

Knowledge, Attitude, and Acceptability of COVID-19 Vaccine in Oman: A Cross-sectional Study

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ABSTRACT

Objectives: To evaluate the knowledge, attitude, and acceptance of COVID-19 vaccine among the general population of Oman, on the eve of the rollout of vaccination program in the country. **Methods:** A cross-sectional study was conducted using a structured and validated online questionnaire. Adults residing in Oman were invited to participate in the study between 22 and 24 December 2020. Logistic regression analysis was used to identify the factors associated with COVID-19 vaccine acceptability. **Results:** Of the total of 966 participants, the majority (612; 63.4%) were women. Most participants were younger than 40 years (572; 59.3%). Participants displayed good awareness about COVID-19 (946; 97.9%) and the global vaccine development initiatives (831; 86.0%). Only 265 (27.4%) participants were willing to get themselves vaccinated. The majority were either uncertain 365 (37.8%) or unwilling 336 (34.8%). The main driver of vaccine acceptance was to protect oneself and others (186/265; 70.0%). The main reasons given for vaccination hesitation/refusal were concerns over possible side-effects (505/701; 72.0%), safety concerns (386/701; 55.0%), and ineffectiveness of the vaccine (107/701; 15.3%). **Conclusions:** On the eve of the first-ever rollout of COVID-19 vaccine in Oman in December 2020, the surveyed residents of the country expressed significant hesitancy to get themselves vaccinated. Participants' perceptions of risk of contracting COVID-19, their trust in vaccines, government, and their health system were important predictors of vaccine acceptance. These results enabled development of strategies to address such concerns to facilitate vaccine acceptance among the residents of Oman. The results of this study can be used by researchers to conduct comparative research in future, with more emphasis on Omani youth (< 40 years).

The coronavirus pandemic, caused by the new SARS-CoV-2, overwhelmed the world rapidly after the emergence of the first case in Wuhan, China towards the end of 2019. On March 11, 2020, the World Health Organization (WHO) officially declared COVID-19 a global pandemic. As of December 22, 2021, the virus caused > 277 million cases and over 5.3 million deaths worldwide.^{1,2} By the same date, Oman reported cumulative 304938 cases and 4113 deaths.^{1,2} As recommended by WHO, most countries including Oman adopted strict social distancing and quarantine measures which helped slow down the spread of the virus.³ As there were no effective remedies for the disease, development

of COVID-19 vaccines became the focus of the best minds in medical research worldwide. This was accompanied by an unprecedented willingness from major institutions, whether laboratories, research institutes, or pharmaceutical companies. As of August 26, 2021, 21 vaccines against COVID-19 had been authorized by at least one regulatory authority in different countries around the world.⁴ However, the public acceptance of the then new initiative (COVID-19 vaccine) was variable and often skeptical.⁵⁻¹¹

Oman has one of the best childhood immunization programs in the world, with nearly 100% coverage since 2001.⁵ But ever since Edward Jenner introduced the concept of inoculation in late

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18th century England, the concept of vaccination has had its detractors.^{1,12} However, vaccine skeptics could not command sufficient public exposure to seriously disrupt public vaccination drives in most countries.

A big reversal occurred from the dawn of 21st century, when online social media began to challenge the legitimacy of the traditional health information sources. Social media influencers with little medical knowledge were able to use their online presence to bypass genuine medical authorities and directly influence people's knowledge, attitudes, and emotions towards medical matters. Omani population has been no exception to this, which led to a decline in vaccination acceptance among the general population and even some healthcare workers in Oman.⁶ An example is the low public acceptance of Oman towards the recently introduced influenza vaccine.^{6-8,13} It was amidst this low vaccine-friendliness that Oman announced its first COVID-19 vaccination program on December 27, 2020.¹⁴

To assess the level of public acceptance, we conducted this pre-vaccination-rollout survey among the public to assess the public perceptions and attitudes to optimize the COVID-19 vaccination program, make contingency plans for unforeseen challenges, and to ensure positive reception from the citizenry. Having been conducted at a pivotal moment, this study has become an important reference point for future surveys, not only on public acceptance of the COVID-19 vaccine but also for all future vaccination drives in Oman.

METHODS

This online cross-sectional study was conducted during 22–24 December 2020 among both Omani and non-Omani residents aged ≥ 20 years, living in any of the 11 governorates of Oman. The self-administered anonymous questionnaire in both Arabic and English languages was developed after an extensive literature review on COVID-19, COVID-19 vaccine, and previous COVID-19 vaccine acceptance studies. The clarity and relevance of the Arabic and English versions of the questionnaire were assessed by a pilot study among 22 adults (> 20 years) living in Muscat Governorate. Potential participants' contact information was extracted from the Governorate Health Services database and the questionnaire was sent to all the eligible participants. The link to the questionnaire

was then distributed to participants across all governorates through WhatsApp® and email. A link to the survey was provided, and participants could only assess the questionnaire by clicking the link.

The minimum sample size was estimated at 700 based on the conservative assumption that the level of acceptability was 50%, with a margin of error of 3% and a 95% CI. Completion of the online survey was expected to take 10–12 minutes. The invitees were assured that their participation in the study was entirely voluntary and that they could opt-out of it. Participants were requested to provide informed consent (online) prior to answering the survey questionnaire.

A total of 25 questions was classified into multiple categories: (A) sociodemographic characteristics; (B) COVID-19 awareness and perceived risk; (C) COVID-19 vaccine acceptance and factors influencing it; and (D) information sources preferred by the participants with trust levels. The choices of answers for most of the questions were limited to a 2-point scale: 1) 'Yes' and 2) 'No'. Other questions were on Likert scale with graded response options: 1) strongly agree, 2) agree, 3) neutral, 4) disagree, and 5) strongly disagree.

The data was analyzed using IBM® SPSS® Version 27.0 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp.). Frequencies and percentages were used to describe the sociodemographic characteristics. The chi-square (χ^2) test was used to assess the difference between subgroups. *P*-value of < 0.050 was considered statistically significant. The univariate analysis was performed using the Mann-Whitney U test for continuous variables and χ^2 test for categorical variables as appropriate. Phi and Cramer's value were used to assess the degree of association. Fisher's exact test was performed when < 5 of the expected count was presented in 1 degree of freedom (df) table. Multiple logistic regressions were used to assess the factors associated with vaccine acceptance and barriers to vaccination. A binary logistic regression analysis was performed to evaluate predictors of willingness to accept vaccination against COVID-19 and attitudes towards COVID-19 vaccination. Variables with a *p*-value < 0.200 in the bivariate analysis were further entered into a multivariate logistic regression model where the adjusted odds ratio (aOR) and their corresponding

Table 1: Binary logistic regression of sociodemographic characteristics versus willingness to accept COVID-19 vaccine.

Sociodemographic characteristics	Frequency N = 966	Willingness to accept COVID-19 vaccine, Yes n = 265; 27.4%	Willingness to accept COVID-19 vaccine, No and Not sure n = 701; 72.6%	Willingness to get vaccinated Yes vs. No and Not sure		
	n (%)	n (%)	n (%)	p-value	OR	95% CI
Governorate						
Muscat	318 (32.9)	88 (27.7)	230 (72.3)		Ref	
Dhofar	25 (2.6)	5 (20.0)	20 (80.0)	0.061	0.66	0.43–1.02
Musandam	5 (0.5)	3 (60.0)	2 (40.0)	0.114	0.43	0.15–1.22
Al-Buraymi	8 (0.8)	4 (50.0)	4 (50.0)	0.308	2.58	0.42–16.03
Al-Dakhiliyah	143 (14.8)	36 (25.2)	107 (74.8)	0.456	1.72	0.41–7.21
North Al-Batinah	114 (11.8)	27 (23.7)	87 (76.3)	0.040*	0.58	0.34–0.98
South Al-Batinah	69 (7.1)	17 (24.6)	52 (75.4)	0.029*	0.53	0.30–0.94
South Al-Sharqiyah	53 (5.5)	11 (20.8)	42 (79.2)	0.086	0.56	0.29–1.08
North Al-Sharqiyah	103 (10.7)	27 (26.2)	76 (73.8)	0.039*	0.45	0.21–0.96
Al-Dhahirah	128 (13.3)	47 (36.7)	81 (63.3)	0.090	0.61	0.35–1.08
Age						
20-29	159 (16.5)	53 (33.3)	106 (66.7)		Ref	
30-39	413 (42.8)	101 (24.5)	312 (75.5)	0.033*	0.65	0.43–0.96
40-49	328 (34.0)	90 (27.4)	238 (72.6)	0.181	0.76	0.50–1.13
50-59	58 (6.0)	18 (31.0)	40 (69.0)	0.749	0.90	0.47–1.72
≥ 60	8 (0.8)	3 (37.5)	5 (62.5)	0.808	1.20	0.28–5.21
Gender						
Male	354 (36.6)	147 (41.5)	207 (58.5)	0.001**	2.97	2.22–3.98
Female	612 (63.4)	118 (19.3)	494 (80.7)		Ref	
Marital Status						
Single	173 (17.9)	55 (31.8)	118 (68.2)	0.157	1.29	0.90–1.85
Married	793 (82.1)	210 (26.5)	583 (73.5)		Ref	
Nationality						
Omani	918 (95.0)	244 (26.6)	674 (73.4)		Ref	
Non-Omani	48 (5.0)	21 (43.8)	27 (56.3)	0.011*	2.15	1.19–3.87
Education						
Non-formal education	4 (0.4)	1 (25.0)	3 (75.0)	0.869	0.83	0.09–7.99
Preparatory or less	7 (0.7)	3 (42.9)	4 (57.1)	0.419	1.86	0.41–8.38
Secondary	186 (19.3)	40 (21.5)	146 (78.5)	0.048*	0.68	0.46–0.99
Diploma or higher	769 (79.6)	221 (28.7)	548 (71.3)		Ref	
Current employed						
Yes	695 (71.9)	201 (28.9)	494 (71.1)	0.097	1.32	0.95–1.82
No	271 (28.1)	64 (23.6)	207 (76.4)		Ref	
Occupation sector						
Governmental	610 (74.1)	164 (26.9)	446 (73.1)	0.202	0.80	0.57–1.13
Non-governmental	213 (25.9)	67 (31.5)	146 (68.5)		Ref	

OR: Odds ratio.

p-value significant at < 0.050; *p-value < 0.050; **p-value < 0.005; Acceptors = Yes; Hesitators = No and not sure.

95% CI were calculated to explore the association related to risk perception, perceived facilitators and barriers towards COVID-19 vaccination, and trust in the government. Friedman's test was used to

calculate the mean ranking for priority population for COVID-19 vaccination, information sources, and trust of information sources related to the COVID-19 and COVID-19 vaccine.

Table 2: Binary logistic regression of awareness and perceived risk about COVID-19 and the willingness to accept COVID-19 vaccine.

COVID-19 awareness and perceived risk	Frequency n = 966	Willingness to accept COVID-19 vaccine, Yes n = 265; 27.4%	Willingness to accept COVID-19 vaccine, No and Not sure n = 701; 72.6%	Willingness to get vaccinated Yes, vs. No and Not sure.		
	n (%)	n (%)	n (%)	p-value	OR	95% CI
Awareness of the COVID-19 cases in Oman						
Yes	946 (97.2)	260 (27.5)	686 (72.5)	0.805	1.14	0.41–3.16
No	20 (2.1)	5 (25.0)	15 (75.0)		Ref	
Has COVID-19 affected your life personally, socially, mentally, or economically?						
Yes	704 (72.9)	201 (28.6)	503 (71.4)	0.202	0.81	0.58–1.12
No	262 (27.1)	64 (24.4)	198 (75.6)		Ref	
Do you think you are at risk of contracting COVID-19?						
Yes	777 (80.4)	226 (29.1)	551 (70.9)	0.020*	1.58	1.07–2.32
No	189 (19.6)	39 (20.6)	150 (79.4)		Ref	
Have you been ill with COVID-19?						
Yes	157 (16.3)	43 (27.4)	114 (72.6)	0.989	1.01	0.68–1.47
No	809 (83.7)	222 (27.4)	587 (72.6)		Ref	
Do you know anyone close to you who was/is ill with COVID-19?						
Yes	911 (94.3)	253 (27.8)	658 (72.2)	0.338	0.73	0.38–1.39
No	55 (5.7)	12 (21.8)	43 (78.2)		Ref	
Have you received flu vaccine within the past 5 years?						
Yes	463 (47.9)	148 (32.0)	315 (68.0)	0.003**	1.55	1.17–2.06
No	503 (52.1)	117 (23.3)	386 (76.7)		Ref	
Awareness of the COVID-19 vaccine development in different parts of the world						
Yes	831 (86.0)	253 (30.4)	578 (69.6)	0.001**	4.48	2.44–8.86
No	135 (14.0)	12 (8.9)	123 (91.1)		Ref	
Awareness of the COVID-19 vaccine implementation in Oman once available						
Yes	945 (97.8)	264 (27.9)	681 (72.1)	0.001**	7.75	1.03–58.1
No	21 (2.2)	1 (4.8)	20 (95.2)		Ref	
Main worries about COVID-19						
<i>Infect someone else</i>						
Yes	761 (82.6)	225 (29.6)	536 (70.4)	0.023*	1.62	1.07–2.44
No	160 (17.4)	33 (20.6)	127 (79.4)		Ref	
<i>Getting infected by others</i>						
Yes	563 (62.9)	174 (30.9)	389 (69.1)	0.013*	1.48	1.08–2.02
No	332 (37.1)	77 (23.2)	255 (76.8)		Ref	
<i>Death</i>						
Yes	505 (55.9)	154 (30.5)	351 (69.5)	0.040*	1.37	1.01–1.84
No	399 (44.1)	97 (24.3)	302 (75.7)		Ref	
<i>Losing the job</i>						
Yes	250 (29.2)	75 (30.0)	175 (70.0)	0.380	1.16	0.84–1.60
No	607 (70.8)	164 (27.0)	433 (73.0)		Ref	
<i>Economic crisis</i>						
Yes	723 (78.7)	202 (27.9)	521 (72.1)	0.499	0.88	0.62–1.27
No	196 (21.3)	50 (25.5)	146 (74.5)		Ref	

OR: Odds ratio.

p-value significant at < 0.050; *p-value < 0.050; **p-value < 0.005; Acceptors = Yes; Hesitators = No and not sure.

The study was conducted according to the guidelines of the Declaration of Helsinki, and

approved by the National Ethical Committee, MOH, Oman (Reference number: MoH/CSR/20/24135).

Table 3: Multinomial logistic regression and binary logistic regression of willingness to get vaccinated versus potential barriers for the COVID-19 vaccination.

Potential barriers for the COVID-19 vaccination in Oman	Frequency	Binary logistic regression		Multinomial logistic regression	
	N = 601	Willingness to get vaccinated (Yes vs. no and not sure)		Willingness to get vaccinated (Yes vs. no and not sure)	
	Positive sentiments	B	aOR [95% CI]	B	aOR (95% CI)
I valued the importance of vaccine and vaccination before the COVID-19 pandemic.	492	----	-----	----	-----
I value the importance of vaccines and vaccination after the onset of the COVID-19 pandemic.	427	3.620	37.50 (5.10–273.80)**	0.932	2.54 (0.20–32.84)
I trust the government on COVID-19 vaccination planning and introduction.	431	1.810	6.08 (2.13–17.38)**	0.243	0.78 (0.13–4.75)
My government provides transparent and up-to-date information on COVID-19 vaccine development and its introduction in Oman.	451	1.290	3.65 (1.61–8.27)**	0.640	0.53 (0.13–2.08)
COVID-19 crisis is well handed by my government.	470	0.870	2.34 (1.18–4.84)*	0.103	1.11 (0.34–3.59)
COVID-19 vaccine is safe and effective.	209	5.500	249.90 (34.10–1831.60)**	3.830	46.09 (5.65–376.16)*
I think the COVID-19 vaccine is the only solution to end the pandemic in the shortest time possible.	275	4.020	55.65 (17.26–179.3)**	1.821	6.18 (1.62–23.55)*
I think COVID-19 is dangerous to my health.	446	1.857	6.41 (2.26–18.18)**	1.123	3.07 (0.77–12.30)

Data reported is only for positive sentiments (strongly agree and agree) with a negative sentiments (strongly disagree and disagree) as reference category; OR: odds ratio; B: regression coefficient. p-value significant at < 0.050; *p-value < 0.050; **p-value < 0.005; Acceptors = Yes; Hesitators = No and not sure; the reference category for this logistic regression analysis: Hesitators.

RESULTS

A total of 966 valid responses were received from residents of 10 out of 11 Governorates of Oman (none from Al Wusta). One-third of the responses were from the highly urbanized Muscat governorate (318/966; 32.9%). Female respondents 612 (63.4%) outnumbered the males (354; 36.6%). Nearly half of the participants were aged 30–39 years (413; 42.8%), followed by those in the age groups 40–49 (328; 34.0%), and 20–29 (159; 16.5%) years. The majority were married (793; 82.1%), and most had higher education diploma, or higher (769; 79.6%), with only four (0.4%) reporting non-formal education. Regarding employment status, 695 (71.9%) were employed, 271 (28.1%) were unemployed, 610 (74.1%) held government positions, while 213 (25.9%) were privately employed [Table 1].

Out of the total 966 respondents, only 265 (27.4%) were willing to receive the about-to-be-introduced COVID-19 vaccine. The majority of the participants (701/966; 72.6%) stated that they

were either unsure (336; 34.8%) or unwilling (365; 37.8%) to be vaccinated. The 'unsure' participants were categorized as 'hesitant' for further analysis.

The vast majority (946; 97.2%) were aware of the COVID-19 cases in Oman. The participants also showed high-risk perception, with 777 (80.4%) indicating that they were at risk of contracting COVID-19. The vast majority of respondents (911; 94.3%) reported knowing someone who was ill with COVID-19, while 157 (16.3%) said they themselves had been ill due to COVID-19. [Table 2].

The awareness about the COVID-19 vaccine development was high, 831/966 (86.0%) participants stating that they were aware of COVID-19 vaccine development in different countries, and 945 (97.8%) knew that Oman was planning to introduce the vaccine in the country once available. Over half of the participants (503; 52.1%) revealed not having taken influenza vaccine (provided free in Oman) in the past five years [Table 2]. Participants had various reasons to be concerned about contracting COVID-19

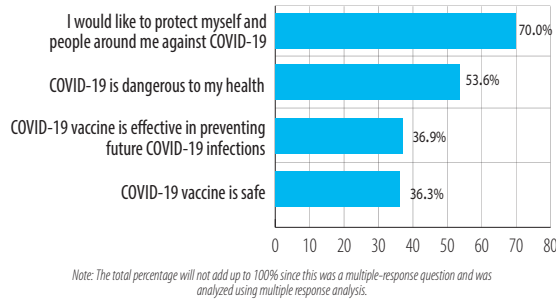


Figure 1: Bar graph showing different reasons for acceptance of COVID-19 vaccine among the study participants, Oman (n = 593).

themselves. Their biggest concern (761; 82.6%) was about infecting their families with the virus. Over one-fourth (250 (29.2%) of study participants feared losing their job due to COVID-19. However, 723 (78.7%) respondents indicated that the economic crisis that might follow the COVID-19 crisis was their main concern [Table 2].

Most (686; 71%) participants indicated their trust in the government on planning and introducing the COVID-19 vaccination program, while 78.2% believed that the government was handling the COVID-19 crisis well. In addition, three-fourth (755, 75.0%) agreed that the government was providing timely and transparent information on the development of the COVID-19 vaccine and its introduction in Oman. Nearly half (442; 45.8%) of the respondents emphasized that the COVID-19 vaccine was the only way to end the pandemic in the shortest time possible, but fewer (336; 34.8%) had the confidence that the new COVID-19 vaccine would be both safe and effective. The vast majority recalled that even before the COVID-19 pandemic, they had agreed on the general importance of vaccinations, with 235 (39.1%) expressing 'strong agreement' and 257 (42.8%) expressing 'agreement' on the general importance of vaccinations. Curiously, the onset of the COVID-19 pandemic seems to have dampened their erstwhile vaccine positivity, with 242 (40.3%) participants now 'agreeing' and 185 (30.8%) 'strongly agreeing' that they still considered vaccines to be important [Table 3].

The major reason for our respondents' willingness to receive the COVID-19 vaccine was to protect themselves and their families from COVID-19, as endorsed by 186/265 (70.0%) of the participants. In addition, 142/265 (53.6%) of the participants stated that COVID-19 was dangerous to their

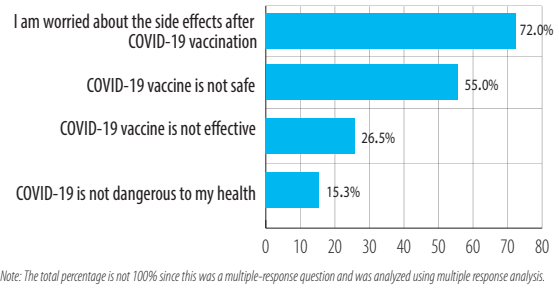


Figure 2: Bar graph representing various reasons for not willing and not sure to receive COVID-19 vaccine among the study participants, Oman (n = 422).

health. However, only 98/265 (36.9%) participants believed in the effectiveness and 96/265 (36.3%) in the safety of the forthcoming COVID-19 vaccine [Figure 1].

In contrast, concerns over the possible side effects of COVID-19 vaccination were the major reason cited by the participants 505/701 (72.0%) participants for their unwillingness. Doubts on the COVID-19 vaccine safety and efficacy were also highlighted by 55.0% and 26.5% of the participants respectively as important reasons for not willing to be vaccinated against COVID-19 [Figure 2].

For our participants, doctors were the most common source of information on COVID-19, COVID-19 vaccine and vaccination, followed by newspaper/news on the Internet. Social media platforms such as Facebook®, Instagram®, and Twitter® were the third major information sources. WhatsApp®, radio, and posters/leaflets were listed as the least frequent information sources [Table 4].

Doctors were also the most trusted sources of information on COVID-19, its vaccine, and whether to get vaccinated. The second and third most trusted sources were newspaper/news on the Internet, and the Ministry of Health website, respectively. Social media (Facebook, Instagram, Twitter)®, WhatsApp® and posters/leaflets were among the least trusted sources of information [Table 4].

Binary regression analysis showed that participants living in North Al-Batinah (27/114; 23.7%, OR = 0.58; 95% CI: 0.34–0.98), South Al-Batinah (17/69; 24.6%, OR = 0.53; 95% CI: 0.30–0.94) and North Al-Sharqiyah (27/103; 26.2%, OR = 0.45; 95% CI: 0.21–0.96) were less willing to receive COVID-19 vaccine compared to those from Muscat Governorate. Participants in the 30–39 years

Table 4: Friedman ANOVA test for preference and credibility of information sources. (Mean rank categorized in the order of importance).

Preference and credibility of information sources			
Main sources of information	Mean	Chi-square	p-value
Doctors	3.55	900.9	< 0.001
Newspaper/news on the internet	3.80		
Social media (Instagram, Facebook, Twitter)	4.29		
Television	4.46		
Family and friends	5.10		
Ministry of Health website	5.25		
WhatsApp	5.28		
Radio	5.82		
Poster/leaflet/brochure	7.46		
The rank of sources you trust the most for COVID 19 vaccine information			
Doctors	2.04	1660.3	< 0.001
Newspaper/news on the internet	4.00		
Ministry of Health website	4.30		
Television	4.45		
Family and friends	4.80		
Radio	5.11		
Social media (Instagram, Facebook, Twitter)	6.15		
WhatsApp	6.98		
Poster/leaflet/brochure	7.18		

Note: Last mean rank implies the most preferred or most trusted information sources.

age group (101/413; 24.5%, OR = 0.65; 95% CI: 0.43–0.96) were comparatively less willing to receive the vaccine with 20–29 years as the reference group. Male participants were nearly three times more likely to accept the COVID-19 vaccine than female participants (147/354; 41.5%, OR = 2.97; 95% CI: 2.22–3.98). Non-citizens were 2.15 times more likely to accept the COVID-19 vaccine (21/48; 43.8%, OR = 2.15; 95% CI: 1.19–3.87) than the citizens (244/918; 26.6%). Participants with secondary education were more vaccine-hesitant than those with diploma or higher education (OR = 0.68; 95% CI: 0.46–0.99) [Table 1].

In this study, the perceived risk of COVID-19 was directly related to the willingness to accept the COVID-19 vaccine. Participants who believed that they were at risk of contracting COVID-19 were 1.58 times more likely to accept the COVID-19 vaccine (OR = 1.58; 95% CI: 1.07–2.32). Moreover, participants who were aware of the COVID-19 vaccine development globally as well as about the COVID-19 vaccine implementation in Oman were 4.48 (OR = 4.48; 95% CI: 2.44–8.86) and 7.75 (OR = 7.75; 95% CI: 1.03–58.10) times more willing

to receive the COVID-19 vaccine, respectively. There was a positive significant association between influenza vaccine uptake and COVID-19 vaccine acceptance (OR = 1.55; 95% CI: 1.17–2.06), meaning that people who received the flu vaccine during the last 5 years were 1.55 more likely to get the COVID-19 vaccine when compared to those who did not receive the flu vaccine. It was also seen that the participants who were worrying more about infecting others (OR = 1.62; 95% CI: 1.07–2.44), getting infected by others (OR: 1.48; 95% CI = 1.08–2.02), and deaths (OR = 1.37; 95% CI: 1.01–1.84) due to COVID-19 were more likely to accept the vaccine [Table 2].

Binary logistic regression revealed that participants with higher trust in the government on COVID-19 vaccination and planning were significantly more likely to take the COVID-19 vaccine (OR = 6.08; 95% CI: 2.13–17.38). Participants who highlighted that the government provides transparent and up-to-date information on COVID-19 vaccine development and its introduction in Oman were 3.65 times more willing to receive the COVID-19 vaccine (OR = 3.65;

95% CI: 1.61–8.27). Moreover, multiple regression analysis showed that participants who believed that the COVID-19 vaccine was the only solution to end the ongoing pandemic (OR = 6.18; 95% CI: 1.62–23.55) and who believed that the vaccine is safe and effective (OR = 46.09; 95% CI: 5.65–376.16) were also more likely to accept the vaccine [Table 3].

DISCUSSION

Our results are best understood keeping in mind the pivotal juncture at which it was conducted—i.e., in the last week of December 2020, just before the first-ever COVID-19 vaccine rollout in the country. It was also a time of high levels of social media-led vaccine-skepticism worldwide. In addition, the COVID-19 vaccine was a very new phenomenon.

Thus, despite a high level of COVID-19-related knowledge displayed by our participants, only 27.4% were willing to accept the vaccine. The remaining 72.6% were either uncertain or in refusal. Our results must be compared with another pre-vaccination campaign knowledge, attitudes, and practices study conducted in Oman from 15–31 December 2020. That study showed a more positive picture, with 56.8% of the participants willing to accept the vaccine once available.¹⁵

The difference with our study could be due to a different data collection method, which was based on structured phone interview unlike our study.¹⁵ Similarly, wide variations also occurred among two separate studies conducted online in Saudi Arabia whose COVID-19 vaccine acceptance rates were 29.4%¹⁶ and 64.7%,¹⁷ respectively. This suggests that participants' willingness to accept the vaccine is contextual and influenced by various factors, including time of study, test methodology, COVID-19 cases during the study period, the level of awareness, and other factors.^{6–11} Our findings also revealed similar levels of acceptance of the COVID-19 vaccine relative to neighboring countries such as Kuwait (23.6%) and Jordan (28.4%).¹⁸

However, our participants showed significantly low levels of vaccine acceptance compared to similar surveys conducted in China (91.3%),¹⁹ Malaysia (83.3%),²⁰ US (69%),²¹ Iran (64.3%),²² Iraq (34.7%)¹⁶ and when compared with the studies on healthcare workers in Pakistan (60%)²³ and 58% in 10 countries in the Eastern Mediterranean Region (EMR).²⁴ The vaccine acceptance in Oman revealed by our study

was among the lowest globally at that juncture.^{18,25} A lack of confidence in COVID-19 vaccines or in the healthcare workers, complacency towards the need for vaccination, and vaccine inconvenience in terms of accessibility, as well as the very newness of COVID-19 vaccine may have been the leading factors behind the higher COVID-19 vaccine hesitancy in the EMR.^{9–11}

In this study, the primary motive of those who were willing to get vaccinated (70.0%), was to protect themselves and the people around them. This indicates their sense of social responsibility. Moreover, 53.6% of the full cohort believed that vaccination could effectively prevent future infections, indicating their positive attitude about the effectiveness of the COVID-19 vaccine. A study conducted in Pakistan revealed that 75% of healthcare workers acknowledged that vaccination decreases their risk of contracting COVID-19.²³ The vaccine-hesitant group in our study cited possible side-effects (72.0%) as the main reason to not get the COVID-19 vaccine. Similar findings were observed in China¹⁹ and the US²¹ where participants were also concerned about the potential side-effects after vaccination and doubted the rapid development of the COVID-19 vaccine respectively. Possible reasons for these concerns about COVID-19 safety, efficacy, and side-effects, could be the global deluge of often-conflicting information related to the pandemic. In other words, we are in the midst of an 'information-pandemic', or an *infodemic*, which WHO has defined as "too much information including false or misleading information in digital and physical environments during a disease outbreak".²⁶ Thus *infodemic* can be considered to 'infect' the collective public mind through the internet and social media, and has become a serious public health challenge in the management of the COVID-19 pandemic, and a potential barrier to achieving the targeted herd immunity of $\geq 70\%$.^{17,18,22,25}

Men in our study, were thrice as willing as women to vaccinate themselves. Similar results were found in a study conducted in Iran where more men than women (aOR = 1.32; 95% CI: 1.13–1.54) accepted the COVID-19 vaccine.²² Studies in China¹⁹ and the US²¹ also indicated a similar trend. Several theories have been proposed for this difference among sexes. One argument is that more men than women work in jobs that require public exposure.²² Sallam et al,¹⁸ study in different countries of the

EMR found females to score higher than males in vaccine conspiracy belief scale (26.3 in females vs. 24.1 in males; $p < 0.001$; M-W). Another reason may be medical. Studies have shown that males have higher risk for COVID-19 complications, thereby biasing male participants to accept the COVID-19 vaccine.²⁷ Other sociodemographic factors such as marital status described in other studies (the vast majority of our participants were married) were not significant predictors in this study.¹⁹

Our non-Omani participants were more willing than Omani citizens to accept the COVID-19 vaccine. One reason may be that in times of socioeconomic emergencies in a country, its expatriates may face greater pressure to keep themselves fit and productive, and also may not have the same levels of insurance coverage compared to the citizenry.^{22,28,29}

In our study, those who received the influenza vaccine in the last five years were more likely to be receptive to the COVID-19 vaccine as well. These results align with a previous study conducted by Al Awaidy et al,⁸ in Oman where healthcare workers reported higher levels of general vaccine acceptance if they had received influenza vaccination during the previous five years.

Most respondents were confident in the government's planning and introduction of COVID-19 vaccination in the country. They also felt that the Omani government was transparent in dispensing the pandemic-related information provided and that the COVID-19 crisis was being adequately managed. Our results were in line (AOR = 6.08; 95% CI: 2.13–17.38) with a previous study conducted in Saudi Arabia, where participants who trusted the health system were 3.05 (AOR = 3.05; 95% CI: 1.13–4.92) times more likely to accept the vaccination than those who reported no trust.¹⁷ A study conducted in Jordan and Kuwait among other Arab countries also showed lower COVID-19 vaccine hesitancy among those who relied on medical doctors, scientists, and scientific journals (mean: 23.9; SD: 11.4), as compared to those who relied on TV programs and news releases (mean: 25.7; SD: 10.0).¹⁸

A systematic review of COVID-19 acceptability done globally reported similar results whereby lack of trust in governments and the health care system led to increased conspiracy beliefs and vaccine hesitancy.²⁵

The vast majority of the participants were aware of the number of COVID-19 cases in Oman, as well of the impending introduction of the COVID-19 vaccine. This demonstrates adequate knowledge among the participants regarding the COVID-19 pandemic and vaccination in Oman. Those who thought they were at risk for COVID-19 were more likely to accept the COVID-19 vaccine (OR = 1.58; 95% CI: 1.07–2.32). Similar results emerged from a Saudi Arabian study by Al-Mohaithef et al,¹⁷ where perceived high risk of contracting COVID-19 (AOR = 2.13; 95% CI: 1.35–3.85) was an important determinant for COVID-19 vaccine acceptance.

The main sources of information on COVID-19 and the vaccine were, medical doctors, newspapers or online news, and the Ministry of Health website were the most trusted information sources, while social media ranked much lower (seventh) among the trustworthiness of sources of information. This contradicts the knowledge, attitudes, and practices study in Oman where social media emerged as the top source of information related to COVID-19, followed by television.¹⁵

It is worth mentioning that, in our study, healthcare workers are key determinants of trust and acceptance regarding vaccination. Previous studies in Oman have consistently shown that people follow the vaccination recommendations of their healthcare workers;^{22,30} therefore, it is imperative this class of health professionals receive continuously updated education on the COVID-19 vaccines, in addition to imparting listening and communication skills, supported by evidence where necessary, so they can make effective vaccination recommendations to their patients and communities they serve.

The greatest reluctance to get vaccinated was observed among social media users (mean trust: 27.4; SD: 10.2). However, it is important to note that social media fell to rank 7/9 of trusted sources, even though it was the third most visited. This dichotomy between high usage of social media, yet having low trust in it, echoes the results of a large international study (conducted around the same time as ours) which reported low trust in social media and preference for legitimate health sources such as WHO. That study was conducted among 23 500 respondents from the world youth (aged 18–40 years) in many countries, both developed and developing.³¹ It is possible that the millennials and Generation-X populations, being more 'online

native' than older adults, may have come prefer legitimate health information via social media related to COVID-19. However, the authors also warn that fake news are often difficult to distinguish from genuine medical news and recommends additional initiatives to filter out fake health information and promote public Internet savviness. It is advisable to conduct more detailed age-group-specific research to identify whether a new online 'maturity' is emerging among the Omani youth and compare the results with those elsewhere.

There were limitations to this study. Its online methodology caused it to be skewed to those who were active on the internet and online social networking groups and excluded those who were not active internet users. In addition, denials and uncertainties expressed regarding vaccination are likely to change later. The public attitudes prior to introduction of a vaccine need not be predictive of actual behavior once it is actually rolled out.

As of March 2022, 59.2 % of Oman's adult residents were fully vaccinated against COVID-19, and 63.8% had received at least one dose of the vaccine.³² These figures follow the international trend. Despite concerted health education efforts in Oman and the rest of the world, 'infodemic' is still keeping a significant proportion of the world population vaccine-hesitant.³³

CONCLUSION

This study, conducted on the eve of the initial vaccine rollout in Oman, suggested suboptimal acceptance of the COVID-19 vaccine among the general public in Oman. There was a high level of hesitancy regarding the COVID-19 vaccine uptake due to multiple factors, including a lack of confidence in COVID-19 vaccines due to concerns about possible side effects and low trust in the safety and efficacy of the vaccine which was then very new. Participants' perceived risk and trust in vaccines, the government and the health system were found to be important predictors of intent to receive the COVID-19 vaccine in Oman. The findings suggest the need to develop tailored strategies (educating public on importance of COVID-19 vaccines, awareness of potential side-effect after vaccination, and trustworthy information sources) to address the concerns raised in the study to ensure optimal vaccine uptake among the general population of Oman.

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