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ORIGINAL RESEARCH

Prevalence, Knowledge and Potential Determinants of COVID-19 Vaccine Acceptability Among University Students in the United Arab Emirates: Findings and Implications

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Objective: To evaluate the prevalence, knowledge, attitude and acceptance of the COVID-19 vaccines and related factors among university students in the United Arab Emirates.

Methods: Analytical cross-sectional study undertaken among a convenient sample of medical and non-medical colleges of Ajman University using a self-administrated questionnaire. The questionnaire included demographic data as well as assessing knowledge of COVID-19, attitudes and acceptance of COVID-19 vaccines.

Results: A total of 467 students participated in the study and completed the questionnaire. A total of 181 (38.8%) participants reported that they have been vaccinated against COVID-19 virus, principally with the Sinopharm vaccine (84%). Vaccination against the COVID-19 virus was less prevalent among Arabic nationalities compared to other nationalities, but more prevalent among students from health science colleges compared to those from non-health science colleges. The acceptance rate of COVID-19 vaccine among study participants was 56.3%, exacerbated by worries regarding unforeseen problems (65.5%, 306), general mistrust (47.3%, 221) and unforeseen impacts (35.1%, 164). The average knowledge score was 60.1%, with 142 (30.4%) having poor knowledge, 127 (27.2%) acceptable knowledge and 198 (42.4%) good knowledge. There were common misconceptions about symptoms including nausea and diarrhoea, as well as the route of transmission, with half believing antibiotics are effective treatment.

Conclusion: There was variable knowledge of COVID-19 among students. Misconceptions need addressing going forward. To enhance COVID-19 vaccination uptake in the country and worldwide, health education targeting diverse sociodemographic categories should be prioritized.

Keywords: acceptance, knowledge, vaccine, COVID-19, university student, concerns, Ajman University

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Introduction

COVID-19 has now spread worldwide with over 230 million infected and over 4 million deaths by September.[1] In the United Arab Emirates, there has been over 733,000 cases reported and 2000 deaths as of 22 September 2021.[2]

Most people who get infected with COVID-19 will experience mild-to-moderate symptoms and recover without special treatment; however, an appreciable number will still have severe illness until vaccination rates increase, with this often-continuing post discharge, and some will die.[3–6]

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The virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or exhales.[7,8] Countries within Africa and Asia that introduced preventative measures early appeared to have lower prevalence and morbidity rates than countries than introduced such measures later on such as Western European countries certainly during the early stages of the pandemic.[9–11]

The knowledge, attitude and practices of an illness that is infectious will always be influenced by several factors that depend on the gravity and spread as well as case fatality rates. While knowledge, attitude and practices have been increasing regarding COVID-19 since the start of the pandemic, there is still an incomplete picture regarding its pathophysiology and treatment.[12–14] This is important as there has been considerable fear of contracting COVID-19 among populations, with effective vaccines potentially helping to reduce this.[15,16] There are currently over 176 vaccines in their early development and 66 in clinical trials, while 10 have already reached the final stage and are being tested on patients.[17,18]

The Ministry of Health in UAE has currently accepted four vaccines (Sinopharm, AstraZeneca, Pfizer-BioNTec, and Sputnik V). Each one has been developed in a different vaccine platform.[19]

We are aware of concerns regarding COVID-19 vaccine acceptance, building on general concerns to vaccines fuelled by social media.[20–30] This is perhaps not surprising given the general level of misinformation there has been regarding COVID-19 including the hype surrounding the use of hydroxychloroquine for management and prevention, which led to deaths in some countries.[31,32] In addition, the novel technology used enhances scepticism among some since there is no prior experience or success with such vaccines. Alongside this, the speed of the development and registration of the vaccines, which took less than a year, with worries about potential effectiveness and safety in routine clinical use.[33–35] However, it is vital for any successful vaccination campaign that concerns with vaccines which fuel vaccine hesitancy rates are addressed to maximise their clinical and economic benefits.[26,36–38]

Published studies have shown a range of vaccine hesitancy rates across countries and populations. In their global survey, Lazarus et al found that vaccine acceptance rates ranged from 90% in China to less than 55% in Russia.[28] In their systematic review, Sallam (2021) also found considerable variation among the general adult population, with acceptance rates ranging from 97% in Ecuador to 28.4% in Jordan and 23.6% in Kuwait.[23] Studies in sub-Saharan Africa suggest acceptance rates of 51%, with rates of 67% in Saudi Arabia.[39] There have been similar variations in the acceptance of the COVID-19 vaccine among healthcare workers (HCWs). In his systematic review, Sallam documented acceptance rates varying from 78.1% in Israel to only 27.7% in the Congo.[23,40] Other published studies have shown similar variations among HCWs.[41–44] We have also seen considerable variation among students including health science students across countries, with vaccine hesitancy rates higher in low- and middle-income countries.[12,45]

Positive reasons for accepting the vaccine include helping society including enhancing the health and the financial situation of a country.[46,47] Reasons for hesitancy include issues of mistrust/confidence in the vaccine and the Government, available information and recommendations, as well as issues of their effectiveness and safety.[29,30,48,49] Encouragingly, hesitancy rates appear to decrease as more information becomes available.[29]

Additional factors that influence decision-making regarding the acceptance of the vaccine include attitude, sociodemographic factors including the level of education, political views, and beliefs regarding COVID-19.[50–54]

We believe to date there have been limited studies assessing vaccine hesitancy in the United Arab Emirates (UAE) although there have been concerns with high rates of vaccine hesitancy among the population in Arab countries as well as among parents of young adults.[23,55–57] However, this is not universal.[58–60] Consequently, our aim was to evaluate the acceptance of the COVID-19 vaccination and the related factors among university students in UAE. We chose university students for this initial study as a number of these people will become influential in the future. This includes those studying health sciences and potentially treating patients.

Methods

Study Design and Setting

Using an analytical cross-sectional study approach,[57,61] the prevalence, knowledge, attitude and acceptance of the COVID-19 vaccination were assessed among students of Ajman University. Potential participants were sent a link to the online questionnaire via email, and the data were collected from 6 March to 20 August 2021.

Study Participants (Inclusion and Exclusion Criteria)

The target population was the students, both UAE nationals and non-national residents, at Ajman University. The inclusion criteria were 1) aged 18 and above and 2) willing to participate in the study.

Questionnaire Development

The questionnaire used in this study was derived from a review of similar studies that evaluated participants' knowledge of and attitude towards the COVID-19 vaccine.[62,63] Based on this review, existing surveys were adapted to develop a structured self-administered questionnaire that evaluated all key research points and was suitable for the target population. Subject experts were asked to review and assess the questionnaire's design, content, relevance, readability and comprehensibility. Subsequently, three pharmacy lecturers at Ajman University (AU) validated the questionnaire, and some minor changes were made in response to their feedback. An additional pilot study of the questionnaire was then performed before it was fully implemented. The pilot study and the consequent changes to the instrument ensured its reliability and robustness. The responses from the pilot study's 23 participants were not included in the final analysis. The reliability of the questionnaire was assessed using Cronbach's α, which was found to be 0.79, indicating that the internal consistency was acceptable.

Questionnaire Scoring

The prevalence of vaccination against COVID-19 virus was identified by the answer to the question of "Have you been vaccinated against COVID-19 virus". The acceptance of vaccination against COVID-19 virus was measured by the answer to the question of "It is important to take the vaccine to protect the people from COVID-19". Knowledge about COVID-19 was measured by 24 questions distributed as follows: eight questions evaluated the most likely COVID-19 symptoms, six questions assessed COVID-19 transmission and 10 questions assessed general knowledge about COVID-19. Questions evaluating COVID-19 symptoms and transmission included three items with categorical responses: (yes /no/do not know) wile general knowledge questions included three items with categorical responses: (true /false/do not know).

Correct answers were given a score of 1 point, while a wrong answer was scored 0 points. Questions evaluating attitudes concerning the COVID-19 vaccine included nine items with categorical responses: (agree/disagree). Knowledge scores were calculated for each respondent by summing the grading for the correct responses.

In this study, three cut-off limits were used for grading the knowledge scores based on quadrants. The level of knowledge considered poor if the total knowledge score range was less than 13 (25th quartile), acceptable if scores ranged from 13 to 17 (26–75th quartile) and good if they were greater than 17 points (>75th quartile).

Sample Size and Sampling Technique

Since the prevalence of acceptability of COVID-19 vaccines is 60% according to Albahri et al,[63] we set the alpha level to 5% in order to generate 95% confidence intervals. In addition, the precision (D) of the mentioned 95% confidence intervals was set to 5% in order to maximize the spectrum of the 95% at 10%. As a result, we calculated the minimum acceptable sample size needed as n = 527 candidates if we assumed a nonresponse rate of approximately 30%.

With support from the Admission and Registration Department of Ajman University in the form of an Excel datasheet containing staff and student names, colleges, study years, and email addresses, we contacted potential respondents. We used a simple random-sample selection method, wherein we randomly selected the study population using their identification (ID) number. Subsequently, the selected respondents were stratified according to their college and department.

Questionnaire Administration

The questionnaire was designed to be self-administered by the participants, who were randomly preselected using the method outlined earlier and who received a web-based electronic link via email. The questionnaire's first page described the study's nature and purpose. If respondents moved on to the next page, it was considered that they had given their consent to participate. Non-respondents were sent monthly reminders via email, and all participants received a thank-you message upon completion of the study. No incentives were offered to the respondents in return for their participation.

Ethical Consideration

The study was approved the Ajman University Institutional Ethical Review Committee. The study's aim was clearly presented on the questionnaire cover page, and all respondents were informed that their participation was

completely voluntary. Participants were considered to have given their consent if they proceeded to the second page of the questionnaire. The participants' identities were not recorded, and the confidentiality of their data was guaranteed.

Statistical Analysis

The data were analysed using the SPSS version 26. Qualitative variables were summarized using frequencies and percentages. Chi square test and univariate logistic regression analysis were used to investigate the association between the vaccination against COVID-19 virus and significant factors. Similarly, multivariate logistic regression was used to evaluate the associations between the acceptance of vaccination against COVID-19 virus and related significant factors. A p value <0.05 was chosen as the criteria to make decisions regarding statistical significance.

Results

Demographic and Baseline Characteristics

A total of 467 students participated in the study and completed the questionnaire (Table 1). The majority of participants were female (n=358, 76.7%). Arabian students (n=383, 82%) constituted the largest ethnic group in the study and most of them were aged below 25 years (80.9%). Of the total participants, 69 (14.8%) were first-year students, 101 (21.6%) second-year students, 100 (21.4%) third-year students, 125 (26.8%) were fourth-year students, 18 (3.9%) were fifth-year students and 54 (11.6%) were master students. Study areas included business administration (18%), 40 (8.6%) dentistry, 17 (3.6%) education and basic sciences, 122 (26.1%) engineering, 31 (6.6%) medicine, 24 (5.1%) information technology, 9 (1.9%) law and 22 (4.7%) mass communication and humanities.

COVID-19 Vaccination Status, Types and Related Perceptions

A total of 181 (38.8%) [95% CI: 34.3–43.2] of the participants reported they had been vaccinated against the COVID-19 virus. Of the 181 participants, 1 (0.6%) received AstraZeneca vaccine, 152 (84%) received the Sinopharm vaccine, 22 (12.2%) received the Pfizer vaccine and 6 (3.3%) did not know what vaccine type they received. The acceptance rate of COVID-19 vaccine among the study participants was 56.3% with a 95% confidence interval ranging between 51.8% and 60.8% (Table 2).

Table 1 Number and Percentages of the Questions of Demographic Characteristics of Study Participants (n=467)

Demographic	Groups	Frequency	Percentage
Gender	Female	358	76.7%
	Male	109	23.3%
Age (years)	<25	378	80.9%
	25–40	65	13.9%
	40–65	24	5.1%
Nationality	African	13	2.8%
	Arabic	383	82%
	Asian	17	3.6%
	Emirati	42	9%
	Western	12	2.6%
Study year	First	69	14.8%
	Second	101	21.6%
	Third	100	21.4%
	Fourth	125	26.8%
	Fifth	18	3.9%
	Master student	54	11.6%
Major	Business administration	84	18%
	Dentistry	40	8.6%
	Education and basic sciences	17	3.6%
	Engineering	122	26.1%
	Faculty of medicine	31	6.6%
	Information technology	24	5.1%
	Law	9	1.9%
	Mass communication and humanities	22	4.7%
	Pharmacy	80	17.1%
	Other	38	8%.1

Vaccination against the COVID-19 virus was less prevalent among Arabic nationalities (OR 0.269; 95% CI 0.080–0.910) compared to other nationalities, but more prevalent among students from health science colleges

Table 2 Number and Percentages of Questions on Vaccination Status Among Study Participants (n=467)

COVID-19 Vaccine	Groups	Frequency	Percentage
Have you vaccinated against COVID-19 virus?	Yes	181	38.8%
	No	286	61.2%
What kind of vaccines you were vaccinated (n=181)?	AstraZeneca vaccine	1	0.6%
	Sinopharm vaccine	152	84%
	Pfizer vaccine	22	12.2%
	Do not know	6	3.3%
It is important to take the vaccine to protect the people from COVID-19	Yes	263	56.3%
	No	204	43.7%

(OR 1.802; 95% CI 1.214–2.675) compared to those from non-health science colleges (Table 3).

Participants' Knowledge About COVID-19, Symptoms and Transmission

The average knowledge score was 60.1% with a 95% confidence interval (CI) [58.6%, 61.5%]. Of the total participants, 142 (30.4%) have poor knowledge, 127 (27.2%) have acceptable knowledge and 198 (42.4%) have good knowledge.

The results of this study showed misunderstanding of the most common symptoms of COVID-19. More than half participants wrongly identified that nausea, vomiting, diarrhea and no symptoms as most common symptoms of COVID-19. Similarly, the study participants reported poor knowledge regarding the transmission routes of COVID-19. Nearly half participants wrongly identified that airborne, waterborne and insects as the common transmission routes of COVID-19 (Table 4).

Another area of concern is that half of the participants believed that antibiotics are an effective treatment for COVID-19 and 58.9% of them believed in evidence that vaccines against pneumonia will protect you against the COVID-19 (Table 5).

Participants' Attitude About COVID-19 Vaccination

Table 6 shows the participants' perception towards COVID-19 vaccination. Of the total subjects, 65.5% (n=306) worried about unforeseen impacts, 35.1% (n=164) have general mistrust of the benefits of vaccines and 47.3% (n=221) reported the preference of natural immunity. Among the participants, 66% perceived that the government would make the vaccine available free for all citizens, 23.1% believed that most people will refuse to take the COVID-19 vaccine once it's licensed in their country and 35.8% reported that side-effects will prevent them from taking the vaccine. Moreover, 61.7% of the respondents perceived that pharmaceutical companies are going to develop safe and effective COVID-19 vaccines and 34.9% agreed that their decision on taking the vaccine would change depending on the country of manufacture.

Factors Associated with the Acceptance of COVID-19 Vaccination

Table 7 displays the multivariate logistic regression analysis for the factors that contributed to the acceptance of COVID-19 Vaccine. The results of this procedure showed individuals with good knowledge about COVID-19 were more likely to accept the vaccine (OR 1.9; 95% CI 1.2–2.94).

Individuals who believed that pharmaceutical companies are going to develop safe and effective COVID-19 (OR 5.1; 95% CI 3.2–8.1), and individuals whom their decision on taking the vaccine will change depending on the country of manufacture (OR 2; 95% CI 1.2–3.3), showed a higher acceptance for vaccination against COVID-19 virus

However, significantly decreased level of vaccination against COVID-19 virus were observed among students who had mistrust of the vaccines' benefits (OR 0.406; 95% CI 0.245–0.673), were concerned with potential side effects associated with vaccines (OR 0.309; 95% CI

Table 3 COVID-19 Vaccination Status According to Demographic Characteristics

		COVID-19 Vaccination				
Variable	**Groups**	**Estimate**	**OR**	**95% CI**		**P-value**
				Lower	**Upper**	
Gender	All Male	181 (38.8%) 44 (40.4%)	Ref.	–	–	0.694
	Female	137 (38.3%)	0.916	0.591	1.419	
Nationality	African	7 (53.8%)	0.583	0.115	2.952	0.515
	Arabic	134 (35%)	0.269	0.080	0.910	0.035*
	Asian	7 (41.2%)	0.350	0.075	1.634	0.182
	Emirati	25 (59.5%)	0.735	0.191	2.834	0.655
	Western	8 (66.7%)	Ref.	–	–	–
Age (years)	18–24	151 (39.9%)	Ref.	–	–	–
	25–40	21 (32.3%)	0.717	0.410	1.255	0.244
	>40	9 (37.5%)	0.902	0.385	2.114	0.812
Study year	First	25 (36.2%)	0.852	0.452	1.605	0.621
	Second	36 (35.6%)	0.831	0.469	1.470	0.524
	Third	40 (40.0%)	Ref.	–	–	–
	Fourth	57 (45.6%)	1.257	0.738	2.142	0.40
	Fifth	5 (27.8%)	0.577	0.191	1.744	0.330
	Mater student	18 (33.3%)	0.750	0.375	1.500	0.416
Major	Health science colleges	73 (48.3%)	1.802	1.214	2.675	0.003*
	Non-health science colleges	108 (34.2%)	Ref.	–	–	–

Note: * P-values less than 0.05 were considered statistically significant.
Abbreviations: OR, odds ratio; CI, confidence interval.

0.31–0.82) and had a preference of natural immunity (OR 0.342; 95% CI 0.213–0.99).

Discussion

We believe this is the first study in the UAE reporting the knowledge, attitude, and practices of students towards the COVID-19 vaccine. The acceptance rate of COVID-19 vaccine among the study participants was 56.3%, with prevalence rates higher among students from the health sciences versus other study areas. This is similar to studies in Japan and the UK, which showed that 62.1% and 64% of the participants were very likely to receive a vaccine against COVID-19, respectively.[46,64] This was enhanced in Japan by 74.9% of participants believing that the vaccine is highly effective.[64] Similarly, 50.5% of HCWs in Saudi Arabia,[65] and 49% of participants in Chile would accept the vaccine.[29] However, the rates seen in the UAE were considerably higher than 35% among personnel at Jordan University Hospital,[57] and 27.7% among HCWs in the Democratic Republic of Congo.[40] Other studies though have shown higher rates of vaccine update than seen in our study. Lim et al found that only 32% if graduate students expressed vaccine hesitancy,[66] with Riad et al ascertaining worldwide that only 13.9% of the dental students would reject the COVID-19 vaccine.[67] Barello et al also ascertained that 86.1% of the students in Italy would take the vaccine for COVID-19, with no significant difference between acceptance among healthcare students versus non-healthcare students.[12] Similarly, Almaki

Table 4 Number and Percentages of the Questions on Knowledge About COVID-19 Symptoms and Transmission

	Yes		No		Do not know	
Most COVID-19 Symptoms	**F**	**%**	**F**	**%**	**F**	**%**
Fever	**402**	**86.1%**	36	7.7%	29	6.2%
Cough	**388**	**83.1%**	45	9.6%	34	7.3%
Sore throat	**328**	**70.2%**	61	13.1%	78	16.7%
Shortness of breath	**411**	**88%**	31	6.6%	25	5.4%
Nausea	198	42.4%	**140**	**30%**	129	27.6%
Vomiting	150	32.1%	**185**	**39.6%**	132	28.3%
Diarrhea	253	54.2%	**111**	**23.8%**	103	22.1%
No any symptoms	92	19.7%	**283**	**60.6%**	92	19.7%
Transmission						
Surfaces recently touched by someone who is affected	**403**	**86.3%**	30	6.4%	34	7.3%
Airborne	314	67.2%	**98**	**21%**	55	11.8%
Waterborne	124	26.6%	**225**	**48.2%**	118	25.3%
Insects	63	13.5%	**278**	**59.5%**	126	27%
Droplets spread through coughing or sneezing	**430**	**92.1%**	13	2.8%	24	5.1%
Touching or shaking hands with a person who is affected	**421**	**90.1%**	24	5.1%	22	4.7%

Note: The correct answers are in bold.
Abbreviations: F, frequency; %, Percentage.

Table 5 Number and Percentages of the Questions on General Knowledge About COVID-19

General Knowledge	**True**		**False**		**Do not Know**	
	F	**%**	**F**	**%**	**F**	**%**
1. There is an effective medicine available for treating COVID-19	69	14.8	**271**	**58.0**	127	27.2
2. There are ways to help slow the spread of COVID-19	**406**	**86.9**	20	4.3	41	8.8
3.Currently there is no vaccine to protect against COVID-19	86	18.4	**295**	**63.2**	86	18.4
4. The ordinary flu vaccine will protect me from COVID-19	31	6.6	**323**	**69.2**	113	24.2
5.Antibiotics are an effective treatment for COVID-19	89	19.1	**231**	**49.5**	147	31.5
6. Taking vitamin C or other vitamins will protect you from the COVID-19	**235**	**50.3**	142	30.4	90	19.3
7. There is no evidence that vaccines against pneumonia will protect you against the COVID-19	**192**	**41.1**	50	10.7	225	48.2
8. Regularly rinsing your nose with saline will protect you against the COVID-19	**100**	**21.4**	176	37.7	191	40.9
9. There is no evidence that eating garlic will protect you against the COVID	**204**	**43.7**	105	22.5	158	33.8
10. The health effects of COVID-19 appear to be more severe for people who already have a serious medical condition	**374**	**80.1**	30	6.4	63	13.5

Notes: Adapted from Faasse and Newby.[89] The correct answers are in bold.
Abbreviations: F, frequency; %, Percentage.

Table 6 Number and Percentages of the Questions on Attitude About COVID-19 Vaccination

Attitude Items	Agree		Disagree	
	F	%	F	%
1. Worries about unforeseen impacts	306	65.5%	161	34.5%
2. Pharmaceutical companies are going to develop safe and effective COVID-19 vaccines	288	61.7%	179	38.3%
3. General mistrust of vaccines benefits	164	35.1%	303	64.9%
4. Your decision on taking the vaccine will change depending of the country of manufacture	163	34.9%	304	65.1%
5. Concerns about commercial profiteering	219	46.9%	248	53.1%
6.Side effects will prevent me from taking the vaccine for the prevention of COVID-19	167	35.8%	300	64.2%
7. Preference of natural immunity	221	47.3%	246	52.7%
8. Most people will refuse to take COVID-19 vaccine once its licensed in your country	108	23.1%	359	76.9%
9. The government of your country will make the vaccine available for free for all citizens	308	66%	159	34%

Abbreviations: F, frequency; %, Percentage.

Table 7 Multivariate Regression Analysis for the Factors Associated with Acceptance of COVID-19 Vaccine

Factors	Acceptance of COVID-19 Vaccine			
	OR	95% CI		P-value
Worries about unforeseen impacts	1.594	0.983	2.585	0.059
Pharmaceutical companies are going to develop safe and effective COVID-19	5.090	3.201	8.093	<0.001*
General mistrust of vaccines benefits	0.406	0.245	0.673	<0.001*
Your decision on taking the vaccine will change depending of the country of manufacture	2.014	1.224	3.315	0.006*
Concerns about commercial profiteering	1.396	0.871	2.237	0.166
Side effects will prevent me from taking the vaccine for the prevention of COVID-19	0.502	0.309	0.816	0.005*
Preference of natural immunity	0.342	0.213	0.551	<0.001*
Most people will refuse to take COVID-19 vaccine once its licensed in your country	0.583	0.341	1.034	0.054
The government of your country will make the vaccine available for free for all citizens	1.528	0.968	2.412	0.069
Knowledge about COVID-19 **(Ref. Poor knowledge)**				
Acceptable knowledge	1.765	1.087	2.866	0.022*
Good knowledge	1.902	1.228	2.944	0.004*
Vaccinated against COVID-19 virus	3.325	2.220	4.979	<0.001*

Note: * P-values less than 0.05 were considered statistically significant.
Abbreviations: OR, odds ratio; CI, confidence interval.

et al ascertained that 90.4% of the students in Saudi Arabia would be happy to be vaccinated once they became available.[59]

In this study, the average knowledge score was 60.1%, with 69.6% of participants having good and acceptable knowledge. This is similar to studies undertaken in Egypt

and Bangladesh indicating high knowledge towards COVID-19.[68,69] However, other studies have much higher knowledge rates with the vast majority (99.5%) of those surveyed in Northern Nigeria having good knowledge of COVID-19 with similarly high rates (90%) among students in Jordan with social media and the internet key information sources.[60,70] We believe the numerous awareness campaigns regarding coronavirus that the university has undertaken contributed to the high scores in our study; however, further research is needed before we can say anything with certainty. Of concern though, is that 30.1% of the students surveyed had poor knowledge, which we believe came from non-scientific resources given the level of misinformation circulating regarding the vaccines.[71–74] Higher rates of poor knowledge though were seen in a study Nigeria where 96.0% of those surveyed had poor knowledge of the disease, with again social media as the main source of information.[75]

There was also concern with the level of misunderstanding of the most common symptoms of COVID-19 in our study. More than half of the participants mistakenly identified nausea, vomiting, diarrhoea, and no symptoms as the most common symptoms of COVID-19. Similarly, study participants reported poor knowledge regarding the transmission routes of COVID-19. Nearly half of the participants mistakenly identified that airborne, waterborne and insects as the common transmission routes of COVID-19. This compares with findings in Jordan where 72.8% of those surveyed knew that vomiting is not a common symptom of COVID-19, with 61% saying this about diarrhoea.[59] In our study, common symptoms such as fever, cough, and shortness of breath were chosen by 86.1%, 83.1%, and 88% respectively of those surveyed as common symptoms of COVID-19, with higher rates in Jordan at 94.5%, 90.5%, and 91.9%, respectively. Encouragingly, antibiotic use was only seen as proper in our study by 19.1% of those surveyed, appreciably lower than the rate of 79.4% reported in Jordan.[59] This is welcomed since only a small minority of patients with COVID-19 have concomitant bacterial or fungal infections necessitating antibiotics, with overuse likely to drive up antimicrobial resistance rates and costs.[38,76–78]

Encouragingly as well, 66% of the participants perceived that the government would make the vaccine available free for all citizens, with 61.7% perceiving pharmaceutical companies will develop safe and effective COVID-19 vaccines. Whilst there have been studies ascertaining levels of willingness-to-pay for COVID-19 vaccines, uptake will be enhanced if available without any patient co-payments.[79,80] However, this could be difficult to sustain long-term potentially requiring a hybrid approach among countries based on income levels and risk.[81–83] 23.1% believed that most people will refuse to take COVID-19 vaccine once licensed. This is exacerbated by 35.8% reporting that side effects would prevent them from taking the COVID-19 vaccine, and 34.9% agreeing that their decision on taking the vaccine would change depending on the country of manufacture. These issues need to be addressed going forward to reduce vaccine hesitancy as more vaccines become available. This compares with a study in China where 83.3% of participants were willing to take the vaccine once available, with 76.5% believing that the vaccine is beneficial for their health. However, 74.9% showed some concerns and attitudes that was neutral regarding the adverse effects from potential vaccines.[84]

The multivariable analysis indicated a lack of confidence towards the COVID-19 vaccine depending on the country of origin, with 76.5% of participants preferring a vaccine that is domestically manufactured instead of imported.[84]

We are aware our study has several limitations. Firstly, it is a self-reported cross-sectional study and dependent on the participants' honesty and recall ability. Consequently, the findings may be subject to recall bias and influenced by the surroundings during that period. Second, it was an online survey. Consequently, only those participants with access to the internet were able to participate in the study. Finally, in this study, psychological factors regarding the vaccine and any hesitancy were not fully evaluated. These included key issues such as individuals' engagement in extensive information searching as well as discussion with peers and other social media activities. On the other hand, the strengths of our study include the large sample size and its nature to ascertain multiple outcomes and exposures. Consequently overall, we believe our findings are robust providing initial direction to all key stakeholders in the UAE going forward as more groups are surveyed.

Conclusion and Recommendations

In conclusion, the participants had a good knowledge regarding the infection. Concerns with the vaccine were mainly due to its potential side effects and limited trial data on the benefits of the vaccine. To enhance COVID-19 vaccination uptake in the country and worldwide, health education targeting diverse sociodemographic categories should be prioritized. Greater knowledge regarding the effectiveness and side-effects of the vaccine will help with studies showing vaccine hesitancy reduces over

time as more knowledge becomes available.[30,54,85,86] This can be facilitated by increasing education among students since we are aware that credible vaccine promoters including physicians can enhance uptake rates.[87,88,89]

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Disclosure

The authors declare that they have no conflict of interest to disclose.

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