



# Public awareness of coronavirus in Al-Jouf region, Saudi Arabia

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## Abstract

**Aim** Since 2012 and to date, outbreak/new cases of Middle East respiratory syndrome-related coronavirus (MERS-CoV) were always reported in Saudi Arabia. Al-Jouf region is considered as one of the most vulnerable areas to the disease outbreak. This research aimed to assess (to the best of our knowledge), for the first time, the current level of awareness towards MERS-CoV among the Al-Jouf region population through a well-designed multistage questionnaire.

**Subjects and methods** A cross-sectional study of 384 participants recruited from various places in Al-Jouf government was conducted through a valid and reliable questionnaire including sociodemographic and MERS-CoV knowledge data.

**Results** The majority of the participants showed generally moderate knowledge about MERS-CoV. Age, education, and occupation were the only significant predictors of the level of low awareness concern. Also, the public awareness about the nature, communicability, and lethal effect of the disease was good overall; however, knowledge about incubation period, clinical picture, and epidemiology of the disease needs more governmental concern. The Ministry of Health was the main source of information.

**Conclusion** Empowering public information regarding the incubation period and epidemiology of the disease is needed. Frequent communication between healthcare providers and both school students and non-educated individuals is recommended to help the Saudi government in controlling the disease outbreak.

**Keywords** Awareness · Coronavirus · Population · Jouf · Camels

## Introduction

Middle East respiratory syndrome-related coronavirus (MERS-CoV) is an extremely fatal viral respiratory disease. It was initially announced in Saudi Arabia in 2012 and has been spread to other countries ever since. Mortality from MERS-CoV had been reported in the Middle East; hence, it acquired its name (Al-Osail and Al-Wazzah 2017).

The Kingdom of Saudi Arabia (KSA) remains the most affected country, with remarkable morbidity and mortality rates. This has been considered a serious health problem because millions of pilgrims from all over the world visit Saudi Arabia for Hajj annually (World Health Organization, WHO 2014).

From 2012 through 31 July 2019, a total of 2458 laboratory-confirmed cases of MERS-Cov, along with 849

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associated deaths, have been reported to the WHO globally in Saudi Arabia. As of 13 February, 39 cases have been identified and reported as part of the Wadi Aldwasir outbreak (WHO 2019). Recently, in 2017, in Al-Jouf government, 20 cases of MERS cluster were reported in an outbreak of the disease in Domat Aljandal (Arabi et al. 2018). Moreover, in 2018, one lethal case of non-cluster type was recorded in another outbreak in Al-Qurayat (WHO 2019).

The causative agent for MERS-CoV is a positive sense single-stranded RNA virus of the beta-coronavirus measuring 120–160 nm in diameter (Al-Mohrej and Agha 2017; Joshi 2013). Bats, camels (direct contact or by camel milk), and close contact with an infected person has been identified as a mode of transmission of the virus. Other animal reservoirs are not excluded from the possibility of being the host (Elbur et al. 2016). Dromedaries and camels are still considered as the main animal reservoirs due to their high prevalence in the Arabian Peninsula (Memish et al. 2014). Human-to-human transmission in healthcare workers, due to overcrowding, has a role in disease transmission. The disease spreads through large respiratory droplets ( $\geq 10 \mu\text{m}$  in diameter), fomites, and hand contamination (Seto et al. 2013).

Worldwide, due to the occurrence of recent deaths, coronavirus has become one of the crucial viruses. Globally, since 2012, the WHO has reported 1864 laboratory-confirmed MERS cases, with 659 associated deaths in 27 countries. KSA remains the most affected country, with remarkable morbidity and mortality rates. MERS-CoV has been considered a serious health problem because millions of pilgrims from all over the world visit Saudi Arabia for Hajj every year (Joshi 2013).

The incubation period for MERS-CoV ranges between 5 and 14 days (Health Protection Agency (HPA) UK Novel Coronavirus Investigation Team 2013). In Saudi Arabia, the median incubation period was calculated as 5.2 days (Assiri et al. 2013). The clinical features of MERS-CoV ranged from asymptomatic or mild disease to acute respiratory distress syndrome and multiorgan failure, which leads to death (Al-Osail and Al-Wazzah 2017).

Unfortunately, to date, there is no specific drug treatment or vaccination. Therefore, infection control measures are essential for the prevention of its spread in healthcare facilities, as well as in the community (Joshi 2013). Several studies in KSA were conducted among healthcare workers and medical students for measuring the awareness of MERS-Cov according to their sociodemographic states (Al-Mohrej and Agha 2017; Kharma et al. 2015; Alsahafi and Cheng 2016; Khan et al. 2014). Moreover, awareness towards MERS-CoV was not acknowledgeable among the Saudi population. A previous study on the disease was limited due to the insignificant number of participants (Kharma et al. 2015). Unfortunately, although Al-Jouf region has been considered as one of the most vulnerable areas, suspected to be due to the abruptness of MERS-CoV outbreaks, there was a lack of previous studies

detecting the degree of awareness among the Al-Jouf population. Hence, we can say that the assessment of public awareness in Al-Jouf region through this survey is reasonable. So, the goal of this research was to assess (to the best of our knowledge), for the first time, the current level of awareness towards MERS in relation to sociodemographic states among the Al-Jouf region population through a well-designed multi-stage questionnaire (supplementary material 1).

## Participants and methods

### Design and sampling

The design of the study was a descriptive cross-sectional study that was conducted in Al-Jouf region between 2018 and 2019. The sampling was a multistage random sampling and the form of the sampling is a questionnaire. Estimation of the sample size was done using  $n = P(1-P)Z^2/d^2$ , assuming unknown prevalence of 50%,  $Z = 1.96$ ,  $d = 0.05$ , confidence level = 95% (margin of error = 5%), and 80% power of the study. The calculated sample size of this study is 384 participants. The sample was detected according to the last report of the General Authority for Statistics (GAS), Kingdom of Saudi Arabia in 2010 (population 440,000) (General Authority for Statistics (GAS), Kingdom of Saudi Arabia 2010).

### Inclusion and exclusion criteria

Consecutive samples of all male and female Saudi and non-Saudi participants of Al-Jouf region were included in this study. The age of the sample size ranges between < 20 to 60 years. Medical students and healthcare providers were excluded from the study.

### Data collection and measures

For data collection, a closed-ended questionnaire comprising multiple-choice questions, in both Arabic and English forms, was used. The questionnaire measured the sociodemographic data (name, age, sex, nationality, educational level, region, and income) and disease knowledge (mode of infection, clinical picture, methods of control, and sources of information). The possible responses regarding disease knowledge were classified as 'correct', 'incorrect', and 'I do not know'. A correct answer was given 1 point, while both incorrect and 'I do not know' responses were assigned 0 points. The higher the score, the greater the expected knowledge the respondent had. The results of the test were represented as follows: 21–25, excellent knowledge; 16–20, good knowledge; 11–15, moderate knowledge; 6–10, fair knowledge; and 0–5, poor knowledge. The questionnaire was validated for its reliability, resulting in a statistical value of 0.90 (Cronbach's alpha).

The questionnaire was reviewed and validated by three experts in the microbiology, internal medicine, and biostatistics fields. A pilot study (tested with a group of 15 people) was done to ensure applicability of the questionnaire and to estimate the time frame needed to complete it. The questionnaires were handed out by the investigators at the site personally and collected from the respondents after they had been completed individually and anonymously. All questionnaires were attached with a greeting letter detailing the purpose of the study and informed the participants that their participation is optional, with the right of withdrawal at any stage of the study.

### Ethical approval

This study was approved by the Institutional Review Board (IRB) committee of the College of Medicine at Al-Jouf University, Saudi Arabia.

### Statistical analysis

Data entry and analysis was performed using SPSS version 21 (SPSS Inc. Armonk, NY). Descriptive statistics were used to describe all variables. The mean and standard deviation were used to identify the mean scores for the different studied domains. The Chi-squared test was used to depict statistical differences among groups. Significant differences were noted when  $p$ -values were less than 0.05.

### Results

There was a total of 384 respondents, which were almost equally distributed in terms of gender (47.0% male; 52.9% female). More than half (61.5%) of the respondents belonged to the age group 20–39 years old and almost all of them were Saudi (88.3%), from urban regions (95.8%), and more than half had a family monthly income > 8000 SAR/month (58.9%). Though a good number of the participants graduated from university (63.8%), more than half were unemployed (56.5%). As most of the Al-Jouf region is considered as desert rural areas, about one-third of the respondents had farms (34.9%), with a few having camels (9.6%) and minimal contact with camels (6.3%) (Table 1).

The cumulative score of the respondents' knowledge on coronavirus disease revealed that most of the respondents (309) possessed moderate knowledge, a considerable number (52) had a good knowledge, while some of them (23) had a fair knowledge on coronavirus disease, with an absence of respondents having poor and excellent knowledge (Fig. 1).

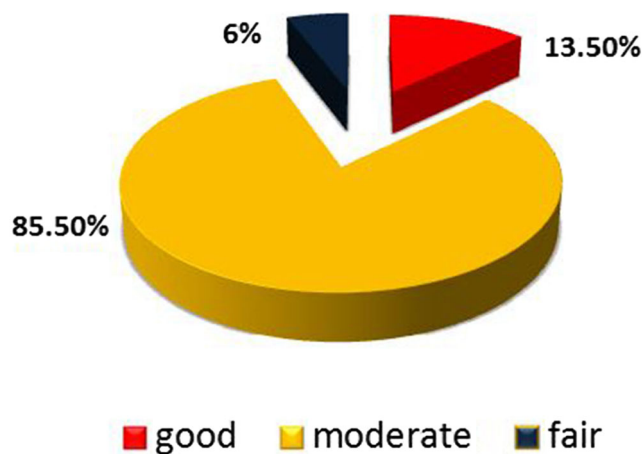
The relationship between the sociodemographic data and degree of knowledge about MERS-CoV is represented in Table 2. It can be seen that there was no significant difference ( $p < 0.05$ ) in the amount of knowledge between males and

**Table 1** Sociodemographic characteristics of the study sample

Sociodemographic data	Number	Percentage
Age (years)		
< 20	100	26.0%
20–39	236	61.5%
40–60	48	12.5%
Sex		
Male	181	47.1%
Female	203	52.9%
Education level		
School	121	31.5%
University	245	63.8%
Postgraduate	18	4.7%
Occupation		
Unemployed	216	56.3%
Government	131	34.1%
Non-government	32	8.3%
Retired	5	1.3%
Family income (SAR/month)		
<3000	11	2.9%
3000–5500	78	20.3%
5500–8000	68	17.7%
>8000	227	59.1%
Nationality		
Saudi	339	88.3%
Non-Saudi	45	11.7%
Region		
Urban	368	95.8%
Non-urban	16	4.2%
Farm owner		
Yes	134	34.9%
No	250	65.1%
Camel owner		
Yes	37	9.6%
No	347	90.4%
Contact with camels		
Yes	24	6.3%
No	360	93.8%

females, Saudis and non-Saudis, rural and urban areas, or between farmers, camel owners, and contact with camels. However, there was a significant difference regarding age ( $p = 0.001$ ), level of education ( $p = 0.007$ ), and occupation ( $p = 0.024$ ). The groups of participants that have a high level of knowledge were 20–40 years old, postgraduates, unemployed, and government employed.

On examining the data in Table 3 to obtain an idea about the quantity of knowledge among the Al-Jouf population, the researchers noticed that the vast majority of the respondents were mindful that MERS-CoV was a viral illness (93.2%),



**Fig. 1** Cumulative score of the respondents' knowledge on Middle East respiratory syndrome-related coronavirus (MERS-CoV)

contagious, and could lead to death (86.5%) but were not aware (85.7%) that its incubation period ranged from 4 to 5 days. Moreover, less than half of the respondents (46.9%) and more than one third were mindful that camels and personal contact (respectively) can transmit the disease. However, the vast majority of them (92.2% and 97.9%, respectively) did not know that bats and domestic animals can transmit the disease also.

In regards to symptoms, more than half (55.2%) of the respondents agreed that a person with MERS-CoV may develop upper respiratory symptoms. About one fifth (19.8%) of the respondents were aware that the disease can develop lower respiratory symptoms, while a vast majority of them did not know that it can develop general symptoms (fever and muscle pain), gastrointestinal symptoms, and central nervous system symptoms (88.3%, 88.5%, and 98.7%, respectively).

In addition to the above observations on knowledge and regarding MERS-CoV prevention, more than one third of the respondents agreed that specific hygiene and avoiding contact practices and measures are needed for protection from the disease. Although more than three quarters (76.8%) of them knew that there is no specific vaccine towards MERS-CoV, the vast majority did not know that good general health played a role in the prevention of the disease (91.1%) and, also, that there is no specific preventive measures against the disease (94.8%).

As for knowledge on MERS-CoV treatment, a vast majority of the respondents did not know that MERS-CoV could be treated by supportive measures at home (95.6%) or a few days spent at hospital (97.9%). More than half (53.6%) of the respondents believed that the affected individuals could only be treated in the intensive care unit and one third (35.9) of them knew that there is no specific drug for the disease. Although more than one third of the respondents were knowledgeable that the Arabian Peninsula is a vulnerable region of the disease, the vast majority of them did not know about other international vulnerable regions.

**Table 2** Relation between sociodemographic data and Middle East respiratory syndrome-related coronavirus (MERS-CoV) knowledge

Sociodemographic data	Fair		Moderate		High		p-Value
	No.	%	No.	%	No.	%	
<b>Age (years)</b>							
< 20	13	13	78	78	9	9	0.001*
20–40	5	2.1	191	80.9	40	16.9	
41–60	5	10.4	40	83.3	3	6.3	
<b>Sex</b>							
Male	7	3.9	145	80.1	29	16	0.126
Female	16	7.9	164	80.8	23	11.3	
<b>Education level</b>							
School	15	12.4	91	75.2	15	12.4	0.007*
University	8	3.3	204	83.3	33	13.5	
Postgraduate	0	0	14	77.8	4	22.2	
<b>Occupation</b>							
Unemployed	1	1.3	59	78.7	15	20	0.024*
Student	16	11.3	112	79.4	13	9.2	
Government	5	3.8	105	80.2	21	16	
Non-government	1	3.1	28	87.5	3	9.4	
Retired	0	0	5	100	0	0	
<b>Family income (SAR/month)</b>							
< 3000	1	9.1	9	81.8	1	9.1	0.960
3000–5500	5	6.4	61	78.2	12	15.4	
5500–8000	3	4.4	53	77.9	12	17.6	
> 8000	14	6.2	185	81.9	27	11.9	
<b>Nationality</b>							
Saudi	21	6.2	272	80.2	46	13.6	0.894
Non-Saudi	2	4.4	30	82.2	6	13.3	
<b>Region</b>							
Urban	23	6.3	294	79.9	51	13.9	0.364
Non-urban	0	0	15	93.8	1	6.3	
<b>Farm owner</b>							
Yes	7	5.2	107	79.9	20	14.9	0.778
No	16	6.4	202	80.8	32	12.8	
<b>Camel owner</b>							
Yes	0	0	32	86.5	5	13.5	0.268
No	23	6.6	277	79.8	47	13.5	
<b>Contact with camels</b>							
Yes	0	0	19	79.2	5	20.8	0.280
No	23	6.4	290	80.6	47	13.1	

\*p-Value < 0.05 is considered significant.

Lastly, from Fig. 2, we detected that the Ministry of Health, community communication, and social networks represented the highest efficiency rates as awareness sources (25%, 23.7%, and 22.6%, respectively). However, hardly any information was gained from infected people (0.52%). Medical campaigns as well as self-learning had small roles in awareness (5.73% and 4.43%, respectively) among the public in the Al-Jouf region.

**Table 3** Responses to the questionnaire on knowledge of Middle East respiratory syndrome-related coronavirus (MERS-CoV)

Statements	Correct		Incorrect	
	No.	%	No.	%
Knowledge on the cause				
Corona is caused by a virus	358	93.2	26	6.8
Knowledge on the communicability of the disease				
Contagious and leads to death	332	86.5	46	13.5
Knowledge on the incubation period of the disease				
5–14 days	51	13.3	333	86.7
Knowledge on the transmission				
The disease is transmitted by camels	180	46.9	204	53.1
The disease is transmitted by bats	30	7.8	354	92.2
The disease is transmitted by domestic animals	8	2.1	376	97.9
The disease is transmitted by infected persons	148	38.5	236	61.5
Knowledge of symptoms of the disease				
The disease has upper respiratory symptoms	212	55.2	172	44.8
The disease has lower respiratory symptoms	76	19.8	308	80.2
Fever and muscle pain are symptoms of the disease	45	11.7	339	88.3
The disease has gastrointestinal symptoms	44	11.5	340	88.5
The disease has central nervous system symptoms	5	1.3	379	98.7
Knowledge on disease prevention				
Hand washing with alcohol could prevent the disease	141	36.7	243	63.3
Covering nose and mouth could prevent the disease	158	41.1	226	58.9
Keep in good general health could prevent the disease	34	8.9	350	91.1
Vaccine could prevent the disease	89	23.2	295	76.8
There is no preventive measure	20	5.2	364	94.8
Knowledge on disease treatment				
Supportive treatment at home is a measure of treatment	17	4.4	367	95.6
Hospitalization is a measure of treatment	8	2.1	376	97.9
Intensive care is a measure of treatment	206	53.6	178	46.4
No drug treatment available	138	35.9	246	64.1
Knowledge on the epidemiology of the disease				
Arabian Peninsula is a vulnerable region	157	40.9	227	59.1
North and South Africa are vulnerable regions	44	11.5	340	88.5
South America is a vulnerable region	2	0.5	382	99.5
Jordan and Lebanon are vulnerable regions	4	1.0	380	99.0

## Discussion

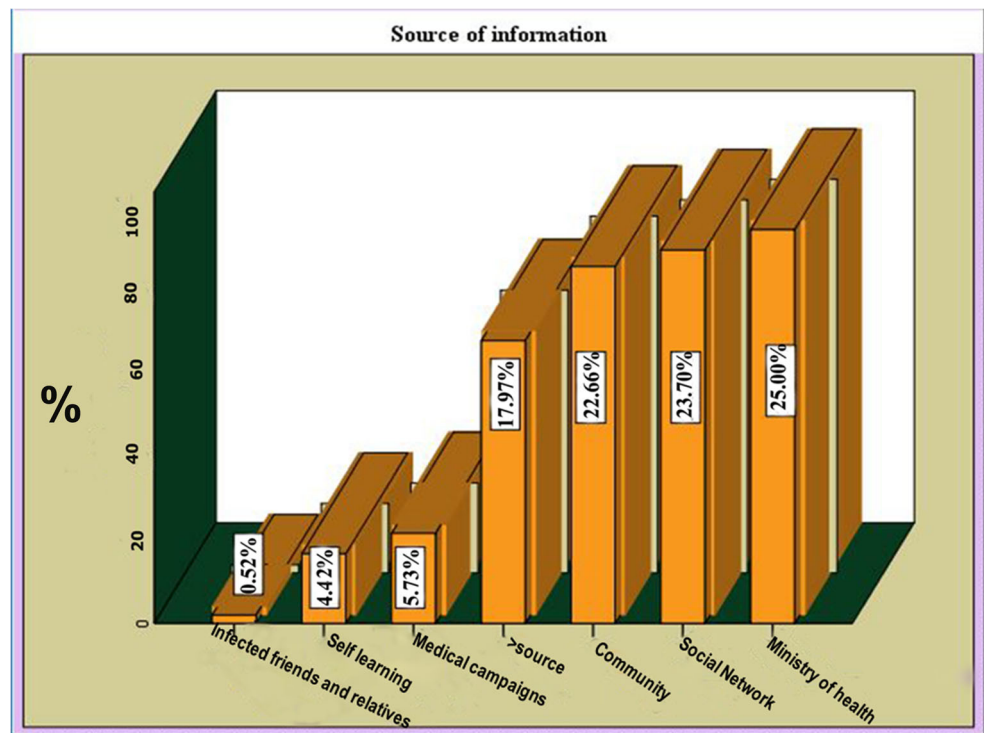
Studies have examined the various levels of knowledge towards MERS-CoV outbreaks in various regions in Saudi Arabia (Almutairi et al. 2015; Alqahtani and Aldawsari 2015; Al-Abdullah et al. 2016), but a literature search has not found any public reports on knowledge regarding coronavirus among the population of Al-Jouf region until now. Therefore, this population-based survey could provide baseline data to Al-Jouf government for preventive measures in case of future outbreaks.

The present study revealed that awareness of MERS-CoV among the Al-Jouf population is generally good. This is

attributed to findings of this research that indicated that the Ministry of Health campaign, social networks, and social communication were the most cited sources of information on MERS-CoV infection. The importance of these results is that this survey covered different types of population with good validity and reliability, as the study was voluntary, with personal interview methods.

This results of this survey showed that there was no significance difference in MERS-CoV knowledge regarding sex, nationality, region, or income. However, there was a significant difference regarding age, level of education, and employment. Similar to the results of Alqahtani and Aldawsari (2015) and Al-Abdullah et al. (2016), the level of

**Fig. 2** Different sources of the respondents' knowledge on Middle East respiratory syndrome-related coronavirus (MERS-CoV)



knowledge was higher particularly among younger individuals in the age range 20 and 40 years. This might be attributed to the capability of young persons to gain their knowledge from social media. Social media represents the second major source of information to the respondents in this work, as shown by our result. This comes in contrast to elderly people, who gained their knowledge from newspapers, television, and radio. Therefore, alleviating the concerns of the government in using various routes to reach different population groups is crucial. It is not surprising that postgraduates as well as governmental employees showed a high level of knowledge. This might be due to self-education and sharing the governmental campaign about MERS-CoV, respectively. In contrast to this, the greater knowledge of unemployed participants might come via benefiting from their free time in self-education and use of social networks.

It is essential to note that, while the majority of the respondents were highly informed of the nature, communicability, and lethal effect of the disease, a still quite significant proportion of the respondents held wrong concepts about the mode of transmission. For instance, nearly half of the respondents were aware that corona is transmitted by camels. We considered this percentage to be insufficient and increasing public awareness of the people in Al-Jouf region, especially those who live in rural areas, should be taken seriously. Al-Jouf region, as with other desert regions in Saudi Arabia, is famous for raising camels since ancient times. There is even an area that lies 800 m from Sakaka, and known as Al-Jamal area, where large stones carved in the mountains were found in the

form of camels (Center for International Communication, CIC 2018). It has been known that MERS-CoV was detected in dromedary camels in a number of countries and represented 22–25% of camel-to-human transmissions (Aguanno et al. 2018; Lin et al. 2018). Studies powerfully suggested that MERS-CoV has been primarily passed through an evolutionary recombination process in dromedary camels in Africa and exported to the Arabian Peninsula through the camel trading routes (Andualem 2017).

On the other hand, although one third of the respondents knew that the disease could be transmitted through direct personal contact, almost all of the respondents were aware about the role of bats and domestic animals in the transmission of the disease. Due to the desert and rural nature of Al-Jouf region, it is normal to bridge this gap of knowledge to prevent epidemic outbreak of the disease.

Good knowledge on the clinical picture of MERS-CoV is essential for recognizing the disease, obtaining appropriate measurements, and preventing outbreaks to save lives. While between one fifth to one half of the respondents knew that MERS-CoV can be represented by lower and upper respiratory symptoms, respectively, a vast majority of them did not know that it can develop general gastrointestinal and central nervous system symptoms. The accurate incubation period (Health Protection Agency (HPA) UK Novel Coronavirus Investigation Team 2013) of MERS-CoV was not well known by most of the respondents. However, it is crucial, as it contributes to early healthcare-seeking behavior. For that reason, periodic educational interventions from experts to

demonstrate the stages and clinical picture of the disease will be beneficial in controlling the disease.

In 2015 in King Abdullah University Hospital, it was estimated that MERS-CoV patient care costs from 4000 to 5000 SAR, despite there being no definitive treatment until now (Al-Abdullah et al. 2016). As the drug prices increased sharply in the past 4 years and vaccines are still in the research stages, it is reasonable to concentrate on preventive measures. The knowledge of the participants in this study about preventive measurement is still less than adequate. This implied that precautionary activities in avoiding infection by coronavirus need to be encouraged and strengthened.

Regarding the most vulnerable area, although about 40.9% of respondents knew that Arab regions and a few (11.5%) knew about North and South Africa, almost all respondents were unaware of the other international vulnerable areas. Public awareness about outbreak areas in neighboring vulnerable places like Jordan and Lebanon that have road connections with the Al-Jouf region is crucial.

The findings also indicated that the Ministry of Health followed by social media and community communication represented the most cited sources of information on MERS-CoV disease. Interestingly, only a small proportion of the respondents cited the university medical campaign, self-learning, and relatives of infected individuals as sources of information. This clearly proved the efficacy of governmental public health education programs as well as technology in increasing the knowledge and awareness of the disease. Thus, university medical staff and students should maximize their role in awareness campaigns as well as in research aspects.

### Limitations of the study

The present study has several limitations:

1. Generalization of the result study had been potentially limited, since it depended on researchers' convenience to the participants to share in the study. This investigation was conducted among residents in selected municipalities, with less conduction in rural areas, which is the location of the target groups (farmers and camel owners). As it was difficult for female researchers to reach these areas, due to conservative customs and traditions of the Al-Jouf community, we thought of sending the questionnaire by mail. However, it would have been troublesome, considering that the questionnaire might be misplaced during delivery and that many of the rural villages do not have postal systems.
2. Difficulty in obtaining the full patient data at the hospital in Al-Jouf prevented the researchers from assessing the relationship between corona disease and other risk factors to determine a cause–effect relationship.

### Conclusion and recommendation

From this survey, we can conclude that:

1. People in Al-Jouf region had good knowledge about Middle East respiratory syndrome-related coronavirus (MERS-CoV) and this may reflect the effective circulation of the information about MERS-CoV by the Ministry of Health, social networking sites, and the media. However, the university medical campaign has an unremarkable role in increasing MERS-CoV awareness in the future.
2. Although the Al-Jouf public awareness level is generally good, it is less than expected, especially in regards to the modes of transmission by bats and domestic animals, incubation period, and epidemiology of the disease (especially to the neighboring countries of Jordan and Lebanon), which is still weak and insufficient, so we suggest increasing the level of awareness towards them.
3. Public health education programs have confirmed their value in increasing the awareness of MERS-Cov disease. Consequently, the Ministry of Health should expand its awareness role through providing the media, schools and health centers, and governmental and non-governmental organizations with adequate and sound information and educational materials about the disease features and preventive measures. In addition to this, cooperation with the university medical research centers to invent new preventive and control agents is necessary.
4. Health workers can provide public awareness and reach target groups through public health campaigns. So, improving their skills through an orientation training course about MERS-CoV disease might help to control disease outbreaks.
5. Despite some limitations posed by this investigation, the results provided useful inputs and knowledge that would help the government in planning, designing, and initiating programs to help in MERS-CoV disease control and prevention.

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### Compliance with ethical standards

**Conflict of interest** All authors declare that the research was approved by all authors and was conducted in the absence of any commercial or financial relationships. Also, the authors emphasize that the research is not under consideration for publication elsewhere and, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically, without the written consent of the copyright holder. Also, the datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Ethical approval** This study was approved by the Institutional Review Board (IRB) committee of the College of Medicine at Al-Jouf University.

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