

Conference Paper

Middle East Respiratory Syndrome Corona Virus (MERS-CoV): Levels of Knowledge and Awareness in Bahrain

A. Shammah¹, H. Budoor¹, M. Suad¹, Alahmadi¹, K. Richard², S. Maha¹, and G. V. Asokan¹

¹Departments of Nursing & Public health, CHS, UOB, Bahrain

²South Asian Cochrane Centre and Network, Christian Medical College, Vellore, India

Abstract

The Middle East respiratory syndrome coronavirus (MERS–CoV) was first identified in the Kingdom of Saudi Arabia (KSA) in 2012 that accounts 80% of the global cases. On 10th of April 2016, Bahrain notified WHO of a first fatal case. Hence, as a public health research and practice, the authors sought to assess the knowledge and awareness of MERS-CoV in Bahrain. A cross-sectional, conveniently sampled study was carried out through face-to-face interviews using a structured Arabic questionnaire among 498 Bahraini adults. While, 95% had a travel history to KSA, around 50% had the knowledge and awareness of MERS CoV being a viral lethal disease and its associated symptoms. Stratifying by socio-demographics, the authors found that the levels of education, occupation, history of travel to KSA were significantly associated with the knowledge and awareness of MERS CoV ($p < 0.05$). On the preventive measures of MERS CoV, occupation and history of travel to KSA were significantly associated ($p < 0.05$). Considering the first notified case from Bahrain, proximity and travel history to KSA of 95% of the Bahrainis, the knowledge and awareness of MERS CoV is found to be inadequate. Therefore, the knowledge and awareness campaign on MERS CoV is pivotal as a good public health practice.

Keywords: MERS-CoV, Knowledge, Awareness, Bahrain

Corresponding Author:

A. Shammah

Received: 18 September 2018

Accepted: 10 October 2018

Published: 15 October 2018

Publishing services provided by
Knowledge E

© A. Shammah et al. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the Sustainability and Resilience Conference Committee.

1. Introduction

The novel lineage C beta corona virus (Middle East respiratory syndrome coronavirus, or MERS–CoV) was first identified in the Kingdom of Saudi Arabia in 2012¹. Although, current evidence suggests that insectivorous bats are likely to be the original source², dromedary camels (*Camelus dromedarius*) are a natural host and likely source of human MERS-CoV infection that can cause fatal respiratory disease in humans³.

OPEN ACCESS

Notably, Arabian Peninsula, Pakistan and North, West, and East Africa harbor MERS-CoV-infected camels, and camel trade promotes the movement of infected hosts^{4,5,6}. Despite, 80% of human MERS cases have been reported from Saudi Arabia, the disease has spread globally; 27 countries in four continents have reported cases of MERS and approximately 35% of reported MERS patients have died. By June 2018, 2229 cases of laboratory confirmed cases and 791 associated deaths were reported globally^{7,8}. Of importance, the first MERS-CoV outbreak of 185 cases occurred in South Korea in 2015 from a single imported case from the Kingdom of Saudi Arabia, signaling the propensity to spread in new geographic locations. Due to delayed diagnosis of index patients, the reproductive number (Ro) greatly exceeded 1 in the early stages of the outbreak^{9,10}. Recently, the global seasonal occurrence of MERS-CoV outbreak cases were estimated with the available data between 2012 and 2017. It was found that the highest occurrences were found in the month of June, while the lowest was found in the month of January, further, seasonal variations were also observed¹¹.

The Kingdom of Bahrain in the Arabian Gulf is made up of 33 islands with a population of 1.3 million, which includes Bahrainis (48%) and multi-ethnic expatriates (52%)¹². The 25-km causeway, launched in 1986, links Bahrain to the eastern region of the Kingdom of Saudi Arabia (epicenter of MERS-CoV). It is reckoned to be a busiest bridge in the region. Based on 2013 data, the traffic flow is estimated to be of 20 million passengers both ways. Mainly during the Haj season, but also at other times, many international pilgrims transit Bahrain to visit the holy cities of Mecca and Medina in the Kingdom of Saudi Arabia. MERS-CoV-specific antibodies have been detected in the serum of dromedary camels across Northern Africa and across the Arabian Peninsula¹³, therefore, Bahrain's geographic location places itself at risk for MERS-CoV infection. After a gap of four years since the first case reported in 2012 from neighboring Kingdom of Saudi Arabia, on 10th of April 2016, the National IHR focal point of Bahrain notified WHO of a first fatal case of MERS-CoV¹⁴. This notification of the first case was puzzling particularly Bahrain's close proximity to the Kingdom of Saudi Arabia and considering the heavy traffic in the causeway. However, no serological tests have been performed on camels or humans in Bahrain, to evaluate the genetic susceptibility, antibodies, or possible carrier state and presence of undetected cases, if any, while the burden of MERS-CoV infection in the Bahraini population is unknown.

It is evident that there is a large MERS-CoV camel reservoir, and there is no specific treatment or vaccine, therefore, the potential risk of global spread is ever present¹⁵. Given the enigmatic first case reported from Bahrain, the rapid mass mobility of people through causeway on both ways of Bahrain and the Kingdom of Saudi Arabia and

the international pilgrims transiting through Bahrain to visit the holy places in the Kingdom of Saudi Arabia, the potential risk of MERS CoV in Bahrain cannot be underestimated. Hence, as an early stage in public health research and practice, we sought to assess the knowledge and awareness of MERS-CoV in the Bahraini community.

2. Literature Review

Current evidence suggests that MERS-CoV is a zoonotic virus. MERS-CoV is genetically related to bat β CoV¹ and bats were also found to be susceptible to MERS-CoV infection. Preliminary reports on the role of camels as a MERS-CoV reservoir were evident by the prevalence of MERS antibodies in camels from Oman, Egypt and the Kingdom of Saudi Arabia. Further, dromedary camels from African countries such as: Algeria, Ethiopia, Kenya, Nigeria, Sudan and Tunisia, and Arabian Peninsula such as: Jordan, Oman, Qatar and the United Arab Emirates were seropositive with high titers of MERS-CoV antibodies. These mounting evidence suggests on the zoonotic transmission potential and dromedary camels are a reservoir for MERS-CoV^{16,17}. Other than Bahrain and the countries in or near the Arabian peninsula with MERS cases, countries outside of the Arabian Peninsula or Africa with travel-associated MERS cases include: Austria, China, France, Germany, Greece, Italy, Malaysia, Netherlands, Philippines, Republic of Korea, Thailand, Turkey, United Kingdom (UK), and United States of America (USA)¹⁸.

The incubation period for MERS is usually about 5 or 6 days (range: 2 to 14 days). People confirmed with MERS-CoV infection have had severe acute respiratory illness with symptoms of fever, cough and shortness of breath. Gastrointestinal symptoms including diarrhea and nausea/vomiting were found in some, and many had more severe complications such as pneumonia and kidney failure. The mortality rate is about 30-40%. Most who died had an underlying medical condition. Some had mild flu-like symptoms or no symptoms at all and they recovered. Research evidence suggests that people with comorbidities may be more likely to become infected with MERS-CoV, or have a severe disease. The comorbidities included diabetes; cancer; chronic lung disease, heart, and kidney disease. Individuals with weakened immune systems are also at higher risk for MERS-CoV or acquiring a severe disease¹⁹. A Saudi gentleman, who was admitted for an elective coronary bypass surgery developed an acute respiratory illness, postoperatively. The patient was found positive for MERS-CoV and incidentally became the first confirmed case of MERS-CoV infection in the Kingdom of Bahrain. Contact tracing was made on 40 close contacts and all healthcare workers

who had been with the index case and were followed up. There were no secondary cases detected¹⁴.

During Ramadan, 2015 in the holy mosque in Makkah, Kingdom of Saudi Arabia, a cross-sectional study²⁰ was carried out on 417 Arab participants at King Fahad extension, King Abdullah Prayer extension and, King Abdullah Piazza extension after prayers. The mean knowledge score on MERS-CoV was 52.56. Majority (91.3%) was familiar with MERS-CoV and the Saudi nationals had significantly higher knowledge of MERS-CoV than non-Saudis. Those who had received health advice on MERS-CoV had significantly higher average knowledge. Likewise, among the Australian Hajj pilgrims who attended Hajj in 2015, a forward looking cohort study²¹ identified the relationship between travelers' awareness of MERS-CoV, and compliance with preventive measures and exposure to camels. Only 28% of Australian Hajj pilgrims were aware of MERS-CoV in the Kingdom of Saudi Arabia. In a similar fashion, following an outbreak of MERS-CoV in an University community of the Kingdom of Saudi Arabia²², 1541 participants completed a survey on the knowledge on MERS-CoV. The overall knowledge score was 43.2% and participants from medical college had significantly higher scores. While the majority (78.9%) of the respondents recognized the typical symptoms of MERS-CoV but only 67.1% were aware of the recommendations.

3. Research Methodology

A cross-sectional study using a convenience sampling approach by face-to-face interviews in the community of Bahrain was conducted by the fourth year students enrolled in Bachelor of Science in Nursing at the College of Health Sciences, University of Bahrain, Kingdom of Bahrain. The sample size was estimated using the following conservative parameters for prevalence: expected population proportion of 50%, 95% confidence interval, and a 5% precision estimate on two sides of the true population proportion. These parameters indicated a required sample size of 385. The required sample was increased to 400 participants (a level of precision of 4.9% either side) to account for potential invalid or incomplete responses. An estimated sample size of 400 was considered adequate.

Based on an in-depth literature review of MERS-CoV infection, we chose to use the structured Arabic questionnaire of Alotaibi MS et al.²³ after obtaining the approval from the primary author. The chosen questionnaire was more suitable and compatible with the Bahraini society regarding demographic, economic, and socio-cultural aspects. The

questionnaire was found to be reliable with a Cronbach's alpha of 0.875. The questionnaire had two main sections. The first section involved the sociodemographic characteristics, time of visiting Makkah, any health advice about the disease received, awareness of the seriousness of MERS-CoV, familiarity with MERS-CoV, and whether he/she had ever caught MERS-CoV. The second section contained 31 structured questions, eliciting "Yes", "No", and "I do not know" responses, which dealt with knowledge about the disease in terms of symptomatology of MERS-CoV's modes of transmission, complications, and measures for preventing the transmission of the disease.

The study had a standard approval from the institutional scientific research committee of the College of Health Sciences, University of Bahrain, Bahrain. Before gathering the data, the interviewer explained the study purpose to the participants and without persuasion informed consent was obtained. The participants' information was de-identified and kept confidential for ensuring protection of the data gathered during the study and thereafter. The data from the questionnaires were cleaned, coded, and entered in Excel (Microsoft, Redmond, WA, USA) and then exported to SPSS version 21 (SPSS Inc, Chicago, Illinois, USA) for statistical analysis. Twenty percent of the survey was randomly selected for a quality control check using random generated numbers²⁴.

4. Findings

A survey was conducted in Bahrain to estimate the knowledge and awareness of MERS -CoV. There were 498 participants who completed the survey, of which, 57% were males. Majority of the participants were between the age group of 20-39 years (67.5%) with a minimum qualification of university degree (45.4%). While 39.4% were employed, 47.2 % of the study participants hold student status (Table-1). Health status was summarized in Table 2: chronic disease was reported among 13.8% of the individuals. We ranked the order of the chronic diseases with diabetic mellitus being first followed by the hypertension, asthma and others.

A total of 469 (94.2 %) of them have visited the Kingdom of Saudi Arabia in the past (Table-3); a major reason for having undertaken the travel was reported to be pilgrimage - 326 (65.4%), followed by tourism, and less than 10% of them travel either for their higher studies and business. Merely, one fifth of the participants seek some travel health advice prior to their travel. Seeking the general physician's advice or browsing the internet was their major source of travel health advice; 14.6% of them protect themselves by taking travel associated vaccinations prior undertaking a pilgrimage.

TABLE 1: Socio-demographics of the study participants (n=498).

Socio-Demographics			
		n=498	Percentage
Gender	Male	284	57.0%
	Female	214	43.0%
Age	Younger than 20	79	15.8%
	20-39	336	67.4%
	40 - 60	81	16.4%
	Older Than 60	2	0.4%
Educational levels attained:	Illiterate	7	1.4%
	Less than High School	33	6.6%
	High School	146	29.4%
	Diploma	32	6.4%
	University	226	45.4%
	Master/PHD	54	10.8%
Occupational level:	Employed	198	39.8%
	Currently a Student	235	47.2%
	Business	46	9.2%
	Retired	19	3.8%

TABLE 2: Health status of the study participants (n=498).

Health conditions	Status	n=498	Percentage
Do you have any chronic disease?	No	429	86.2%
	Yes	69	13.8%
What are the chronic disease(s) that you have			
Diabetes Mellitus	No	477	95.8%
	Yes	21	4.2%
Asthma	No	489	98.2%
	Yes	9	1.8%
Heart Disease/High Blood Pressure	No	484	97.2%
	Yes	14	2.8%
Cancer	No	490	98.4%
	Yes	8	1.6%
Kidney Disease	No	498	100 %
	Yes	0	0 %

Awareness of MERS-CoV is summarized in Table-4. A set of five questions formed the awareness domain. More than half of them (57.8%) have at least heard of MERS-CoV ($p < 0.05$). However, 3/498 (0.6%) of them were the victims of the MERS-CoV. Majority of the participants, (262/498) 52.8% in general have said that they don't know

TABLE 3: Travel history and travel health advice status of the study participants (n=498).

Have you ever travelled to KSA?	No	29	5.8%
	Yes	469	94.2%
Pilgrimage	No	172	34.6%
	Yes	326	65.4%
Business	No	457	91.8%
	Yes	41	8.2%
Tourism	No	296	59.4%
	Yes	202	40.6%
Study	No	482	96.8%
	Yes	16	3.2%
Have you ever travelled to GCC countries?	No	88	17.6%
	Yes	410	82.4%
The number of times you travelled to Mecca:			
	Once	69	32.4%
	Twice	36	16.7%
	Three Times	27	12.5%
	Four Times	20	9.3%
	More	62	29.2%
Did you receive any travel health advice before undertaking the pilgrimage?	No	399	80.0%
	Yes	99	20.0%
What were the sources of this advice			
Travel agency	No	485	97.4%
	Yes	13	2.6%
General Physician	No	459	92.2%
	Yes	39	7.8%
Internet	No	466	93.6%
	Yes	32	6.4%
Friends or Relatives	No	486	97.6%
	Yes	12	2.4%
Others	No	496	99.6%
	Yes	2	0.4%
Did you get vaccinated before undertaking the pilgrimage?	No	425	85.4%
	Yes	73	14.6%

the cause of the disease ($p < 0.05$). Among the 288 participants who reported that they have heard about this virus, 186/288 (64.7%) were able to correctly classify it as a viral

disease indicating that the remaining 35% of them are still lacking the awareness of MERS- CoV ($p < 0.05$). We observed similar estimates of more than 50% on the organ systems to which MERS-CoV has predilection to ($p < 0.05$).

TABLE 4: Awareness of MERS –CoV of the study participants (n=498).

		n=498	Percentage	p-Value
Have you ever heard of MERS-CoV?	No	210	42.2%	<0.05
	Yes	288	57.8%	
Have you ever contracted this disease?	No	495	99.4%	<0.05
	Yes	3	0.6%	
MERS-CoV is a	I don't Know	262	52.8%	<0.05
	Bacterial disease	16	3.2%	
	Viral Disease	214	43.2%	
	Fungal Disease	2	0.4%	
	A parasite	2	0.4%	
MERS-CoV affects which system				
Respiratory system	No	292	58.6%	<0.05
	Yes	206	41.4%	
Circulatory system	No	470	94.4%	
	Yes	28	5.6%	
Urinary system	No	491	98.6%	
	Yes	7	1.4%	
Digestive system	No	476	95.6%	
	Yes	22	4.4%	
Neurological system	No	482	96.8%	
	Yes	16	3.2%	
I don't know	No	228	45.8%	
	Yes	270	54.2%	
Do you think that contracting the MERS corona is:	Not stated	73	14.6%	
	very lethal	148	29.8%	
	Kind of lethal	242	48.6%	
	Not lethal	35	7.0%	

Knowledge of MERS-CoV is summarized in Table-5: Knowledge was evaluated on four major domains such as signs and symptoms, transmission, complication and prevention. For each domain there were multiple questions with option to choose the correct response. We observed an equal proportion of participants were able to correctly classify the signs and symptoms except for vomiting, diarrhea, and joint and muscle pain. More than 65% of them correctly classified the mode of transmission of the

diseases: we observed a similar pattern of 50% of them who correctly identified the transmission mode of MERS- CoV and over 60% of them were able to correctly classify the complications of MERS-CoV ($p < 0.05$). On the prevention aspects, more than 50% of them incorrectly classified the prevention strategy ($p < 0.05$). There were a lack of knowledge in identifying the signs and the symptoms, transmission and prevention of MERS-CoV. Complication is the only domain in which the participants were able to respond with the correct answers.

Bivariate analysis (Table-6): we have computed the bivariate analysis comparing each outcome questions against the socio-demographic variables. We found a statistically significant associations between the education, occupation and previous travel history to the Kingdom of Saudi Arabia with respect to the awareness and knowledge domains ($p < 0.05$).

5. Discussion of Findings

This study on exploring the levels of knowledge and awareness on MERS -CoV in Bahrain was necessitated on the bases that: i. the origins of the virus are not clearly understood, but, believed to have originated in bats and was transmitted to camels sometime in the distant past⁸, ii. the enigmatic first case reported from Bahrain, the closest neighbor to the Kingdom of Saudi Arabia- the epicenter for MERS-CoV, iii. rapid mass mobility of people through causeway on both ways of Bahrain and the Kingdom of Saudi Arabia, iv. increase in the number of countries notifying MERS-CoV regionally and globally, v. MERS-CoV continues to be an endemic public health threat and vi. possibility of the virus to mutate and exhibit increased inter-human transmissibility with accentuated pandemic potential^{25,26}.

This community based study had majority of the participants between the age group of 20-39 years with a minimum qualification of university degree. Half of the study participants hold student status and younger, therefore, the chronic disease reported was less than 15%. Almost 95% of the responders have visited the Kingdom of Saudi Arabia in the past: two thirds were for pilgrimage and others for tourism, higher studies or business. It has been documented that MERS cases reported from outside the Kingdom of Saudi Arabia invariably have a history of recent travel from the Arabian Peninsula or were a close contact of a primary case²⁰. However, only 20% of the participants sought travel health advice prior to their travel from a general physician or browsing the internet was their major source of travel health advice and 15% had travel associated vaccination coverage (Table-3), whereas, Australian Hajj pilgrims

TABLE 5: Knowledge of MERS –CoV of the study participants (n=498).

	Yes	No	I don't know
1-Signs and Symptoms of MERS-CoV are:			
Cough	259(52%)	23(4.6%)	216(43.4%)
Fever	234(47%)	21(4.2%)	243(48.8%)
Shortness of breath	245(49.2%)	17(3.4%)	236(47.4%)
Nasal and throat congestion	270(54.2%)	28(5.6%)	200(40.2%)
Vomiting and diarrhea	324(65%)	79(15.8%)	95(19.2%)
Joint and muscle pain	341(68.6%)	75(15%)	82(16.4%)
2- It can be transmitted by			
Droplet like coughing and sneezing	227(45.6%)	22(4.4%)	249(50%)
Blood transfusion	287(57.6%)	58(11.6%)	153(30.8%)
Shaving equipment	320(64.2%)	73(14.6%)	105(21.2%)
Contacting an infected individual	266(53.4%)	48(9.6%)	184(37%)
Eating and drinking	320(64.2%)	73(14.6%)	105(21.2%)
Animals(camels)	301(60.4%)	41(8.2%)	156(31.4%)
Sex	341(68.6%)	66(13.2%)	91(18.2%)
3- Complications of MERS-CoV are:			
There are no complications (move to Q4 if answered yes)	348(70%)	80(16%)	70(14%)
Sepsis	361(72.6%)	49(9.8%)	88(17.6%)
Organ failure(liver and kidney)	354(71.2%)	35(7%)	109(21.8%)
Death	309(62%)	23(4.6%)	166(33.4%)
Severe shortness of breath and infection	296(59.4%)	15(3%)	187(37.6%)
4-Methods of Prevention of MERS-CoV:			
Wearing a face mask	314(63%)	6(1.2%)	178(35.8%)
Washing hands with soap and water	203(40.8%)	13(2.6%)	282(56.6%)
Using sanitizer	212(42.6%)	19(3.8%)	267(53.6%)
Avoiding an infected individual	208(41.8%)	18(3.6%)	272(54.6%)
Using a tissue or a napkin to cover the mouth and nose when sneezing	204(41%)	13(2.6%)	281(56.4%)
Avoiding to touch the mouth, nose and eyes as much as possible	235(47.2%)	21(4.2%)	242(48.6%)
Avoid contact with animals and consuming their products (camels)	286(57.4%)	26(5.2%)	186(37.4%)
* Numbers in bold indicate p<0.05			

who were aware of MERS-CoV in Saudi Arabia and were more likely to receive travel associated vaccines²⁰. More than half of the participants have heard of MERS-CoV but do not know the cause of the disease (60%). About half were able to respond on the organs of predilection to MERS-CoV. Al-Mohrej et al.²¹ found that female participants, married participants, and participants aged >60 years were more aware about MERS-CoV than other participants. Similarly, a cross-sectional survey on awareness of MERS-CoV among the Saudi population was found to be generally good²². Our findings in Bahrain reflect that the levels of awareness (Table-4) are not adequate, probably due to a single case reported from Bahrain so far.

TABLE 6: Bivariate analysis of Awareness and Knowledge of MERS –CoV to the Socio-demographics of the study participants (n=498).

Awareness and Knowledge Domains	Gender	Age	Educational Levels	Employment	Chronic Health Conditions	Travel history of KSA
MERS corona is a	0.350	.033*	.003*	0.472	0.319	0.173
Respiratory system-MERS corona affects which system	0.712	0.275	0.554	.016*	0.366	.007*
circulatory system-MERS corona affects which system	0.706	0.189	0.802	0.678	0.939	0.177
urinary system-MERS corona affects which system	0.437	0.827	.039*	0.379	0.97	0.509
Digestive system-MERS corona affects which system	.046*	0.414	0.128	0.297	0.982	0.797
Neurological system-MERS corona affects which system	0.652	0.153	0.262	0.779	0.878	0.244
I don't know-MERS corona affects which system	0.654	0.891	0.233	.035*	0.377	.016*
Do you think that contracting the MERS corona is:	0.321	0.136	.013*	0.058	0.151	0.117
Cough- signs and symptoms of MERS corona	0.745	0.286	0.383	0.275	0.314	0.060
Fever- signs and symptoms of MERS corona	0.711	0.118	0.563	0.071	0.250	.005*
Shortness of breath- signs and symptoms of MERS corona	0.748	0.283	0.823	.028*	0.429	.028*
Nasal and throat congestion- signs and symptoms of MERS corona	0.236	0.641	0.672	0.206	0.677	.016*

Awareness and Knowledge Domains	Gender	Age	Educational Levels	Employment	Chronic Health Conditions	Travel history of KSA
Vomiting and diarrhea-signs and symptoms of MERS corona	0.740	0.087	0.468	0.176	0.392	.039*
Joint and muscle pain-signs and symptoms of MERS corona	0.769	0.118	0.304	0.216	0.852	0.091
Droplet like coughing and sneezing-It can be transmitted by	0.202	0.585	0.208	0.194	0.509	.009*
Blood transfusion-It can be transmitted by	0.707	0.153	0.148	.001*	0.256	.010*
Shaving equipment-It can be transmitted by	0.192	0.508	0.283	0.296	0.926	0.305
Contacting an infected individual	0.384	0.381	0.414	0.087	0.576	.001*
Eating and drinking	0.903	0.443	0.178	.027*	0.720	0.203
Animals(camel)-It can be transmitted by	0.874	0.091	0.472	0.597	0.932	0.079
Sex	0.648	0.468	0.648	0.199	0.681	0.107
There are no complications (move to Q4 if answered yes)	0.168	0.866	.044*	0.532	0.488	0.392
Sepsis	0.197	0.812	0.331	0.533	0.948	0.376
Organ failure(liver and kidney)	0.987	0.553	0.428	0.178	0.370	0.320
Death	0.669	0.199	0.420	.025*	0.835	.048*
Severe shortness of breath and infection	0.386	0.721	0.151	.016*	0.795	.024*
Wearing a face mask	0.786	0.46	0.628	0.582	0.142	0.139
Washing hands with soap and water	0.895	0.272	0.632	0.051	0.406	.044*
Using sanitizer	0.512	0.75	0.773	.038*	0.249	0.072
Avoiding an infected individual	0.282	0.755	0.631	0.068	0.072	0.058
Using a tissue or a napkin to cover the mouth and nose when sneezing	0.734	0.421	0.481	0.058	0.386	.047*
Avoiding to touch the mouth, nose and eyes as much as possible	0.418	0.307	0.932	0.061	0.883	0.098
Avoid contact with animals and consuming their products (camels)	0.533	0.142	0.772	.044*	0.494	0.600
*. The Chi-square statistic is significant at the .05 level.						

The factors that influence the levels of knowledge on an infectious illness include the severity of the disease, transmission dynamics, and ways of disseminating the

knowledge. We observed an equal proportion of participants (50%) in our study who were able to correctly classify the signs and symptoms except for vomiting, diarrhea, and joint and muscle pain and this was lower when compared to a study among the students community of a University in the Kingdom of Saudi Arabia, where, the majority (78.9%) of the respondents recognized the typical symptoms of MERS-CoV²⁷. Results from documented literatures suggest that many details of camel-to-human transmission are not clear, however, transmission from camels to human constitute the only confirmed zoonotic source for the human infection. Patients may be exposed to MERS-CoV by consumption of unpasteurized camel milk^{28,29}. Over 65% of the study participants significantly identified the mode of transmission of the diseases, and over 60% of them were able to classify the complications of MERS-CoV. We were puzzled to note that more than 50% of them were unable to classify the prevention strategy, as there are no vaccines to protect or antivirals available to treat the MERS-CoV. There was a lack of adequate knowledge in identifying the signs and the symptoms, transmission and prevention of MERS-CoV among the Bahraini community. The bivariate analysis (Table-6) has given us statistically significant associations between the education, occupation and previous travel history to the Kingdom of Saudi Arabia that has a significant value on the awareness and knowledge domains of MERS-CoV.

Our study is the foremost to assess the levels of Knowledge and Awareness in Bahrain on MERS-CoV, however, with a few limitations. First, the representativeness of the sample is unknown, as we adopted the convenient sampling method in the study. Second, considering the face-to-face interview method adopted in the study, interviewer bias could not be eliminated as an individual's style, expression and explanation may have affected the participant's response. Third, self-reported data is subject to recall bias.

Several important questions about MERS-CoV epidemiology, routes of transmission, pathogenesis, and treatment still remain unanswered. During mass gathering, good infectious disease surveillance and control measures are essential. Raising awareness about MERS-CoV among travelers to and from affected countries is good public health practice. In accordance, the Kingdom of Saudi Arabia periodically issues/updates health guidelines for the pilgrims and visitors³⁰. Although, achieving community participation in awareness and knowledge of health issues has remained a challenge, following the guidelines issued by the health authorities would be helpful. The Bahraini community needs to be made aware to avoid direct contact with camels when travel to Kingdom of Saudi Arabia is undertaken. Infection-control practices in the hospitals have to be strengthened in the wake of an MERS-CoV case detected. Further, the health officials

should highlight the seasonal occurrence of MERS-CoV outbreak¹¹ and take better preventive measures to minimize the incidence and burden of MERS-CoV.

6. Conclusion

Our study highlights the need for awareness and health education among the Bahrainis about MERS-CoV infection, transmission potential, avoid direct contact with camels when travel to Kingdom of Saudi Arabia is undertaken, management of infected individuals, especially elderly individuals with comorbidities, and preventive measures. Infection-control practices in the hospitals have to be strengthened in the wake of an MERS-CoV case detected. Adopting guidelines issued by the health authorities would be helpful.

References

- [1] 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.
- [2] Anthony SJ, Gilardi K, Menachery VD, Goldstein T, Ssebide B, Mbabazi R, Navarrete-Macias I, Liang E, Wells H, Hicks A, Petrosov A, Byarugaba DK, Debbink K, Dinnon KH, Scobey T, Randell SH, Yount BL, Cranfield M, Johnson CK, Baric RS, Lipkin WI, Mazet JA. Further Evidence for Bats as the Evolutionary Source of Middle East Respiratory Syndrome Coronavirus. *MBio.* 2017 Apr 4;8(2). pii: e00373-17. doi: 10.1128/mBio.00373-17.
- [3] Azhar EI, El-Kafrawy SA, Farraj SA, Hassan AM, Al-Saeed MS, Hashem AM, et al. Evidence for camel-to-human transmission of MERS coronavirus. *N Engl J Med.* 2014;370:2499–505.
- [4] Ali M.A., Shehata M.M., Gomaa M.R., Kandeil A., El-Shesheny R., Kayed A.S., El-Taweel A.N., Atea M., Hassan N., Bagato O., et al. Systematic, active surveillance for Middle East respiratory syndrome coronavirus in camels in Egypt. *Emerg. Microbes Infect.* 2017;6:e1. doi: 10.1038/emi.2016.130. [PMC free article, PubMed, Cross Ref]
- [5] Miguel E., Chevalier V., Ayelet G., Ben Bencheikh M.N., Boussini H., Chu D.K., El Berbri I., Fassi-Fihri O., Faye B., Fekadu G., et al. Risk factors for MERS coronavirus infection in dromedary camels in Burkina Faso, Ethiopia, and Morocco, 2015. *Euro Surveill.* 2017;22doi: 10.2807/1560-7917.ES.2017.22.13.30498. [PMC free article, PubMed, Cross Ref]

- [6] Saqib M., Sieberg A., Hussain M.H., Mansoor M.K., Zohaib A., Lattwein E., Muller M.A., Drosten C., Corman V.M. Serologic evidence for MERS-CoV infection in Dromedary Camels, Punjab, Pakistan, 2012–2015. *Emerg. Infect. Dis.* 2017;23:550–551. doi: 10.3201/eid2303.161285. [PMC free article, PubMed, Cross Ref]
- [7] World Health Organization. Middle East respiratory syndrome coronavirus (MERS-CoV) situation update. Available online at: <http://www.who.int/emergencies/mers-cov/en/>
- [8] World Health Organization. Fact Sheets. Middle East respiratory syndrome coronavirus (MERS-CoV). Available online at: [http://www.who.int/en/news-room/fact-sheets/detail/middle-east-respiratory-syndrome-coronavirus-\(mers-cov\)](http://www.who.int/en/news-room/fact-sheets/detail/middle-east-respiratory-syndrome-coronavirus-(mers-cov)).
- [9] Wong G, et al. MERS, SARS, and Ebola: the role of super-spreaders in infectious disease. *Cell Host Microbe.* 2015;(18)398–401.
- [10] Lee SS, Wong NS. Probable transmission chains of Middle East respiratory syndrome coronavirus and the multiple generations of secondary infection in South Korea. *Int J Infect Dis.* 2015;38:35–7.
- [11] Nassar MS, Bakhrebah MA, Meo SA, Alsuabeyl MS, Zaher WA. Global seasonal occurrence of middle east respiratory syndrome coronavirus (MERS-CoV) infection. *Eur Rev Med Pharmacol Sci.* 2018 Jun;22(12):3913–3918. doi: 10.26355/eur-rev_201806_15276.
- [12] Kingdom of Bahrain Ministry of Health. Health Statistics 2015. Available online at: https://www.moh.gov.bh/Content/Files/Publications/statistics/HS2015/hs2015_e.htm (last accessed 2 June 2017)
- [13] Harcourt JL, Rudoler N, Tamin A, Leshem E, Rasis M, Giladi M, Haynes LM. The prevalence of Middle East respiratory syndrome coronavirus (MERS-CoV) antibodies in dromedary camels in Israel. *Zoonoses Public Health.* 2018 May 31. doi: 10.1111/zph.12482. [Epub ahead of print]
- [14] Nahed Seddiq, Manaf Al-Qahtani, Jaffar A. Al-Tawfiq, and Nazar Bukamal, “First Confirmed Case of Middle East Respiratory Syndrome Coronavirus Infection in the Kingdom of Bahrain: In a Saudi Gentleman after Cardiac Bypass Surgery,” *Case Reports in Infectious Diseases*, vol. 2017, Article ID 1262838, 4 pages, 2017. <https://doi.org/10.1155/2017/1262838>.
- [15] Hui DS, Perlman S, Zumla A. Spread of MERS to South Korea and China. *Lancet Respir Med.* 2015 Jul;3(7):509–10. doi: 10.1016/S2213-2600(15)00238-6. Epub 2015 Jun 4.
- [16] Bermingham A, Chand MA, Brown CS et al. Severe respiratory illness caused by a novel coronavirus, in a patient transferred to the United Kingdom from the Middle East. *Euro Surveill* 2012; 17: 20290. [PubMed]

- [17] Ithete NL, Stoffberg S, Corman VM et al. Close relative of human Middle East respiratory syndrome coronavirus in bat, South Africa. *Emerg Infect Dis* 2013; 19: 1697–1699. [PMC free article, PubMed]
- [18] Centers for Disease Control. Middle East Respiratory Syndrome. Available online at: <https://www.cdc.gov/coronavirus/mers/index.html>
- [19] Mayo Clinic: MERS-CoV. Available online at: <https://www.mayoclinic.org/diseases-conditions/sars/expert-answers/what-is-mers-cov/faq-20094747>
- [20] Alqahtani AS, Wiley KE, Mushta SM, Yamazaki K(2), BinDhim NF, Heywood AE, Booy R, Rashid H. Association between Australian Hajj Pilgrims' awareness of MERS-CoV, and their compliance with preventive measures and exposure to camels. *J Travel Med.* 2016 Jul 18;23(5). doi: 10.1093/jtm/taw046.
- [21] Al-Mohrej OA, Al-Shirian SD, Al-Otaibi SK, et al. Is the Saudi public aware of Middle East respiratory syndrome? *Journal of infection and public health* 2016;9(3):259-66.
- [22] Al-abdullah, Nabeela. Assessment Of The Awareness Of Middle East Respiratory Syndrome-Coronavirus Infection In Saudi Arabia: A Cross- Sectional Survey. *The Internet Journal of Infectious Diseases.* 2016; 15: 1-8. 10.5580/IJPH.46719.
- [23] Alotaibi MS, Alsubaie AM, Almohaimede KA, Alotaibi TA, Alharbi OA, Aljadoa AF, Alhamad AH, Barry M. To what extent are Arab pilgrims to Makkah aware of the middle east respiratory syndrome coronavirus and the precautions against it? *J Family Community Med.* 2017 May-Aug;24(2):91-96. doi: 10.4103/2230-8229.205119.
- [24] Random.Org. True Random Number Generator. Available online at: <https://www.random.org/>
- [25] Zumla A, Hui DS, Perlman S. Middle East respiratory syndrome. *Lancet.* 2015 Sep 5;386(9997):995-1007. doi: 10.1016/S0140-6736(15)60454-8. Epub 2015 Jun 3.
- [26] Masters PS, Perlman S. Coronaviridae. In: Knipe DM, Howley PM, editors. *Fields Virology.* Lippincott Williams & Wilkins; Philadelphia, PA: 2013. pp. 825–58.
- [27] Al-Mohaissen M. Awareness among a Saudi Arabian university community of Middle East respiratory syndrome coronavirus following an outbreak. *East Mediterr Health J.* 2017 Jul 16;23(5):351-360.
- [28] Reusken CB, Farag EA, Jonges M, Godeke GJ, El-Sayed AM, Pas SD, et al. Middle East respiratory syndrome coronavirus (MERS-CoV) RNA and neutralizing antibodies in milk collected according to local customs from dromedary camels, Qatar, April 2014. *Euro Surveill.* 2014;19(23):20829.

- [29] Samara EM, Abdoun KA. Concerns about misinterpretation of recent scientific data implicating dromedary camels in epidemiology of Middle East respiratory syndrome (MERS) *mBio*. 2014;5(4):e01430-14.
- [30] Al-Tawfiq JA, Memish ZA. Mass gathering medicine: 2014 Hajj and Umra preparation as a leading example. *Int J Infect Dis*. 2014;27:26-31.