



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Is the Saudi public aware of Middle East respiratory syndrome?



Omar A. Al-Mohrej^a, Sarah D. Al-Shirian^a,
Salman K. Al-Otaibi^a, Hani M. Tamim^b, Emad M. Masuadi^c,
Hana M. Fakhoury^{d,*}

^a *College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia*

^b *Clinical Research Institute, Faculty of Medicine, American University of Beirut, Beirut, Lebanon*

^c *Research Unit, Department of Medical Education, College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia*

^d *Department of Basic Sciences, College of Science and Health Professions, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia*

Received 9 July 2015; received in revised form 21 September 2015; accepted 5 October 2015

KEYWORDS

Coronavirus;
MERS;
Public awareness;
Saudi Arabia

Summary To limit the spread of Middle East respiratory syndrome coronavirus (MERS-CoV) in Saudi Arabia, the Ministry of Health tried to raise public awareness using different public campaigns. We aimed to measure public awareness of MERS in Saudi Arabia.

A cross-sectional study was conducted between May and June 2014 using a newly designed Arabic questionnaire that was distributed and completed online.

We analyzed the response of 1149 respondents across Saudi Arabia. We found that 97% of the participants were aware of MERS. In addition, 72% realized that coughing and sneezing could spread the infection. Furthermore, 83% thought that some patients with MERS could be cured. Moreover, 62% knew that no vaccine can prevent the disease. However, only 36% realized that taking antibiotics will not stop the infection, and only 41% recognized that no medication has yet been manufactured to treat it. Regarding protection measures, 74% used hand sanitizers, 43% avoided crowded places, and 11% wore masks in public places. Moreover, only 47% knew that bats and camels are the primary source of the virus. As anticipated, this level of awareness varied between the different categories of the studied population. Female, married, older, and more educated participants were significantly more knowledgeable about the disease.

* Corresponding author at: Basic Sciences Department, College of Science and Health Professions, Female Branch, King Saud Bin Abdulaziz University for Health Sciences, P.O. Box 3660, Riyadh 11481, Saudi Arabia. Tel.: +966 11 8011111x47127.

E-mail address: hana.fakhoury@gmail.com (H.M. Fakhoury).

Public awareness of MERS is generally sufficient. However, some false beliefs about treatment were fairly common. In addition, almost half of the population remains unaware that bats and camels are the most likely sources of the virus.

© 2015 King Saud Bin Abdulaziz University for Health Sciences. Published by Elsevier Limited. All rights reserved.

Introduction

The first case of Middle East respiratory syndrome (MERS) was reported in Saudi Arabia in June 2012 [1]. Since then, 1564 cases of MERS have been reported through the 11th of September 2015, with a fatality rate of approximately 35% [2]. The disease is caused by a novel *betacoronavirus* of the *Coronaviridae* family [3]. Initially, scientists suspected that the virus might be transmitted from bats [4,5]. However, more recent studies have shown a strong link between the virus and camels [6–8]. It is now generally accepted that both species serve as natural reservoirs for this virus [9].

The modes of transmission between animals and humans and humans-to-humans remain unclear [10]. However, it is believed that close contact with infected individuals causes transmission. According to the WHO, a large number of MERS cases seem to occur among health care workers, secondary to close contact with primary infected patients [11].

Flu like symptoms and dyspnea are among the signs and symptoms of the initial presentation. Gastrointestinal tract disturbances have also been reported in some patients [12]. In severe cases, acute respiratory failure, acute kidney injury, lymphocytopenia, thrombocytopenia, coagulopathy, and multi-organ failure have been described [12]. These critical presentations are usually associated with senior and/or comorbid patients [13].

To limit the spread of the infection, the Ministry of Health quickly turned to public awareness campaigns to educate the community regarding the possible modes of transmission of this novel virus. The campaign was one of the largest campaigns launched by the Ministry of Health. It included television advertisements that introduced the virus to the public and discussed ways to avoid contracting the infection. It also used text messages to update the public on new developments; these were sent via mobile phones and different social media platforms.

As public awareness is highly important to controlling the disease, this study aimed to measure public awareness toward MERS in Saudi Arabia.

Materials and methods

Ethical approval was obtained from the Institutional Review Board at King Abdullah Medical International Research Centre, National Guard Health affairs, Riyadh, Saudi Arabia. A cross-sectional study was conducted between May and June 2014. The study target population was current residents of Saudi Arabia, regardless of their nationality.

An English questionnaire was designed and translated to Arabic. The Arabic version was pretested on students of King Saud Bin Abdulaziz University for Health Sciences. The questionnaire was uploaded as a Google document and distributed to the Twitter accounts of Saudi celebrities who have more than 1 million followers. The celebrities included writers, politicians, TV presenters, sports personnel, and religious leaders. The celebrities were contacted via email, and nearly all of them agreed to post the survey link. Additionally, they encouraged their followers to participate.

The questionnaire included a section on demographic and socioeconomic factors. However, personal information of the participants, such as names and full addresses, was not gathered, making the data anonymous. Another section of the survey covered general awareness of the infection and protective measures, while the final section addressed knowledge of the disease epidemiology.

Because there were no previous studies in Saudi Arabia regarding MERS awareness among the general population, a conservative choice of 50% awareness was used to determine the sample size. Consequently, a sample of 1066 subjects was needed to calculate a 95% confidence interval with a margin of error of 3%.

Every day, 200 questionnaires were selected randomly and added to the dataset. This systematic

approach was followed until the intended number was reached.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS, version 20). Descriptive statistics were used to assess the baseline demographics and socioeconomic factors. A total score of awareness/knowledge was calculated as the percentage of most acceptable answers. One-way ANOVA and two-independent sample *t*-test were used to examine the differences in the total score between different categories of baseline characteristics.

Results

Baseline characteristics of the respondents

The questionnaire was completed by 1149 respondents. Table 1 summarizes the baseline characteristics of the respondents. Almost half (52%) of the questionnaire respondents were female. The majority (95%) were Saudi and young, with only 3% above the age of 50. The respondents came from six different provinces, with the highest response of 59% from the Central region. Almost half (44%)

of the questionnaire respondents were married. As for educational levels, 29% of the respondents had secondary school certificates or less, 62% had undergraduate degrees, and only 9% had postgraduate degrees. The monthly income varied among the respondents, with a majority (60%) earning less than 7000 SR.

MERS awareness scores

Table 2 is divided into three sections: a score of general awareness of the infection, a score of protective measures against the virus, and a score of knowledge of the disease epidemiology.

An overwhelming majority (97%) of the questionnaire respondents were aware of MERS, with 89% being familiar with its signs and symptoms. Moreover, 72% realized that coughing and sneezing could spread the infection, and 74% knew that the infection is transmitted via close contact. Among the respondents, 64% knew that coronavirus is the cause of MERS. Furthermore, 83% thought that some patients with MERS could be cured. However, 62% knew that no vaccine can prevent the disease. Only 36% recognized that taking antibiotics will not

Table 1 The baseline characteristics of the respondents.

Variable	Categories	N	%
Gender	Female	596	51.9%
	Male	553	48.1%
Nationality	Non-Saudi	55	4.8%
	Saudi	1094	95.2%
Age	11–20 years old	245	21.3%
	21–30 years old	492	42.8%
	31–40 years old	259	22.5%
	41–50 years old	119	10.4%
	51 or more	34	3%
Province of residency	Northern region	52	4.5%
	Southern region	37	3.2%
	Central region	682	59.4%
	Eastern region	122	10.6%
	Western region	224	19.5%
Marital status	Unmarried	646	56.2%
	Married	503	43.8%
Education level	Secondary school or less	336	29.2%
	University degree	707	61.5%
	Postgraduate degree (Master, Doctorate)	106	9.2%
Monthly income ^a	Less than 7000 SR	690	60.1%
	7000 to less than 12,000 SR	218	19.0%
	12,000 to less than 18,000 SR	137	11.9%
	18,000 SR or more	104	9.0%

^a In Saudi Riyals (1US\$ = 3.75 SR).

Table 2 The frequency of the awareness/knowledge of the infection, protective measures against the virus, and awareness of the epidemiology of the disease items as well as the corresponding scores.

Questions	Total sample, N = 1149		
	Most acceptable answer	N	%
Awareness, knowledge of the infection score			
Are you aware of MERS?	Yes	1116	97.1%
Are you aware of the MERS signs and symptoms?	Yes	1021	88.9%
Coughing and sneezing do NOT spread MERS-CoV	False	826	71.9%
There is a vaccine that can stop adults from getting MERS	False	711	61.9%
A person will NOT contract MERS if she or he is taking antibiotics	False	409	35.6%
Corona and MERS are commonly used to refer to the same thing	True	618	53.8%
Some infected people can be cured	True	950	82.7%
MERS-CoV is the cause of MERS	True	734	63.9%
A person with MERS can look and feel healthy	False	391	34.0%
MERS has been shown to spread from person to person via close contact, but without sustained community transmission	True	853	74.2%
Some drugs have been made for the treatment of MERS	False	474	41.3%
Protective measure against virus score			
Did you start to avoid crowded places to stop yourself from contracting MERS?	Yes	491	42.7%
Did you start to avoid going to hospitals/clinics to stop yourself from contracting MERS?	Yes	471	41.0%
Did you start to wash your hand and use hand sanitizers to stop yourself from contracting MERS?	Yes	848	74.0%
Did you start to wear masks to protect yourself from contracting MERS?	Yes	125	10.9%
Awareness of the epidemiology of the disease score			
Do you know the primary source of MERS-CoV?	Bats/camels	541	47.1%
What areas of the body can MERS-CoV infect?	Respiratory system	897	78.1%
	Uncommon	237	20.6%
How common is MERS in Saudi Arabia?			
Which population is at greater risk of developing MERS?	Elderly	547	47.6%
What is the fatality rate caused by MERS?	30%	261	22.7%

prevent the infection, and only 41% realized that no new medication has been manufactured to treat MERS.

Regarding protection measures, 74% used hand sanitizers, 43% avoided crowded places, 41% avoided going to clinics and hospitals, and 11% wore masks in public places.

Concerning knowledge of the disease epidemiology, only 47% knew that both bats and camels are the primary sources of coronavirus. In addition, 78% knew that MERS-CoV primarily attacks the respiratory system. On the other hand, a small minority (21%) knew that MERS is not a very common disease. A similar percentage (23%) realized that the

fatality rate was approximately 30%. Finally, almost half of the respondents knew that the elderly have the highest risk of developing MERS.

MERS awareness scores in relation to the baseline characteristics of the respondents

We studied the awareness scores in relation to the baseline characteristics of the respondents as depicted in Table 3. Interestingly, female individuals scored significantly better than males for the questions related to protective measures ($p=0.004$). Moreover, married individuals

Table 3 The association between the knowledge, protective measures, and awareness scores (considering scores as percentages) and the baseline characteristics.

Variable	Categories	N	Awareness, knowledge of the infection score		Protective measure against virus score		Awareness of the epidemiology of the disease score		Total score	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gender	Female	596	64.4	19.6	44.4	27.8	42.8	20.2	57.9	16.1
	Male	553	63.8	23.0	39.6	28.9	43.7	24.6	56.8	19.2
	P-value		0.673		0.004		0.466		0.309	
Nationality	Non-Saudi	55	66.1	19.0	46.4	26.1	45.5	22.9	60.0	15.6
	Saudi	1094	64.0	21.4	41.9	28.5	43.1	22.4	57.2	17.7
	P-value		0.475		0.254		0.449		0.255	
Age	11–20 years old	245	61.7	20.1	40.1	30.7	39.3	22.6	54.5	17.2
	21–30 years old	492	64.0	22.5	43.1	28.0	42.6	23.2	57.3	18.5
	31–40 years old	259	65.5	20.8	43.9	26.8	44.9	21.0	59.0	16.8
	41–50 years old	119	65.9	18.9	39.7	29.2	49.1	20.0	59.4	15.5
	51 or more	34	66.0	22.2	36.0	25.5	47.6	24.1	58.4	19.2
	P-value		0.259		0.255		0.001		0.035	
Province of residency	Northern	52	66.1	22.0	39.9	32.9	45.4	22.4	58.6	19.7
	Southern	37	60.7	25.6	39.2	29.8	41.1	20.0	54.2	18.1
	Central	682	64.9	20.3	42.3	28.1	43.8	21.8	58.0	16.8
	Eastern	122	61.8	22.6	40.4	26.6	42.1	22.5	55.3	18.2
	Western	224	63.8	22.1	44.9	28.3	42.2	24.0	57.5	18.8
	Outside Saudi Arabia	32	59.9	25.5	31.3	31.1	40.0	26.4	51.8	19.1
	P-value		0.417		0.156		0.743		0.212	
Marital status	Unmarried	646	63.2	21.4	40.7	28.6	41.1	23.4	56.0	17.9
	Married	503	65.2	21.2	43.9	28.1	45.9	20.9	59.1	17.1
	P-value		0.117		0.053		<0.005		0.003	
Education	Secondary school or less	336	58.5	21.6	39.6	29.1	40.4	24.0	52.9	18.8
	University degree	707	66.1	20.7	42.5	27.7	44.1	21.7	58.8	16.9
	Postgraduate degree	106	68.4	21.3	47.6	30.4	46.2	21.4	61.8	16.2
	P-value		<0.005		0.033		0.016		<0.005	
Monthly income ^a	Less than 7000	690	62.3	21.4	41.4	29.0	41.6	22.2	55.7	18.0
	7000 to less than 12,000	218	63.3	21.8	45.0	27.3	42.8	23.7	57.4	18.3
	12,000 to less than 18,000	137	69.7	19.0	42.9	26.1	47.3	21.4	61.9	14.9
	18,000 or more	104	70.6	19.8	39.9	29.7	49.4	21.0	62.3	15.6
	P-value		<0.005		0.338		0.001		<0.005	

^a In Saudi Riyals (1\$ = 3.75 SR).

had a significantly higher total score in comparison to unmarried individuals ($p=0.003$). Of great interest was the finding that knowledge was significantly correlated with age. Indeed, older individuals had a significantly higher total score ($p=0.035$). On the other hand, both educational attainment and monthly income impacted the level of knowledge. As expected, more educated individuals scored significantly higher than others ($p<0.005$). In addition, individuals with higher income had significantly higher scores ($p<0.005$).

Discussion

This study reached a wide range of Twitter users in the Saudi community to measure their MERS awareness. We used Twitter, one of the best social media networks and a fast-growing platform for data collection. Participation in this study was completely voluntary, which makes the statistical data valid and reliable. The expected percentage, as analyzed by the statistical software of public awareness, was 50%, and the actual percentage revealed by this study was much higher.

One might conclude from this study that MERS awareness among the Saudi public is generally satisfactory. Female, married, older, and more educated participants were significantly more knowledgeable about the disease. However, some false beliefs about treatment were fairly common, as demonstrated by the fact that only 36% of the respondents could recognize that antibiotics cannot treat the infection and only 41% knew that doctors do not have an antiviral drug for MERS.

Moreover, heightened anxiety was noted, especially in that only 21% knew that MERS is not a very common disease. In addition, lack of information about the source of the virus was quite common, with almost half of the population remaining unaware that bats and camels are the most suspected sources of the virus.

In comparison with two studies regarding the knowledge of MERS among French and Australian pilgrims [14,15], our study demonstrates that the Saudi public is much more aware of the disease. Approximately 65% of the French and only 35% of the Australian pilgrims were aware of the MERS epidemic in Saudi Arabia. However, according to the French study, the French pilgrims were more serious about taking protective measures. Most French pilgrims (90%) used hand sanitizers and wore masks in comparison to 74% of our study participants who used hand sanitizers and only 11% who wore masks in public places.

One could argue that some of the questions addressed were not truly dichotomous and might have constituted a bipolar trap for the respondents. However, it is important to note that the questionnaire was designed and offered in Arabic and that an English translation might have conveyed some inevitable inaccuracy.

Although the efficacy of the protective measures described in this questionnaire, such as facemasks, is not fully established [16], these measures are among the very few readily available methods that the general public can use for protection.

It is noteworthy that new findings have been observed since the time that the study was conducted. For instance, the presence of asymptomatic carriers of the disease was not well established previously. However, it is now evident that asymptomatic health care workers can spread the illness among hospitalized patients, making the disease nosocomial [17].

The results of this study should be interpreted bearing in mind its limitations. Our studied population consisted mainly of Twitter users, who tend to be more educated and younger individuals in the Saudi community, and therefore, our findings are limited to this subpopulation. In addition, most of the participants were from the Central province. This limitation might be because the Central region is highly populated and includes the Capital City of Riyadh, where most of the celebrities reside. Our questionnaire did not address the source of information that the public used to become informed about MERS. Therefore, we could not determine which method is most effective in educating the Saudi public. A further limitation is not addressing the issue of the avoidance of pilgrimage and visiting crowded places, such as the Holy Mosques of Makkah and Medina. The questionnaire included a vague question on avoidance of crowded places without any further description. Another shortcoming is the lack of information on the consumption of camel products. Drinking raw camel milk and consuming camel meat are Saudi traditions. Additionally, using camel urine as an alternative medicine is still practiced by some Saudi individuals. This is of high significance, especially as more studies are linking the consumption of raw camel products with MERS-CoV infection [18].

MERS remains a serious threat that has a large impact on public health in the Kingdom. As the disease continues to evolve, vaccine and specific antiviral agents are urgently needed. In the meantime, promoting protective measures among the public will enhance safety and help reduce the spread of the infection. Based on the present findings, we recommend a more rigorous public

awareness campaign to correct misconceptions. This can be done by addressing the public through clear television advertisements, mobile messages, and different social media modalities. Alternatively, campaigns carried out in schools, colleges, and malls can also educate the public. More essentially, site visits to camel farms by veterinary or infection control officers are important strategies for preventing MERS-CoV transmission between camels and humans. The Saudi public must be clearly instructed to avoid direct contact with camel body fluids until the eradication of the infection is made possible. In addition, the consumption of raw camel products must be avoided. More importantly, persons with frequent contact with camels should be targeted in future MERS education campaigns. The Ministry of Agriculture should find a method for educating those individuals and convincing them of the health hazard that camels pose. These health education messages should be conveyed without creating anxiety and fear in the community to avoid irrational and unnecessary demands on health services.

In light of the latest Riyadh outbreak, one cannot stress the role of health care workers in containing the infection enough. Implementing strict infection control measures under all circumstances is extremely important. In this regard, continuous training and contingency measures are needed in all health care settings to prevent such outbreaks.

Funding

No funding sources.

Conflicts of interest

The authors have declared that no competing interests exist.

Ethical approval

Not required.

Acknowledgements

The authors would like to thank Prof. Ali H. Hajeer for his supervision of this student research project. Additionally, the study would not have been possible without the constructive help of Dr. Noura

K. Al-Ayedh, who offered support in collecting the study data.

References

- [1] Zaki AM, van Boheemen S, Bestebroer TM, Osterhaus AD, Fouchier RA. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. *N Engl J Med* 2012;367:1814–20.
- [2] WHO. Middle East respiratory syndrome coronavirus (MERS-CoV) – Saudi Arabia; 2015.
- [3] Woo PC, Lau SK, Huang Y, Yuen KY. Coronavirus diversity, phylogeny and interspecies jumping. *Exp Biol Med (Maywood)* 2009;234:1117–27.
- [4] Memish ZA, Mishra N, Olival KJ, Fagbo SF, Kapoor V, Epstein JH, et al. Middle East respiratory syndrome coronavirus in bats, Saudi Arabia. *Emerg Infect Dis* 2013;19:1819–23.
- [5] Smith I, Wang LF. Bats and their virome: an important source of emerging viruses capable of infecting humans. *Curr Opin Virol* 2013;3:84–91.
- [6] Briese T, Mishra N, Jain K, Zalmout IS, Jabado OJ, Karesh WB, et al. Middle East respiratory syndrome coronavirus quasispecies that include homologues of human isolates revealed through whole-genome analysis and virus cultured from dromedary camels in Saudi Arabia. *MBio* 2014;5:e01146–1214.
- [7] Haagmans BL, Al Dhahiry SH, Reusken CB, Raj VS, Galiano M, Myers R, et al. Middle East respiratory syndrome coronavirus in dromedary camels: an outbreak investigation. *Lancet Infect Dis* 2014;14:140–5.
- [8] Reusken CB, Haagmans BL, Muller MA, Gutierrez C, Godeke GJ, Meyer B, et al. Middle East respiratory syndrome coronavirus neutralising serum antibodies in dromedary camels: a comparative serological study. *Lancet Infect Dis* 2013;13:859–66.
- [9] Maltezou HC, Tsiodras S. Middle East respiratory syndrome coronavirus: implications for health care facilities. *Am J Infect Control* 2014;42:1261–5.
- [10] Raj VS, Osterhaus AD, Fouchier RA, Haagmans BL. MERS: emergence of a novel human coronavirus. *Curr Opin Virol* 2014;5:58–62.
- [11] WHO. Summary of current situation, literature update and risk assessment – as of 7 July 2015; 2015.
- [12] Assiri A, Al-Tawfiq JA, Al-Rabeeh AA, Al-Rabiah FA, Al-Hajjar S, Al-Barrak A, et al. Epidemiological, demographic, and clinical characteristics of 47 cases of Middle East respiratory syndrome coronavirus disease from Saudi Arabia: a descriptive study. *Lancet Infect Dis* 2013;13:752–61.
- [13] Arabi YM, Arifi AA, Balkhy HH, Najm H, Aldawood AS, Ghabashi A, et al. Clinical course and outcomes of critically ill patients with Middle East respiratory syndrome coronavirus infection. *Ann Intern Med* 2014;160:389–97.
- [14] Gautret P, Benkouiten S, Salaheddine I, Belhouchat K, Drali T, Parola P, et al. Hajj pilgrims knowledge about Middle East respiratory syndrome coronavirus, August to September 2013. *Euro Surveill* 2013;18:20604.
- [15] Tashani M, Alfelali M, Barasheed O, Fatema FN, Alqahtani A, Rashid H, et al. Australian Hajj pilgrims' knowledge about MERS-CoV and other respiratory infections. *Virol Sin* 2014;29:318–20.
- [16] Wang M, Barasheed O, Rashid H, Booy R, El Bashir H, Haworth E, et al. A cluster-randomised controlled trial to

- test the efficacy of facemasks in preventing respiratory viral infection among Hajj pilgrims. *J Epidemiol Glob Health* 2015;5:181–9.
- [17] Zumla A, Hui DS, Perlman S. Middle East respiratory syndrome. *Lancet* 2015;386:995–1007.
- [18] Gossner C, Danielson N, Gervelmeyer A, Berthe F, Faye B, Kaasik Aaslav K, et al. Human-Dromedary camel interactions and the risk of acquiring zoonotic Middle East respiratory syndrome coronavirus infection. *Zoonoses Public Health* 2014.

Available online at www.sciencedirect.com

ScienceDirect