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MERS-CoV infection: Mind the public knowledge gap



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ABSTRACT

In August 2015, the Corona outbreak caused by Middle East respiratory syndrome coronavirus (MERS-CoV) was the 9th episode since June 2012 in Saudi Arabia. Little is known about the public awareness toward the nature or prevention of the disease. The aim of this work was to assess the knowledge of the adult population in Riyadh toward the MERS-CoV.

In this cross-sectional survey, a self-administrated questionnaire was distributed to randomly selected participants visiting malls in Riyadh. The questionnaire contained measurable epidemiological and clinical MERS-CoV knowledge level variables and relevant source of information.

The study included 676 participants. Mean age was 32.5 (\pm SD 8.6) years and 353 (47.8%) were males. Almost all participants heard about the corona disease and causative agent. The study showed a fair overall knowledge (66.0%), less knowledge on epidemiological features of the disease (58.3%), and good knowledge (90.7%) on the clinical manifestation of the MERS-CoV. Internet was the major (89.0%) source of disease information, and other sources including health care providers, SMS, television, magazines and books were low rated (all <25%). In a multivariate logistic regression analysis age \leq 30 years (Odds Ratio (OR) = 1.647, 95%CI 1.048–2.584, P = 0.030), male gender (OR = 1.536, 95%CI 1.105–2.134, P = 0.01), and no tertiary education (OR = 1.957, 95%CI 1.264–3.030, P = 0.003) were independent significant predictors of poor epidemiological knowledge.

This study concludes that there was inadequate epidemiological knowledge received by the public and the reliance mostly on the clinical manifestations to recognizing the MERS-CoV disease. Comprehensive public health education programs is important to increase awareness of simple epidemiological determinants of the disease is warranted.

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Introduction

Middle East respiratory syndrome coronavirus (MERS-CoV) is a novel coronavirus that causes a viral respiratory disease (Middle East respiratory syndrome, MERS) [1]. Globally, the World Health Organization (WHO) has reported 1864 laboratory-confirmed MERS-CoV cases with 659 associated deaths in 27 countries since September 2012 [2]. According to the last WHO report, the Kingdom of Saudi Arabia (KSA) remains the most afflicted country,

with remarkable morbidity and mortality rates [3]. The first case of coronavirus infection was identified in the KSA in June 2012 [4]. Subsequently, continuous detection of the virus has been reported in different healthcare facilities in the KSA and other Asian countries, including Korea, the United Arab Emirates and Iran [5–8]. Most of the reported cases have emerged from the Middle East; other cases reported elsewhere had direct connections with primary cases of infection in the Middle East [9]. Therefore, many countries worldwide have implemented prevention measures, particularly amongst potential travelers to Middle Eastern countries. The KSA is a particular concern since it is the epicenter of the disease and a destination for millions seeking the Hajj pilgrimage or Umrah annually.

Strict guidelines have been developed for disease control and prevention, with a particular emphasis on protective measures [10]. These guidelines include frequent and thorough hand washing and avoiding people who are sick and coughing, undercooked meat, unsafe water, close contact with animals and camel-based

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products, such as unpasteurized milk or raw meat [4]. Because no MERS-CoV vaccine is available currently, these protective measures can potentially reduce the risk of viral infection.

Major gaps exist in the knowledge of the epidemiology, prevalence and clinical spectrum of the infection [1]. As highlighted by the WHO, provision of information to the general public about the virus, its transmission modes and adequate protective measures is the cornerstone for prevention and control of the disease [10,11].

Although there is a great need to clarify the nature, genomic features, and epidemiological characteristics of the disease, the number of investigations conducted in this field is far from the expected. This information is urgently needed for the planning and effective implementation of preventive and control measures to combat dissemination of the virus within and outside of the Middle Eastern region. Despite the strong link between the transmission patterns of the disease and both zoonotic transfers and human-to-human transmission [12], data on the risk and contributing factors to the rapid spread and health effects of the virus are lacking, particularly in hospitalized patients from the KSA [8]. Significant questions remain unanswered on the extent of the Saudi people's awareness of the characteristics and nature of this virus. Finding answers to these questions is instrumental for the implementation of effective preventive measures to reduce and control the frequent occurrence of MERS-CoV outbreaks. Increased public awareness of the disease may decrease the risk of the virus and help combat the disease in the annual mass-gathering events that occur in the KSA, such as the Hajj and Umrah. This study aimed to identify the gap in knowledge of the adult population residing in Riyadh, KSA, toward the nature and transmission modes of MERS-CoV infection.

Methods

A cross-sectional study was conducted from June to September of 2015. Five main commercial malls in Riyadh were randomly selected. People in the main cities in the KSA visit malls for different purposes, including shopping and entertainment, all year long. Therefore, malls can be considered representative of the Saudi population for purposes such as scientific research. Approval for the project was obtained from the Research Committee, College of Public Health and Health Informatics, King Saud Bin Abdul-Aziz University for Health Sciences, and from the Institutional Research Board Committee (IRBC) at King Abdullah International Medical Research Center (KAIMRC) (#IRBC/383/15), Riyadh, National Guard Health Affairs at the Ministry of the National Guard.

The study included Saudi adults living in Riyadh aged 18 years and older. The study excluded non-Saudi adults or visitors from outside of Riyadh. Proportional quota sampling was used to ensure that the respondents were demographically representative of the general population, with quotas based on age, gender, region and social class. A sample size of 768 was calculated based on an expected 50% proportion of poor knowledge in this population toward MERS-CoV transmission and prevention measures at 80% power with a 95% confidence level and a design effect of two [10]. A two-stage sampling method was employed. The first stage consisted of selecting 5 top malls located in different zones of Riyadh city (north, south, middle, east, and west). Then, a simple random sample of adults shopping in these malls who were willing to participate in the study was interviewed using a self-administered questionnaire. To measure the level of knowledge in both males and females, a 1:1 ratio was purposefully chosen. The enrollment strategy was undertaken to cover all three different work shifts of the malls (morning, afternoon, and night). Of 768 possible participants, 676 individuals of both genders were successfully interviewed (response rate = 88.02%).

Data collection tool

All respondents were informed of the purpose of the study. Consenting participants were selected randomly from each study site, and a self-administered questionnaire was distributed and filled out by the participants. The questionnaire was initially designed in English after a thorough search for relevant recent literature on public knowledge, attitudes and practices. Further information was retrieved from the WHO and the KSA Ministry of Health websites on both the H1N1 virus [10] and MERS-CoV [13–15] and was adapted with some modifications to the local context of both the nature of coronaviruses and the cultural context of the KSA. Furthermore, the questionnaire was reviewed by experts in infectious diseases for relevance, simplicity and internal consistency. Arabic translation of the questionnaire was conducted by a professional translator.

The questionnaire was designed to contain 5 parts, of which three parts were reported in this study. These parts included socio-demographic information [age (<30 or ≥30 years), gender, marital status (married or unmarried), education level (tertiary or no tertiary) and occupation (employed or unemployed)], seven questions on the participants' sources of information about the disease and 18 questions measuring the level of knowledge (nature of the disease, transmission, signs and symptoms, and methods of prevention). A Likert scale (yes, no, and do not know) was used in 18 questions to measure knowledge. The 18 knowledge questions were categorized into two knowledge domains (epidemiological and clinical). The former domain included 10 questions, and the latter domain included 8 questions. The epidemiological domain questions were related to knowledge of the nature of the causative agent, modes of transmission (droplets, contact, and animal to man or other transmission), incubation period and availability of vaccines. The clinical domain measured knowledge of the clinical signs and symptoms (cough, fever, shortness of breath, pharyngitis, diarrhea, no symptoms, death and other consequences) and questions inquiring about the availability of a cure for the disease. To evaluate the responses to these questions, a correct answer was allocated a value of one, and a wrong answer was allocated a value of zero. The total possible knowledge score of 18 (range from 0 to 18) was dichotomized to poor knowledge if the total score was <14 (25th percentile of the total score) or good knowledge if the score was ≥14.

A pilot study on 20 subjects was conducted, and the data were analyzed to ensure face validity, comprehension and feasibility. Cronbach's alpha reliability coefficient was 0.71, which was considered satisfactory for the purpose of this study.

Data analysis

Data were summarized as frequencies and proportions and were compared using the Chi-square test. Logistic regression models were fitted to identify factors associated with a poor score (a score <14). Variables found significant in the univariate analyses were included in the final multivariate logistic regression analysis. All tests were two-sided, and statistical significance was considered at a *P*-value of <0.05. The data entry and statistical analysis were performed using the Statistical Program for Social Sciences (IBM SPSS Corp, SPSS Statistics ver. 20, USA).

Results

Sociodemographic characteristics of the participants

The study included 676 participants. Of these, 289 (42.8%) were aged <30 years, 353 (52.2%) were males, 389 (57.5%) were married, 557 (82.4%) had received a tertiary education and 622 (92%)

Table 1
Socio-demographic characteristics of the participants (N=676).

Characteristics		n	%
Age	>30 years	289	42.8
	≤30 years	387	57.2
Gender	Female	323	47.8
	Male	353	52.2
Marital status	Married	389	57.5
	Unmarried	287	42.5
Tertiary education	No	119	17.6
	Yes	557	82.4
Employment	No	54	8.0
	Yes	622	92.0

Table 2
Association between source of information and overall level of knowledge on MERS-CoV.

	Poor		High		Total		P-value
	No.	%	No.	%	No.	%	
Internet	257	87.1	539	90.0	796	89.0	0.197
SMS	80	27.1	134	22.4	214	23.9	0.118
Television	52	17.6	115	19.2	167	18.7	0.571
Health care workers	40	13.6	99	16.5	139	15.5	0.249
Family members	34	11.5	79	13.2	113	12.6	0.482
Magazines	29	9.8	69	11.5	98	11.0	0.447
Books	19	6.4	55	9.2	74	8.3	0.162

were employed. The sociodemographic characteristics of the participants are shown in [Table 1](#).

Source of information regarding the disease

The majority (89.0%) of the respondents reported that information about MERS-CoV was received from the internet, followed by the SMS (23.9%). Few participants reported that they received information from other sources, such as television, healthcare workers, family members, magazines or books (18.7%, 15.5%, 12.6%, 11.0%, and 8.3%, respectively). No significant differences were found in the sources of information between respondents with a good or poor level of knowledge on MERS-CoV in this cohort of participants ([Table 2](#)).

Knowledge assessment

[Table 3](#) shows the frequencies of correct responses to each question in the epidemiological and clinical domains. Almost all of the participants had heard of the coronavirus disease and were able

Table 3
Positive responses on different questions related to epidemiological and clinical knowledge.

	Questions	n	%
1	Have you ever heard about Corona (MERS-CoV)	676	100.0
2	The corona disease is caused by a virus	669	99.0
3	MERS-CoV can be transmitted through cough droplets	672	99.4
4	MERS-CoV can be transmitted from person to person	638	94.4
5	MERS-CoV can be transmitted through talk with others	354	52.4
6	MERS-CoV can be transmitted through hand shake with others	333	49.3
7	MERS-CoV can be transmitted from animal to person	584	86.4
8	Camels transmit the virus	573	84.8
9	MERS-CoV can cause multiple infections	448	66.3
10	Do you know of a vaccine against MERS-CoV	508	75.1
11	Fever and cough are among the signs and symptoms of MERS-CoV	670	99.1
12	Shortness of breath is among the signs and symptoms of MERS-CoV	668	98.8
13	Pharyngitis is among the signs and symptoms of MERS-CoV	669	99.0
14	Diarrhea is among the signs and symptoms of MERS-CoV	662	97.7
15	MERS-CoV can lead to direct death	605	89.5
16	Do you know how long after exposure to MERS-CoV can an individual get sick	400	59.2
17	A MERS-CoV patient can be cured	169	25.0
18	MERS-CoV can be found in individuals with no signs or symptoms	163	24.1

to relate its cause to a viral origin (100% and 99%, respectively). The participants also highly recognized the mode of transmission of the disease as via the respiratory tract through coughing (99.0%) and from person to person (94.4%). However, they were less likely to associate the transmission of infection with talking with an infected person or to shaking hands with an infected person (52.4% and 49.3%, respectively). Frequencies of correct answers to questions related to whether the virus could be transmitted from an animal to a person, whether the camel was a reservoir of the causative agent, whether the agent could cause repeated infections and whether they knew of any vaccine against the agent were 86.4%, 84.8%, 66.3%, and 75.1%, respectively. Knowledge about signs and symptoms, such as fever, cough, shortness of breath, pharyngitis and diarrhea, was high (97%). Questions such as “Could MERS-CoV lead to direct death” also showed a high rate of positive answers (89.5%). However, the participants’ knowledge about other questions related to the incubation period of the disease, the recovery of patients and infection without signs and symptoms was poor (59.2%, 25.0%, and 24.1%, respectively).

Factors related to knowledge about MERS-CoV

Overall, good knowledge was reported in this study (66.4%). However, according to the analysis of the two knowledge domains (epidemiological and clinical), the participants were less knowledgeable (58.3%) regarding the epidemiological features of the disease, whereas they scored high in knowledge (90.7%) regarding the clinical manifestation of MERS-CoV ([Table 4](#)).

The overall level of knowledge varied across several characteristics of the study participants. Individuals who were 30 years of age or older ($P=0.016$), female ($P=0.04$), married ($P=0.028$), had received a tertiary education ($P<0.001$) and were employed ($P=0.10$) showed significantly better overall knowledge about MERS-CoV than their counterparts. Knowledge about the clinical manifestations of the disease did not vary significantly by age ($P=0.58$), marital status ($P=0.54$), or employment status ($P=0.34$) ([Table 4](#)).

[Table 5](#) shows the final multivariate logistic models for independent predictors of poor epidemiological, clinical, and overall knowledge scores. Some socio-demographic characteristics, such as age, gender, and education level, were significant independent predictors of poor epidemiological knowledge, whereas only the female gender and a tertiary educational level were significant predictors for poor clinical knowledge ([Table 5](#)).

Table 4
Association between participant characteristics and epidemiological, clinical and overall knowledge toward MERS-CoV disease.

Characteristic		Epidemiological					Clinical					Overall				
		Good		Poor		<i>P</i> [†]	Good		Poor		<i>P</i>	Good		Poor		<i>P</i>
		<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%	
Age	>30 years	152	38.6	137	48.6	0.010	260	42.4	29	46.0	0.580	176	39.5	113	49.1	0.016
	≤30 years	242	61.4	145	51.4		353	57.6	34	54.0		270	60.5	117	50.9	
Gender	Female	202	51.3	121	42.9	0.032	305	49.8	18	28.6	0.001	231	51.8	92	40.0	0.004
	Male	192	48.7	161	57.1		308	50.2	45	71.4		215	48.2	138	60.0	
Marital status	Married	240	60.9	149	52.8	0.036	355	57.9	34	54.0	0.546	270	60.5	119	51.7	0.028
	Unmarried	154	39.1	133	47.2		258	42.1	29	46.0		176	39.5	111	48.3	
University	No	49	12.4	70	24.8	0.000	93	15.2	26	41.3	0.000	55	12.3	64	27.8	0.000
	Yes	345	87.6	212	75.2		520	84.8	37	58.7		391	87.7	166	72.2	
Employment	No	24	6.1	30	10.6	0.032	47	7.7	7	11.1	0.337	27	6.1	27	11.7	0.010
	Yes	370	93.9	252	89.4		566	92.3	56	88.9		419	93.9	203	88.3	

P[†]: χ test.

Table 5
Multivariate factors associated with the poor knowledge toward MERS-CoV disease.

Factor		Epidemiological			Clinical			Overall		
		OR [†]	95% CI	<i>P</i> [†]	OR	95% CI	<i>P</i>	OR	95% CI	<i>P</i>
Age (years)	>30 years	1.647	1.048–2.584	0.030	1.370	0.660–2.950	0.421	1.618	1.01–2.591	0.045
	≤30 years	1			1			1		
Gender	Male	1.536	1.105–2.134	0.011	2.556	1.399–4.670	0.002	1.790	1.264–2.534	<0.001
	Female	1			1			1		
Marital status	Unmarried	0.845	0.538–1.328	0.466	0.640	0.294–1.395	0.262	0.846	0.528–1.356	0.487
	Married	1			1			1		
University	No University	1.957	1.264–3.030	0.003	4.059	2.196–7.502	<0.0001	2.267	1.460–3.520	<0.001
	University	1			1			1		
Employment	Employed	1.576	0.855–2.904	0.145	1.026	0.402–2.617	0.957	1.742	0.938–3.235	0.079
	Unemployed	1			1			1		

OR[†]: Odds ratio. *P*[†] Wald test.

Discussion

The present study measured epidemiological and clinical knowledge regarding the MERS-CoV disease among the Saudi population in Riyadh city. Approximately 66% of the study participants had overall good knowledge regarding MERS-CoV (66.4%). This frequency is comparable to the reported knowledge score from a study conducted in Al Qaseem (73.2%) but higher than the knowledge score reported in a study conducted in Makah (32.4%) [15,16]. However, these two studies enrolled only healthcare workers and had different sample sizes and respondent characteristics. More nurses were included in the study from Makah than in the study from Qaseem. Our study went further to explore the gap in knowledge among the general population regarding the characteristics of the disease and to determine related factors. To the best of our knowledge, this study is the first to comprehensively assess the necessary and required epidemiological and clinical knowledge aspects of the disease. The study highlights gaps in knowledge and the essential elements required to educate and encourage the Saudi public to play active roles in the prevention and treatment of the disease and possibly reverse the course of this rapidly growing, highly infectious and fatal disease. Additionally, our study adopted a unique approach of separately evaluating the epidemiological and clinical knowledge domains, which typically are combined together in similar studies. Combined assessment of these two domains might overstate the overall knowledge score and obscure the identification of areas with a significant lack of knowledge. Reliance mostly on the clinical manifestations of these types of diseases to assess public knowledge might produce biased results. Our approach allowed us to glean information concerning these areas and identify inadequate epidemiological knowledge and skills that need urgent educational interventions. This approach could be useful for similar studies evaluating public knowledge toward

infectious diseases other than Mers-Cov, such SARS, H1N1, Zika, and Ebola.

The overall aim of our analysis was to determine whether the epidemiological and clinical features of the disease were well understood by the public. The findings demonstrated that the public was less knowledgeable regarding the epidemiological features of the disease (58.3%), whereas they expressed good knowledge (90.7%) on the clinical aspects of the disease. In a recent study conducted in Riyadh, Al-Mutairi et al. reported a high rate (91.6%) of public awareness of the viral cause of MERS-CoV [17]. Almutairi et al. relied exclusively on the clinical manifestations of the MERS-CoV disease in their assessment of public knowledge. Compared with the Almutairi et al., study, our study adopted a unique approach of separately evaluating the epidemiological and clinical knowledge domains.

Al-Mohrej and his colleagues concluded in a similar study that Saudi public awareness of MERS-CoV was generally satisfactory [18]. A previous study conducted among the Saudi public in Riyadh regarding the swine flu demonstrated that only 56% of the population was knowledgeable of this viral diseases [19]. This issue of insufficient knowledge of the Saudi public regarding frequently emerging outbreaks underscores the level of implementation of public preventive measures related to outbreak control. Many previous studies designed to assess public attitudes and knowledge regarding the nature of diseases causing outbreaks, such as SARS, H1N1 influenza, and recently MERS-CoV, found that the majority of the participants lacked appropriate information about the infectious agents and how to behave adequately toward these infections [7,9,12,20–23].

The significant predictors of the participants' overall good knowledge in our study were an age ≥ 30 years, a university educational level, and female gender. This pattern suggests that more emphasis should be placed on the young, male participants and

those with a low level of education in programs aimed at increasing awareness of the disease among the public to improve their knowledge about the pandemic MERS-CoV disease.

Similar to a recent study regarding information-seeking behavior for MERS-CoV in Saudi Arabia [24], most of the participants in this study reported the Internet as their main source of information about MERS-CoV. For this particular reason, research is urgently needed to determine how the Internet can be used for health promotion, particularly for emerging infectious diseases in this country or in a similar context. Alarmingly, the previous study found that the individuals who underestimated the fatality rate of MERS-CoV disease received their information from the Internet [24]. This finding may suggest that the quality of information currently available through the Internet is inadequate and in need of revision. Moreover, a very low percentage of participants indicated that their main source of information was healthcare providers. This scenario reflects a lack of engagement of healthcare workers in increasing awareness of the public regarding the different aspects of MERS-CoV. Measures should be taken to ensure that healthcare workers actually assume their role as the main providers of reliable and correct information.

We acknowledge our study limitations. The study was based on a self-reported questionnaire. Therefore, recall bias and social desirability bias cannot be excluded. The impact of these biases in our study is difficult to assess. The inclusion of innovative interventional methods with informative evaluation plans to monitor the level of knowledge among the community, respond to their needs and fill the gaps with better preventive methods would be helpful in prospective research.

Conclusion

Promotion of public knowledge, attitudes and behaviors toward MERS-CoV disease is important due to the virulence, high fatality rate and risk of rapid transmission of the virus in the community. Individuals need more information about the MERS-CoV disease, its transmission mode, and the preventive measures required to minimize its impact. Government health systems and institutions should design and implement advanced and motivational health promotion programs to educate the public and healthcare workers about infectious diseases in general that may spread among populations and about all possible future pandemics.

Authors' contribution

The study was conceptualized and designed by AB. The data were collected by EA. The data analysis was conducted by AB, AA and MB. The manuscript was drafted by AB and HJ. All authors critically reviewed and approved the final version of the manuscript.

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Competing interests

None declared.

Ethical approval

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