# Knowledge, Attitude and Acceptability of COVID-19 vaccine among the General Public in Oman: A Cross-sectional study

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Received: 25 September 2021

Accepted: 27 December 2021

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DOI 10.5001/omj.2022.70

## Abstract

***Background:*** The Coronavirus disease 2019 (COVID-19) has overwhelmed the world since December 2019, leading to dramatic loss of lives around the world. Vaccination is considered as one of the key strategies to control the COVID-19 pandemic. Successful immunization programs, therefore, depend on the availability and acceptance of vaccines by a large proportion of the population. This study aims to understand the acceptance of COVID-19 vaccine among the general

population of Oman. ***Methods:*** A cross-sectional study was conducted using a structured and validated online questionnaire. Adults and seniors residing in Oman were invited to participate in the study between 22 and 24 December 2020. Logistic regression analysis was used to identify the potential factors associated with COVID-19 vaccine acceptability. ***Results:*** A total of 966 participants was surveyed, of which 63.4% were female and 42.8% were between 30-39 years age group. The level of knowledge in COVID-19 cases (n = 946; 97%) and the international COVID-19 vaccine development (n = 831; 86%) was high among the study participants. However, only 27% (265) of the participants were willing to get the COVID-19 vaccine, while 38% (365) were not sure and 35% (336) would not accept the vaccine. The main driver of COVID-19 vaccine acceptance was to protect themselves and the people around them (70%). Concerns over side-effects after COVID-19 vaccination (72%), vaccine safety concerns (55%) and vaccine ineffective (15.3%) were cited as the main reasons for hesitation towards a COVID-19 vaccine. ***Conclusion:*** A significant level of hesitancy with respect to the COVID-19 vaccine was identified among the study participants. Participants' perceived risk and trust in vaccines, government and their health system were found to be important predictors of COVID-19 vaccine acceptance. The results suggest the need for tailored strategies to address the concerns raised in the study to ensure optimal vaccine acceptance among the general population in Oman.

**Keywords:** COVID-19, COVID-19 vaccine, awareness, acceptance, general public, Oman

## Introduction

The coronavirus pandemic, caused by the new Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), has overwhelmed the world since the first case was reported at the end of 2019 in Wuhan, China, by the World Health Organization (WHO). The WHO officially

declared the SARS-CoV-2 epidemic an international public health emergency of concern on January 30, 2020 prior to the declaration of global pandemic on March 11, 2020. The virus has since then spread around the world with more than 277 million cumulative cases and over 5.3 million deaths worldwide as of December 22, 2021.[1,2] By the same date, Oman reported 304,938 cases and 4,113 deaths since the start of the pandemic.[1,2] Thus, countries were urged to adopt strict social distancing and quarantine measures to avoid virus spreading and reduce mortality and morbidity rates.[3] Vaccines are considered as the most promising tool for the effective fight against the pandemic. 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 acceptance of the vaccine has varied with space, time, social class, ethnicity and contextual human behavior.[5,6,7,8, 9,10,11]

Oman has one of the best childhood immunization programmes in the world, with nearly 100% coverage since 2001.[5] Nevertheless, vaccination programs, in general, have been subjects of false beliefs leading to low acceptance among the general population and healthcare workers in Oman.[6] For example, the reasons for the low influenza vaccination rates in Oman when the vaccine is available and provided free of costs are multifaceted and include misperceptions and erroneous interpretations of the efficacy and safety of the vaccine, and the perceived threat influenza poses to health. [6,7,8,12] A set of these factors may also affect the current COVID-19 vaccination uptake in Oman.

Oman started the COVID-19 vaccination program on December 27, 2020.[13] Since then, several COVID-19 vaccines have been authorized to prevent COVID-19 in the country. However, people still have concerns about the safety and effectiveness of vaccines, including side-effects and the appropriateness of COVID-19 vaccination.[14] Unfortunately, to the best of our knowledge, there

are limited studies to assess the Omani population's acceptability of COVID-19 vaccination. Therefore, this research study assesses the acceptance of the COVID-19 vaccine among the general public in Oman.

## Methods

### *Study settings and questionnaire design*

The online cross-sectional study was conducted in both Omani and non-Omani residents (20 years old or older) living in any of the 11 governorates of Oman. The self-administered anonymous questionnaire in both language Arabic and English were developed after an extensive literature review on COVID-19, COVID-19 vaccine, and previous COVID-19 vaccine acceptance studies. The questionnaire was piloted among 22 adults (above 20 years) living in Muscat Governorate (in both Arabic and English) to assess the questionnaire's clarity and relevance. Consequently, no significant changes in the questionnaire were required. The participants' contact information was extracted from Governorate Health Survives database and the questionnaire were sent to all the eligible participants (20 years and older). The link to the questionnaire was then distributed to participants across all governorates through WhatsApp® and email. The link to the survey was provided, and participants could only assess the questionnaire when clicking the link.

The survey was conducted between 22 and 24 December 2020 using an Arabic and English-languages questionnaire.

The minimum sample size was 700 based on the conservative assumption that the level of acceptability was 50%, with a margin of error of 3% and a 95% confidence interval. Completion of the survey would take 10 to 12 minutes. Participation in the study was entirely voluntary.

Participants were required to provide informed consent prior to answering the survey questionnaire.

***Measures***

A total of 25 questions was classified into multiple categories: (A) Socio-demographic characteristics; (B) COVID-19 awareness and perceived risk; (C) COVID-19 vaccine acceptance and factors influencing the acceptance; and (D) preference and trust on the information sources. The choices of answers for most of the questions were limited to a 2-point scale: "1. Yes" and "2. No". Other questions were of "multiple options", "Rank cases" and scale (Strongly Agree, Agree, Neutral, Disagree or Strongly Disagree).

***Data Analysis***

The data were analyzed using IBM® SPSS® Statistics Version 27.0. Frequencies and percentages were used to describe the socio-demographic characteristics. A chi-square test was used to assess the difference between subgroups. P-value ($p$) <0.05 (two-tailed test) was considered statistically significant. The univariate analysis was performed using the Mann-Whitney U test for continuous variables and Chi-square 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 less than 5 of the expected count 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 < 0.2 in the bivariate analysis were further entered into a multivariate logistic regression model where the adjusted odds ratio (aOR) and their corresponding 95% confidence interval 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.

### *Ethical Approval*

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)

## Results

### *Socio-demographic factors*

A total of 966 responses were recorded from 10 Governorates of Oman (no responses from Al Wusta) with a majority recorded from the capital, Muscat (318 (32.9%)). Out of the total, there were 612 (63.4%) female and 354 (36.6%) male participants. Most of the participants were aged 30-39 (413 (42.8%)), while the 40-49 (328 (34%)) and 20-29 (159 (16.5%)) age groups were also represented. The majority of participants were married (n=793; 82.1%), had a higher education degree (diploma or higher) (769 (79.6%)), while only 4 (0.4%) had a non-formal education. As far as employment status is concerned, 695 (71.9%) were employed and 271 (28.1%) were unemployed. In addition, 610 (74.1%) held a government position, while 213 (25.9%) held a job that was not associated with the government [Table 1].

### *Willingness to receive the COVID-19 vaccine*

Out of the total 966 respondents, only 265 (27.4%) were willing to receive the 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 receive the COVID-19 vaccine. The participants who responded to be unsure were categorized as hesitant for further analysis.

***Awareness, attitude and perception towards COVID-19 and COVID-19 vaccine***

It was observed that 946 (97.2%) participants were aware of the COVID-19 cases in Oman. Risk perception among the study participants was significantly higher: 777 (80.4%) indicated that they were at risk of contracting COVID-19. Less than one-fifth of the participants (157 (16.3%)) indicated that they had become ill due to COVID-19. However, 911 respondents (94.3%) reported knowing someone who was ill with COVID-19 [Table 2].

In addition, the awareness about the COVID-19 vaccine development among the study participants was high with 831 (86%) participants stating that they knew about the COVID-19 vaccine development in different countries around the world, and 945 participants (97.8%) were aware about the COVID-19 vaccine implementation plans in Oman as soon as it will be available. Over half of the study participants (503 (52.1%)) did not receive influenza vaccine in the past five years [Table 2]. Participants also highlighted various reasons to be concerned about COVID-19. One of the main concerns reported by respondents (761 (82.6%)) was infecting family members if COVID-19 is contracted. 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].

Above 70% of the participants highlighted that they trust the government on planning and introduction of the COVID-19 vaccination program, and the majority (78.2%) of the participants believed that the government is handling the COVID-19 crisis well. In addition, three-fourth (75%) of participants agreed that the government provides timely and transparent information on the development of the COVID-19 vaccine and its introduction in Oman. Around 46% of respondents

emphasized that the COVID-19 vaccine is the only solution to end the pandemic in the shortest time possible, but just above one-third (34.7%) of the participants believed that the COVID-19 vaccine is both safe and effective. The vast majority strongly agreed (235 (39.2%)) or agreed (257 (42.8%)) on the importance of vaccination, even before the COVID-19 pandemic. On the other hand, more than 70% participants agreed (242 (40.3%)) or strongly agreed (185 (30.8%)) that vaccines are important after the onset of the pandemic [Table 3].

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

A key reason among the participants for willingness to receive the COVID-19 vaccine was to protect themselves and their families from COVID-19, as highlighted by 70% of participants. In addition, 53.6% of the participants stated that COVID-19 is dangerous to their health. Above one-third (36.9%) of the participants believed that the COVID-19 vaccine is effective in preventing future infections as well as the vaccine is safe (36.3%) [Figure 1].

In contrast, concerns over side-effects after receiving COVID-19 vaccination was the major reason among the participants (72%) for not willing to accept the COVID-19 vaccine. Doubts on the COVID-19 vaccine safety and efficacy were also highlighted by 55% and 26.5% of the participants respectively as important reasons for not willing to be vaccinated against COVID-19 [Figure 2].

***Sources of information and trust in information sources***

For the study 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 (Facebook, Instagram, Twitter)® was the third major information source among the study participants. Media like WhatsApp®, radio, and poster/leaflets were listed as the least frequent information sources [Table 4].

Doctors were also the most trusted sources of information on COVID-19, COVID-19 vaccine, and vaccination among the study participants. The second and third most trusted information sources among the study participants were Newspaper/News on the internet and the Ministry of Health website respectively. Social media (Facebook, Instagram, Twitter)®, WhatsApp® and posters/leaflets were listed as the least trusted sources of information by the study participants [Table 4].

***Factors influencing COVID-19 vaccine acceptance***

Binary regression analysis showed that participants living in North Al-Batinah (OR [95% CI]: 0.58[0.34- 0.98]), South Al-Batinah (OR [95% CI]: 0.53[0.30- 0.94]) and North Al-Sharqiyah (OR [95% CI]: 0.45[0.21- 0.96]) were less willing to receive COVID-19 vaccine compared to participants from Muscat Governorate. Participants in the 30-39 years age group (OR [95% CI]: 0.65[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 (OR [95% CI]: 2.97[2.22-3.98]). Moreover, Non-citizen were 2.15 times more likely to accept the COVID-19 vaccine than the Oman-citizen (OR [95% CI]: 2.15 [1.19- 3.87]). Participants with secondary education were less likely to accept the vaccine than participants with a diploma or higher education (OR [95% CI]: 0.68 [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 [95% CI]: 1.58 [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 [95% CI]: 4.48 [2.44-8.86]) and 7.75 (OR [95% CI]: 7.75 [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 [95% CI]: 1.55 [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 [95% CI]: 1.62[1.07- 2.44]), getting infected by others (OR[95% CI]: 1.48[1.08- 2.02]) and deaths (OR[95% CI]: 1.37[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 [95% CI]: 6.08[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[95% CI]: 3.65[1.61-8.27]). Moreover, multiple regression analysis showed that participants who believed that the COVID-19 vaccine is the only solution to end the ongoing pandemic (OR [95% CI]: 6.18[1.62-23.55]) and who believed that the vaccine is safe and effective (OR [95% CI]: 46.09[5.65- 376.16]) were also more likely to accept the COVID-19 vaccine [Table 3].

**Discussion**

It was observed that only 27% of the study participants were willing to accept the COVID-19 vaccine when it was available, while the remaining 73% of participants were uncertain or did not want to receive the COVID-19 vaccine. However, a pre-vaccination campaign KAP study conducted in Oman from 15-31 December 2020 showed that 56.8% of the participants were 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] Likewise, two separate studies conducted online in Saudi Arabia also highlighted different COVID-19 vaccine acceptance rates, as 29.4% [16] and 64.7%.[17] This illustrates that participants' willingness to accept the vaccine is contextual and influenced by various factors, including time of study, COVID-19 cases during the study period, the level of awareness and other social 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%) [18] and Jordan (28.4%).[18] On the contrary, this research study showed a significantly low level of vaccine acceptance when compared with similar studies conducted in China (91.3%)[19], Malaysia (83.3%) [20], United States (69%) [21], Iran (64.3%) [22], Iraq (34.7%)[16] and when compared with the studies on healthcare workers in Pakistan (60%)[23] and in 10 countries in the Eastern Mediterranean Region (EMR) (58%).[24] The low vaccine acceptance in Oman is alarming since it appears to be among the lowest acceptance rates globally.[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 are the leading factors behind COVID-19 vaccine hesitancy in the region including Oman.[9 ,10,11]

In this study, most participants who are willing to get vaccinated (70%) would accept the vaccine to protect themselves and the people around them which highlights the sense of social responsibility among the study participants. Moreover, 53.6% believed that the vaccine could effectively prevent future infections, indicating that participants had a positive attitude about the effectiveness of the COVID-19 vaccine. Similar results were found in a study conducted in Pakistan, where 75% of healthcare workers acknowledged that vaccination decreases their risk of contracting COVID-19 and its complications.[23] The vaccine-hesitant group in our study cited side-effects (72%) as the main reason to not get the COVID-19 vaccine. Similar findings were

observed in the study conducted in China [19] and the US [21] 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 easy access to information related to the pandemic, which might not always be trustworthy and reliable (infodemics). In addition, there are high levels of sensationalism and conspiracy theories circulating, especially in the social media. This set of factors represents a public health challenge to control the COVID-19 pandemic as fewer people would accept the COVID-19 vaccine that is required for herd immunity of at least 70%, and that misinformation could push these levels further away from herd immunity targets.[17,18, 22, 25]

In our study, men were three times more likely to accept the COVID-19 vaccine than women. Similar results were found in a study conducted in Iran where men were more likely than women (aOR = 1.32, [1.13-1.54]) to accept the COVID-19 vaccine.[22] In addition, studies in China [19] and the United States [21] indicated that women were less likely to accept the COVID-19 vaccine. A reason for this could be that men in the region, including Oman have jobs that might expose them to more potential infected cases, like construction, driving, or public service jobs. Thus, the perceived risk of COVID-19 in men could be potentially higher than in women, as described in the study by Askarian et al.[22] An additional reason could be a possible tendency for females in the EMR to be more susceptible to believe conspiracy theories behind COVID-19 vaccines, as shown in the study done by Sallam et al[18] in different countries of the EMR (mean Vaccine Conspiracy Belief Scale (VCBS): 26.3 vs. 24.1 in males; $p < 0.001$, M-W). Moreover, independent reports have highlighted a higher risk for COVID-19 complications among the male population, thereby biasing male participants to accept the COVID-19 vaccine.[26] However, other sociodemographic

factors such as marital status described in other studies were not significant predictors in this study.[19]

Supplementary findings showed that Omani citizens were less likely to accept the COVID-19 vaccine when compared to Non-Omani citizens, this could be related to potential barriers that Non-Omani citizens could be confronted with (language, health insurance, economic issues etc.) which makes them feel more susceptible and at higher risk to contract COVID-19.[27,28]

In our study, those who received the influenza vaccine in the last five years were more likely to accept the COVID-19 vaccine. These results align with the study conducted by Al Awaidy, S.T. et al[8] in Oman where healthcare workers reported higher levels of general vaccine acceptance if they have been receiving the influenza vaccination during the last 5 years.

Most respondents were found to be confident in the government's planning and introduction of COVID-19 vaccination in the country. Moreover, they believed that the Omani government is transparent in the information provided and that the COVID-19 crisis is adequately managed. These factors, along with individual factors, make participants more likely to accept the COVID-19 vaccine. The results are in line 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 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 participants stated that they were aware of the number of COVID-19 cases in Oman, as well of the introduction of the COVID-19 vaccine. This demonstrates the high level of knowledge among the participants regarding the COVID-19 pandemic and vaccination in Oman. Moreover, those who thought they were at risk for COVID-19 were more likely to accept the

COVID-19 vaccine than their counterparts. Similar findings were shown in the study of Al-Mohaithef et al[17], where perceived risk factors for acquiring COVID-19 (AOR: 2.13; [1.35–3.85]) was found to be important determinants for COVID-19 vaccine acceptance.

The main sources of information on COVID-19 and the vaccine were 1st medical doctors, 2nd newspapers or news on the internet and 3rd social media (Facebook, Twitter, Instagram). Of these, medical doctors, newspapers, and the Ministry of Health website were the most trusted information sources. However, another KAP study conducted in Oman showed that social media (1st) and television (2nd) were the main source of information among the study participants.[15] It is worth mentioning that, in our study, healthcare workers are key determinants of trust and acceptance regarding vaccination. Previous studies have consistently shown that people follow the vaccination recommendations of their healthcare workers[22,29] therefore, they must be well educated and trained about the COVID-19 vaccines, so they can make a strong vaccination recommendation to their patients as well as to address their concerns. The Ministry of Health website was also highly trusted by the study participants. I It is important to note that social media fell in position 7/9 of trusted sources, even though it was the third most visited. The reason could be the high utilization and ease of access of these platforms by ordinary citizens, who may be vulnerable to believe circulating misinformation. Although people are aware of possible fake/hoax information on social media, which explains the low trust score, they are usually not well trained to identify reliable trustworthy information from fake/hoax news. A study conducted in Jordan and Kuwait among other Arab countries showed similar results with 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] The greatest reluctance to get vaccinated was observed among social media users (mean = 27.4, SD = 10.2).

A considerable number of study participants (38%) reported "Not sure" about their intention to uptake the COVID-19 vaccination. The real intention could be different when the vaccine is available and when the perceived risk is increased. Thus, the results should take into caution as the intent is never completely predictive of actual behavior, especially considering future distribution barriers that are unforeseeable at this point and therefore were not assessed. In addition, the current study used a sample of online social networking groups which excludes those who have no access to the internet.

## Conclusion

This study demonstrated sub-optimal 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 lack of confidence in COVID-19 vaccines due to possible side effects and low trust in the safety and efficacy of the vaccine. 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 on potentials side-effects after vaccination and trust-worthy information sources) to address the concerns raised in the study to ensure optimal vaccine uptake among the general population of Oman.

## Funding

The study did not receive any funding.

SC was registered in the EMJMD LIVE (Erasmus+ Mundus Joint Master Degree Leading International Vaccinology Education), co-funded by Universitat de Barcelona, Universitat Autónoma de Barcelona, Universiteit Antwerpen, Université Jean Monnet de Saint-Etienne, Université Claude Bernard Lyon 1 (Coordinator), European commission (EACEA-2018-1484), Sanofi Pasteur, Institut Mérieux, IDEXLYON of Université de Lyon in the frame of "Investissements d'avenir" (ANR-16-IDEX-0005 Project, and received a scholarship from the EACEA.

**Author's contribution**

STAA and CD developed the original idea and are the supervisors of the research study. MK and SC developed the questionnaire and drafted the study protocol in supervision of STAA, CD and AAS. STAA, HAS, AAS and SAM coordinated questionnaire distribution, data collection and assisted with ethical clearance. MK and SC conducted data analysis and wrote the draft manuscript. All authors reviewed the analyzed data, manuscript writing and provided input into the manuscript. All authors are equally responsible for the content of the manuscript.

**Acknowledgement**

We would like to thank all the participants who participated in the study.

**Declaration of competing interest**

All authors declare no conflict of interest.

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