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Original Article

Assessing COVID-19 Vaccine's Acceptability Amongst Health Care Workers in Oman: A cross-sectional study



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ABSTRACT

Background: COVID-19 vaccines are considered to be a vital tool in controlling the pandemic. Hesitation with COVID-19 immunization has been reported worldwide. The acceptability of the COVID-19 vaccine among health care workers (HCWs) is an important step in determining the success of any new vaccination program. This study aims to estimate the acceptability of COVID-19 vaccines among HCWs in Oman.

Methods: A cross-sectional study using a self-administered questionnaire was conducted among HCWs in December 2020. Data were analyzed using a bivariate level to identify the statistical association with acceptability using the Chi-squared test. At the multivariate level, we determined the socio-demographic and knowledge factors associated with vaccine acceptability.

Results: A total of 608 out of 700 HCWs participated (response rate 87%), of which 64.8% were Oman citizens and 53.8% were aged between 30 and 39 years. The majority of the participants were female (62.8%) and married (87.0%), while 48.5% of the respondents were doctors. Only 43% of the participants were willing to be vaccinated against COVID-19, while 57% were either uncertain 35% or unwilling 22% to be vaccinated. The main reason for not being willing to receive the vaccine was their perceived adverse events after vaccination. The male participants (OR: 1.96 95% CI 1.22–3.13) and those with a positive attitude towards the vaccine (OR: 9.17(95% CI 1.78–47.07) were more willing to receive the COVID-19 vaccine. Similarly, trust in the government (OR: 2.41 95% CI 1.57–3.71) and having sound knowledge of the COVID-19 vaccine (OR: 15.91 95% CI 9.81–25.88) improved the acceptability to vaccinate among the HCWs. In contrast, having a previous experience with SARS-CoV-2 (OR: 1.65, 95% CI: 1.08–2.54), was associated with a significant decrease in COVID-19 vaccine acceptability.

Conclusion: 50% of HCWs reported being uncertain or unwilling to be vaccinated against the COVID-19 vaccine. Male gender, positive attitude towards the vaccines, trust in government and knowledge of COVID-19 vaccine as key factors that determine improved vaccine acceptability among HCWs. Therefore, to facilitate herd immunity among the population, it is necessary to initiate effective communication strategies among HCWs in order to sensitize them towards the acceptability of the COVID-19 vaccine.

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Introduction

The COVID-19 pandemic, caused by a new Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), has created an extraordinary burden for healthcare systems across the globe [1].

The first two COVID-19 cases in Oman were reported on February 24, 2020, and they were linked to travel to the Islamic Republic of Iran [2]. By April 31, 2022, the total number of laboratory-confirmed COVID-19 patients reported and cured will have reached 389,460, with a mortality rate of 1.1% [3]. Oman was one of the first countries to respond to COVID-19 control and prevention by implementing social distancing, lockdown, public health awareness, and behavioral

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change programs, and the implementation was quick and consistent through out.

As vaccines are considered to be the most functional and cost-effective public healthcare interventions for preventing transmissible/communicable diseases [4], COVID-19 vaccine is an integral component of a long-term and effective public health strategy to contain SARS-CoV-2 in addition to non-pharmaceutical interventions (NPIs). To date, more than 267 COVID-19 vaccine candidates are in different phases of pre-clinical and clinical development with 13 vaccines approved and being used under Emergency Use Authorization (EUA) in different countries worldwide [5].

In October 2020, Oman's Ministry of Health announced that the COVID-19 vaccine would be publicly available. Subsequently, the national COVID-19 vaccination campaign was launched in January 2021 first using the Pfizer®/BioNTech vaccine. The original target groups for the vaccination campaign included high-risk groups such as front-line healthcare workers (HCW) and the elderly. HCWs are potential victims of the disease and consequently spreaders due to increased rates of exposure [6]. Protecting HCWs from SARS-CoV-2 infection is beneficial for them, their social contacts and patients and is therefore crucial for the preservation, protection and smooth functioning of the entire healthcare system. Therefore, the acceptance and uptake of the COVID-19 vaccine among HCWs plays a major role in combating this pandemic.

There are many misconceptions and wrong impressions amongst HCWs with respect to the COVID-19 vaccine [7]. The massive amount of online information available on COVID-19 and its vaccines can potentially influence decision-making and recommendation-making behaviors of the HCWs [8]. The World Health Organization (WHO) identified vaccine hesitancy amongst the top ten threats for global health in 2019 [9]. Vaccine hesitancy refers to a delay in acceptance or complete refusal of vaccination despite its availability [8]. There are many misconceptions amongst HCWs with respect to the COVID-19 vaccine [5,7]. The massive amount of online information available on COVID-19 and its vaccines can potentially influence decision-making and recommendation-making behaviors of HCWs [6,10]. This study aims to evaluate the opinions of HCWs regarding COVID-19 immunization, specifically whether or not they would accept the vaccine and also recommend the vaccine to others, with a view to provide recommendations to the Ministry of Health in Oman to inform outreach programs.

Methods

Study setting

Oman is located in the south-eastern corner of the Arabian Peninsula with sea coasts that extend 3165 km from the Strait of Hormuz and whose borders include Yemen to the south, and the Kingdom of Saudi Arabia and United Arab Emirates to the west. The country has a population of nearly 5 million out of which 39 % are foreign-born individuals (non-citizens). Out of the total, 2,739,954 (61.3 %) are males and 1,731,194 (38.7 %) are females [11]. Oman is one of 22 countries located within the Eastern Mediterranean Region (EMR) of the World Health Organization (WHO).

Study design and population

This study is an observational cross-sectional questionnaire based study that queried all available and consenting HCWs working at government and private health facilities in Oman.

The sample size was 700, with a margin of error of 3 % and a 95 % confidence interval, based on the conservative assumption that the level of acceptability of 50 %.

The survey will take 10–12 min to complete. The study's participation was purely voluntary. Prior to answering the survey

questions, participants were needed to express informed permission.

Data collection and analysis

A questionnaire was developed and distributed using SurveyMonkey™. The questionnaire was organized in four sections: (1) demographic information; (2) general knowledge of COVID-19; (3) awareness, attitudes and behaviors related to the COVID-19 vaccine; and (4) perception or confidence in the government with respect to handling the COVID-19 crisis and the vaccination campaign. The expected outcome variable was willingness to be vaccinated.

Nine questions were used to evaluate awareness of COVID-19 in general, eight related to awareness of the COVID-19 vaccine. Four questions were used to assess attitude towards the vaccine and three questions assessed trust in the government and perceptions towards the government's responses to manage the COVID-19 crisis and provide up-to-date information on COVID-19 vaccine development and its introduction in Oman.

The questionnaire was pilot tested with 11 healthcare workers from Muscat Governorate to assess its coherence and clarity, and no significant modification of the questionnaire was required. The actual study was conducted in the third week of December 2020, using a self-administered anonymous questionnaire in English language. The participants were able to provide consent at the time of participation in the study before answering the questionnaire. The questionnaire was distributed online through a unique link by the Ministry of Health, Oman, and data were collected in the password encrypted SurveyMonkey platform. Data were analyzed using SPSS version 26.

Descriptive analysis

Socio-demographic data is summarized as categorical variables and disaggregated in terms of willingness to take the vaccine (Yes, No, Uncertain (Not sure)) and presented as a frequency table.

Responses were categorized as binary (True/False; Yes/No) or as scale (Strongly Agree, Agree, Neutral, Disagree or Strongly Disagree). Participants' responses were disaggregated according to their willingness to be vaccinated and presented in the form of frequency tables.

Analytical statistics

The knowledge and attitude score was calculated by giving a score of one or zero according to the nature of the question. For binary responses, the correct answer was given a score of 1. For binary analysis, the median score served as the cut-off point. For binary analysis, the median score served as the cut-off point of seven for COVID-19 knowledge, whilst 100 % score was used for attitude and perception. For scale variables related to attitude, questions were scored as one or zero depending on the response. For COVID-19 awareness (scoring more than seven versus less than seven), whilst for other variables, the median scores were corresponded to 100 %. Un-adjusted odds ratios were initially calculated. To control for confounding and interactions, only p -value < 0.2 variables were included in the multivariate analysis.

Patient and public involvement statement

- At what stage in the research process were patients/public first involved in the research and how? The questionnaires were sent randomly to the Healthcare workers. The participants were involved during the data collection and questionnaire validation phase of the study.

- How were the research question(s) and outcome measures developed and informed by their priorities, experience, and preferences? The questions and outcome measures were developed after reviewing multiple study literatures on COVID-19 vaccine acceptance globally taking into account the Oman context. In addition, input from the research team was also taken into consideration during the planning and implementation phase of the research study.
- How were patients/public involved in the design of this study? The participants were asked to fill the online questionnaire sent to them randomly.
- How were they involved in the recruitment to and conduct of the study? The questionnaires were sent randomly and participants were asked to provide the consent before answering the questionnaire.
- Were they asked to assess the burden of the intervention and time required to participate in the research? The information on the burden of the intervention as well as estimated time to answer the questionnaire was provided in the consent form which was attached to the questionnaire.
- How were (or will) patients and the public be involved in choosing the methods and agreeing plans for dissemination of the study results to participants and wider relevant communities. The study results will be communicated to the hospitals which were involved in the study and the Ministry of Health Oman is provided with the preliminary results of the study.

Results

Socio-demographic characteristics

A total of 608 out of 700 HCWs participated in the study (response rate 87%). The majority of participants were Omani nationals (64.8%; $n = 394$) and 30% ($n = 183$) were from Muscat Governorate. Of the participants, 62.8% ($n = 382$) were female, 87% ($n = 539$) were married, 89.6% ($n = 545$) were under 50 years of age, 71.7% ($n = 436$) had a bachelor's or higher degree, 83.9% ($n = 510$) were doctors or nurses and 69.6% ($n = 423$) were employed in a primary health care facility.

One hundred and eighty two (28.3%) of the participants were previously infected with SARS-CoV-2, whilst 56% ($n = 342$) were actively treating COVID-19 patients (Table 1).

Willingness to take COVID-19 vaccine

Two hundred and sixty four (43%) participants state that they were willing to take a COVID-19 vaccine. Of the participants willing to take the vaccine 59% ($n = 134$) were below 39 years of age, 55% ($n = 144$) were males, 90% ($n = 237$) were married, 54% ($n = 142$) were Omani nationals, 78% ($n = 205$) had completed a bachelors or higher degree, 80% ($n = 211$) were either nurses or doctors, 70% ($n = 185$) were working at primary healthcare facilities; 56% ($n = 149$) were treating COVID-19 patients and 75% ($n = 198$) were not previously infected with SARS-CoV-2 (Table 1).

The majority of the participants 57% ($n = 344$;) were either not sure (uncertain) 35% ($n = 213$) or unwilling (answering No) 22% ($n = 131$) to receive a vaccine. Total number of responses were 608; Yes: 43% ($n = 264$); No: 22% ($n = 131$); Not sure: 35% ($n = 213$).

Of the participants who were hesitant (either not sure (uncertain) or unwilling (answering No)) to receive the vaccine 57% ($n = 344$;) 55% ($n = 190$) were between the ages of 30 and 39 years, 76% ($n = 262$) were female, 85% ($n = 292$) were married, 73% ($n = 252$) were citizens of Oman, 67% ($n = 237$) had an undergraduate degree or higher education, 78% ($n = 267$) were physicians and nurses, and 68% (234) worked in primary care facilities, 69%

($n = 238$) had not previously been infected with COVID-19 %, and 56% ($n = 193$) were currently treating patients with COVID-19 (Table 1).

There was sufficient awareness about COVID-19 / SARS-CoV-2 among the participants. However, 45% ($n = 271$) were unfamiliar with the similarity between SARS-CoV-2 and MERS-CoV, 34% ($n = 206$) believed there was a significant stigma associated with the acquisition of COVID-19, 13.5% ($n = 82$) were of the view that COVID-19 was not a critical illness for them, 6% ($n = 39$) did not consider COVID-19 to be a serious illness for their family and 10% ($n = 59$) believed it was not a condition that requires serious attention (Table 2).

Eighty-seven percent of participants ($n = 526$) had received seasonal influenza immunizations in the past five years and 96% ($n = 583$) were aware that the Government of Oman was planning to introduce the COVID-19 vaccine in the country. 87% ($n = 531$) of the participants believed that they were at risk of contracting COVID-19. Half of the participants (50% ($n = 307$)) were of the view that the vaccine could protect them from COVID-19, 57% ($n = 344$) believed that the vaccine could protect their families from acquiring COVID-19 %, and 63% ($n = 386$) were of the opinion that the vaccine could prevent complications associated with COVID-19 (Table 3).

Perception on COVID-19 vaccine

One hundred and thirty-four participants (22%) believed that they will not contract COVID-19 after immunization, whilst 35% ($n = 215$) of the respondent's believed that COVID-19 prevention using non pharmaceutical interventions is much better than to be vaccinated and 18% ($n = 106$) stated that the COVID-19 vaccine would not yield any benefit to them since they were healthy (Table 4).

In addition, 63% ($n = 385$) of participants expressed concern over the safety of COVID-19 vaccines and 65% ($n = 395$) of participants were concerned about adverse events following COVID-19 immunization (Table 4).

The majority of participants 77% ($n = 361$) had a positive perception towards the government's strategy on handling the COVID-19 crisis, 78% ($n = 364$) were confident in the government's strategic planning and introduction of COVID-19 immunization, and 78% ($n = 369$) were satisfied with the seamless and up-to-date information provided by the government on the development of the COVID-19 vaccine and its introduction (Table 4).

Seventy-two percent 72% ($n = 337$) of participants appreciated the importance of immunization prior to the COVID-19 pandemic, and this number remained consistent following the COVID-19 crisis as well (Table 4).

Reasons for willingness and not willing to receive COVID-19 vaccine

One of the major reasons for the participants' willingness to accept COVID-19 vaccine was their sense of social responsibility, as stated by almost three-quarter of the participants (74.6%) that they would like to protect themselves and their families by getting vaccinated against COVID-19. Moreover, 70.4% of the participants believed that COVID-19 vaccine could be effective in preventing future COVID-19 spread (Fig. 1).

In contrast, concerns about the potential side effects of COVID-19 vaccination was the main reason why participants (77.2%) did not accept the COVID-19 vaccine, and doubts on vaccine safety were also highlighted by almost half of the participants (48.8%) (Fig. 2).

Recommendation of COVID-19 vaccine, vaccine efficacy criteria

Out of 471 participants, 76.6% ($n = 361$) stated that they would recommend the COVID-19 vaccine to their patients, whilst 68.6%

Table 1
Socio-demographic characteristics of healthcare workers participating in the study (n = 608).

Characteristics	Willing to receive COVID-19 vaccine			Total participants n (%)
	Yes n (%)	No n (%)	Not sure yet n (%)	
Age				
20–29	17 (6 %)	13 (10 %)	22 (10 %)	52 (9 %)
30–39	137 (52 %)	69 (53 %)	121 (57 %)	327 (54 %)
40–49	78 (30 %)	40(30 %)	48 (23 %)	166 (27 %)
50–59	27 (10 %)	8 (6 %)	22 (10 %)	57 (9 %)
≥ 60	5 (2 %)	1 (1 %)	0	6 (1 %)
Gender				
Male	144 (55 %)	29 (22 %)	53 (25 %)	226 (37 %)
Female	120 (45 %)	102 (78 %)	160 (75 %)	382 (62.8 %)
Marital status				
Married	237 (90 %)	110 (84 %)	182 (85 %)	529 (87 %)
Single	27 (10 %)	21 (16 %)	31 (15 %)	79 (13 %)
Nationality				
Omani	142 (54 %)	108 (83 %)	144 (68 %)	394 (64.8 %)
Non-Omani	122 (46 %)	23 (17.6 %)	69 (32 %)	214 (35.2 %)
Highest educational level				
Diploma	59 (22 %)	46(35 %)	67 (31 %)	172 (28.3 %)
Completed bachelors	115 (44 %)	50 (38 %)	94 (44 %)	259 (42.6 %)
Completed masters	56 (21 %)	20 (15 %)	33 (15 %)	109 (17.9 %)
Specialist	24 (9 %)	9 (7 %)	14 (7 %)	47 (7.7 %)
Doctorate	10 (4 %)	6 (5 %)	5 (2 %)	21 (3.5 %)
Job Title				
Doctor	158 (60 %)	50 (38 %)	88 (41 %)	296 (48 %)
Nurse	53 (20 %)	45 (34 %)	84(39 %)	214 (35 %)
Pharmaceutical	11 (4 %)	11(4 %)	10(5 %)	12 (2 %)
Public health staff	3(1 %)	0(0 %)	3(1 %)	6 (1 %)
Paramedic	9(3 %)	11 (8 %)	12 (6 %)	32 (5 %)
Midwives	2 (1 %)	5 (4 %)	5 (2 %)	12 (2 %)
Other	28(11 %)	9(7 %)	11 (5 %)	48 (7 %)
Governorate				
Muscat	68(26 %)	45(34 %)	70(33 %)	183 (30 %)
Al-Dhahirah	7(3 %)	6(5 %)	4(2 %)	17 (2 %)
South Al-Batinah	51 (19 %)	20(15 %)	38(18 %)	109 (18 %)
Musandam	5(4 %)	29(11 %)	11(5 %)	45 (7 %)
Al-Buraymi	3 (2 %)	3(1 %)	3(1 %)	9 (1 %)
North Al-Batinah	16(6 %)	8(6 %)	11 (5 %)	35 (6 %)
Al-Dakhiliyah	12 (5 %)	8(6 %)	13 (6 %)	33 (5 %)
North Al-Sharqiyah	15 (6 %)	10 (8 %)	5(2 %)	30 (5 %)
South Al-Sharqiyah	5(2 %)	4(3 %)	14(7 %)	23 (4 %)
Dhofar	49(19 %)	20(15 %)	39(18 %)	108 (18 %)
Al Wusta	9(3 %)	2(1 %)	5(2 %)	30 (4 %)
Type of health facility				
Primary	185 (70 %)	94 (72 %)	144(68 %)	423 (70 %)
Secondary	48(18 %)	14(11 %)	37(17 %)	99 (16 %)
Tertiary	31 (12 %)	23(18 %)	32 (15 %)	86 (14 %)
Infected with SARS-CoV-2 before				
No	198 (75 %)	95 (72 %)	143 (67 %)	436 (72 %)
Yes confirmed	30(11 %)	16 (12 %)	33 (15 %)	79 (12 %)
Yes suspected	12 (4 %)	6 (5 %)	17 (8 %)	58 (10 %)
Not sure	24 (9 %)	14(11 %)	20(9 %)	35 (6 %)
Treating COVID-19 patients				
Yes	149 (56 %)	76 (58 %)	117 (55 %)	342 (56 %)
No	115 (44 %)	55 (42 %)	94 (44 %)	264 (43 %)

(n = 323) would recommend COVID-19 vaccine to their family members (Table 3). Bivariate analysis showed that there was no association between participants' willingness to receive COVID-19 vaccine and recommending the vaccine to their patients, but participants who were willing to receive COVID-19 vaccine were also likely to recommend the vaccine to their family members (OR: 162.79; 95 % CI: 39.54–670.23) (Table 4).

Above three-quarter of the participants (360/471; 76.4 %) emphasized that they would receive and recommend the COVID-19 vaccine if its efficacy is proven to be $\geq 80\%$. Only 15 % (n = 71) and 8.5 % (n = 40) of the participants indicated that they would receive the vaccine with 50–80 % efficacy and irrespective of vaccine efficacy respectively. Bivariate analysis revealed that participants who would receive/recommend a 50–80 % effective vaccine were more likely to accept the COVID-19 vaccine (p-value: 0.02; OR: 2.56; 95 % CI:

1.15–5.68) compared to those who would accept/recommend the vaccine irrespective of the efficacy data. However, there was no association between willingness to receive/recommend $\geq 80\%$ effective vaccine with the acceptance of COVID-19 vaccine (p-value: 0.29; OR: 1.44; 95 % CI: 0.74–2.82).

Source of information on COVID-19, COVID-19 vaccine and vaccination, and communication on COVID-19 vaccination

Social media was the main source of information on COVID-19, COVID-19 vaccine and vaccination for the study participants (Friedman's test; mean rank: 3.03), followed by scientific journals (mean rank: 3.27). Workplace was the third major source of information among the study participants (mean rank: 3.41). The Ministry of Health's website (mean rank: 3.79) and fellow colleagues

Table 2

Participants' knowledge and attitude towards COVID-19 and willingness to receive COVID-19 vaccine (Yes, No, Not sure) (n = 587).

Variables	Willing to receive COVID 19 vaccine						Total population	
	Yes		No		Unsure		N	%
	N	%	N	%	N	%		
COVID-19 spreads via respiratory droplets of infected population.								
TRUE	256	42 %	124	20 %	207	34 %	587	97 %
FALSE	7	1 %	8	1 %	4	1 %	19	1 %
Person with COVID-19 cannot transmit the virus to others when fever is absent.								
TRUE	8	1 %	9	1 %	17	3 %	34	6 %
FALSE	256	42 %	122	20 %	194	32 %	572	94 %
Corona virus (SARS-CoV-2) is similar to SARS-CoV and MERS-CoV								
TRUE	143	24 %	76	13 %	113	19 %	332	55 %
FALSE	117	19 %	55	9 %	98	16 %	270	45 %
There is no effective therapeutic cure for COVID-19 yet.								
TRUE	232	38 %	109	18 %	182	30 %	523	86 %
FALSE	31	5 %	22	4 %	29	5 %	82	14 %
All my activities will be disrupted if I get ill with COVID-19.								
Strongly agree	122	20 %	26	4 %	75	12 %	233	39 %
Agree	84	14 %	36	6 %	61	10 %	181	30 %
Neutral	25	4 %	25	4 %	33	5 %	83	14 %
Disagree	27	4 %	28	5 %	37	6 %	92	15 %
Strongly disagree	6	1 %	5	1 %	4	1 %	15	2 %
I am worried that I might experience stigma if i get ill with COVID-19.								
Strongly agree	23	4 %	11	2 %	17	3 %	51	8 %
Agree	63	10 %	26	4 %	66	11 %	155	26 %
Neutral	51	8 %	20	3 %	39	6 %	110	18 %
Disagree	56	9 %	28	5 %	47	8 %	131	22 %
Strongly disagree	45	7 %	70	12 %	41	7 %	156	26 %
COVID-19 is a serious disease for me.								
Strongly agree	91	15 %	28	5 %	60	10 %	179	30 %
Agree	101	17 %	32	5 %	92	15 %	225	37 %
Neutral	49	8 %	33	5 %	37	6 %	119	20 %
Disagree	18	3 %	31	5 %	19	3 %	68	11 %
Strongly disagree	4	1 %	7	1 %	3	0 %	14	2 %
COVID-19 is a serious disease for my family.								
Strongly agree	46	8 %	136	22 %	110	18 %	292	48 %
Agree	97	16 %	45	7 %	69	11 %	211	35 %
Neutral	22	4 %	23	4 %	19	3 %	64	11 %
Disagree	7	1 %	12	2 %	11	2 %	30	5 %
Strongly disagree	2	0 %	5	1 %	2	0 %	9	1 %
COVID-19 is not a disease that needs serious attention.								
Strongly agree	11	2 %	2	0 %	4	1 %	17	3 %
Agree	7	1 %	23	4 %	12	2 %	42	7 %
Neutral	14	2 %	19	3 %	15	2 %	48	8 %
Disagree	92	15 %	45	7 %	73	12 %	210	35 %
Strongly disagree	140	23 %	41	7 %	107	18 %	288	48 %

(mean rank: 4.08) were listed as the least frequent source of information on COVID-19 (Table 5).

Participants emphasized that direct counseling would be the most suitable way for communication and spreading awareness on COVID-19 vaccination in Oman, followed by Television and social media platforms. Newspapers and posters/leaflets/brochures were categorized as the least appropriate communication channel.

Out of 471 participants, the majority of the participants stated that it is necessary to communicate on COVID-19 vaccine safety (73.9 % (n = 348)), efficacy (75.8 % (n = 357)) and benefits-risk associated with the vaccine (75.2 % (n = 354)). Around 65 % (n = 306) emphasized that the importance of COVID-19 vaccination to mitigate the spread of the disease should also be communicated.

Predictors for COVID-19 vaccine acceptance

In determining the predictors for COVID-19 vaccine our hypothesis was that there would be no difference to willingness to intake the COVID 19 vaccine by gender, age, nationality and Government trust.

Males (OR: 3.82; 95 % CI: 2.66–5.49), participants with completed bachelors or higher education degrees (OR: 1.70; 95 % CI: 1.16–2.51), good knowledge of the COVID-19 vaccine (OR: 1.73; 95 % CI:

1.23–2.43), positive attitudes towards vaccines (OR: 19.31; 95 % CI: 4.76–168.49) and higher trust in the government (OR: 3.05; 95 % CI: 2.16–4.32) were significantly more likely to take the COVID-19 vaccine. However, Omani nationals (OR 0.42; 95 % CI: 0.30–0.66) were less likely than non-Omani nationals to take the vaccine. Males (OR: 1.96 95 % CI (1.22–3.13)), positive attitude towards the vaccine (OR: 9.17(95 % CI-1.78–47.07), trust in the government (OR: 2.41 95%CI 1.57–3.71) and sound knowledge of COVID-19 vaccine (OR: 15.91 95%CI 9.81–25.88)** remained significant positive predictors of the COVID-19 vaccine uptake after multivariate logistic regression analysis (Table 6).

Participants who were previously infected with COVID-19 were less willing to take the COVID-19 vaccine (OR: 1.59; 95 % CI: 1.02–2.45). In addition participants with a positive attitude towards COVID-19 vaccination (OR: 9.17; 95 % CI: 1.78–47.07) were significantly more likely to accept the COVID-19 vaccine (Table 6).

Discussions

The COVID-19 vaccine is a vital tool in responding to the ongoing pandemic [12]. Current evidence shows that COVID-19 immunization reduces the risk of contracting a serious SARS-CoV-2 infection and its associated hospitalization and mortality [13].

Table 3

Participants' knowledge and attitude towards COVID-19 vaccine and vaccination and willingness to receive COVID-19 vaccine (Yes, No and Not sure) (n = 526).

Variables	Willing to receive COVID 19 vaccine						Total population	
	Yes		No		Unsure		n	%
	n	%	n	%	n	%		
Have you receive influenza vaccine during the last five years?								
Yes	236	39 %	105	17 %	185	30 %	526	87 %
No	28	5 %	26	4 %	28	5 %	82	13 %
Are you aware that Oman is planning for the introduction of COVID-19 vaccine once available in coming months?								
Yes	259	43 %	124	20 %	200	33 %	583	96 %
No	5	1 %	7	1 %	11	2 %	23	4 %
COVID-19 vaccination can protect me from getting infected by SARS-CoV-2.								
Strongly agree	83	14 %	0	0 %	10	2 %	93	15 %
Agree	136	22 %	18	3 %	60	10 %	214	35 %
Neutral	31	5 %	57	9 %	115	19 %	203	33 %
Disagree	10	2 %	39	6 %	19	3 %	68	11 %
Strongly disagree	4	1 %	17	3 %	7	1 %	28	5 %
COVID-19 vaccination will protect my family as well if they are also vaccinated.								
Strongly agree	96	16 %	1	0 %	15	2 %	112	19 %
Agree	139	23 %	20	3 %	73	12 %	232	38 %
Neutral	250	41 %	59	10 %	109	18 %	193	32 %
Disagree	4	1 %	35	6 %	13	2 %	52	9 %
Strongly disagree	0	0 %	15	2 %	1	0 %	16	3 %
One of the ways to prevent COVID-19 complication is through COVID-19 vaccination.								
Strongly agree	106	18 %	2	0 %	17	3 %	125	21 %
Agree	141	24 %	23	4 %	94	16 %	258	44 %
Neutral	45	8 %	10	2 %	84	14 %	123	21 %
Disagree	7	1 %	39	7 %	12	2 %	58	10 %
Strongly disagree	0	0 %	21	4 %	4	1 %	25	4 %

Achieving collective/herd immunity is vital to the impact of the COVID-19 vaccine on the population as well as to control the pandemic. It is therefore essential, at an early stage of vaccine deployment, to determine the potential factors associated with reluctance to receive the COVID-19 vaccine, in such a way that the communication and health promotion strategy can be altered or strengthened.

HCWs who are reluctant to receive the COVID-19 vaccine should undergo counseling to understand the source of the hesitation if we are to mitigate harm in the workplace and obtain collective immunity. The Centre for Disease Control recommended that healthcare workers be amongst the first group in any country to be vaccinated against COVID-19 [14]. These data are based on HCWs who may be exposed to COVID-19 while caring for and treating patients, and HCWs who are likely to transmit the virus to patients during treatment contact [3].

Successful deployment of HCW vaccination may have a positive impact on the general acceptability and uptake of vaccination among the local population. Additionally, a positive attitude from HCWs toward COVID-19 vaccination and a high uptake rate of the COVID-19 vaccine is likely to influence the decision of patients to be vaccinated [6].

Low levels of COVID-19 vaccine acceptance in HCWs can have a negative impact on the general population, since HCWs who are willing to receive the vaccine are more likely to recommend vaccination to patients and their families [15]. This is also a worrisome situation given the front line position of healthcare workers in the fight against the spread of the COVID-19 pandemic, serving those most at risk of serious complications related to COVID-19 [16].

Previous research has shown that HCWs intending to be vaccinated plan to recommend the vaccine to family and friends which aligns with the findings in our study [15].

The willingness of HCWs to be vaccinated against COVID-19 was 43% in Oman. Findings from this study contradict findings from other studies conducted through self-administered surveys in 6 countries: China, India, Indonesia, Singapore, Vietnam and Bhutan on willingness to vaccinate, which showed that over 95% of HCWs surveyed in those countries were willing to receive the COVID-19

vaccine. [13] A survey of HCWs in France, French-speaking Belgium and Quebec, Canada, demonstrated 72.4% acceptance for COVID-19 vaccination among healthcare workers [17].

In addition, the willingness to be vaccinated is lower in our study as compared to a survey conducted at the State University of New York (SUNY), New York, amongst HCWs where a 57.5% willingness to take the COVID-19 vaccine was observed. This result is similar to a survey conducted amongst HCWs, comprising physicians and administrative health care assistants in Poland showing a 54.3% willingness to be vaccinated against COVID-19 [18].

The willingness to be vaccinated is lower in our study as compared to studies conducted among HCWs in Saudi Arabia where 50.5% and 65% were willing to receive the COVID-19 vaccine [19,20]. Furthermore, an online survey conducted across Middle Eastern Region via social marketing indicated that 62.4% (n = 543) of the participants would accept COVID-19 vaccine if it became available free of charge [21]. In contrast our findings are higher than the 25% willing to receive a vaccine and 33% being hesitant as reported via a self-administered questionnaire was distributed through social media applications in four Arab countries (Jordan, Saudi Arabia, Lebanon, and Iraq) [22]. The willingness to be vaccinated is higher in our study than in an analytical cross-sectional study among 23 congolese referral hospitals, including three university hospitals, located in three towns indicating that only 27.7% of HCWs were willing to accept the COVID-19 vaccination [23].

Males were more willing to accept COVID-19 vaccination and this has been consistently shown in other studies [23–25]. The increased willingness for COVID-19 vaccine uptake amongst males could be due to their positive perception of the underlying risks, as a number of reports have shown higher risks for COVID-19 complications, infectivity and death among males than females [26].

In our study HCWs with good knowledge of COVID-19 (OR: 1.73; 95% CI: 1.23–2.43) and the vaccine (OR 15.91(9.81–25.88)) were more willing to be vaccinated against COVID-19. Knowledge of both COVID-19 and the vaccination is important in influencing a decision to take the COVID-19 vaccine. This was also found in a study in Vietnam in two general hospitals that indicated HCWs with good

Table 4
Participants' attitude towards COVID-19 vaccine and vaccination and trust in the government and willingness to receive COVID-19 vaccine (Yes, No and Not sure).

Variables	Willing to receive COVID 19 vaccine						Total population	
	Yes		No		Unsure		n	%
	n	%	n	%	n	%		
I am worried about the safety of COVID-19 vaccine.								
Strongly agree	10	2 %	80	13 %	71	12 %	161	27 %
Agree	88	15 %	39	6 %	95	16 %	222	37 %
Neutral	81	13 %	6	1 %	37	6 %	124	20 %
Disagree	67	11 %	6	1 %	8	1 %	81	13 %
Strongly disagree	18	3 %	0	0 %	0	0 %	18	3 %
I am worried that there will be side effects after COVID-19 vaccination.								
Strongly agree	9	1 %	78	13 %	70	12 %	157	26 %
Agree	94	16 %	40	7 %	102	17 %	236	39 %
Neutral	104	17 %	8	1 %	30	5 %	142	24 %
Disagree	43	7 %	2	0 %	9	1 %	54	9 %
Strongly disagree	13	2 %	2	0 %	0	0 %	15	2 %
I believe COVID-19 disease prevention method naturally is much better than to be vaccinated (with COVID-19 vaccine).								
Strongly agree	6	1 %	57	9 %	20	3 %	83	14 %
Agree	28	5 %	33	5 %	66	11 %	127	21 %
Neutral	70	12 %	28	5 %	80	13 %	178	29 %
Disagree	120	20 %	9	1 %	40	7 %	169	28 %
Strongly disagree	40	7 %	4	1 %	5	1 %	49	8 %
I value the importance of vaccine and vaccination more now after the onset of COVID-19 pandemic.								
Strongly agree	105	22 %	6	1 %	28	6 %	139	30 %
Agree	104	22 %	19	4 %	75	16 %	198	42 %
Neutral	11	2 %	43	9 %	46	10 %	100	21 %
Disagree	3	1 %	16	3 %	4	1 %	23	5 %
Strongly disagree	1	0 %	6	1 %	1	0 %	8	2 %
My government is handling the COVID-19 crisis very well.								
Strongly agree	77	16 %	24	5 %	49	10 %	150	32 %
Agree	100	21 %	36	8 %	75	16 %	211	45 %
Neutral	35	7 %	17	4 %	27	6 %	79	17 %
Disagree	9	2 %	8	2 %	4	1 %	21	4 %
Strongly disagree	3	1 %	5	1 %	1	0 %	9	2 %
I valued the importance of vaccine and vaccination before the COVID-19 pandemic as well.								
Strongly agree	105	22 %	6	1 %	28	6 %	139	30 %
Agree	104	22 %	19	4 %	75	16 %	198	42 %
Neutral	11	2 %	43	9 %	46	10 %	100	21 %
Disagree	3	1 %	16	3 %	4	1 %	23	5 %
Strongly disagree	1	0 %	6	1 %	1	0 %	8	2 %
My government provides transparent and up-to-date information on COVID-19 vaccine development and its introduction in the Sultanate of Oman.								
Strongly agree	90	19 %	25	5 %	46	10 %	161	34 %
Agree	109	23 %	31	7 %	68	14 %	208	44 %
Neutral	22	5 %	18	4 %	33	7 %	73	15 %
Disagree	3	1 %	11	2 %	8	2 %	22	5 %
Strongly disagree	1	0 %	5	1 %	1	0 %	7	1 %
I trust the government on COVID-19 vaccination planning and introduction.								
Strongly agree	99	21 %	10	2 %	36	8 %	145	31 %
Agree	114	24 %	31	7 %	74	16 %	219	47 %
Neutral	10	2 %	29	6 %	44	9 %	83	18 %
Disagree	1	0 %	15	3 %	0	0 %	16	3 %
Strongly disagree	0	0 %	5	1 %	2	0 %	7	1 %

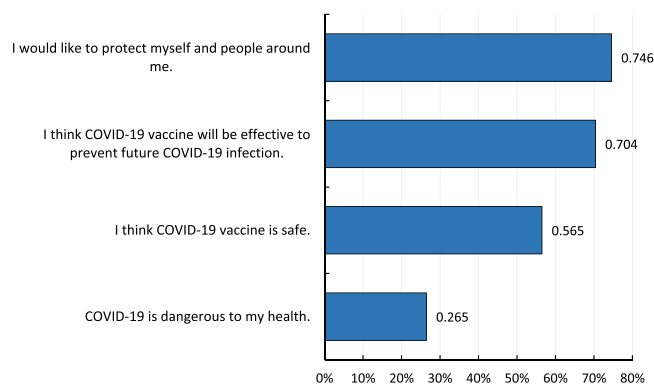


Fig. 1. Bar graph showing different reasons for acceptance of COVID-19 vaccine among the study participants (n = 260). Note: The total percentage is not 100% since this was a multiple response question and was analyzed using multiple response analysis.

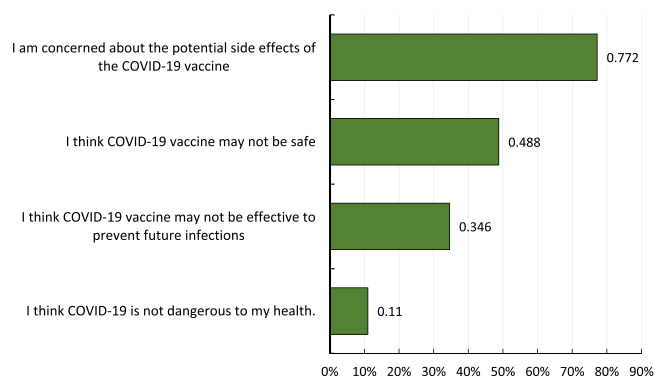


Fig. 2. Bar graph representing various reasons for not willing and not sure to receive COVID-19 vaccine among the study participants (n = 246). Note: The total percentage is not 100% since this was a multiple response question and was analyzed using multiple response analysis.

knowledge had a 3.37 more likely odds to accept COVID-19 vaccines [27].

Similar to other studies our study found that HCWs with positive perception towards the COVID-19 vaccination and trust in the government's strategies were more willing to receive the COVID-19 vaccination. A six nation study in Asia showed that those willing to be vaccinated were more likely to “have trust in the country's public healthcare system/government competency” (p -value < 0.001); 2) belief that the “country's public healthcare system/government has responded effectively to the COVID-19 pandemic”, and participants willing to vaccinate were more likely to believe that the “country's public healthcare system/government has provided honest information/been transparent about the COVID-19 pandemic to the public” (p -value = 0.014) [28].

The above findings highlight the importance of appropriate communication by the relevant authorities to build trust and confidence towards the vaccination program. In the current era of easy access to social media, a comprehensive and transparent strategy that encompasses explanations of how vaccines work, how they are developed, importance of vaccines in controlling the pandemic, the time needed to reach an effective level (requirement of multiple doses), contingency management plans in situations of unexpected health adverse effects, and the importance of herd immunity is essential firstly for healthcare workers and then to the general population. Moreover, additional training and awareness programs and supportive supervision on COVID-19 vaccine and vaccination programs can be implemented to boost the confidence of healthcare workers.

Table 5
Sources of information on COVID-19, COVID-19 vaccine and vaccination.

Source of information	Friedman's test (mean rank)	Rank
Social Media (Facebook, Twitter, LinkedIn, Instagram)	3.03	1st
Scientific Journals	3.27	2nd
Workplace	3.41	3rd
Radio, Television, Newspaper	3.42	4th
Ministry of Health website	3.79	5th
Fellow colleagues	4.08	6th

Note: Least mean rank implies the major information source.

Table 6
Multinomial logistic regression and binary logistic regression of willingness to get vaccinated vs different variables.

Statistical analysis Outcomes Variables	Bivariate Will vaccinate OR (95% confidence interval)	Multivariate Will vaccinate OR (95% confidence interval)
Age		
≤ 39 versus ≥ 39 years	0,74 (0,53–1,05)	1,04(0,65–1,65)
Gender		
Males versus females	3,82(2,66–5,49)**	1,96(1,22–3,13)*
Marital status		
Married versus single	1,57(0,93–2,68)	1,93(0,98–3,03)
Nationality		
Omani versus non Omani	0,42(0,30–0,66)**	0,68(0,41–1,12)
Education		
Completed Bachelors/Masters/Doctorate/Specialist versus Diploma	1,70(1,16–2,51)**	0,96(0,56–1,57)
Occupation		
Clinician (Doctor; Nurse) versus Allied Health & Others	1,01(0,66–1,56)	
Type of facility		
Primary versus Secondary/Tertiary	1,05(0,73–1,51)	
Infected with SARS previously		
Yes versus No	0,71(,73–1,51)	1,00(0,56–1,75)
Recommend COVID-19 vaccine to patients		
Yes versus No		
Recommend COVID-19 vaccine to family members		
Yes versus No	162,79(39,54–670,23)**	605,29(134,48–2724,37)**
Knowledge of COVID-19		
≥ 7 versus ≤ 7	1,73(1,23–2,43)*	1,25(0,81–1,93)
Knowledge of COVID-19 vaccine		
Score ≥ 8 versus score ≤ 8	20,04(12,50–32,54)**	15,91(9,81–25,88)**
Trust on Government		
Score ≥ 3 versus score ≤ 3	3,05(2,16–4,32)**	2,41(1,57–3,71)**
Attitude towards COVID-19 vaccine		
Attitude score ≥ 4 versus attitude score ≤ 4	19,31(4,76–168,49)**	9,17(1,78–47,07)*

Note: $P < 0.05$ * $P < 0.001$ **.

Limitations

This is a cross-sectional study, which does not allow the assessment of causality. Second, the questionnaires were self-administered due to the strict infection control measures in all participating institutions. Therefore, the information obtained is subject to self-reporting bias. Furthermore, the mode of communication was through WhatsApp® and email and it is assumed that most healthcare workers in Oman have access to this platform. The findings are not generalizable to the general public given that the healthcare workers' perception and risk profile of the pandemic differ. In addition, the COVID-19 vaccine acceptance among Oman's HCWs is predicted to have altered between data collection and publication of the findings. The existing research shows that vaccination acceptance changes between subgroups of the community and over time, possibly due to a shift in vaccine perceptions, increased or decreased faith in COVID-19 vaccine, or increased or decreased trust in health authorities/government.

Conclusions

To the best of our knowledge, this is the first study of its kind focusing on HCWs in Oman regarding COVID-19 vaccination. Despite many prevailing concerns regarding the COVID-19 vaccine, 43% of HCWs in Oman are willing to receive the COVID-19 vaccine. Participants outlined the social responsibility of protecting themselves and people around them as the main reason to accept the COVID-19 vaccine, whereas the major reason for not willing to receive the vaccine was the concern about the potential side-effects of COVID-19 vaccination. Males HCWs, having a good knowledge of the COVID-19 disease, COVID-19 vaccination, positive attitude and good

government perception of handling the COVID-19 pandemic were positive predictors of willingness to take the vaccine. The above determinants demonstrate the need for a comprehensive, clear, fact-based and transparent communication to the HCWs to increase the uptake as well as to improve the recommendation behavior of HCWs towards COVID-19 vaccine.

Previous Presentations Statement

None.

Patient consent for publication

Not required.

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Ethics approval

Ethical approval for this study was granted from the National Oman Ethical Committee (#MoH/CSR/20/24135). This study does not contravene the internal institutional review board and follows the Declaration of Helsinki.

CRedit authorship contribution statement

All authors were involved during the planning of this study. STA, HA, MK, AA, SA and CD conceptualized the project and conducted initial background research, STA, HA, AA, SA and OM planned and conducted the formal analysis and validation, STA, OM, HA, AA and SA interpreted the results, STA led the writing (original draft and editing) of the manuscript, STA, HA, MK, AA, SA and OM write the manuscript STA, CD, HA and MK supervised the project. All authors approved the final article.

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Data availability statement

The data are available from the correspondence author upon reasonable on request.

Competing interests

None declared.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.jiph.2022.06.005](https://doi.org/10.1016/j.jiph.2022.06.005).

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