Assessment of knowledge and attitude among healthcare workers towards monkeypox disease: a cross-sectional study from Saudi Arabia

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ABSTRACT

Background. Monkeypox has been announced recently as a global public health emergency by the World Health Organization. The recent outbreak of monkeypox has brought back concerns about how this viral infection can spread easily between individuals and cause a major health concern. Objectives. The objective of this study was to assess healthcare workers' (HCWs) knowledge about monkeypox illness, its transmission, prevention, and attitudes toward this re-emerging disease. Materials and Methods. A descriptive correlational cross-sectional survey was conducted in Saudi Arabia from June to August 2022 and targeted HCWs including medical technologists and technicians, physicians, nurses, pharmacists, and others. Results. A total of 385 participants were included where 53.5% of respondents were male compared to 46.5% female. The average score for knowledge was 9.90, and the majority of respondents had an inadequate understanding of monkeypox. In addition, the average score of attitude toward monkeypox infection was 50.19, which indicate that HCWs have a positive view of efforts to prevent monkeypox. Conclusions. In Saudi Arabia, HCWs were found to have an inadequate understanding of the virus that causes monkeypox. This study shows how important it is for HCWs to learn more, since managing contagious infections requires a lot of help from trained and knowledgeable medical professionals.

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Introduction

Monkeypox is a viral zoonotic infection that was detected in macaque monkeys in 1958 as a result of an outbreak in an animal research facility in Denmark, and thus, was given the name "monkeypox".[1] Human monkeypox was then discovered from a smallpox suspected patient in 1970 in the Democratic Republic of the Congo during the smallpox eradication program.[2,3] Following this, the disease became endemic across regions of central and West Africa while reported cases beyond these regions were detected due to international travel to the endemic regions.[4] In fact, monkeypox was regarded as a neglected infection resulting in small outbreaks in several areas of central and west Africa.[5] Like most zoonotic diseases, previous genetic analysis showed that zoonotic spillover was the reason behind the transmission where the virus spread from animal reservoirs into the human population.[6,7] The genetic

makeup of the monkeypox virus consists of an enveloped double-stranded DNA virus with a genome size of 196,858 base pairs forming the essential part for viral replication in the hosted cell.[8] Previous studies have shown that monkeypox infection occurs with sporadic outbreaks in humans in Africa owing to contact with wildlife animals such as rodents.[2,9] Since the virus is rarely seen in North American and European countries, the present monkeypox outbreak is extremely unusual, causing the World Health Organization (WHO) to declare the monkeypox outbreak a global public health emergency over the ongoing increase in cases. Currently, Europe is considered a hot spot region where more than 80% of confirmed cases have been detected followed by the American regions (approximately 12%) and a minor percentage in other parts of the world.[10] The clinical picture of monkeypox infection resembles that of smallpox and becomes apparent after an incubation period that typically lasts from 7 to 14 days.[10] This includes lymphadenopathy followed by or concomitant with a rash located in some parts of the body including the genital area, upper and lower extremities, chest, face, or mouth. Other symptoms include flu-like symptoms, such as fever, chills, sore throat, nasal congestion; and muscle aches.[3,11] Epidemiological studies showed that the virus can be transmitted from animals to human by close contact, through biting, scratching or due to contact with skin lesions and exposure to respiratory droplets.[12,13] Human-to-human transmission was rarely reported in the past, however, some studies showed that prolonged contact with lesion materials or respiratory droplets has been suggested to be the process of transmission. Other risk factors include living in the same room and sharing household items such as dishes and spoons can also cause the transmission.[14-16]

In Saudi Arabia, the official Saudi press agency declared the detection of the first case of monkeypox on July 14, 2022, for a person returning from overseas in the city of Riyadh.[17] Transmission and thus prevention of communicable diseases relies on several factors including environment, contact pattern, host factors, and socio-economic factors.[18] Moreover, prior knowledge and presence of awareness background in dealing with causative infections play an important role in reducing transmission. Therefore, the main aim of this study was to assess the extent of knowledge about monkeypox disease, its transmission, prevention, and attitude toward this re-emerging disease among healthcare workers (HCWs). Prior knowledge of such fundamental information gives officials a baseline impression of how to implement practical steps toward prevention, control, and implementation of effective practices to eradicate such highly infectious diseases. This is particularly important for healthcare workers due to their direct contact and communication with suspected patients.

Materials and Methods

Study setting

This study was performed among HCWs in various regions of Saudi Arabia between July and September 2022. There are 13 provinces in Saudi Arabia: Makkah, Riyadh, Eastern, Asir, Jazan, Medina, Al-Qassim, Tabuk, Ha'il, Najran, Al-Jawf, Al-Bahah, and the Northern Borders. The total number of HCWs in Saudi Arabia reached 44,277 in 2018 as declared by the Ministry of Health.[19]

Study design and participants

A descriptive cross-sectional survey was performed using a self-administered questionnaire prepared through Google forms and distributed electronically to healthcare workers using social media applications including Twitter and WhatsApp. Sample size was estimated through the Raosoft sample size calculator.[20] The total number of required samples for this study was estimated to be 384 with a 95% confidence level, ±5% margin of error, and 50% response distribution. The participants were categorized based on sociodemographic theme. The questionnaire consisted of 39 questions related to socio-demographic information, knowledge about monkeypox infection, and attitude toward the disease. Eligibility criteria included HCWs from different professions who consented to participate comprising mainly medical technologists and technicians, physicians, nurses, pharmacists, and other professionals related to healthcare. Exclusion criteria were applied to those individuals from other non-health science backgrounds, ages below 20 years as well as any responder who refused to be engaged in the study.

Data analysis

There were 19 close-ended questions (items) to construct the core knowledge related to monkeypox infection. The attitude towards the Monkeypox disease variable comprised 11 statements, each measured on a 5-point Likert scale, where 1 reflected "strongly agree," while 5 reflected "strongly disagree." A simple average was used to calculate the variables. A positive attitude was considered when the score was ≥4, while a negative attitude was considered when the score was ≤3. Data analyses were performed using the IBM SPSS 23 software. Descriptive statistics, such as means and standard deviations, were used to evaluate the participants' level of knowledge and attitude. Pearson's r correlation was used to

analyze the connection between monkeypox knowledge and attitude. One-way analysis of variance was performed to analyze differences in the primary research variables based on categorical demographics. Linear regression was performed to investigate factors that can be utilized to predict sentiments toward monkeypox. Cronbach's alpha values were calculated for the survey and its subscales to evaluate the internal consistency of the survey.

Results

A total of 385 participants were included in this study. As shown in Table 1, 93.2% of the participants were from Saudi Arabia, while the rest (6.8%) belonged to other nationalities. In addition, 53.5% of the respondents were males and 46.5% were females. With regard to the age groups, 53.8% of respondents from the age group of 20-29 years represented the highest proportion of participants, followed by the age groups of 30-39 years (35.6%), 40-49 years (8.8%), and ≥50 years (1.8%). Among all the respondents, 55.8% were single in terms of marital status, followed by 41.6% married, and 2.6% divorced. In terms of occupation, this study found that 70.4% of respondents were medical technologists/technicians followed by 10.9% physicians, 9.4% nurses, 3.9% pharmacists, and 5.5% represented other professions in the healthcare settings. The work experience was classified into 5 groups comprising 31.2% were interns, 29.1% had 1-5 years of experience, 18.7% had 6-10 years, 11.7% had 11-15 years, and 9.4% had more than 15 years of experience.

Table 2 demonstrates the knowledge of HCWs regarding the monkeypox virus. Most of the participants (80.5%) believed that the monkeypox infection is caused by the virus which was the correct answer. However, there were some mixed responses to the question related to transmission of the disease. Around 28.1% of respondents thought contact with body lesions, body fluids, and respiratory droplets was the main route of transmission. Others (25%) believe that sexual intercourse is the route of transmission. In addition, 35.8% of the participants had no knowledge about the incubation period of the monkeypox virus. The majority of participants (73%) were unaware of the correct genus of the human monkeypox virus. Most of the respondents (77.4%) thought that the monkeypox infection originated from animals which was correctly answered. All age groups are equal and are at a higher risk of getting monkeypox infection thought by 72.7% of respondents which was wrongly answered. Almost half of the respondents had no knowledge about the vaccination for monkeypox disease.

Table 3 shows the attitude or perception of monkeypox among the HCWs. The majority of respondents (83.6%) strongly agreed on the importance of maintaining hygienic practices to avoid the infection. This is similar to other beliefs that fall under the attitude in terms of strong agreement which include personal protective equipment usage (83.1%), sharps safety and safe injection practices (83.9%),

Table 1. Frequency distribution of socio-demographic profile of the respondents (N=385).

Variables	Categories	Frequency	Percent
Nationality	Saudi	359	93.2
	Non-Saudi	26	6.8
Gender	Male	206	53.5
	Female	179	46.5
Age group	20-29 year	207	53.8
	30-39 year	137	35.6
	40-49 year	34	8.8
	50 and above	7	1.8
Marital status	Single	215	55.8
	Married	160	41.6
	Divorced	10	2.6
Occupation	Medical technologist/technician	271	70.4
	Pharmacist	15	3.9
	Physician	42	10.9
	Nurse	36	9.4
	Others	21	5.5
Working experience	Intern	120	31.2
	1-5 years	112	29.1
	6-10 years	72	18.7
	11-15 years	45	11.7
	More than 15 years	36	9.4

sterilization of instruments and disinfection of environmental surfaces (83.1%), avoidance of close contact with suspected infected persons (82.6%), isolation of suspected individuals (81.3%) as well as restriction of animal trade to limit transmission of the virus (73%). Other items of attitude showed variable percentages with mostly tend toward strong agreement. This is applied to immunization that, with the smallpox vaccine, may grant protection against monkeypox (61.6%), HCWs who obtained smallpox vaccination should be chosen to deal with suspected patients (63.1%), feeling fearful of job (57.7%) and avoidance of family or community from HCWs (64.4%).

Table 4 shows the level of knowledge and attitudes among HCWs toward the monkeypox infection. The average knowledge score was 9.90 indicating an overall of poor knowledge. In addition, the average score of the attitude part was 50.19, indicating respondents have a good and positive attitude towards monkeypox prevention activities.

Table 5 shows no significant difference in knowl-

Table 2. The frequency distribution of knowledge-related questions among the respondents (N=385).

Question of knowledge	Categories	Frequency	Percentage
Have you heard about monkeypox infection?	Yes	379	98.4
	No	6	1.6
Where did you hear about the monkeypox infection?	Haven't heard	6	1.6
	Social Media (Twitter, Facebook)	290	75.3
	TV/ Radio	40	10.4
	Workplace	45	11.7
	Other	1	0.3
	All of above	3	0.9
The causative agent of monkeypox infection is	Bacteria	4	1.0
	Fungi	7	1.8
	Parasite	3	.8
	Virus	310	80.5
	I don't know	61	15.8
Monkeypox infection is transmitted by	Contact with an infected person or animal, or with material contaminated with the causative agent	256	24.2
	Contact with body lesions, body fluids, respiratory droplets	297	28.1
	Contaminated materials such as bedding and towels	241	22.8
	Sexual intercourse	264	25.0
What is the average incubation period of monkeypox infection?	1-6 days	50	13.0
	7-14 days	134	34.8
	15-21 days	63	16.4
	I don't know	138	35.8
Which genus type does the Human monkeypox agent belongs to?	Avipoxvirus	47	12.2
	Leporipoxvirus	8	2.1
	Orthopoxvirus	49	12.7
	I don't know	281	73.0
The monkeypox infection was originated most likely from?	Animal	298	77.4
	Human	27	7.0
	I don't know	60	15.6
Who is at higher risk of getting monkeypox infection?	Adults	55	14.3
	All age groups are equal	280	72.7
	Children	23	6.0
	Elder people	27	7.0
The symptoms of monkeypox infection	Fever	308	17.1
	Skin rash	345	19.1
	Headache	242	13.4
	Muscle aches	241	13.3
	Fatigue	282	15.6
	Lymphadenopathy	197	10.9
	Respiratory symptoms such as sore throat	191	10.6
Current recommended treatment of patient	Antiviral treatment that can be used for serious cases only antiviral	133	42.8
	Supporting treatment (palliative) for majority of patients	178	57.2
Is there a specific vaccine for monkeypox disease?	Yes	64	16.6
	No	192	49.9
	Not sure	129	33.5

edge and attitude scores among the HCWs based on occupations and working experience.

Table 6 shows a significant difference (P=0.000) between the level of knowledge and attitude scores regarding the level of knowledge about monkeypox infection.

Discussion

The clinical management of monkeypox virus outbreaks involves close collaboration of skilled and well-trained HCWs to prevent the spread of such contagious infections. Sufficient knowledge of the disease

Table 3. Attitudes of monkeypox virus among the respondents (N=385).

Attitude	Categories	Frequency	Percentage
Hand and respiratory hygiene practice should be implemented to prevent monkeypox infection	Strongly disagree	2	.5
	Disagree	6	1.6
	Not sure	11	2.9
	Agree	44	11.4
	Strongly agree	322	83.6
Personal protective equipment should be worn when dealing with suspected patients	Strongly disagree	2	.5
	Disagree	8	2.1
	Not sure	15	3.9
	Agree	40	10.4
	Strongly agree	320	83.1
Sharps safety and safe injection practices should be implemented to prevent transmission of monkeypox infection	Strongly disagree	2	.5
	Disagree	8	2.1
	Not sure	13	3.4
	Agree	39	10.1
	Strongly agree	323	83.9
Sterilization of instruments and disinfection of environmental surfaces should be carried out to prevent transmission of monkeypox infection	Strongly disagree	2	.5
	Disagree	7	1.8
	Not sure	13	3.4
	Agree	43	11.2
	Strongly agree	320	83.1
Avoid close contact with suspected infected persons	Strongly disagree	2	.5
	Disagree	7	1.8
	Not sure	17	4.4
	Agree	41	10.6
	Strongly agree	318	82.6
Immunization with smallpox vaccine may grant a protection against monkeypox	Strongly disagree	6	1.6
	Disagree	19	4.9
	Not sure	69	17.9
	Agree	54	14.0
	Strongly agree	237	61.6
Healthcare workers who have already received smallpox vaccination should be chosen for dealing with suspected patients	Strongly disagree	7	1.8
	Disagree	23	6.0
	Not sure	59	15.3
	Agree	53	13.8
	Strongly agree	243	63.1
Isolation of individuals with suspected symptoms should be carried out	Strongly disagree	3	.8
	Disagree	7	1.8
	Not sure	17	4.4
	Agree	45	11.7
	Strongly agree	313	81.3
Restriction of animal trade should be implemented, and suspected infected animals should be isolated from other animals	Strongly disagree	3	.8
	Disagree	13	3.4
	Not sure	35	9.1
	Agree	53	13.8
	Strongly agree	281	73.0
Feeling fearful of getting infection to my family members due to my job	Strongly disagree	11	2.9
	Disagree	34	8.8
	Not sure	42	10.9
	Agree	76	19.7
	Strongly agree	222	57.7
Healthcare workers may experience family or community avoidance	Strongly disagree	5	1.3
	Disagree	17	4.4
	Not sure	38	9.9
	Agree	77	20.0
	Strongly agree	248	64.4

is necessary for the control and prevention of all elements of the disease, including the detection of cases, administration of vaccinations, and provision of the highest level of medical care. This approach may increase the understanding of the human monkeypox virus among HCWs and make training more efficient and practical. According to the WHO, this can increase health workers' preparation for mitigation and response to address the increasing danger that the human monkeypox virus poses.[21] Therefore, this study aimed to assess the knowledge and attitudes of HCWs regarding the monkeypox virus.

The findings of this study showed that the vast majority of respondents had heard about the monkeypox virus outbreak. When asked about the disease's transmission mechanism, more than half of the participants felt that it was sexually transmitted. In addition, the majority of respondents (80.5%) correctly answered the question regarding the causative agent, that is the virus. This is similar to the findings obtained in recent studies, where most respondents thought the disease was a viral-based infection.[22,23] Approximately 28.1% of the respondents believed that contact with bodily lesions, body fluids, and respiratory droplets was the

Table 4. Frequency distribution of level of knowledge and attitudes regarding monkeypox (N=385).

Variable	Level	Frequency	Percent
Knowledge	Poor (<10)	197	51.2
	Moderate (11-14)	155	40.3
	Good (15<)	33	8.6
	Level	**Mean**	**SD**
Knowledge score		9.90	3.72
Attitude	Poor (<32.99)	7	1.8
	Moderate (33-43.99)	40	10.4
	Good (44<)	338	87.8
Attitude score		50.19	6.92

Table 5. Differences in knowledge and attitude scores based on occupations and working experience of healthcare workers (N=385).

		Category	N	Mean	SD	Statistic (P-value)
Occupation	Knowledge	Medical technologist/technicians	271	9.7528	3.63544	
		Physician	42	10.7619	4.04131	
		Nurse	36	10.0278	4.12993	1.652 (0.161)
		Pharmacist	15	11.3333	3.24404	
		Others	21	8.8571	3.66450	
	Attitude	Medical technologist/technicians	271	50.3358	7.06752	
		Physician	42	50.0714	5.76107	
		Nurse	36	48.6111	8.32304	0.597 (0.665)
		Pharmacist	15	50.5333	5.47549	
		Others	21	51.0952	5.52182	
Working experience	Knowledge	Intern	120	9.5250	3.87399	
		1-5 Years	112	9.7857	3.53217	
		6-10 Years	72	10.0972	3.48502	1.378 (0.241)
		11-15 Years	45	9.8889	4.02956	
		More than 15 years	36	11.1389	3.84821	
	Attitude	Intern	120	49.6917	6.82038	
		1-5 Years	112	50.4107	8.07348	
		6-10 Years	72	49.9722	6.64592	0.506 (0.732)
		11-15 Years	45	51.3333	5.37672	
		More than 15 years	36	50.2222	5.70769	

Table 6. Correlation between knowledge and attitudes regarding monkeypox among the participants (N=385).

	Level of knowledge	N	Mean	SD	Statistics (P-value)
Attitude score	Poor (<10)	197	48.9391	8.27686	
	Moderate (11-14)	155	51.0839	5.08621	8.639 (0.000*)
	Good (15<)	33	53.5152	2.55100	

primary transmission mechanism. Some individuals (25%) assumed that sexual contact was their mode of transmission. These results are also comparable with those of a recent study conducted by Sallam *et al.* to determine the knowledge of HCWs regarding monkeypox infection in Jordan.[23] In addition, the incubation period was variably answered by the participants, indicating a lack of correct information, and a significant number did not know the correct period of viral incubation. In addition, the majority of the participants (73%) showed a lack of knowledge about the viral genus that causes human monkeypox. This is very similar to the findings obtained by a recent study performed in Saudi Arabia among physicians.[24] The majority of respondents (77.4%) believed that the monkeypox virus originated in animals, which was correctly answered; and 72.7% of the respondents believed that all age groups were equally susceptible to contracting monkeypox. In fact, children are more susceptible to disease progression and, thus, are at higher risk than other age groups.[25] Almost half of the respondents in this survey were uninformed about immunization for monkeypox. These results were comparable to those of four other recent studies.[22-24,26]

The assessment of participants' knowledge regarding monkeypox showed that 51.2% of them had poor knowledge, which is better compared to other recent studies where the majority of respondents' knowledge was found to be poor.[22,24,27] Harapan *et al.* conducted a similar study in Indonesia to assess general practitioners' understanding of the monkeypox virus. Their study included 432 general practitioners. Most respondents (96.6%) were aware that monkeypox is caused by a virus that can also cause smallpox, which is similar to the findings of this study. A small percentage of medical professionals provided accurate responses to the remaining questions, which included the mode of transmission, the rate at which the epidemic was spreading, and the treatment of the disease. The general practitioners' lack of understanding was attributed to the absence of the disease in Indonesia, which was considered the cause. Most survey participants from Indonesia (73.6%) learned what they knew from different online sources. Moreover, the study found that practitioners who graduated from institutions situated in areas with a higher degree of development had a better level of knowledge.[28]

A recent study showed that the majority of HCWs, particularly physicians, have poor knowledge about monkeypox, but they have a positive attitude toward monkeypox prevention.[24] Similarly, this study found that the majority of respondents (83.6%) strongly believed that maintaining hygiene is essential, as is the use of personal protective equipment and other attitude items. However, few participants strongly agreed that smallpox vaccine immunization may offer protection against monkeypox (61.6%). In this study, a significant relationship between knowledge levels and attitude scores was observed. This finding indicates the critical need for public education on monkeypox to increase public knowledge and participation before the pandemic. In addition, this highlights the urgent need for extensive ongoing medical education on monkeypox in Saudi Arabia. Evidence from past pandemics and epidemics, such as Zika and COVID-19, shows a critical need for training and knowledge assessment.[29-31]

Finally, as this is a re-emerging disease outside Africa, studies are needed in several aspects, including treatment and prevention, which include the use of vaccinations against this virus.[32] To provide the best available clinical management, evidence-based guidelines for monkeypox should be developed, implemented, and widely disseminated among healthcare professionals in Saudi Arabia and other countries. This is especially important because, although the majority of monkeypox cases resolve without complications, fatality cases may occur, as reported by Kalthan *et al*.[33]

Conclusions

It is concerning that some HCWs have inadequate understanding of monkeypox virus despite working in the healthcare field. This highlights the importance of providing ongoing education and training for HCWs on emerging infectious diseases, including monkeypox virus, to ensure that they are equipped with the knowledge and skills necessary to effectively respond to outbreaks. Furthermore, the positive attitude towards monkeypox infection among HCWs is also alarming. It is essential that professional and objective approach to infectious diseases maintained appropriately to ensure the best possible care for their patients.

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