

# Understanding hesitancy towards vaccination against SARS-COV2 among Health professionals in Tunisia

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**Research Article**

**Keywords:** COVID-19 Vaccines, Health Personnel, Attitude of Health Personnel, Tunisia

**Posted Date:** June 30th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-512937/v2>

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# Abstract

## Background:

Since the end of 2019, the world was seriously upset by the emergence of the “COVID-19 disease. Vaccines that were authorized for emergency use in a wide range of countries brought a glimmer of hope. However, sufficient vaccination coverage is conditioned by the people’s acceptance of these vaccines especially by health professionals. Indeed, they represent the leaders of the current war against COVID-19. Several studies focused on this issue in developed countries. However, few were reported from developing ones including Tunisia.

Objective: The current study aimed to estimate the prevalence and the predictors of hesitancy towards the vaccination against the SARS-COV2 among the Tunisian health professionals.

## Methods:

A cross-sectional study was led online between the 7<sup>th</sup> and the 21<sup>th</sup> of January 2021 among Tunisian health professionals. A number of at least 460 participants was required. Snowball sampling method served to recruit participants. Data were collected using a pre-established and pre-tested questionnaire recorded in a free Google form. The link of the questionnaire was disseminated online to be self-administered anonymously to the participants. The generated online Google Sheet was uploaded and exported to SPSS software. Responses of non eligible participants were deleted before analysis.

## Results:

Of the 546 responses, 493 were retained. The mean age was 37.4 ( $\pm 9.5$ ) years. Females represented 70.2% of participants. Social media represented the most frequently used source of information about SARS-COV2 (reported by 66.9% of participants). Prevalence of hesitancy towards COVID-19 vaccination was 51.9% (95% CI: 47.5-56.3)). Fear of eventual harmful components in the upcoming vaccines, female gender and having its professional activity far from the capital predicted more hesitancy among participants. However, a history of previous infection by SARS-COV2 and the use of the official national site for information about COVID19 predicted less hesitancy towards COVID-19 vaccination.

## Conclusions:

An effective national information campaign is required to reduce hesitancy towards COVID-19 vaccination among Tunisian Health professionals. More international solidarity would increase vaccine availability in developing countries such Tunisia and ensure therefore faster resolution of the current pandemic.

# Background

The new corona virus disease (COVID-19) has drastically altered people's lives (1). One year after declaring COVID-19 as Public Health emergency, the number of deaths caused by this new disease exceeded two millions worldwide (2). Measures such as lockdowns, social distancing, traveling restrictions and wearing protection tools for long time; limited people's freedom, triggered psychological issues, reduced the income of the disadvantaged groups and worsened the existing social and health inequalities (1, 3). Until now, there is no specific treatment to beat this new disease. Nonetheless, several vaccines were developed in a record time and were authorized for emergency use in a wide range of countries (4). Indeed, speed vaccination of people is required not only to cut the spread of the severe acute respiratory syndrome corona virus 2 (SARS-COV2) but also to tackle the emergence of new variants threatening the efficacy of these vaccines (5). However, hesitancy towards these vaccines represents a major barrier to obtain sufficient vaccination coverage and to control the current COVID-19 pandemic (6). Indeed, in 2019, the World Health Organization listed vaccine hesitancy as one of the top 10 threats to world Health (7).

Health professionals represent the leaders of their communities in term of adherence to COVID-19 vaccination (8). Their recommendations can bolster support for the vaccinations in the community (8). Furthermore, they represent a high risk group that must be prioritized in terms of vaccination as they are at the frontline of the war against the SARS-COV2 and may increase the spread of COVID-19 among the users of healthcare facilities (9).

Hesitancy towards COVID-19 vaccination among them would be therefore challenging for achieving coverage for population immunity. Reasons behind this reluctance may be related to the quick production of vaccines, concerns about long-term safety of the new vaccines, the politicization of vaccination, altruism towards higher-risk populations...etc.)(10, 11). A recent scoping review of 35 studies, led mainly in developed countries, reported an average worldwide prevalence of hesitancy towards COVID-19 vaccination of 22.51% in healthcare workers with variable rates ranging from 4.3–72% (12). It is therefore relevant to lead more studies about vaccine hesitancy among health professionals especially in developing countries which are also suffering from scarcity of vaccines (13).

In Tunisia, a developing country that has undergone a rapid epidemiological transition thanks to its successful national vaccination program (14), is now facing a new challenge: To succeed in its vaccination strategy against SARS-COV2. In fact, there was a delay in obtaining vaccines doses (15). Estimation of the prevalence and predictors of hesitancy towards SARS-COV2 vaccines among Tunisian health professionals would guide the national vaccination campaign against SARS-COV2 and orient international organizations for a more equal access to the vaccines.

## **Objective**

To determine the prevalence and the predictors of hesitancy towards COVID-19 vaccine among Tunisian health professionals.

## Methods

### Study design:

A cross-sectional study was led online between the 7th and the 21th of January 2021 among Tunisian health professionals in order to evaluate their willingness to get vaccination against COVID-19.

### Study population:

All Tunisian health professionals represented the target population. The following formula:  $n = [(Z\alpha/2)^2 \times p \times (1-p)]/i^2$  was used to calculate the required sample size. A proportion (p) of vaccine hesitancy towards COVID-19 vaccination of 50%, a precision (i) of 5%, a first species risk ( $\alpha$ ) of 5% and a loss of 20% due to non-eligible participants were considered which gave a required sample of at least 460 participants.

Given that no updated national list of Tunisian health professionals with contact details was available in Tunisia, random sampling was not possible. Accordingly, the study was led using a snowball sampling. Initially, the investigators: an Associate Professor in Occupational Medicine, an Assistant Professor in Public Health, a Residency Trainee in Family Medicine and a Doctor of Dental Medicine working in different hospital wards, disseminated the survey online. They used their own mailing lists to send e-mails and their Facebook profiles to send messages and to post publications in the Facebook groups of Tunisian health professionals (62 Facebook groups were integrated by the investigators). In fact Facebook is the most popular social media in Tunisia (16). They targeted Medical Doctors, Pharmacists, Dentists, Health Technicians and Nurses who are tenured or in tenure-track. They also recommended to their colleagues in and out of their hospital wards as well as to the participants to disseminate the online survey. In total almost 2500 e-mails were sent with a daily sharing in 62 Facebook groups.

### Data collection:

The investigators, based on their experience and a literature review, designed a questionnaire written in French, as it is the public administration and education language in Tunisia. The questionnaire included parts exploring socio-demographic (age, gender), professional characteristics (field of activity, position, sector, geographic location of health activities and direct contact with hospitalized COVID-19 patients), medical history (chronic disease, allergy, vaccination against influenza for the current season), sources of information about SARS-COV2 vaccine, perceptions and attitudes related to the vaccination against SARS-COV2. The questionnaire was given to two other experts (a Public Health Professor and an Occupational Professor) who were familiar with the assessment methods of content validity. They evaluated the items with respect to appropriate wording, grammar, clarity, understandability and relatedness to Tunisian culture. They were also required to review the items with respect to their relevance.

The questionnaire was then pre-tested on a convenience sample of 30 health professionals to assess the acceptability and the understandability of the items. Unclear items and those that were difficult to understand by two or more health professionals were reformulated taking into account their comments

and the experts' opinion. The final version of the questionnaire was recorded in a free Google form with two sections: one for the consent and one for the entire questionnaire. A question was added at the end of the form to determine whether the participant has responded to the same questionnaire previously in order to identify duplicated responses. In order to limit missing data, all questions were mandatory to reply before sending the filled form. The link of the questionnaire was disseminated online to be self-administered anonymously to the participants.

## **Definition of the hesitancy towards vaccination against SARS-COV2:**

To measure the hesitancy towards the vaccination against SARS-COV2, the following question was used: "When the vaccine against SARS-COV 2 (the virus responsible for the COVID 19 disease) would be available in Tunisia, will you accept to be vaccinated?"

The possible responses were: "Yes, certainly", "Yes, probably", "I do not know yet", "Probably no", "Certainly no", "No I have already contracted the COVID-19", "No it is contra-indicated for me" and "Other response".

The responses: "Yes probably", "I do not know yet", "Probably no" and "Other response" were re-coded to "yes" to indicate hesitancy towards the SARS-COV2 vaccine. The other responses ("Yes, certainly", "Certainly no", "No I have already contracted the COVID-19", "No it is contra-indicated for me") were re-coded to "no" to indicate no hesitancy.

## **Data Analysis:**

The generated online Google Sheet was uploaded and exported to the Statistical Package for the Social Sciences (SPSS) 10.0 software (IBM Inc, Chicago, IL) for analysis. Responses of non eligible participants were deleted. Descriptive statistics were reported as frequencies for categorical variables and as means and standard deviations for quantitative ones. Differences between groups were examined using the Chi-squared ( $\chi^2$ ) test to compare proportions.

To determine predictors of hesitancy towards vaccination against SARS-COV2, binary logistic regressions were performed. The dependent variable was "hesitancy towards vaccination against SARS-COV2"; all factors that were revealed associated with the dependent variable with a significance level less than 25% were included in a multivariable model. Then, a stepwise backward approach was used to identify predictors of hesitancy towards vaccination against SARS-COV2. Observations with missing data about some variables that were used in the different regression models were deleted. Results of the regression models were expressed as odds ratios (ORs) with confidence interval (CI) of 95%. All statistical tests were two-tailed, and p-values < 0.05 were considered statistically significant.

## **Ethical Considerations:**

The current study was carried out in accordance with the ethical principles of the Declaration of Helsinki. An introducing paragraph explaining the purpose and the conduct of the study preceded the two sections

of the Google form. Anonymity of responses was highlighted. Participants had to give consent to access to the rest of the questionnaire by clicking on the response “yes” to the following question: “Do you agree to participate in the study?” In case of responding by “No”, the rest of questions were not administered to the user of the link.

The response option “I do not want to answer” was added to the questions about the gender, the age and the medical history. Furthermore, to ensure anonymity, first and last names were not collected and e-mail addresses were not collected.

## Results

A total of 546 responses to the online questionnaire were obtained with 23 refusal and 523 acceptances. Among those who accepted to participate, 28 were not health professionals and two were not Tunisian. Accordingly, the retained participants accounted for 493.

The mean age of participants was 37.4 ( $\pm$  9.5) years. Females represented 70.2% of participants. Medical Doctors, Dentists, Pharmacists and Paramedical professionals represented respectively 19.7%, 15.8%, 14.2% and 10.8% of participants. Concerning the geographic location of their professional activities, 196 (39.8%), 188 (38.1%) and 105 (21.3%) were affected respectively in the North, the Center and the South of Tunisia. Whereas, 82 (16.6%) participants reported daily direct contact with COVID-19 inpatients. More details about the sociodemographic characteristics are displayed in Table 1.

Table 1

Individual characteristics of the Tunisian health professionals which accepted to participate to the study (n = 493).

<b>Socio-demographic characteristics</b>	<b>n</b>	<b>%</b>
<b>Age</b>		
<40 years	326	66.1
≥40 years	167	33.9
<b>Gender</b>		
Female	346	70.2
Male	131	26.6
<b>Grade</b>		
Trainee	102	20.7
Graduated	391	79.3
<b>Field of activity</b>		
Medicine	292	59.2
Dentistry	78	15.8
Pharmacy	70	14.2
Paramedical	53	10.8
<b>Location of activity</b>		
North of Tunisia	196	39.8
Center of Tunisia	188	38.1
South of Tunisia	105	21.3
<b>Sector of activity</b>		
Public	330	66.9
Private	155	31.4
Public and private	8	1.6
<b>Frequency of direct contact with COVID-19 inpatients</b>		
Never	235	47.7
Sometimes	176	35.7
Every day	82	16.6

<b>Socio-demographic characteristics</b>	<b>n</b>	<b>%</b>
History of chronic condition	101	20.5
History of allergy	89	18.1
History of infection by SARS-COV2	30	6.1
Vaccination against influenza during the current season	151	30.6
<b>Sources used to be informed about the SARS-COV-2</b>		
Social media	330	66,9
Radio stations	183	27,1
Television channels	276	56,0
The national web site of the Ministry of Health	199	40,4
The web site of the Pasteur institute of Tunis	42	8,5
The Tunisian web site of the Observatory of new and emergent diseases	127	25,8
The Tunisian web site for health professionals: "SAUVE.tn"	39	7,9
The Tunisian web site for information about COVID-19: "Covid.tn"	191	38,7
Newspapers	96	19,5
Websites of international scientific organizations	226	45,8
Scientific journals	285	57,8
<b>Perceptions</b>		
<b>The vaccines that will be available in Tunisia may contain harmful components</b>	337	68.4
<b>Lackof information about the vaccination against SARS COV2</b>	403	81.7
<b>High or very high risk of infection by SARS COV2</b>	327	66.3
<b>High or very high risk of complications in case of infection by SARS COV2</b>	105	21.3

Focusing on the most frequently used sources to get information about SARS-COV2, social media were the most consulted by participants followed by scientific journals and the television channels with the frequencies of 66.9%, 57.8% and 56% respectively while 39 (7.9%) participants used the national information site for Tunisian health professionals (SAUVE.tn). The other reported sources of information are detailed in Table 1.

Asking participants about their perceptions revealed that 327 (66.3%) were thinking that they have high or very high risk of SARS-COV2 infection and 105 (21.3%) were thinking that they risk serious complications in case of infection. On the other hand, 337 (68.4%) were afraid from the eventual harmful components

that may contain the upcoming vaccines in Tunisia. Otherwise, lack of information about the vaccination against COVID19 was reported by 403 (81.7%) of participants (Table 1).

Of the 493 respondents 256 (51.9%; 95% CI: 47.5–56.3)) reported hesitancy towards vaccination against SARS COV2 while 62 (12.6%; 95% CI: 9.7–15.5) were sure to refuse it and 175 (35.5%; 95% CI: 31.3–39.7) were sure to accept it when it will be available in Tunisia.

Proportion of health professionals under the age of 40 years was significantly superior (72.3%) among those hesitating to get the vaccine than those not hesitating (59.5%) ( $p = 0.003$ ). Similarly, females represented 74.6% of those who hesitate against 65.4% in those who do not with a  $p$  value of 0.047. Concerning the professional activity, having it in the North of Tunisia or in the public sector was significantly associated with more hesitancy towards the SARS-COV2 vaccine (Table 2). However, having been infected by the SARS-COV2 was negatively associated with hesitancy towards the vaccine (0.4% among hesitating participants versus 12.2% among those not hesitating ( $p = < 0.001$ )).

Table 2  
Hesitancy towards the vaccination against SARS-COV-2 according to the individual characteristics of the participants (n = 493).

	Hesitancy towards the vaccination against SARS-COV-2		
	Yes (n = 256)	No (n = 237)	p
<b>Age</b>			<b>0.003</b>
<40 years	185(72.3)	141 (59.5)	
≥ 40 years	71 (27.7)	96 (40.5)	
<b>Gender</b>			<b>0.047</b>
Male	59 (23.0)	72 (30.4)	
Female	191(74.6)	155 (65.4)	
<b>Grade</b>			0.263
Trainee	58(22.7)	44(18.6)	
Graduated	198(77.3)	193(81.4)	
<b>Field of activity</b>			0.974
Medicine	150(58.6)	142(59.9)	0.765
Dentistry	41(16.0)	37(15.6)	0.902
Pharmacy	36(14.1)	34(14.3)	0.928
Paramedical	29(11.3)	24(10.1)	0.667
<b>Location of activity</b>			<b>0.020</b>
North of Tunisia	89(34.8)	107(45.1)	
Center of Tunisia	101(39.5)	87(36.7)	
South of Tunisia	65(25.4)	40(16.9)	
<b>Sector</b>			<b>0.025</b>
Public	187(72.4)	151(63.7)	
Private	69(27.0)	86(36.3)	
<b>Frequency of direct contact with COVID-19 inpatients</b>			0.141
Never	133(52.0)	102(43.0)	
Sometimes	84(32.8)	92(38.8)	

	<b>Hesitancy towards the vaccination against SARS-COV-2</b>		
Every day	39(15.2)	43(18.1)	
<b>History of chronic condition</b>			0.666
No	200(78.1)	178(75.1)	
Yes	51(19.9)	50(21.1)	
<b>History of allergy</b>			0.084
No	212(82.8)	181(76.4)	
Yes	39 (15.2)	50 (21.1)	
<b>History of infection by the SARS-COV-2</b>			<b>&lt; 0.001</b>
No	255(99.6)	208 (87.8)	
Yes	1 (0.4)	29 (12.2)	
<b>Vaccination against influenza during the current season</b>			0.274
No	182(71.4)	157(66.8)	
Yes	73(28.6)	78(33.2)	
<b>Sources used to be informed about the SARS-COV-2</b>			
Social media	182(71.1)	148(62.4)	<b>0.026</b>
Radio stations	97(37.9)	86(36.3)	0.392
Television channels	151(59.0)	125(52.7)	0.096
The national web site of the Ministry of Health	97 (37.9)	102 (43.0)	0.142
The web site of the Pasteur institute of Tunis	16(6.3)	26(11.0)	<b>0.043</b>
The Tunisian web site of the Observatory of new and emergent diseases	67(26.2)	60(25.3)	0.455
The Tunisian web site for health professionals "SAUVE.tn"	14(5.5)	25(10.5)	<b>0.027</b>
The Tunisian web site for information about COVID-19 "Covid.tn"	84(32.8)	107(45.1)	<b>0.003</b>
Newspapers	45(14.6)	51(21 .5)	0.161
Websites of international scientific organizations	118(46.1)	108(45.6)	0.490
Scientific journals	149(58.2)	136(57.4)	0.463
<b>Perceptions</b>			

	<b>Hesitancy towards the vaccination against SARS-COV-2</b>	
<b>Lack of information about the vaccination against SARS COV2</b>		<b>0.008</b>
No	36(14.1)	54(22.8)
Yes	220(85.9)	183(77.2)
<b>The vaccines that will be available in Tunisia may contain harmful components</b>		<b>0.002</b>
No	66 (25.8)	90(38.0)
Yes	190(74.2)	147 (62.0)
<b>High or very high risk of infection by SARS COV2</b>		<b>0.477</b>
No	87(34.0)	79(33.3)
Yes	169(66.0)	158(66.7)
<b>High or very high risk of complications in case of infection by SARS COV2</b>		<b>0.061</b>
No	209(81.6)	179(75.5)
Yes	47(18.4)	58(24.5)

While, lack of information about the vaccination against SARS COV2 was positively associated with the hesitancy towards the vaccine (85.9% among hesitant people versus 77.2% in non-hesitant ones ( $p = 0.008$ )). Use of social media was also positively associated with the hesitancy among participants towards the vaccination (6.3% among hesitating participants versus 11% among those not;  $p = 0.043$ ) unlike the use of the National website of the Pasteur Institute or the national website for information about COVID-19“Covid.tn” (Table 2).

Otherwise, thinking that the upcoming vaccines may contain harmful components was reported by 74.2% of hesitant professionals versus 62% among the rest of participants ( $p = 0.002$ ). More details about the hesitancy towards the COVID-19 vaccination according to the individual characteristics of participants are displayed in Table 2.

Table 3 details the results of the binary logistic regression analysis. Fear of eventual harmful components in the upcoming vaccines and female gender were revealed to be predictors of hesitancy towards the upcoming COVID19 vaccine with adjusted OR of 1.8 [1.2–2.7] and 1.7 [1.1–2.7] respectively. Besides, having its professional activity in the south of the country predicted more hesitancy (2.3 [1.3–3.9]) than exercising in the central of Tunisia (1.3 [0.8-2.0]) with reference to the north of the country. On the other hand, having been already infected by SARS-COV2 and use of the national site for information about

COVID19 (covid.tn) predicted less hesitancy of the vaccine with OR of 0.024 [0.003-0.2] and 0.6 [0.4–0.9] respectively.

Table 3

Binary logistic regression analysis for characteristics related to hesitancy towards the upcoming COVID-19 vaccine among the Tunisian health professionals in January 2021.

<b>Variables</b>	<b>p-value</b>	<b>Crude OR [95% CI]</b>	<b>p-value</b>	<b>Adjusted OR [95% CI]</b>
<b>Gender</b>	0.048		0.013	
Male	-	1	-	1
Female		1.5 [1.1–2.2]		1.7 [1.1–2.7]
<b>Location of activity</b>	0.011		0.010	
North of Tunisia	-	1	-	1
Central of Tunisia		1.4 [0.9–2.1]		1.3 [0.8–2.0]
Southern of Tunisia		1.9 [1.2–3.2]		2.3 [1.3–3.9]
<b>Having been already infected by the SARS-COV-2</b>	< 0.001		< 0.001	
Yes		0.028 [0.004–0.2]		0.024 [0.003–0.2]
No	-	1	-	1
<b>Use of the national site for information about COVID-19: covid.tn</b>	0.005		0.010	
Yes		0.6 [0.4–0.8]		0.6 [0.4–0.9]
No	-	1	-	1
<b>Think that the vaccines that will be available in Tunisia may contain harmful components</b>	0.004		0.006	
Yes		1.8 (1.2–2.6)		1.8 [1.2–2.7]
No	-	1	-	1

## Discussion

The current survey, led between the 7th and the 21th of January 2021, revealed that 51.9% (95% CI: 47.5–56.3) of the Tunisian health professionals hesitate to uptake vaccine against SARS-COV2. Being affected in the south or in the central of Tunisia, the female gender and the fear of components in the upcoming vaccines predicted more hesitancy among them. While a previous episode of SARS-COV2 infection and the use of the national site for information about COVID19 predicted less hesitancy among them.

Results of the current study should be interpreted with taking into account some limits. Firstly, the cross sectional nature of the study did not allow to report causal relationships but only statistical associations. Besides, random sampling was not possible as no lists of national or regional health professionals were available. However, the required sample size was reached. In addition, the main categories of the health professionals were represented. Finally, attitudes and perceptions were self-reported by participants, this might lead to a social desirability bias. However, data were collected anonymously and participation was voluntary.

The hesitancy rate (51.9%) revealed by the current study was higher than that reported after an online opinion survey conducted almost at the same period (between the 10th and the 20th of January 2021) and which showed a lower hesitancy rate of 33.6% but higher refusal rate of 23.5% (17). This opinion survey was conducted by the “BEDER Association for Citizenship and Fair Development” with five questions about the age, the field of activity, the intention and the motivation to get the vaccine and its recommendation for others. Results of the survey were published on the website of the association (SAUVE.tn) while precisions about the methodology of this online opinion survey were not reported (17). Among our participants, 59.2% were physicians, 15.8% were dentists, 14.2% were pharmacists and 10.8% were from the paramedical staff which was not far from the opinion survey (17). The French language of the questionnaire may explain the reluctance among some categories of the paramedical staff to respond to the survey. An available national updated contact list of the Tunisian health professionals is necessary to allow wider periodic evaluation of the willingness to get the vaccine against the SARS-COV2. In this way, policy makers would be able to adapt their information strategy.

Otherwise, the low rate of vaccine acceptance among participants (35.5%) joins that in USA (36%)(18), France (25.9%)(19), Italia (26%)(11) and the Democratic Republic of the Congo (27,7%)(20) while it is lower than those in Egypt (45.9%) (21), Malta (52%) (22) and Greece (78.5%) (23).

Females represented 70.2% of participants. The trend of feminization in the Tunisian health sector may explain somewhat this female predominance (24). Analyzing hesitancy among participants according to the gender showed that female gender is a predictor of hesitancy among health professionals towards the SARS-COV2 vaccine. This result is harmonious with the majority of previous similar studies (12). The higher male acceptance of vaccine may be due to an innate male propensity for risk taking towards the novel vaccine (25).

Older respondents were significantly less hesitant to uptake the SARS COV2 vaccine. While having a chronic condition or allergy did not seem to contribute to this hesitancy among them. A recent scoping review reported that individuals of older age are more likely to accept COVID-19 vaccines (12). This was

explained by a perception of greater vulnerability to SARS-COV2 infection but also by higher education and greater experience in healthcare (12).

Health professionals from different Tunisian regions responded to our questionnaire. Thirty-nine point eight were working in the north, 38.1% in the center and 21.3% in the south. Having its professional activity far from the north of the country (where is located the capital) predicted more hesitancy among participants. In line with this result, lower vaccination rates among deprived groups were observed in several surveys (18, 20, 26). More efforts should be provided in the Tunisian interior regions to overcome regional disparities in terms of vaccination against SARS-COV2.

Professionals from private sector were significantly less hesitant to get the SARS-COV2 vaccine. This joins the results of a study led in Hong Kong (27). This may be explained by economic reasons as in private sector sick leave in case of COVID19 episode is not regularly paid.

Having been previously infected by SARS-COV2 predicted less hesitancy among participants. A study conducted in Saudi Arabia among healthcare workers did not show significant association between previous personal SARS-COV2 infection and willingness to receive a COVID-19 vaccine (28). Otherwise, among Italian patients recovered from COVID-19, the majority were hesitant or undecided towards SARS-CoV-2 vaccine (11, 29). Similar result was reported in Chicago(30). Lack of knowledge concerning the duration of protection against the SARS-COV2 after infection may explain this fluctuation between countries (31).

Among participants, 81.7% reported lack of information about SARS-COV2 vaccines. Social media was the most source of information reported by participants which joins the results of the Egyptian study (21). Use of social media and lack of information about the SARS-COV2 vaccines were significantly associated with more hesitancy among participants. These results corroborate those in the healthcare workers of Egypt and Italia (11, 21). Fear from harmful components was significantly associated with vaccine hesitancy among participants. In fact, doubts concerning the vaccines safety seems to be a global phenomenon that influence vaccine uptake as it was mentioned in Italy (11), Democratic republic of Congo(20), Egypt (21)and Malta(32). Otherwise, the use of the official national web sites (Pasteur institute of Tunis and COVID19.tn) was significantly associated with less hesitancy rates among participants. Similarly, in Saudi Arabia, healthcare workers who used the Centers for Disease Control and Prevention website to seek valid information about COVID-19 vaccines were 1.5 times more likely to accept potential vaccine candidates than those who used other sources of information (28). Indeed, improved information on vaccines has been shown to increase vaccines' acceptance (33).

The campaign of vaccination against SARS-COV2 began in Tunisia two months after the current study. At the 50th day of this campaign, it was reported in the Facebook page of the Tunisian Ministry of Health that 1.467.558 peoples have subscribed to get the vaccine via the website: EVAX.tn and only 400.363 doses of vaccines were obtained. While, 94.880 received the two doses of the vaccine. However, no reports were available at the official website of the ministry (34). Besides, the Tunisian pharmacovigilance website did not report any statistics about the side effects recorded among the vaccinated

peoples (35). Furthermore, proportion of health professionals that were vaccinated until now is not available. Although, there is scarcity of COVID-19 vaccines in Tunisia in addition to poor resources explaining the slowness of vaccination, an effective information strategy should be implemented as soon as possible. Facebook may represent a good channel for disseminating valid messages and tackling misinformation especially that Facebook is the most social media used in Tunisia (16). This would ensure rapid coverage of the population when the vaccines will be more affordable. Engaging health care professionals in social media to counter the vaccine related misinformation would boost the national information strategy. In addition, reporting the results of the pharmaco-vigilance surveillance would improve the vaccine acceptability among health professionals and the general population as well. More attention should be paid to female health professionals, the youngest ones and those in the regions far from the capital. A special network designed for the Tunisian health workers would facilitate access to them and getting feed back from them in return. The SAUVE.tn website may represent a suitable basis for this network.

Otherwise, regarding the emergence of new strains of SARS-COV2 and the slowness of the vaccination process, reinforcement of the non-pharmaceutical interventions is necessary until sufficient coverage by vaccination will be reached in Tunisia. This underlines once again the necessity of an effective information strategy with multi-sectorial actions and a lobbying for a global COVID-19 vaccine equity.

## Conclusion

The hesitancy rate towards SARS-COV-2 vaccine is high among Tunisian health professionals. An effective national information campaign represents the only solution to overcome this crisis and regain a normal life. International solidarity is strongly recommended to increase vaccine affordability in developing countries such Tunisia.

## Abbreviations

COVID-19: Coronavirus disease 2019

SARS-COV2: Severe acute respiratory syndrome coronavirus 2

## Declarations

**Ethics approval and consent to participate:** The procedures of the study, as described, were approved by the Research Ethics Committee of University Hospital Farhat Hached (Institutional review board code: 00008937). Participants gave informed consent via an online form at the beginning of the survey, which was approved by the ethics committee.

**Consent for publication:** Not applicable

**Availability of data and materials:** The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests

**Funding:** Not applicable

**Authors' contributions:** Authors NZ and AB contributed to the design of the research protocol. Author NM was the principal investigator. NZ, AB, AE and IA disseminated the online survey. AE, RG, SBF, CS, AC and IA participated in data analysis and interpretation. JM and HG validated the results. NZ and AE have written the initial draft. AB, JM and NM contributed to the critical review of the manuscript. AB, HK, OM, SC revised and commented the manuscript. HG supervised all the steps of the manuscript editing. All authors read and approved the final manuscript.

**Acknowledgements:** Not applicable

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