive of actual behaviour, especially considering future distribution barriers that are unforeseeable at this point and, therefore, were not assessed. In addition, the current study used a convenience sample of online social network groups to the exclusion of those who are not online.<sup>[37]</sup> Those with an internet presence are typically younger and of higher socioeconomic status, and future studies should be sure to include older individuals and those with lower economic means as these populations are at higher risk of COVID-19

disease. Lastly, the response rate to the survey invitation was less than 50%, but slightly higher than what has been reported for other online health surveys.<sup>[38-40]</sup>

## Conclusions

This study found that individuals with higher levels of perceived benefits of COVID-19 vaccination, lower levels of concerns about its safety concerns, and greater exposure to others encouraging vaccine acceptance had higher odds of COVID-19 vaccination intent. This suggests that educational campaigns should capitalize on early reports that the COVID-19 vaccine trials demonstrate high effectiveness and no serious side effects and that a wide variety of vaccine messengers should be mobilized to share this message. This study also found low vaccine confidence among health care workers. If this finding is repeated in future studies of COVID-19 vaccine intent, this is of grave concern given the degree to which the public relies on physicians for vaccine advice. A swift and robust campaign to educate health care providers about COVID-19 would be warranted in such a case. Finally, the questionnaire used in this study had remarkable internal validity and reliability. Therefore, it is highly recommended to local health authorities even in modified shape to evaluate their regional willingness toward COVID-19 vaccination, find their obstacles, and take proper action plans to increase vaccine uptake.

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## Conflicts of interest

There are no conflicts of interest.

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