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Original article

Assessment of health awareness and knowledge toward SARS-CoV-2 and COVID-19 vaccines among residents of Makkah, Saudi Arabia

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ABSTRACT

Introduction: Public awareness regarding COVID-19 plays an important role in controlling the virus' spread and treating infected people. A high level of awareness among the public will help to implement preventive measures, particularly in the most populated regions, such as Makkah, Saudi Arabia. COVID-19 is an infectious disease and the Saudi Arabian government has taken serious precautions and implemented several preventive measures. In addition, The Ministry of Health (MOH) has launched many awareness campaigns and provided COVID-19 vaccines for free.

The objectives: To assess the Public's level of health awareness and knowledge toward SARS-CoV-2 and COVID-19 vaccines among residents of Makkah, Saudi Arabia.

Methods: A cross-sectional study was conducted in the Makkah region from February 23 to March 2, 2021. The questionnaire was generated using a Google form and distributed online through social platforms such as Twitter and WhatsApp. The questionnaire consisted of five sections and six hundred participants have answered and completed all questions. Then, All data were imported into Microsoft Excel and analyzed using the statistical tools SAS version 9.4 and SPSS version 25 software.

Results: A total of 600 participants from the Makkah region were found to have a high level of awareness and knowledge about all aspects of SARS-CoV-2 and the COVID-19 disease. For example, all participants considered coronavirus to be contagious, and 89.8% of them knew that COVID-19's symptoms are similar to those of seasonal flu. Most respondents showed a high level of awareness regarding the main factors of SARS-CoV-2 transmission. Over 98.7% of respondents were aware of the role of gatherings and events in further spread of the virus. The participants showed a good level of awareness about other preventive measures, such as maintaining social distancing and wearing a mask. However, the respondents considered COVID-19 vaccines to be effective, but some of them were not aware of their side effects, and 38.8% planned to receive a vaccine.

Conclusion: The residents of Makkah showed a high level of awareness about these aspects; an excellent awareness level was noted for SARS-CoV-2, means of transmission, disease symptoms and prevention of viral spread. On the other hand, the participants had less knowledge regarding COVID-19 vaccines; hence, more effort is required to educate people about the safety and benefits of the vaccines.

1. Introduction

COVID-19 has caused a global pandemic and economic crisis. It affects peoples' lives in many ways; it is health threatening, socially disruptive, leads to job losses and causes substantial stress and fear.[1–3] The first COVID-19 outbreak was in Wuhan, China, when a group of

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cases of pneumonia of unknown cause was reported to the World Health Organization on December 31, 2019[1,4–6] In January 2020, the virus was identified as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), and the disease it causes was named COVID-19 by WHO.[7] Genetic studies confirmed that the virus was the cause of this disease after analyzing many samples.[8–10] Coronaviruses cause respiratory and gastrointestinal diseases. The virus consists of a core of genetic material (positive-sense RNA), helical symmetry of the nucleocapsid surrounded by an envelope with protein spikes that gives it the appearance of a crown (S Fig. 1A).[5,11–13] Coronaviruses are zoonotic, meaning that they are transmitted between animals and humans.[9] SARS-CoV-2 can infect human cells through angiotensin-converting enzyme 2 (ACE2) in the lung and other organs (S Fig. 1C).[14] When the virus spike binds to the ACE2 receptor, the cells become infected. After the number of cases increased in many countries, the World Health Organization (WHO) declared COVID-19 to be a pandemic in March 2020 and announced that globally cooperated efforts would be required to prevent further spread of the virus.[15] As of May 2021, there were almost 160,300,000 million global cases of COVID-19, with approximately 138,040,582 million people having recovered from the disease and almost 3,330,113 million deaths.

Typically, coronavirus infection leads to respiratory disease symptoms. These symptoms could be mild to moderate and similar to seasonal flu symptoms, involving fever, cough, breathing difficulties, fatigue, sore throat and loss of smell and taste.[16,17] Some infected people develop severe symptoms and have to be hospitalized.[18,19] Specific population groups are at a higher risk of severe COVID-19 disease, including older people with serious chronic illnesses such as diabetes, cardiovascular disease, chronic respiratory disease and cancer.[6,16]

There are several means of COVID-19 transmission, with the main route being human to human, such as sneezing and coughing[15,20] COVID-19 may also spread through respiratory droplets or contact with infected secretions on different surfaces (S Fig. 1B).[20] Large events and gatherings have been associated with an increased risk of airborne transmission.

During the spread of COVID-19, the WHO has advised countries and societies to take strong preventative measures, such as frequent hand washing with alcohol-based products or soap.[21] They recommend avoiding touching the eyes, nose, and mouth. Furthermore, people must wear masks and maintain social distancing.[21] Infected people have to self-isolate and seek medical care if they develop severe respiratory symptoms.

In Saudi Arabia, the first COVID-19 case was recorded on the March 2, 2020. Since then, more cases have been reported, almost 428,369. Approximately 412,102 people have recovered from the disease, with almost 7098 deaths by May 2021. Since the beginning of the increase in reported cases, the Saudi Ministry of Health (MOH) has launched many awareness campaigns regarding the nature of the virus, transmission routes and preventative measures and have provided daily updates. The Saudi government has also taken strict measures to control the virus' spread, such as minimizing social activities, suspending schools, preventing public gatherings, quarantining the entire country and closing borders and airports.[21–23] Recently, COVID-19 vaccines have been produced,[24] and the Saudi Food and Drug Authority has approved the import and use of four types of COVID-19 vaccines, including Pfizer-BioNTech (BNT162b2) and AstraZeneca (AZD1222). The MOH provides these vaccines for free to all Saudi Arabian residents, including non-Saudis, and more than ten million people have so far been vaccinated. These efforts are highly likely to contain the virus and prevent new outbreaks.

In this study, we investigated the level of public awareness about COVID-19 in the Makkah region because it has a more than 8.5 million population and major cities, such as Makkah and Jeddah (S Fig. 2). Importantly, holy sites (Masjid Al-Haram) are located in Makkah and have received many visitors for prayers and Umarh during this pandemic, as reported in the Eatmarna App. Such large international religious gatherings in Makkah could contribute to the spread of infectious diseases such as COVID-19[25,26] Thus, it is important to study the level of public awareness in Makkah. We analyzed the level of awareness and knowledge toward SARS-CoV-2 (the nature of the virus, symptoms, transmission, and preventative measures) and COVID-19 vaccine among residents of Makkah, Saudi Arabia.

2. Methods

2.1. Questionnaire design

This descriptive cross-sectional and randomized study was conducted in the Makkah region from February 23 to March 2, 2021, one year after the first case of COVID-19 infection was reported in Saudi Arabia. The questionnaire was adopted with some modifications from previously published literature[21] and was then designed and validated. The questionnaire was generated using a Google form and distributed online through social platforms such as Twitter and WhatsApp because Saudis are highly active in social media; for example, they ranked seventh in the world for Twitter use.[27] The questionnaire consisted of five sections: 1) social and background information, such as age, gender, educational level and nationality, 2) participants' knowledge about the nature of SARS-CoV-2 (12 items), 3) awareness level of SARS-CoV-2 transmission (9 Items), 4) knowledge about preventing SARS-CoV-2 (8 items) and 5) COVID-19 vaccine and drug awareness (6 Items).

All participants were selected from the Makkah region. Makkah is in the west of the Kingdom of Saudi Arabia (S Fig. 2). More than 600 respondents participated in this study. The following inclusion criteria were applied: Saudi or non-Saudi adults (i.e., aged over 17 years); reside in the Makkah region; provide voluntary consent.

2.2. Statistical analysis

All data were imported into Microsoft Excel and analyzed using the statistical tools SAS version 9.4 and SPSS version 25 software.[28,29] T-tests and multivariate statistics ANOVA were used to analyze the significant variables of the level of public knowledge regarding transmission, prevention and vaccines. Statistical significance was considered at a P-value of less than 0.05 for all analyses.[29,30]

3. Results

3.1. Participants' demographic characteristics

Public knowledge is vital to overcome COVID-19. Therefore, we designed a questionnaire to investigate public health awareness in the Makkah region, Saudi Arabia. A total of 600 participants completed the survey, with the gender distribution being 26.5% female (159/600) and 73.5% male (441/600). Most respondents were Saudi (96.3%) and single (65.2%). More than half of respondents were 18–28 and 48–58 years of age (65% and 13.3%, respectively). 65.8% of the participants were bachelor's degree holders. A detailed demographic profile of the study respondents is provided in Table 1.

3.2. Public knowledge regarding the nature and symptoms of COVID-19

To measure the level of public knowledge regarding the nature, symptoms and risk of COVID-19, participants were asked multiple questions (Table .2). We enquired about the initial spread of SARS-CoV-2; more than 90% (550) responded with 'China'. Most participants 593 (98.88%) considered this particular coronavirus to be contagious. 89.8% of respondents stated that COVID-19 symptoms are similar to those of seasonal flu. However, respondents were not sufficiently knowledgeable regarding digestive-system-related symptoms 50.3% of them chose 'Yes', and the rest were divided between 'No' and 'I do not know'. For other symptoms, the participants showed good knowledge, with 94.7%

Table 1
Demographic characteristics of the research sample.

Demographic characteristics	N.	%
Age (years)		
18 to less than 28	390	65
28 to less than 38	68	11.3
38 to less than 48	48	8
48 to less than 58	80	13.3
Greater than 58	14	2.3
Gender		
Male	441	73.5
Female	159	26.5
Education level		
High school	146	24.3
Bachelor's degree	395	65.8
Postgraduate	34	5.7
Other	25	4.2
Marital status		
Single	391	65.2
Married	206	34.3
divorced	3	0.5
Nationality		
Saudi	578	96.3
Non-Saudi	22	3.7
Total N of participants	**600**	

Table 2
Public knowledge regarding the nature and symptoms of the novel coronavirus.

Questions	Yes		No		I do not know	
	N.	%	N.	%	N.	%
Q1. Did the coronavirus initially spread in China?	550	91.7	8	1.3	42	7
Q2. Is coronavirus contagious?	593	98.8	6	1	1	0.1
Q3. Are symptoms of the disease similar to those of seasonal flu?	538	89.7	40	6.7	22	3.7
Q4. Can the virus infect a person more than once?	441	73.5	40	6.7	119	19.8
Q5. Children cannot be infected with the virus that causes COVID-19.	93	15.5	412	68.7	95	15.8
Q6. Does coronavirus infect the respiratory system?	568	94.7	4	0.7	28	4.7
Q7. Is the risk of infection with the coronavirus high?	518	86.3	48	8	34	5.7
Q8. Is diarrhoea a symptom of infection with the coronavirus?	302	50.3	169	28.2	129	21.5
Q9. Is sneezing a symptom of the coronavirus?	392	65.3	141	23.5	67	11.2
Q10. Are elderly people and those with chronic diseases more likely to contract coronavirus?	540	90	32	5.3	28	4.7
Q11. Is coughing one of the symptoms of infection with the coronavirus?	508	84.5	42	7	51	8.5
Q12. Is high temperature one of the symptoms of infection with the coronavirus?	587	97.8	4	0.7	9	1.5

being aware that SARS-CoV-2 infects the respiratory system and knew about these symptoms; awareness of coughing was 84.5% and high temperature 97.8%. 65.3% of respondents chose sneezing, despite it not being a common symptom. Around 86.3% of participants considered the risk of COVID-19 to be high, whereas the remainder underestimated this risk. A high parentage of participants (90%) knew that the elderly people with chronic diseases are more likely to contract COVID-19.

3.3. COVID-19 transmission public awareness

Most respondents had good knowledge about SARS-CoV-2 transmission (Table 3). The majority stated that coughing (82.3%), sneezing (88.5%), hand-shaking (96%) and using tools of the infected person (94.3%) could spread the virus. 93% of respondents stated that touching surfaces contaminated with the virus could lead to SARS-CoV-2 transmission. Over 98.7% of the respondents were aware that gatherings and events contribute to the further spread of the virus. Most respondents (97.3%) showed a high level of awareness about SARS-CoV-2 transmission from infected to non-infected people. 74.3% of respondents disagreed that the virus is transmitted among individuals with genetic diseases, but more than half of them chose immunodeficiency as a factor of transmission (Table 3).

3.4. Public awareness of means of preventing coronavirus

84.7% of respondents chose 'Yes' to the enquiry about washing hands with soap and water for at least 20 s to protect against the coronavirus (Table 4). 90.8% of respondents were aware that using alcohol-based hand sanitiser protects against the virus. Most respondents (97%) chose 'Yes' regarding covering the mouth and nose while sneezing and coughing being able to reduce viral spread. Almost 98% of respondents were aware about the following practices staying at home, maintaining social distancing, and wearing a mask to help reduce the rate of infection with the virus. 90.5% of respondents chose 'Yes' to not touching the nose and mouth with the hand to reduce viral spread. Overall, there was a high level of awareness regarding the prevention of SARS-CoV-2 spreading among Makkah residents.

3.5. Knowledge and attitudes regarding COVID-19 vaccines

We asked participants about COVID-19 treatment availability, and a variety of responses were noted (Fig. 1 and S Table 1). Most respondents agreed that there are available vaccines (88.2%). Regarding antibiotic treatment against coronavirus, the participants were divided into three groups: 28.7% chose 'Yes', 35.7% chose 'No', and 35.7% chose 'I don't know'. 49.7% of respondents were confident of the effectiveness of the COVID-19 vaccines. 72.6% of participants considered these vaccines to be helpful in general. Only 34.5% of respondents were aware of the immediate side effects of the vaccine. Many respondents were happy to

Table 3
Coronavirus transmission awareness.

Questions	Yes		No		I do not know	
	N.	%	N.	%	N.	%
Q1. Is coronavirus transmitted through coughing?	494	82.3	52	8.7	54	9
Q2. Is coronavirus transmitted by sneezing?	531	88.5	29	4.8	40	6.7
Q3. Is coronavirus transmitted by hand-shaking?	579	96	10	1.7	14	2.3
Q4. Is coronavirus transmitted using tools of the infected person?	566	94.3	9	1.5	25	4.2
Q5. Can coronavirus be transmitted when touching surfaces contaminated with the virus?	558	93	14	2.3	28	4.7
Q6. Do gatherings and events contribute to further spread of the virus?	592	98.7	4	0.7	4	0.7
Q7. Is coronavirus transmitted from an infected person to another person who is not infected?	584	97.3	5	0.8	11	1.8
Q8. Is coronavirus transmitted due to genetic diseases?	44	7.3	446	74.3	110	18.3
Q9. Is coronavirus transmitted due to immunodeficiency?	343	57.2	164	27.3	93	15.5

Table 4
Awareness of preventing coronavirus transmission.

Questions	Yes		No		I do not know	
	N.	%	N.	%	N.	%
Q1. Does washing your hands with soap and water for at least 20 s protect you from the coronavirus?	508	84.7	52	8.7	40	6.7
Q2. Does using alcohol-based hand sanitiser protect you from coronavirus?	545	90.8	22	3.7	33	5.5
Q3. Does covering the mouth and nose while sneezing and coughing reduce the spread of the virus?	582	97	7	1.2	11	1.8
Q4. Does maintaining social distancing contribute to preventing the coronavirus?	588	98	6	1	6	1
Q5. Is wearing a mask one of the means of prevention?	589	98.2	8	1.3	3	0.5
Q6. Does staying at home help reduce the rate of infection with the virus?	586	97.7	9	1.5	5	0.8
Q7. Are hand dryers effective in killing the coronavirus?	169	28.2	182	30.3	249	41.5
Q8. Does not touching the nose and mouth with the hand reduce the rate of infection with the virus?	543	90.5	28	4.7	29	4.8

be vaccinated against this virus (38.8%) (Fig. 1 and S Table 1). Further statistical analysis showed that females' knowledge of vaccines was significantly less than males (Table 5 and S Fig. 3).

Furthermore, a comparison of nationality (Saudi vs non- Saudi) and gender (male vs female) was used to examine public awareness of transmission, prevention, and vaccines (Table 5). Males were more knowledgeable about vaccines than females ($p = 0.0138$), whereas no nationality-based knowledge differences were observed. Moreover, analysis of the individual group variance for knowledge toward vaccines to compare the effect of group of age was conducted. Result showed that there was a statistically significant difference of group of age on knowledge toward vaccines ($F(4, 595) = 10.73$, $P < 0.0001$). People who are of age 48 years old to less than 58 years old ($P < 0.0001$, $M = 4.063$) had more knowledge toward vaccines comparing with two group of people who are of age 18 years old to less than 28 years old ($M = 2.841$) and 28 years old to less than 38 years old ($M = 3.250$). As well, people who are of age 38 years old to less than 48 years old ($P = 0.0420$, $M = 3.541$) had more knowledge toward vaccines comparing to the group who are of age 18 years old to less than 28 years old ($M = 2.841$) (S Fig. 3).

4. Discussion

Public awareness is crucial during pandemic management. Therefore, this study aimed to investigate the general level of public awareness towards SARS-CoV2 and its subsequent disease COVID-19 in the Makkah region, Saudi Arabia. This region is the second most populated in the kingdom and has major cities, such as Makkah and Jeddah. Makkah city receives millions of visitors for prayers, Umrah and Hajj each year. These large religious gathering could lead to contagious disease outbreaks, including COVID-19. Therefore, health awareness among residents and visitors to the Makkah region is important in containing potential pandemics. In Makkah city, many additional preventive measures were taken; for example, Umrah was completely stopped, and the holy mosque (Masjid Al-Haram) was closed and cleaned daily with disinfectant liquid and spray.[22] In 2020, Hajj was performed with a small number of pilgrims and only pilgrims who lived inside Saudi Arabia. Then, Eatmarna App was developed and launched; thus, visitors wishing to perform Umrah or prayers have had to register in the App and book a specific time. Then, not infected, they receive a confirmation message and become able to access inside the holy mosque. Recently, a new measure was implanted by the Saudi authority only vaccinated people can visit the holy mosque. All these preventive efforts and strict health measures effectively ensure the safety and wellbeing of residents, visitors and pilgrims of Makkah as well as prevent COVID-19 outbreaks from religious gatherings. This study is the first of its kind to investigate SARS-Cov2 and COVID-19 awareness in Makkah and the first to determine public knowledge about COVID-19 vaccines in Saudi Arabia.

Regarding public awareness about the nature, symptoms and risk of COVID-19, all participants considered coronavirus to be contagious, and 89.8% of them knew that COVID-19's symptoms are similar to those of seasonal flu. However, respondents were not sufficiently aware of symptoms related to the digestive system. The same observation was reported among participants in Riyadh,[21] and it was also documented

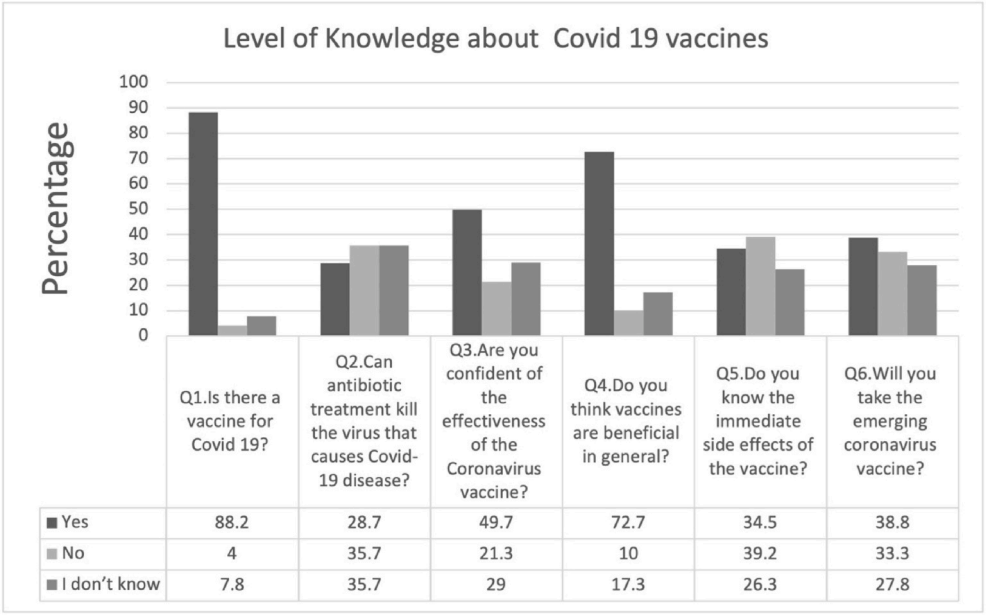

Fig. 1. Participants' knowledge about COVID-19 vaccines.

Table 5
t-test results comparing variables of gender and nationality across five sections of the questionnaire.

			Mean	*df*	*t*	*p-value*
Public knowledge of virus symptoms	Gender	Male Female	9.38 9.37	598	−0.04	0.9696
	Nationality	Saudi Non-Saudi	9.37 9.45	598	0.21	0.8339
Awareness of transmission	Gender	Male Female	7.15 7.11	598	−0.33	0.7418
	Nationality	Saudi Non-Saudi	7.14 7.27	598	0.66	0.5085
Awareness of prevention	Gender	Male Female	6.86 6.81	598	−0.53	0.5998
	Nationality	Saudi Non-Saudi	7.00 6.84	598	0.66	0.5084
Knowledge towards vaccines	Gender	Male Female	3.22 2.84	598	−0.247	0.0138*
	Nationality	Saudi Non-Saudi	3.13 2.95	598	−0.48	0.6299

Note: *: statistically significant p-value <0.05.

that diarrhoea is an underestimated symptom of COVID-19.[31] Therefore, symptoms related to the digestive system need more emphasis in health awareness campaigns. For other symptoms, the participants showed a higher level of awareness and considered fever and coughing as symptoms of COVID-19 (Table 1). Furthermore, they identified people who at higher risk of COVID-19 infection, including the elderly people with chronic diseases and immunodeficiency.

One of the positive findings of this study is that most respondents showed a high level of awareness regarding the main factors of SARS-CoV-2 transmission and knew that coughing, sneezing and hand-shaking contribute to infection with this virus (Table 3).[15] Over 98.7% of respondents were aware of the role of gatherings and events in further spread of the virus. These factors of transmission have been reported to be involved in the increase of infection rate in many countries.

Participants exhibited an excellent understanding of preventive measures, particularly in relation to washing hands and covering the mouth and nose while coughing or sneezing (Table 4). Furthermore, participants showed a good level of awareness about other preventive measures, such as staying at home, maintaining social distancing, and wearing a mask to help reduce the rate of infection with the virus. These preventive measures are among the important measures that need to be considered daily to prevent infection and viral spread. We found that the awareness level of preventing measures was the highest for all types of age (S Fig. 3). This finding corresponds to the extent of observed commitment by citizens and residents to the instructions announced by the MOH during the pandemic. This high level of awareness reflects the success of the health campaigns led by the MOH, which used several approaches to reach people, including social platforms, daily updated statistics, health apps and educational webpages. Participants in this study show better awareness about COVID-19 compared to those analyzed in other studies, including in Riyadh,[21] Qassim[32] and other Saudi cities.[33]

Our participants were aware of COVID-19 treatment availability but were less knowledgeable about COVID-19 vaccines (Fig. 1, S Table 1 and S Fig. 3). Only half of the respondents were confident of the effectiveness of the COVID-19 vaccines, and just a few of the respondents knew the immediate side effects of the vaccine. A small number of respondents would take the emerging COVID-19 vaccines (38.8%), potentially because 1) they are new vaccines developed in a short time, 2) the spread of misinformation about the vaccines and 3) conflicting reports from different countries and media, including social media. We found that knowledge about vaccines for those aged 18–28 years was lowest, which is not surprising because the advertisement campaigns for these vaccines were directed to people with chronic diseases and the most affected age groups, which are the elderly (S Fig. 3). Interestingly, knowledge towards vaccines was affected by educational level and gender. Result showed that there was a statistically significant difference of educational level on knowledge toward vaccines ($F(3, 596) = 3.12$, $P = 0.0255$). People who have a degree other than (high school, bachelor's degree, postgraduate) ($P = 0.0185$, $M = 4.040$) had more knowledge toward vaccines comparing to people who have a bachelor's degree ($M = 3.025$).

Regarding gender, females knew less than males (Table 5 and S Fig. 3B). This finding is consistent with MOH statistics, which reported that more females than males have been infected, despite more males than females having been vaccinated. On the other hand, 72.6% of respondents thought vaccines are helpful in general. Another study reported that only half of participants (residents in Malta and international individuals) were willing to take the vaccine, with the lack of vaccine safety being the main reason for this unwillingness.[34] In the United States, one study reported negative attitudes towards the vaccines.[35] A systematic review of COVID-19 vaccines found that acceptance rates of vaccines were low in several countries and continents, including the Middle East, some European countries, Russia and Africa.[36] To improve the level of public awareness towards vaccines, healthcare providers must make more efforts in raising awareness among society using different communication platforms and strategies. In Saudi Arabia, the vaccination rate is encouraging currently, more than 10 million.

5. Conclusion

Health awareness is a key factor in tackling COVID-19. Increasing this knowledge will encourage people to follow and implement the advice provided by the MOH. In this study, various characteristics of the population were explored to obtain information that could be used for planning a health awareness campaign to tackle COVID-19 transmission and encourage people to take the vaccines. The residents of Makkah showed a high level of awareness about these aspects; an excellent awareness level was noted for SARS-CoV-2, means of transmission, disease symptoms and prevention of viral spread. On the other hand, the participants had less knowledge regarding COVID-19 vaccines; hence, more effort is required to educate people about the safety and benefits of these vaccines.

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Ethical approval

The ethical rules of the ethics committee of Umm-Alqura university were followed and all participants agreed to a voluntary and informed consent. All data were gathered anonymously and only used for scientific research in this project, and we ensured the confidentiality of all participants.

Authors' contributions

AFA, DA, FA and SK contributed to design of the project and performed data analysis. ZA, AA, AA, and AA distributed the survey, gathered the data and did the data analysis. All authors contributed to writing and revising the article. They also approved the final version of

the article.

Declaration of competing interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Appendix A. Supplementary data

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