

Assessment Of The Awareness Of Middle East Respiratory Syndrome-Coronavirus Infection In Saudi Arabia: A Cross-Sectional Survey

N Al-Abdullah, R Kaki, O Almutairi, H Ajaj, A Alamoudi, M Markuobi, F Sugati, N Bajunaid, R Nablawi, I Jali

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Abstract

Objective: The objective of this study was to understand the level of awareness of Middle East respiratory syndrome-coronavirus (MERS-CoV) among the Saudi population.

Design: This was a cross-sectional survey.

Setting: the study was conducted in Saudi Arabia (central, western and eastern regions) between September and December 2015.

Participants: We assumed that about 50% of the Saudi population would have basic information about MERS, and the estimated sample size was calculated with 80% power, 95% confidence limit, design effect that equals 2, and 20 clusters. Our target was to recruit about 10,000 participants. A structured questionnaire regarding MERS-CoV was distributed electronically and manually among the general population between September and December 2015. We received responses from 8,159 participants (average response rate, 82%).

Primary outcome measures: The main outcome of interest was a participant's knowledge of MERS-CoV.

Results: The majority of the participants (6,005; 73.6%) were female, and the most frequent age group was 21–30 years with 3,780 (46.3%) respondents, while the least frequent age group was >60 years with 48 (0.6%) respondents. About 71.2% of the respondents had university-level education. The majority of the respondents (45.1%) were from the central region. A relatively high number of respondents (39.2%) believed that camels are the source of the virus. Among the respondents, 21% claimed to have received sufficient, complete, and good information about MERS-CoV, while 72.2% claimed that they did not receive enough information from their healthcare centres.

Conclusion: Awareness of MERS-CoV needs to be increased in the Saudi community. The Saudi healthcare system needs to distribute timely and complete information about the virus in order to prevent transmission of infection.

Strengths and limitations of this study

- The strength of this study is that it is the largest study on Middle East respiratory syndrome-coronavirus awareness in the kingdom of Saudi Arabia.
- Additionally, the study assessed the entire community, unlike other studies that mainly focused on healthcare workers.
- The limitation of this study is that we could not assess the level of awareness among farmers and camel owners.
- Additionally, the presence of a high number of female participants, young participants, and participants with high education levels might have introduced bias in our research.

INTRODUCTION

Middle East respiratory syndrome (MERS) is a highly lethal,

viral respiratory disease that was first reported in Saudi Arabia in 2012 and has since spread to several other

countries, including the United States.¹ MERS is caused by a novel positive-sense, single-stranded RNA virus of the genus beta-coronavirus, named MERS-CoV.² Most people infected with MERS-CoV were reported to have developed a severe acute respiratory illness, fever, cough, and shortness of breath, which in many cases caused mortality.³

Dromedary camels are hosts for MERS-CoV, and they have been associated with direct or indirect transmission to humans. The clinical features of MERS range from asymptomatic or mild disease to acute respiratory distress syndrome and multi-organ failure resulting in death, especially in patients with underlying comorbidities.⁴ To date, there is no specific drug treatment for MERS, and infection control measures are crucial to prevent its spread in healthcare facilities.^{4 5}

The Ministry of Health reported 1457 cases of MERS-CoV infection in Saudi Arabia between 2012 and September 2016.⁶ In November 2013, King Abdulaziz University Hospital (KAUH) had the first confirmed case of MERS-CoV.⁷ Detailed epidemiological, clinical, serological, and genomic investigations of this case performed by the Infectious Diseases/Infection Control Team at KAUH led to the major discovery that camels are the source of infection in humans.⁷ A large outbreak of MERS occurred around April–May 2014 in several tertiary care hospitals in Jeddah, which caused major panic throughout Saudi Arabia. The primary reason for this outbreak was the failure to perform triage for patients with acute respiratory illness, suboptimal adherence to infection control standards, and overcrowding in the emergency and dialysis units.⁸ The outbreak was so severe that many healthcare workers were infected, and some of these workers died.⁹ In view of the international concern and potential for global transmission, studies on the mechanism of infection of the MERS virus, its mode of transmission, and the high-risk groups have been published.¹⁰ According to the latest WHO status report, there was a recent surge in the number of MERS-CoV cases reported in March 2016; however, a steady decline in the number of cases has been noted in Saudi Arabia from April to May 2016.¹¹ Patients aged 50–59 years have the highest risk of acquiring this infection as primary cases, while those aged 30–39 years have the highest risk of acquiring this infection as secondary cases. The majority of deaths among primary and secondary cases have occurred in patients aged 50–59 years and those aged 70–79 years, respectively.¹¹

The Saudi Ministry of Health has presented protective

measures on their website for the public, in order to prevent disease transmission. Some of the measures are washing hands well with water and soap or disinfectants especially after coughing or sneezing; trying as much as possible to avoid touching the eyes, nose, or mouth; avoiding contact with infected patients; using a handkerchief when coughing; putting on a face-mask when visiting sick patients; adhering to hygiene; and finally, paying attention to healthy life habits, such as good nutritional balance and regular physical activity.¹²

The fatality rate for MERS-CoV infection was exceptionally high at 55% in the year 2013, and it has subsequently shown a decreasing trend. However, the overall current fatality rate is as high as 41.813%.¹³ The high mortality rate and the behavioural uncertainties of this virus have understandably caused major concerns. Owing to the abruptness of outbreaks and the lack of previous studies, public awareness about MERS-CoV is limited, and it has been reported that patients have false beliefs about treatment and that half of the population remains unaware that camels are the most likely source of the virus.¹¹ The present study attempted to understand the current level of MERS-CoV awareness among the Saudi population through a survey, and to identify the aspects of concern based on the results of the survey.

METHODS

Study Design

A cross-sectional survey of the awareness of MERS-CoV was conducted in the city of Jeddah, the second most populous city in Saudi Arabia. At the time of the study, the population of Saudi Arabia was approximately 27,000,000, and the survey participants were recruited from all over the Kingdom. A structured questionnaire on MERS-CoV was prepared in both Arabic and English, based on a review of the literature and consultation with regional community health teams in Saudi Arabia. The questionnaire consisted of the following five domains: (i) socio-demographic characteristics, (ii) information about MERS-CoV, (iii) signs and symptoms, (iv) mode of transmission, and (v) source of information about the disease and its mode of transmission. The content of the questionnaire was validated by an infectious disease epidemiologist and refined during pilot testing.

The survey was conducted by electronic and manual methods between September and December 2015. The

manual questionnaire was administered by undergraduate medical student interns of a medical school affiliated to KAUH. These students received a 2-day training in research methodology, including administration of community-based surveys. The individuals who could correctly identify three modes of transmission were assigned to collect information from the respondents about the mode of transmission.

Study population

Preliminary analysis of the distribution of 1,457 MERS cases (up to October 2, 2016) [6] that occurred in Saudi Arabia since 2012 revealed that the majority of cases were from the following three regions within the country: central region (admitted to hospitals in Riyadh), western region (Jeddah), and eastern region (Al-Ahassa). Few cases were reported from the northern and southern regions of Saudi Arabia. The participants were recruited proportionate to the distribution of MERS cases in Saudi Arabia. We assumed that about 50% of the population would have basic information about MERS, and the estimated sample size was calculated with 80% power, 95% confidence limit, design effect that equals 2, and 20 clusters.

The populations in the selected regions were estimated as follows: central, 5.5–6.0 million; western, 2.5–3.0 million; eastern, 1.5–2.0 million; southern, 1.5–2.0 million; and northern, 1–1.5 million. Our target was to recruit about 10,000 participants. We received responses from 8,159 participants (average response rate, 82%). Among the responders, 100 had completed the questionnaire by themselves (some needed help understanding few questions) and 8,059 responded to the questionnaire electronically.

Inclusion and exclusion criteria

All individuals, except those aged below 15 years, health care workers, and those who did not speak Arabic or English, were eligible for study inclusion.

Data collection

The principle researcher trained 6th year medical students for data collection in order to avoid mistakes or bias. Piloting data collection started manually by interviewing participants in different areas of Jeddah city for validating the questionnaire.

After piloting, no changes or amendments to the questionnaire were needed, as the participants found the questionnaire easy to understand. Investigations were

undertaken to ensure that when distributed, the electronic questionnaire would be clear for participants within the target age group, irrespective of the level of education.

Demographic data, including level of education, level of income, social class, and occupation were collected.

All participants were recruited through the electronic questionnaire, except those in the pilot phase. Each region had a team to distribute the questionnaire link.

Outcome variables

The main outcome of interest was a participant's knowledge of MERS-CoV (either 'sufficient knowledge' or 'no knowledge'). Based on the responses, the participants were divided into specific categories.

Statistical analysis

Univariate analysis was performed to identify the outcome ('aware' or 'not aware'). Categorical data were coded to include 'missing' as a valid response category. Pearson's chi-square test was used for the comparison of categorical data. Binary logistic regression was used to identify independent predictors of participants with an awareness of MERS-CoV. Data collection, analysis, and statistical analyses were performed using SPSS ver. 21 software (SPSS Inc., Chicago, IL).

RESULTS

The survey questionnaire was completed by 8,159 respondents. Table 1 summarises the baseline characteristics of the respondents. The majority of the participants (6,005; 73.6%) were female, and the most frequent age group was 21–30 years with 3,780 (46.3%) respondents, while the least frequent age group was >60 years with 48 (0.6%) respondents. University graduation was the most common level of education (5,810 [71.2%] respondents).

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Table 1

Characteristics of the sample population

| Characteristic | n (%) |
|---------------------|------------|
| Gender | |
| Male | 483 (56.2) |
| Female | 367 (43.8) |
| Age | |
| 18-24 | 180 (21.5) |
| 25-34 | 210 (25.2) |
| 35-44 | 190 (22.8) |
| 45-54 | 150 (18.0) |
| 55-64 | 100 (12.0) |
| 65+ | 50 (6.0) |
| Marital status | |
| Single | 210 (25.2) |
| Married | 357 (42.8) |
| Divorced | 100 (12.0) |
| Widowed | 50 (6.0) |
| Education level | |
| High school | 100 (12.0) |
| College | 150 (18.0) |
| University | 200 (24.0) |
| Postgraduate | 150 (18.0) |
| Occupation | |
| Student | 100 (12.0) |
| Healthcare worker | 150 (18.0) |
| Government employee | 100 (12.0) |
| Private employee | 100 (12.0) |
| Unemployed | 50 (6.0) |

Table 2 shows the distribution of the responses of the participants to the survey questionnaire. The first five sections (questions) were related to the awareness of MERS-CoV in the Saudi population. It was found that the majority of respondents (78.3%) did not have sufficient information, and only 21.7% had received information about MERS-CoV. However, a high proportion of respondents (78%) knew that the disease is caused by a virus. Of the study participants, 27 (0.3%) had experienced MERS-CoV infection. Regarding the epidemiology of the disease, majority of the respondents were not aware that camels are the primary source of the virus (39.2% answered positively). About half of the respondents (54.4%) were aware that MERS could be treated with supportive measures.

Table 2

Awareness of the respondents with regard to MERS-CoV

| Question | Yes (%) | No (%) |
|------------------------------------------------------------------|--------------|--------------|
| 1. Do you know MERS-CoV? | | |
| Yes | 21.7 (26.0) | 78.3 (94.0) |
| No | 78.3 (94.0) | 21.7 (26.0) |
| 2. Do you know MERS-CoV is caused by a virus? | | |
| Yes | 78.0 (94.0) | 22.0 (26.4) |
| No | 22.0 (26.4) | 78.0 (94.0) |
| 3. Have you ever been infected with MERS-CoV? | | |
| Yes | 0.3 (0.4) | 99.7 (119.6) |
| No | 99.7 (119.6) | 0.3 (0.4) |
| 4. Do you know camels are the primary source of MERS-CoV? | | |
| Yes | 39.2 (47.0) | 60.8 (73.0) |
| No | 60.8 (73.0) | 39.2 (47.0) |
| 5. Do you know MERS-CoV can be treated with supportive measures? | | |
| Yes | 54.4 (65.3) | 45.6 (54.7) |
| No | 45.6 (54.7) | 54.4 (65.3) |
| 6. Do you know MERS-CoV is spread by coughing? | | |
| Yes | 74.5 (89.4) | 25.5 (30.6) |
| No | 25.5 (30.6) | 74.5 (89.4) |
| 7. Do you know MERS-CoV is spread by touching surfaces? | | |
| Yes | 59.0 (70.6) | 41.0 (49.4) |
| No | 41.0 (49.4) | 59.0 (70.6) |
| 8. Do you know MERS-CoV is spread by camels? | | |
| Yes | 39.2 (47.0) | 60.8 (73.0) |
| No | 60.8 (73.0) | 39.2 (47.0) |

The next section was related to signs and symptoms of the disease. It was found that most of the respondents (85.5%) knew that fever is the first sign of MERS, followed by difficulty in breathing (74.5%) and cough (59%).

Female participants, single participants, and young adults were significantly more knowledgeable about the disease than male participants, married participants, and older adults

($P = 0.02$). The most common and statistically significant ($P = 0.02$) source of information for the study respondents was social media (48.2%), followed by reading brochures (23.5%) (Table 2).

DISCUSSION

A comparison of the present study with other similar studies is shown in Table 3. The present study on the awareness of MERS-CoV is the largest study conducted in Saudi Arabia and covers a major part of the Saudi community, with the highest proportion of participants from the central and western regions (74.4%), which are the most populous regions of the Kingdom. Other similar studies on the awareness of MERS-CoV in the general population by Al-Mohrej et al. and Almutairi et al. had less than 1,500 respondents, and the latter study was restricted to the city of Riyadh.^{11 14} The results of the present study have better validity and reliability as the study was voluntary and the survey was administered both by electronic and personal interview methods, covering both users and non-users of electronic gadgets. The statistical outcomes can be generalised as the survey covered participants of different ages and socio-economic groups. This study differs from a previous study conducted in Saudi Arabia (table 3), in which majority of the participants were from the highly populated central region.

Table 3

Comparison of the present study with similar studies from the literature

| Study | N | Population | Aware of Pathogen | | Transmission camel/bat | Cough/ Resp. symptoms | Source of information | Infection % control |
|----------------|-------|-----------------|-------------------|------|------------------------|-----------------------|-----------------------|---------------------|
| | | | MERS | MERS | | | | |
| Present Study | 8,159 | General | 22 | 78 | 39 | 74 | Social media | 48 |
| Al-Mohrej 2016 | 1,149 | General | 97 | - | 47 | 72 | - | - |
| Almutairi 2015 | 1,147 | General | 92 | 92 | 49 | 80 | - | 92 |
| Khan 2014 | 153 | HCW | 73 | 77 | - | 96 | Internet | 26 94 |
| Khanna 2015 | 200 | Dental students | 54 | - | 48 | 54 | College | 27 79 |

This study found that awareness of MERS-CoV among the Saudi population is generally good. Additionally, we found that MERS-CoV knowledge was greater in female participants, single participants, and young adults than in male participants, married participants, and older adults ($P = 0.02$). Al-Mohrej et al. found that female participants, married participants, and participants aged >60 years were more aware about MERS-CoV than other participants.¹¹ The majority of participants lacked knowledge of the mode

of transmission and the primary source of the MERS-CoV pathogen. Numerous studies from Saudi Arabia have shown that there is a link between camels and MERS-CoV transmission.^{7 15-18} The Saudi community needs more education about the disease, and an awareness campaign targeted at senior citizens, especially men aged over 40 years, is recommended. In the present study, the question about the mode of transmission was not answered correctly by majority of the participants. Additionally, most of the participants believed that MERS-CoV could be prevented if precautionary measures are taken. In addition, lack of information about the source of the virus was quite common, and this finding is consistent with the findings of previous studies, with almost half of the participants unaware that camels are the most likely source of the virus.^{11 14 19} In a study by Almutairi et al., 43.9% of the respondents stated that sexual contact was a possible mode of transmission.¹⁴

With regard to the signs and symptoms of MERS-CoV infection, majority of the participants were aware that fever, cough, and difficulty in breathing are the most common symptoms, and this finding is consistent with the findings of other studies.^{11 14 20} Therefore, it can be concluded that the respondents were well aware of the signs and symptoms of MERS. Although fever, cough, and shortness of breath are the most common symptoms, some patients present to the hospital with a very different set of symptoms. Such new clinical information has necessitated revision and approval of the MERS-CoV case definition by the WHO advisory council after seeking external CDC expert opinion.²¹ The new case definition has defined several categories based on the reported healthcare-associated symptoms: (i) category 2, MERS-CoV pneumonia; (ii) category 3, non-respiratory characteristics with confirmed infection after initial presentation with acute febrile dengue-like illness with body ache, leucopaenia, and thrombocytopenia; (iii) category 4, contact with people having MERS-CoV, who present with not only lower respiratory tract features, but also isolated upper respiratory tract features. This revised definition has classified the status of patients into the following three categories: suspect, probable, and confirmed infection. Awareness of the revision and the use of the categories of infection in the management algorithm for patients suspected of MERS-CoV infection needs to be created among healthcare workers.²²

The present study also highlights the importance of public health education to prevent transmission of infection, in line

with a previous MERS-CoV study.²³ In response to the recent disease outbreak, the Saudi Government created a position of Deputy Minister for Public Health and changed the 'Directorate of Primary Health Center' to the 'Directorate of Public Health'.²⁴ In order to prevent the spread of infection, the Ministry of Health acted quickly to arrange public awareness campaigns for educating the community regarding the possible modes of transmission of MERS-CoV.²⁵⁻²⁷ An exponential increase in the number of cases of MERS-CoV after the outbreak of 2014 prompted quick action by the Ministry of Health, leading to the setting-up of an advisory council to develop scientific, evidence-based plans to control MERS. A continuously operating command and control centre was also established. Among the several noteworthy measures taken by the Ministry, the most important measures were improving public relations to communicate relevant information to the public, healthcare workers, and local and international media; and overseeing infection control practice and staff training activities.²² The Ministry of Health has also published 'Infection Prevention/Control and Management Guidelines' for hospitals and healthcare workers.²⁸ In a previous study on the knowledge and attitude of healthcare workers with regard to MERS, the most positive attitude of healthcare workers was regarding the use of protective equipment when dealing with MERS patients.²⁰ This finding is in line with the finding of another study, which showed a positive response from healthcare workers with regard to wearing protective goggles and gloves while dealing with healthcare-associated infections.²⁹ However, the healthcare workers in the 2014 study by Bener A were least knowledgeable regarding the management of MERS, as 57.6% of the workers replied wrongly when asked whether antibiotics are the first choice drugs. This finding is somewhat similar to the finding of a previous study on Severe Acute Respiratory Syndrome (SARS), in which 40% of the respondents provided incorrect answers when asked about management of the condition.³⁰ On the other hand, in a study of 200 dental students from Jeddah, more than half (54%) of those interviewed had good knowledge about the aetiology, symptoms, and treatment of MERS-CoV. Additionally, majority (79%) of the respondents were aware of infection control and protection measures.¹⁹ The two major outbreaks of MERS-CoV in Jeddah and Riyadh have highlighted the important role of healthcare workers in containing the infection and implementing strict infection-control measures.^{25 26} Therefore, continuous training and contingency measures are needed in all hospitals to prevent

an outbreak. A recent article explored the status and preparedness of the public health workforce in Saudi Arabia. The study identified shortages within the workforce and lack of training staff opportunities as the key problems facing the Department of Public Health.³¹

In the intervening time, based on the present findings, a more rigorous awareness campaign is recommended to correct misconceptions, especially among the elderly and those who do not use social media. Television could be used to increase awareness. Preventive measures are better than curative measures, as the cost of treatment for a MERS-CoV patient is estimated to be 4,000–5,000 Saudi riyals SR, based on the cost for a patient admitted to KAUH in 2015.

The present study has several limitations. First, we wanted to assess the level of awareness among farmers and camel owners; however, our personal interview was carried out in a large shopping mall, which was not easily accessible to these individuals. Additionally, a large number of these individuals do not use the internet; therefore, we could not send them the questionnaire electronically. 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. Second, the presence of a high number of female participants, young participants, and participants with high education levels might have introduced bias in our research; however, these are the main groups that respond to such questionnaires.

CONCLUSION

In conclusion, the present study highlights the need to create wide-spread awareness about MERS-CoV infection, its mode of transmission through camels and bats, management of infected individuals, especially elderly individuals with comorbidities, and preventive measures, such as hand washing, the use of protective wear, and non-consumption of uncooked food or food that might be infected, among individuals who do not have access to the internet and social media. These individuals can be educated through posters and television, and dissemination of information by local healthcare workers. The Saudi community needs to be clearly instructed to avoid direct contact with camel body fluids until the infection has been eradicated. Additionally, implementing strict infection-control measures in all hospitals under all circumstances is very important. Therefore, continuous training and contingency measures are needed in all hospital settings to prevent further outbreaks of

MERS-CoV in Saudi Arabia. The Ministry of Health in Saudi Arabia has initiated several measures to contain the outbreak, but long-term sustainable benefits will only be possible when people living in the Kingdom are educated on the prevention and management of infection at the local level.

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Author Information

Nabeela Al-Abdullah, PhD

Department of Infection Control and Environmental Health; Department of Public Health, College of Nursing, King Abdulaziz University Hospital
Jeddah, Saudi Arabia

Reham Kaki, MD

Department of Infection Control and Environmental Health; Department of Medicine, College of Nursing, King Abdulaziz University Hospital
Jeddah, Saudi Arabia

Osama Almutairi, MD

Department of Infection Control and Environmental Health, King Abdulaziz University Hospital
Jeddah, Saudi Arabia

Hesham Ajaj, MD

Department of Infection Control and Environmental Health, King Abdulaziz University Hospital
Jeddah, Saudi Arabia

Afanan Alamoudi, MD

Department of Infection Control and Environmental Health, King Abdulaziz University Hospital
Jeddah, Saudi Arabia

Musab Markuobi, MD

Department of Infection Control and Environmental Health, King Abdulaziz University Hospital
Jeddah, Saudi Arabia

Faisal Sugati, MD

Department of Infection Control and Environmental Health, King Abdulaziz University Hospital
Jeddah, Saudi Arabia

Nisreen Bajunaid, MD

Department of Medicine
Jeddah, Saudi Arabia

Rana Nablawi, MD

Department of Medicine
Jeddah, Saudi Arabia

Ibtisam Jali, MD

Department of Medicine
Jeddah, Saudi Arabia