

Knowledge, Attitudes, and Practices (KAPs) of Healthcare Workers towards MERS-CoV Infection at PHCs in Madinah, KSA during Hajj 1440, 2019

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Abstract This research study aims at investigating knowledge, attitudes, and practices (KAPs) of healthcare workers towards the Middle East respiratory syndrome (MERS), also known as camel flu, caused by the MERS-CoV coronavirus. The present study focuses on the Hajj season in 2019 in the city of Al-Madinah Al-Munawwarah in Saudi Arabia as it is one of the most beloved cities for Muslim pilgrims who keep visiting its famous and lovely prophetic Mosque (Al-Masjid Al-Nabawi). For that, almost 500.000 visitors come to Al-Madinah everyday. Most of the year, the prophetic Masjid is crowded from inside and the crowdedness expands to include the mosque's piazzas and even the streets outside the masjid. Unfortunately, overcrowdedness is a risk factor for transmitting many serious respiratory diseases as MERS-CoV. Also, this study is an effort to obtain significant insights and to evaluate the health practices among healthcare workers particularly in the primary healthcare domain. Data collection involves a survey questionnaire distributed to all healthcare workers participating in care delivery during the Hajj season 1440 hijri calendar (2019 Gregorian calendar). Participants were medical students, physicians and nurses at Taibah University, King Fahd hospital and primary healthcare centers (PHCs) taking into account the work experience duration and the study level. MERS-CoV viruses are enveloped RNA viruses that fall into six strains. MERS-CoV viruses cause zoonotic diseases belonging to the gamma genus of corona viruses. MERS CoV infection may be caused by droplet, close patients contact and exposure to camels. March–May period is the season of greatest disease transmission. Incubation period is 3-4 days with respiratory and renal symptoms and subclinical infection. The questionnaire investigated all this basic medical knowledge about MERS-CoV. Responses collected from the questionnaire were analyzed using SPSS where percent reliability was calculated. Results revealed that the current knowledge of health care personnel needs to be augmented and updated for improving the common goal of declining the transmission rates of MERS-CoV.

Keywords: MERS-CoV, KAPs, primary care, epidemiology, educational intervention, questionnaire

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1. Introduction

MERS-CoV viruses are enveloped RNA viruses that fall into six strains. MERS-CoV viruses cause zoonotic diseases belonging to gamma genus of corona viruses. MERS CoV infection may be caused by droplet, close patients contact and exposure to camels. March–May period is the season of greatest disease transmission. Incubation period is 3-4 days with respiratory and renal symptoms and subclinical infection [1]. MERS-CoV infection was reported in the Middle Eastern region, tracing its origin to Jordan [2]. Other countries affected by the virus include Africa, USA, UK, Philippines, Asia, and Austria [3]. Evidence suggests that the disease spreads through dromedary camels having rhinorrhea [4,5,6]. MERS-CoV global case-fatality rate is 30% [7]. Saudi Arabia recorded greater than 80% of MERS-CoV cases with a 50% mortality rate. People in Saudi Arabia have a positive disposition towards its prevention but may require large-scale awareness programs through multiple online and offline channels [8].

Epidemiological approaches in disease control target reduction in animal-to-human transmission risk, prompt case discovery, effective practices in infection control, and contact tracing. WHO and its partner organizations recommend detecting suspected cases, reducing zoonotic transmission, providing safe and effective treatment, and reducing morbidity, and mortality in healthcare settings. WHO also recommends homecare for MERS-CoV patients [3,4,9]. The endemic nature and spread of the disease is largely facilitated by a lack of information or high variance in level of knowledge on disease prevention and transmission among the general public and Hajj pilgrims traveling to Saudi Arabia [10-16]. It is partially attributed to inefficient practices in infection control in healthcare settings [13]. Other factors include delays in medical care and poor clinical outcomes. Therefore, the predictors of the interval between the onset of symptoms and the confirmation of diagnosis are critical to educational interventions [17].

A serious concern among healthcare workers is the possibility of acquiring and transmitting the infection. In a recent survey conducted by Abolfotouh et al. (2017) at three tertiary hospitals in Saudi Arabia, health care workers indicated their concern related to exposure to MERS-CoV and considered effective management of the issue an integral part of suspected outbreaks [18].

2. Subjects and Methods

This study was carried out through a survey focusing on gaps in knowledge among healthcare staff in primary health care settings. The proposed questionnaire gathered information on the level of knowledge about MERS-CoV, its transmission routes, vulnerable populations, risks in animal-to-human contact and factors affecting infection rates. The time of study is the Hajj season (1440 Hijri calendar) that lasted around six weeks between

15-11-1440 and 30-12-1440 according to the Islamic calendar that corresponds to (8/7/2019 to 1/9/2019). The study was designed as a cross-sectional survey for all healthcare workers in the primary healthcare delivering care at the seasonal primary healthcare centers. A self-administered questionnaire encompassing all the above variables will serve as the primary source of information for further statistical analysis.

3. Statistical Methods Used in the Study

In order to fulfill the objectives of the study, a number of statistical techniques were utilized in the data analysis:

- **Cronbach's alpha coefficient:** is measurement of internal consistency which was utilized in this study to assess the overall reliability of the measurement scale for each defined construct of the study, where alpha is defined as an estimate of the proportion of the total variance that is not due to error.
- **Descriptive Statistics:** e.g. means of frequencies (of the study data), and standard deviation. Both were used to identify the major characteristics of respondents in terms of their gender, age, and epidemiology Skills.

4. Results

Data available from the questionnaire were analyzed using SPSS to determine the strength of evidence in light of its objectives. Reliability percentage was applied. Bar charts were drawn to summarize the data from the self-administered questionnaire.

5. Reliability

In this study, highly reliable tests were indicated by their stability over a period of time. Stability is an aspect of reliability and measures the extent to which test scores are stable over time. Reliability tests confirm the reliability of the variables in addition to the internal consistency.

This study was performed as an optional questionnaire distributed to health staff regarding their knowledge about the highly fatal MERS-CoV viral infection. Biological variables for participants were age, gender, specialty, work experience and type of study. 402 participants filled in the questionnaire (88 males, 300 females and 14 persons who did not indicate their sex) and participated in the study. Valid percent for participating males was 22.7% while it was 77.3% for participating females (Figure 1A).

The participants were classified as medical students (5 participants with an a valid percent of 1.4%), physicians (235 participants with an a valid percent of 64.4%), nurses (86 participants with an a valid percent of 23.6%) and others (39 participants with a valid percent of 10.7%) (Figure 1B).

Regarding working experiences of the participants, two participants (valid percent 1.4%) were intern, 91 participants

(valid percent 61.9%) had less than 10 years of work experience, 50 participants (valid percent 34%) had 10-20 years of work experience and 3 participants (valid percent 2%) had 20-30 years of work experience (Figure 1C).

254 students were participating in this study. Among those, 58 students (valid percent 22.8%) were at level 3, 195 students (valid percent 76.8%) were at level 4 and 11 students (valid percent 4%) were at level 11 (Figure 1D).

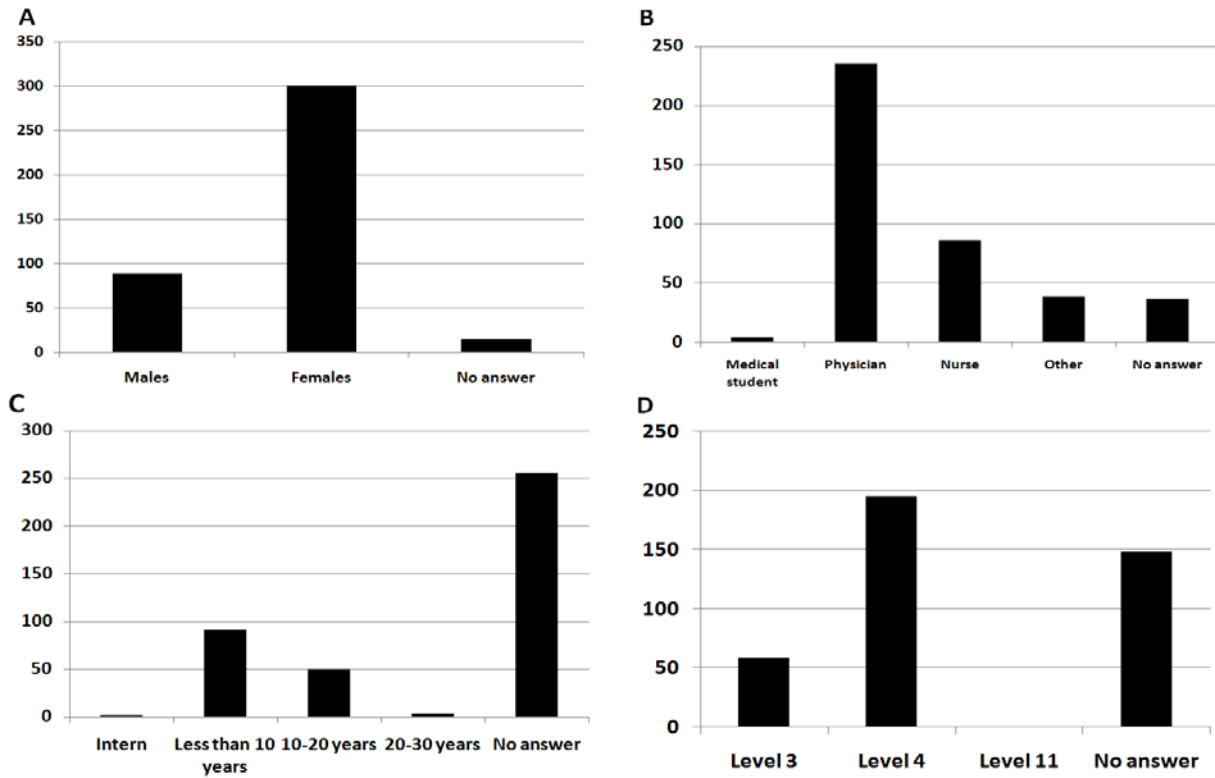


Figure 1. Educational and medical characteristics of the study participants. A. Gender of the participant. B. Profession of the study participant. C. Health work experience of the study participant. D. Place of work in Al-Madinah Al-Munawwarah, Saudi Arabia

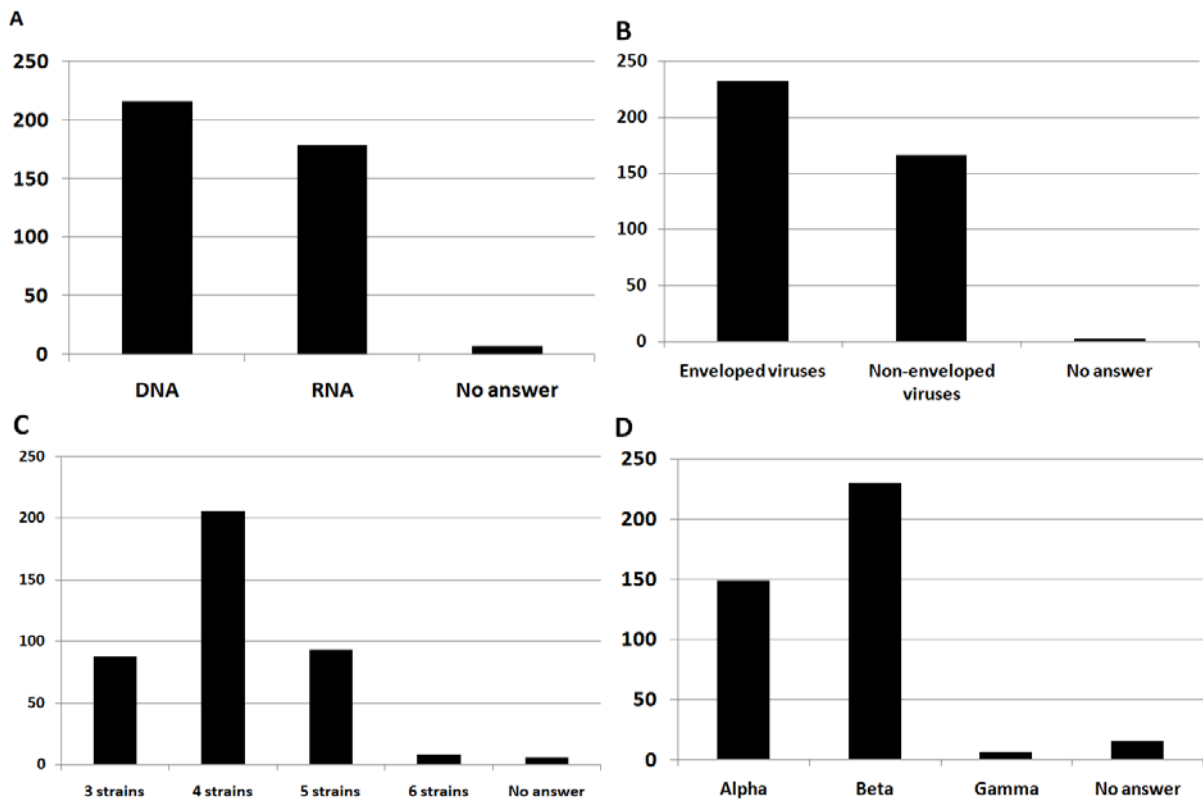


Figure 2. Basic virology knowledge about coronaviruses. A. Type of nucleic acid in coronaviruses (DNA or RNA). B. Is coronavirus an enveloped or non-enveloped virus? C. Number of strains in coronaviruses? D. Genus of MERS-CoV viruses

Regarding the question about type of corona viruses nucleic acids (whether DNA or RNA), the question was answered by 395 participants. 216 participants (valid percent 54.7%) answered that coronaviruses have DNA while 179 participants (valid percent 45.3%) said that coronaviruses have RNA (Figure 2A). Moreover, 232 participants (valid percent 58.1%) said that coronaviruses are enveloped viruses while 167 participants (valid percent 41.9%) said that coronaviruses are nonenveloped viruses (Figure 2B).

Investigated health working participants reported different opinions about the number of strains of coronaviruses that infect humans. 88 participants (valid percent 22.2%) answered that the number of strains of coronaviruses that infect humans are 3 strains. 206 participants (valid percent 52%) answered that the number of strains of coronaviruses that infect humans are 4 strains. 93 participants (valid percent 23.5%) answered that the number of strains of coronaviruses that infect humans are 5 strains. 9 participants (valid percent 2.3%) answered that the number of strains of coronaviruses that infect humans are 6 strains (Figure 2C).

Investigated health working participants reported different opinions about the types of strains of coronaviruses that infect humans whether it's alpha, beta or gamma. 149 participants (valid percent 38.6%) answered that the type of coronaviruses that infect humans

is alpha. 230 participants (valid percent 59.6%) answered that the type of coronaviruses that infect humans is beta. 7 participants (valid percent 1.8%) answered that the type of coronaviruses that infect humans is gamma (Figure 2D).

Regarding the epidemiology of coronaviruses transmission, answers of participants were variable. The questionnaire asked about the cause of coronaviruses infections whether it is close contact or not, 286 participants (valid percent 71.3%) did not agree while 115 participants (valid percent 28.7%) said yes (Figure 3A). Regarding the role of recent travellers in the Arabian peninsula in coronaviruses transmission, 297 participants (valid percent 73.9%) did not agree while 105 participants (valid percent 26.1%) believed that travellers from the Arabian peninsula have a role in MERS-CoV transmission (Figure 3B). Regarding the role of close contacts in the occurrence of confirmed cases of MERS-CoV, 148 participants (valid percent 36.8%) didn't agree while 254 believed that they are at risk and subsequently represent a source of infection to others (Figure 3C). Regarding the role of exposure to camels in the occurrence of coronaviruses transmission, 244 participants (valid percent 60.7%) did not agree while 158 participants (valid percent 39.3%) agreed (Figure 3D). Regarding the risk of infection of healthcare personnel with MERS-CoV, 149 participants (valid percent 37.1%) did not agree while 253 participants (62.9%) agreed (valid percent 62.9%) (Figure 3E).

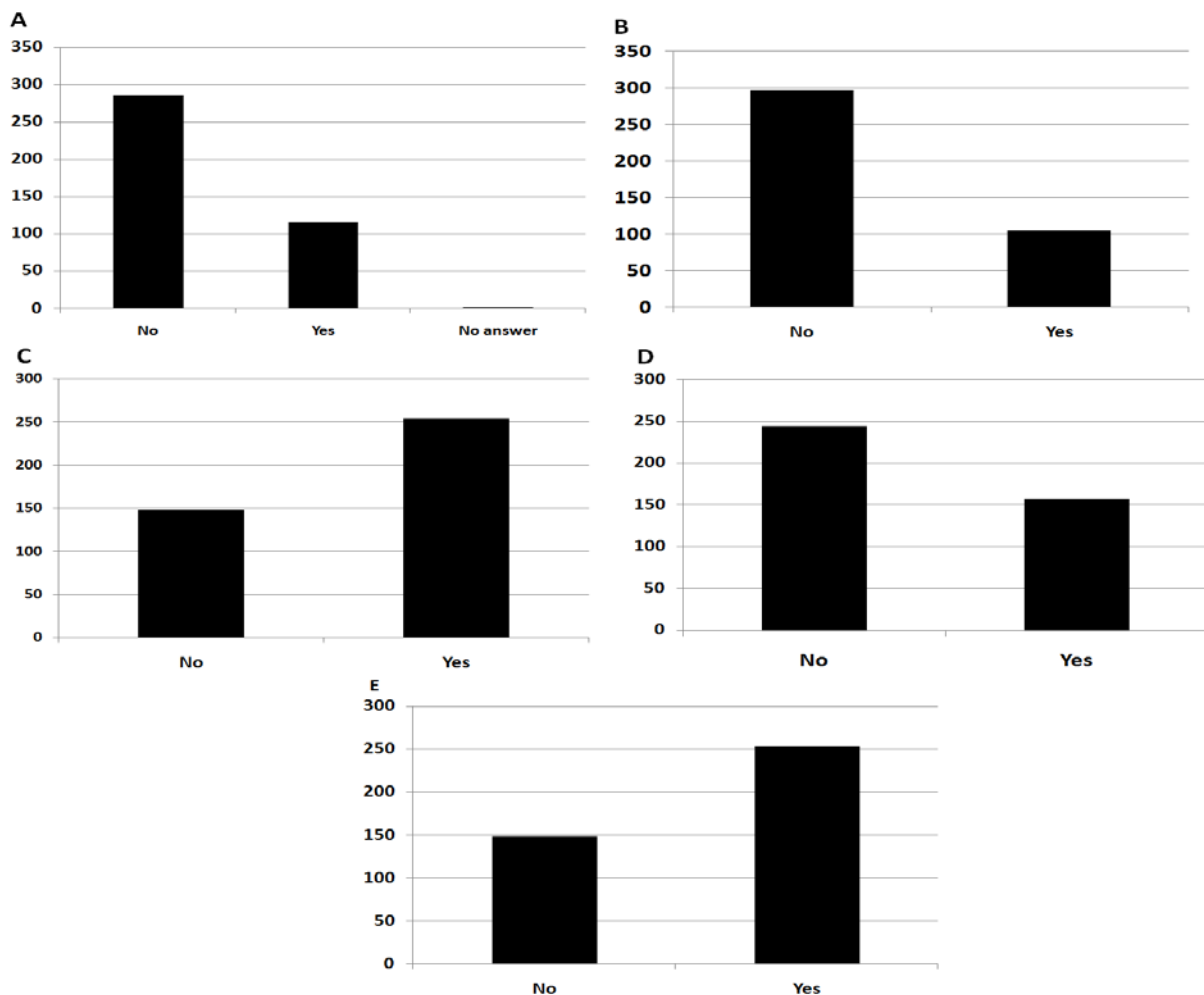


Figure 3. Health knowledge regarding transmission variables affecting corona viruses. A. Effect of close contact on corona transmission. B. Risk of infection of recent travellers from Arabian peninsula. C. Risk of infection of close contacts of a confirmed case of MERS-CoV. D. Risk of infection of people with exposure to camels. E. Risk of infection of healthcare personnel

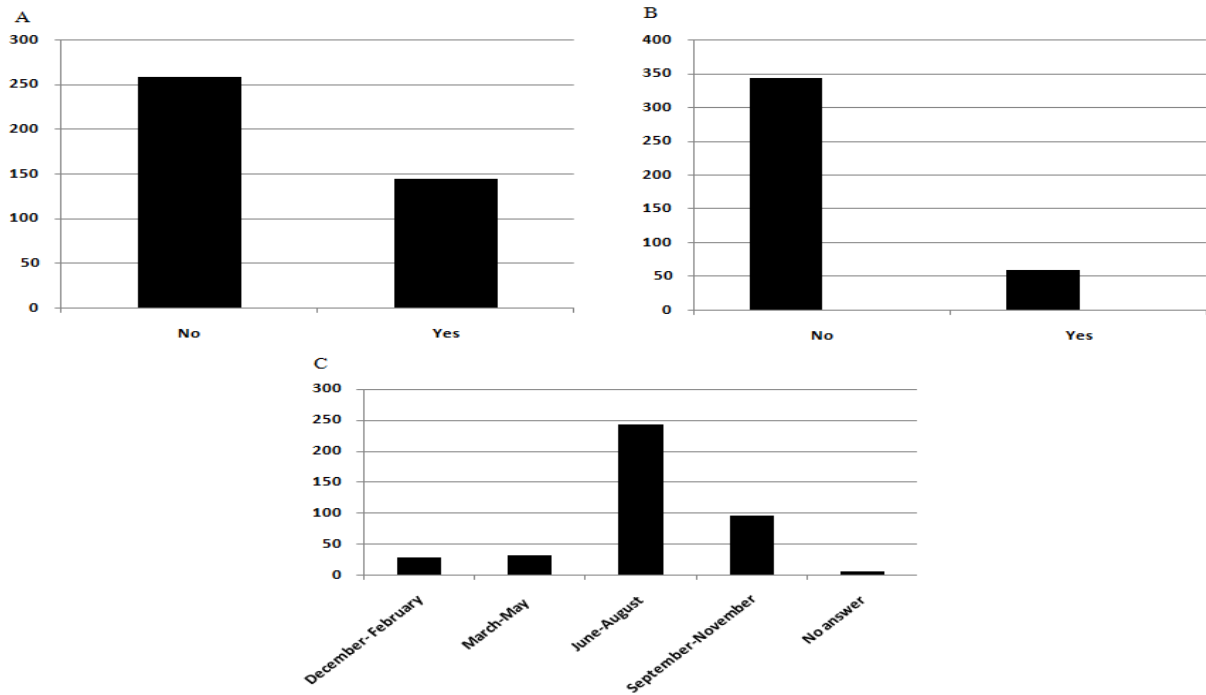


Figure 4. The animals and season participating to MERS-CoV transmission. A. Do camels participate to MERS-CoV transmission? B. Do bats participate to MERS-CoV transmission? C. What is the best Season for coronaviruses transmission?

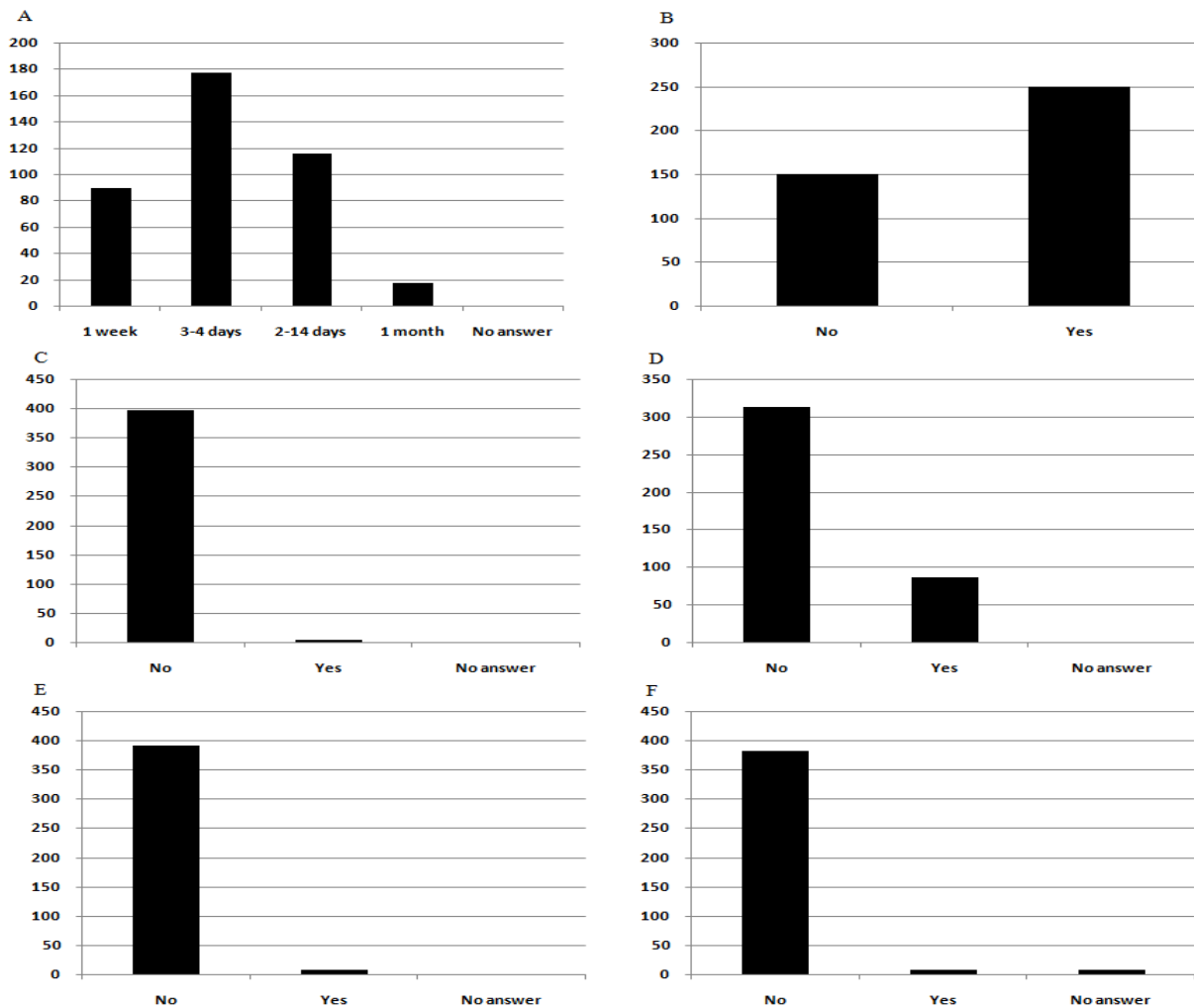


Figure 5. Infectivity and health effects of MERS-CoV infection. A. What is the incubation period of MERS-CoV infection? B. Are there respiratory symptoms for MERS-CoV infection? C. Are there urinary symptoms for MERS-CoV infection? D. Are there gastrointestinal symptoms for MERS-CoV infection? E. Are there skin manifestations for MERS-CoV infection? F. Is there subclinical infection of MERS-CoV?

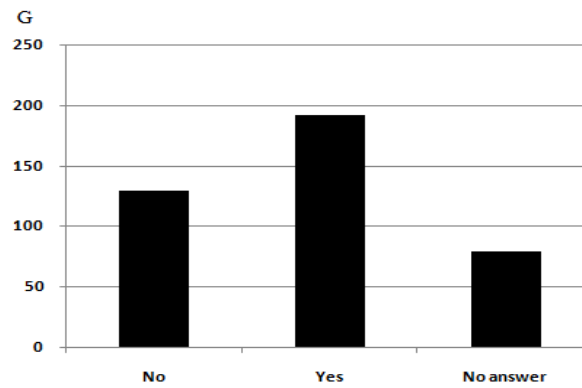


Figure 5. G. Infectivity and health effects of MERS-CoV infection

Then, the questionnaire asked about the role of camels in transmission of MERS-CoV infections. Regarding the roles of camels in coronaviruses transmission, 258 participants (valid percent 64.2%) didn't agree while 144 participants (valid percent 35.8%) agreed (Figure 4A). Regarding the role of bats in coronaviruses transmission, 343 participants (valid percent 85.3%) did not agree while 59 participants (valid percent 14.7%) agreed (Figure 4B).

Regarding the seasons for optimal MERS-CoV infection, 27 participants (valid percent 6.8%) considered December- February as the optimal time for occurrence of MERS-CoV infection. 32 participants (valid percent 8.1%) considered March-May as the optimal time for occurrence of MERS-CoV infection. 243 participants (valid percent 60.4%) considered June-August as the optimal time for occurrence of coronaviruses transmission. 95 participants (valid percent 23.9%) considered September-November as the optimal time for occurrence of MERS-CoV infection (Figure 4C).

Regarding the health knowledge of the incubation period of coronaviruses, 90 participants (valid percent 22.4%) answered that the incubation period for the occurrence of coronaviruses transmission is 1 week. 177 participants (valid percent 44.1%) answered that the incubation period for the occurrence of coronaviruses transmission is 3-4 days. 116 participants (valid percent 28.9%) answered that the incubation period for the occurrence of coronaviruses transmission is 2-14 days. 18 participants (valid percent 4.5%) answered that the incubation period for the occurrence of coronaviruses transmission is 1 month (Figure 5A).

Regarding the symptomatology of coronaviruses infection, 151 participants (valid percent 37.7%) believed that MERS-CoV do not cause respiratory symptoms. 250 participants (valid percent 62.3%) said that MERS-CoV cause respiratory symptoms (Figure 5B). Moreover, 313 participants (valid percent 78.3%) believed that MERS-CoV does not cause gastrointestinal symptoms. 87 participants (valid percent 21.8%) believed that MERS-CoV causes gastrointestinal symptoms (Figure 5C). 391 participants (valid percent 97.8%) believed that MERS-CoV does not cause neurological symptoms. 9 participants (valid percent 2.3%) believed that MERS-CoV causes neurological symptoms (Figure 5D). 397 participants (valid percent 98.8%) said coronaviruses do not cause renal symptoms. 4 participants (valid percent 1%) said coronaviruses cause renal symptoms (Figure 5E). 382 participants (valid percent 97.4%) said coronaviruses do not cause skin manifestations.

10 participants (valid percent 2.6%) said coronaviruses cause skin manifestations (Figure 5F).

Regarding the reported knowledge among the participants for some immunological aspects of coronavirus transmission, the questionnaire investigated health knowledge about presence of subclinical coronaviruses infection. 130 participants (valid percent 40.4%) said coronaviruses cause no subclinical infection. 192 participants (valid percent 47.8%) said coronaviruses cause subclinical infection (Figure 5G).

6. Discussion

Knowledge and subsequent attitudes towards MERS-CoV viral infections is a vital health issue in a country like Saudi Arabia that receives over 3 million people during the pilgrimage season only. Yearly, more than 20 million people do the worship of Umrah and pray in the masjid of Prophet Muhammad peace be upon him. The present study focuses on the Hajj season in 2019 in the city of Al-Madinah Al-Munawwarah in Saudi Arabia as it is one of the most beloved cities for Muslim pilgrims who keep visiting its Al-Masjid Al-Nabawi (prophetic Mosque). For that, almost 500,000 visitors came to Al-Madinah everyday. Most of the year, the prophetic Masjid is crowded from inside and the crowdedness expand to include the mosque's piazzas and even the streets outside the masjid. Unfortunately, overcrowdedness is a risk factor for transmitting respiratory diseases as MERS-CoV. MERS-CoV viruses are enveloped RNA viruses that fall into six strains. MERS-CoV viruses cause zoonotic diseases belonging to gamma genus of corona viruses. MERS-CoV infection may be caused by droplet, close patients contact and exposure to camels. March-May period is the season of greatest disease transmission. Incubation period is 3-4 days with respiratory and renal symptoms and subclinical infection [1].

Majority of the investigated medical personnel were females (Figure 1A) among which physicians and nurses were a majority (Figure 1B). Unfortunately, most participants in the questionnaire did not answer the question regarding the number of work experience years in the medical and health practice (Figure 1C). Majority of investigated students were at level 4 (Figure 1D).

Regarding health personnel's knowledge about corona viruses, the majority of investigated personnel failed to answer the basic knowledge regarding the type of nucleic acid in corona viruses. Coronaviruses are RNA viruses.

Unfortunately, majority of the questionnaire participants (216 out of 402, 53.7%) answered it is a DNA virus while 179 participants (44.5%) got the true answer and said it is an RNA virus (Figure 2A). Majority of participants (232 out of 402, 57.7%) answered correctly regarding the structure of coronaviruses and said it is an enveloped compared to 167 participants (41.5%) who said it is a non-enveloped virus (Figure 2B). Unfortunately, only few participants (9 out of 402, 2.2%) got the correct answer that coronaviruses include 6 strains. Remaining participants either did not get that true answer or did not answer this question (Figure 2C). Few participants (7 out of 402, 1.7%) recognized that the genus of coronaviruses in gamma not alpha or beta. Most participants (98.3%) failed to answer or did not answer this question (Figure 2D).

Regarding the health knowledge about coronaviruses transmission, majority of questioned personnel (286 out of 402, 71.1%) considered close contact not a risk factor for MERS-CoV transmission and answered saying (No) vs 115 participants (28.6%) who considered close contact is not a risk factor for MERS-CoV transmission and answered saying (yes) (Figure 3A). Majority of participating medical personnel (297 out of 402, 73.8%) denied the risk of MERS-CoV for recent travellers from Arabian peninsula while the remainder expected a risk (Figure 3B). Majority of participating medical personnel (254 out of 402, 63.1%) expected MERS-CoV infection risk for close contacts of a confirmed case of MERS-CoV (Figure 3C). Actually, this contradicts their previous answer that considered close contact not a risk factor for MERS-CoV transmission (Figure 3A). Majority of participating medical personnel (244 out of 402, 60.6%) did not expect a high risk of MERS-CoV infection for close contacts of camels (Figure 3D). Majority of participating medical personnel (259 out of 402, 62.9%) expected a higher risk of MERS-CoV infection for healthcare personnel (Figure 3E).

Regarding the health knowledge of the role of animals in MERS-CoV transmission, 258 participants (64.1%) answered saying “No” versus 144 participants (35.8%) answered saying “yes” (Figure 4A). Regarding the role of bats in coronaviruses transmission, 343 participants (85.3%) answered saying “No” versus 59 participants (14.7%) answered saying “yes” (Figure 4B). Regarding the highest season in MERS-CoV infectivity, few participants (32, 7.9%) got the right answer that March-May is the highest season (Figure 4C).

Regarding the epidemiology of MERS-CoV, majority of participants were correct and chose the answers that incubation period is 2-4 days or 2-14 days (Figure 5A). Majority of participants (250 out of 402, 62.1%) were correct and chose the answers that main symptoms of MERS-CoV infection are respiratory (Figure 5B). Majority of subjects did not consider renal manifestations of MERS-CoV (397 out of 402, 98.7%) (Figure 5E). Many reported patients died with renal failure Garout [19]. Majority of participants were correct in choosing gastrointestinal, neurological and skin manifestations as minor symptoms of MERS-CoV infection (Figure 5C-F). Majority of investigated participants confirmed the presence of subclinical infection with MERS-CoV (Figure 5G).

Findings from this study provide a quantitative analysis of KAPs among primary care professionals. They will help devise strategies to deliver targeted educational

interventions at the first point of contact that proves meaningful in terms of significant infection control in the public health domain.

7. Recommendations

This study sheds light on a vital issue regarding the knowledge of healthcare personnel working in Al-Madinah region. Unfortunately, a lot of medical education in this health topic needs to be delivered to such personnel. Many basic knowledge facts are needed for better treatment and preventive purposes.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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Coronavirus Questionnaire

Dear participant:

The purpose of this questionnaire to assess the knowledge and attitude toward Middle East respiratory syndrome coronavirus (MERS-CoV), among healthcare personnel, and medical students, your participation is entirely voluntary, Thank you for your cooperation. (NB: Please remain anonymous).

A S_N (for serial number)					
B Gender:	<input type="radio"/> Male 1		<input type="radio"/> Female 2		
C Age:	<input type="radio"/> 18-25 1	<input type="radio"/> 26-35 2	<input type="radio"/> 36-45 3	<input type="radio"/> 46-55 4	<input type="radio"/> +56 5
D Specialty:	<input type="radio"/> Medical student 0	<input type="radio"/> Physician 1 <input type="radio"/> Nurse 1 <input type="radio"/> Other: 1 (ALL UNDER ONE VARIABLE: HRALTH CARE PERSONELLE)			
E Work for/ study in:	<input type="radio"/> Asser central hospital 1	<input type="radio"/> Primary health center 2	<input type="radio"/> KKU 3	<input type="radio"/> Other: 4	
F Work experience:	<input type="radio"/> Interns 1	<input type="radio"/> Less than 10 years 2	<input type="radio"/> 10-20 years 3	<input type="radio"/> 20-30 years 4	
G Student:	<input type="radio"/> Level 3	<input type="radio"/> Level 4	<input type="radio"/> Level 5	<input type="radio"/> Level 6	<input type="radio"/> Level 7
	<input type="radio"/> Level 8	<input type="radio"/> Level 9	<input type="radio"/> Level 10	<input type="radio"/> Level 11	<input type="radio"/> Level 12

The morphology:				
H Type of coronaviruses:	<input type="radio"/> DNA 1		<input type="radio"/> RNA 2	
I Coronaviruses are:	<input type="radio"/> Enveloped viruses 1		<input type="radio"/> Non enveloped viruses 2	
J Number of strains of coronaviruses infect humans:	<input type="radio"/> 3 strains 1	<input type="radio"/> 4 strains 2	<input type="radio"/> 5 strains 3	<input type="radio"/> 6 strains 4
K MERS-CoV is:	<input type="radio"/> Alpha 1	<input type="radio"/> Beta 2	<input type="radio"/> Gamma 3	<input type="radio"/> Delta 4
L MERS-CoV:	<input type="radio"/> Human disease 1		<input type="radio"/> Zoonotic disease 2	

Transmission: (you can choice more than one)				
M Routes of transmission:	<input type="radio"/> Person-to-person 1	<input type="radio"/> Close contact 2	<input type="radio"/> Droplets 3	
	<input type="radio"/> Air born 4	<input type="radio"/> Food 5	<input type="radio"/> Insect 6	
	<input type="radio"/> Vertical 7	<input type="radio"/> Sexual 8	<input type="radio"/> Direct contact 9	
	<input type="radio"/> Drink raw camel milk 10	<input type="radio"/> Eat undercooked camel meat 11		
N People at Risk to infected by MERS:	<input type="radio"/> Recent Travelers from the Arabian Peninsula 1		<input type="radio"/> Close Contacts of a Confirmed Case of MERS 2	
	<input type="radio"/> People with Exposure to Camels 3		<input type="radio"/> Healthcare Personnel 4	
O The animal who can get the infection	<input type="radio"/> Camels 1	<input type="radio"/> Goats 2	<input type="radio"/> Bat 3	<input type="radio"/> Cows 4
	<input type="radio"/> Sheep 5	<input type="radio"/> Water buffalo 6	<input type="radio"/> Swine 7	<input type="radio"/> Wild birds 8
P Season of transmission	<input type="radio"/> December- February 1	<input type="radio"/> March-May 2	<input type="radio"/> June- August 3	<input type="radio"/> September- November 4
Clinical aspect:				
Q Incubation period	<input type="radio"/> 1 week 1	<input type="radio"/> 3-4 days 2	<input type="radio"/> 2-14 days 3	<input type="radio"/> 1 month 4
R Symptoms: (more than one)	<input type="radio"/> Respiratory symptoms. 1	<input type="radio"/> Gastrointestinal symptoms. 2	<input type="radio"/> Neurological symptoms. 3	
	<input type="radio"/> Urinary symptoms 4	<input type="radio"/> Skin manifestation 5		
S The main symptoms is:	<input type="radio"/> Respiratory symptoms. 1	<input type="radio"/> Gastrointestinal symptoms. 2	<input type="radio"/> Neurological symptoms. 3	
	<input type="radio"/> Urinary symptoms 4	<input type="radio"/> Skin manifestation 5		
T Are there sub clinical infection:	<input type="radio"/> Yes 1		<input type="radio"/> No 2	

