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RESEARCH **ORIGINAL ARTICLE**

Knowledge of Medical Students in Jordan Regarding Monkeypox Outbreak

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ABSTRACT

INTRODUCTION - Human Monkeypox (HMP) is an infectious disease attributed to the orthopoxvirus. HMP was first documented in humans in 1970 in the Congo. Since May 2022, multiple cases of HMP have been identified in several non-endemic countries, including some Middle Eastern countries.

OBJECTIVE - to assess the knowledge about HMP among medical students in Jordan.

METHODOLOGY - A cross-sectional study was conducted using an online-based questionnaire. The questionnaire collected data regarding the source of knowledge, causative organism, natural host, mode of transmission, incubation period, signs and symptoms, duration diagnosis prevention, treatment, and complications of the disease. A sample of 565 medical students completed the questionnaire in May 2022.

RESULTS - Overall, medical students' awareness is low (28.3%). Males constituted (39.6 %) of the total sample. We detected a significantly higher rate of knowledge among males (35.7%) vs. females, P = 0.002, fifth (60.9%), and sixth (43.8%) vs. first, second, and third academic years, P<0.001. Correct knowledge about signs and symptoms showed the highest rate (43.0%), followed by an incubation period, duration, and disease prevention (33.3%, 32.6% & 31.0%, respectively). On the other hand, the lowest knowledge exhibited regarding; natural host (5.0%), mode of transmission (9.2%), psychosocial impact (9.2%), vulnerable age group (14.2%), and complications (14.2%). The majority of students (82.3%) claimed that they gained their knowledge from social media, followed by TV (16.3 %) and the university (8,5%).TV had the highest rate (47.8%) with adequate knowledge, p <0.001 interestingly.

CONCLUSION - Overall, medical students' awareness in different Jordanian universities regarding the monkeypox disease is considerably low (28.3%). Gender and higher academic years are significantly associated with adequate knowledge. Social media is significantly associated with inadequate knowledge among students.

KEYWORDS - Knowledge, Monkeypox, Infectious Disease

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INTRODUCTION

The recent outbreak of the monkeypox virus (MPXV) has occurred in many countries. Most reported cases were travelers to endemic countries. The source of the infection has not been confirmed until now(1).MPXV was identified 1n 1970 during efforts to eradicate smallpox when the virus was isolated from a patient with suspected smallpox infection in the Democratic Republic of the Congo (DRC)(2). It is endemic in both Central and West Africa(1). The Congo Basin (CB) strain and the West African (WA) strain are the two main clades of the human monkeypox virus (MPXV). Congo Basin (CB) has been associated with more significant morbidity, mortality, and human-to-human transmission (3).

Serological surveys report many natural reservoirs of MPXV; they include rats, squirrels, and non-human primates. However, the primary reservoir for human infection remains unknown (4).Zoonotic transmission occurs through contact directly with or using any of the natural viral reservoirs previously mentioned. In addition, it could occur by direct contact with the blood, body fluids, and inoculation from the mucocutaneous lesions of an infected animal (5). Person-to-person spread can occur via respiratory droplets, direct contact with skin abrasions or fomites, and vertical transmission from the mother to the fetus (3). Most cases occurred in young homosexual men with genital lesions suggesting that the mode of transmission occurred through close physical contact (6). Incubation period is about 7-14 days (3).

Regarding the clinical features of the disease, an initial febrile prodrome is accompanied by headache and fatigue, followed by a rash that begins as maculopapular lesions of 2–5 mm in diameter. Contrary to smallpox, lymphadenopathy is characteristic of Monkeypox in which firm, tender, enlarged, and sometimes painful lymph nodes in the maxillary, cervical or inguinal regions may develop before or during the rash, with diameters ranging between 1– 4 cm in many patients (7). Identified complications include diarrhea, vomiting, corneal scarring, conjunctivitis, bronchopneumonia, encephalitis, and sepsis (7).

Regarding diagnosis, gold standard techniques used to confirm MPXV infection are virus isolation, electron microscopy, and PCR (8).The case fatality rates (CFR) range from 0-11% in unvaccinated individuals (2). The disease is more severe and fatal in immunocompromised individuals, such as patients with untreated HIV infections (3).

Previously vaccinated individuals against smallpox have 85% protection against MPXV. The Centers for Disease Control and Prevention (CDC) reported that the smallpox vaccine (ACAM2000TM) could reduce the symptoms but not prevent the disease. Regarding treatment, FDA approved Tecovirimat for the treatment of infected animals. Its effectiveness in treating human cases of MPX is not enough, as reported by CDCv(5).

In this study, we aim to access awareness among medical students in Jordan regarding the re-emerging monkeypox virus outbreak, as well as introduce the reader to the primary information sources that students depend on to retrieve data about the newly trending outbreaks.

METHODOLOGY

STUDY DESIGN AND POPULATION - This cross-sectional study was conducted among undergraduate medical students at six Jordanian universities (Mutah University, Hashemite University, Yarmouk University, Jordan University of Science and Technology, University of Jordan, and Balqa Applied University). It included primary and clinical years, both male and female, of all nationalities. All post-graduate medical students were excluded. The study included 565 students from six medical school colleges in Jordan between May and June 2022. We used a simple random sampling method for selecting the target sample. Mutah university school of medicine's institutional research ethics committee approved the study design, and research permission was donated -under the serial number 0482022-. The privacy of data was maintained.

QUESTIONNAIRE - We used an online (Google form) self-administrated, English survey with 19 multiple-choice questions that followed World Health Organization (WHO) guidelines (Appendix 1) and the Centers for Disease Control and Prevention (CDC) guidelines (Appendix 2). The questionnaire consisted of two parts: the first one asked about the participants' demographics, including gender, academic year, and university. The second one contained 16 multiple-choice questions that assessed the participants' knowledge about the monkeypox virus (microbiology, epidemiology, clinical picture, diagnosis, treatment, and the severity of complications.

DATA COLLECTION - The post on the Internet was distributed through medical social media groups (Facebook, WhatsApp, Twitter, and Telegram).

STATISTICAL ANALYSIS - Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) software version 27 (IBM, 2020). Descriptive statistics were generated for all variables. A comparison between adequate and inadequate levels of awareness was made using Pearson's chi-squared test. The level of statistical significance was set at $p < 0.05$ (9).

RESULTS

The study included 565 medical students from universities across Jordan who completed the questionnaires, and their responses were included in the final analysis. According to table (1), about 60.25% of the participating students were females. Most students (38.1%) were from the first academic year. Many participating students were from Mutah University (48.8%) and JUST University (14.84%). In the table (2), the more significant part of respondents heard about monkeypox disease from social media (70.3%) and TV (16.25%). About 81.6% of the participants knew that the causative organism is a virus. About 21.9% thought correctly that orthopoxvirus is the causative agent. Concerning the natural host of the disease, only 12 % chose squirrels. Concerning the vulnerable group age, 33.3 % of students knew the correct answer and believed that it affects ages 40 to 50. About 33.3% of participating students thought correctly that the incubation period was 7-14 days. Regarding the mode of transmission, 36.1 % animal to human, 17.7% body fluid transmission, 14.5% respiratory route, 4.2% shared items(clothing), 4.8 % fecal-oral route, 6.2 % vertical transmission, and 16.5% did not know the mode of transmission.

According to the table (3), 565 medical students were divided into two groups regarding academic year; group I includes 353 students from the first, second, and third academic years, and group II includes 212 students from the fourth, fifth, and sixth academic year students. About 74.2% of group I and (93.9%) of group II participants thought that the causative organism was a virus. The more significant part of respondents of both groups heard about monkeypox disease from social media (64.9%) for group I and (79.2%) for group II. Table (3) also indicates that the educational level was higher in older students in group II as they have a higher level of awareness about Monkeypox than group I.

In the table (4), male students had more sufficient awareness than female students (35.7% versus 23.5%). Moreover, there was a highly statistically significant association between academic year and level of awareness about the monkeypox outbreak; fifth and sixth academic year students had the highest proportion of sufficient awareness (60.9% & 43.8%, respectively), whereas second academic year students had the lowest proportion of sufficient awareness (5.3%). Additionally, there was a significant association between the university and the level of awareness about the monkeypox outbreak. Concerning the source of information about the monkeypox outbreak, TV was statistically associated with sufficient awareness (47.8%) compared to other sources.

In terms of the association between the level of awareness about the MPXV outbreak and the source of the knowledge that students used to withdraw their information from, TV was statistically associated with sufficient awareness (47.8%) ($\chi 2 = 20.6$, $P < 0.001$) compared to other sources. Social media platforms were widely used among students. However, the awareness gained from these platforms was associated with a (29.3%) ($\chi 2 = 1.1$, $P < 0.3$) sufficient awareness. In addition to that, regular university teaching was the most minor information source that reflected sufficient awareness (29.2%) ($\chi 2 = 0.02$, $P < 0.9$).

Table 1. Basic characteristics of the study participants

Variables		Study participants (n=565)	
		No.	(%)
Gender	Male	224	39.6
	Female	341	60.4
Academic Year	First Year	215	38.1
	Second Year	78	13.8
	Third Year	60	10.6
	Fourth Year	58	10.3
	Fifth Year	90	15.9
	Sixth Year	64	11.3
University	Muta'h	276	48.8
	JU	132	23.4
	Yarmouk	65	11.5
	BAU	52	9.2
	HU	40	7.1

Table 2. Frequency of different responses regarding awareness about Monkeypox of the study participants

Variables		Study participants (n=565)n	
		No.	(%)
Source of information about Monkeypox disease	Social media	397	70.3
	TV	92	16.3
	At university	40	7.1
	Family	4	0.7
	Others	32	5.7
Causative Organism	Viruses	461	81.6
	Others (bacteria, fungi, prions...)	104	18.4
Infectious agent	Orthopoxvirus	124	21.9
	others	441	78.1
Natural host	Squirrels	68	12
	Rats	44	7.7
	others	453	80.3
Vulnerable age group	Younger than 40 -50 years old	80	14.2
	Don't know	485	85.8
Incubation period	7-14 days	188	33.3
	Do not know	377	66.7
Mode of Transmission	Animal To Human	204	36.1
	Respiratory Route	82	14.5
	Vertical Transmission (Mother to Baby	35	6.2
	Feco-Oral Route	27	4.8
	Body Fluids Transmission	100	17.7
	Shared items (clothing)	24	4.2
	don't know	93	16.5
Signs and Symptoms	Fever	340	60.2
	Muscle ache	36	6.4
	Lymphadenopathy	4	0.7
	Exhaustion	20	3.5
	Rash	68	12
	Others (headache, cough, vomiting,)	97	17.2
Duration of disease	2-4 weeks	184	32.6
	Don't know	381	67.4
Definitive Diagnosis	Clinical Diagnosis and PCR	256	45.3
	Others (microscopy, culture, and sensitivity serology,)	309	54.7
Sample type	A fluid of the skin lesions	188	33.3
	Don't know (stool, urine, blood,)	377	66.7
Treatment	Supportive (Fluids and nutrients)	216	38.2
	Analgesia	36	6.4
	Others (antibiotics, antifungal, Antiviral drugs Anti-malarial, .)	313	55.4

Prevention	Good Hand Hygiene	340	60.2
	Use of personal protective equipment	56	9.9
	Isolation of infected patients from others who could be at risk	28	5
	vaccination	40	7.1
	Avoidance of contact with animals that could harbor the virus	28	5
	I don't know	73	12.9
Complications (bad Health effects)	Skin complications	272	48.1
	Eye complications	24	4.2
	Respiratory complications	28	5
	CNS complications	12	2.1
	Dehydration (vomiting, diarrhea, decreased oral intake)	12	2.1
	Sepsis	8	1.4
	Death	12	2.1
	Others (Urinary tract infection, monkey face syndrome.)	197	34.9
Psychosocial impact	Stigma	132	23.4
	Others (depression, psychosis, no psycho-social impact thoughts)	433	76.6
Mortality rate	1%-10%	156	27.6
	Don’t know	409	72.4

Table 3. Awareness of the study participants regarding the academic year:

Variables		Group I : Academic year (1st,2nd,3rd) Participants (n=353)		Group II : Academic year (4th, 5th,6th) Particpants (n=212)	
		No.	(%)	No.	(%)
Source of information about Monkeypox disease	Social media	229	64.9	168	79.2
	TV	61	17.3	31	14.6
	At university	36	10.2	4	1.9
	Family	4	1.1	0	0
	Others	23	6.5	9	4.2
Causative Organism	Viruses	262	74.2	199	93.9
	Others (bacteria, fungi, prions...)	91	25.8	13	6.1
Infectious agent	Orthopoxvirus	62	17.6	62	29.2
	others	291	82.4	150	70.8
Natural host	Squirrels	32	9.1	36	17
	Rats	32	9.1	12	5.7
	others	289	81.8	164	77.3
Vulnerable age group	Younger than 40 -50 years old	45	12.7	35	16.5
	Don’t know	308	87.3	177	83.5

Incubation period	7-14 days	127	36	61	28.8
	Do not know	226	64	151	71.2
Mode of Transmission	Animal To Human	134	37.9	70	33
	Respiratory Route	53	15	29	13.7
	Vertical Transmission (Mother to Baby	15	4.2	20	9.4
	Feco-Oral Route	18	5.2	9	4.2
	Body Fluids Transmission	55	15.6	45	2.1
	Shared items (clothing)	20	5.7	4	1.9
	don't know	58	16.4	35	16.5
Signs and Symptoms	Fever	200	56.7	140	66
	Muscle ache	28	7.9	8	3.8
	Lymphadenopathy	0	0	4	1.9
	Exhaustion	12	3.4	8	3.8
	Rash	40	11.3	28	13.2
	Others (headache, cough, vomiting,)	73	20.7	24	11.3
Duration of disease	2-4 weeks	119	33.7	65	30.7
	Don't know	234	66.3	147	69.3
Definitive Diagnosis	Clinical Diagnosis and PCR	45	12.7	11	5.2
	Others (microscopy, culture, and sensitivity serology,)	308	87.3	201	94.8
Sample type	A fluid of the skin lesions	107	30.3	81	38.2
	Don't know (stool, urine, blood,)	246	69.7	131	61.8
Treatment	Supportive (Fluids and nutrients)	91	25.8	125	59
	Analgesia	32	9.1	4	1.9
	Others (antibiotics, antifungal, Antiviral drugs Anti-malarial, .)	230	65.1	83	39.1
Prevention	Good Hand Hygiene	187	53	153	72.2
	Use of personal protective equipment	41	11.6	15	7.1
	Isolation of infected patients from others who could be at risk	16	4.5	12	5.7
	vaccination	33	9.3	7	3.3
	Avoidance of contact with animals that could harbor the virus	20	5.7	8	3.8
	I don't know	56	15.8	17	8
Complications (bad Health effects)	Skin complications	144	40.8	128	60.4
	Eye complications	24	6.8	0	0
	Respiratory complications	21	5.9	7	3.3
	CNS complications	12	2.1	0	0
	Dehydration (vomiting, diarrhea, decreased oral intake)	8	2.3	4	1.9

	Sepsis	4	1.1	4	1.9
	Death	8	2.3	4	1.9
	Others (Urinary tract infection, monkey face syndrome.)	132	37.4	65	30.7
Psychosocial impact	Stigma	74	21	58	27.4
	Others (depression, psychosis, no psychosocial impact thoughts)	279	79	154	72.6
Mortality rate	1%-10%	94	26.6	62	29.2
	Do not know	259	73.4	150	70.8

Table 4. Association between the level of awareness about the Monkeypox outbreak and characteristics of the study participants

Variables		Level of awareness				X^2	P
		Sufficient (n=160)		Insufficient (n=405)			
		No.	(%)	No.	(%)		
Gender	Male (n=224)	80	35.7	144	64.7	10.0	0.002 S
	Female (n=341)	80	23.5	261	76.5		
Academic Year	First year (n=215)	44	20.7	169	79.3	83.7	<0.001 HS
	Second year (n=78)	4	5.3	72	94.7		
	Third year (n=60)	16	26.7	44	73.3		
	Fourth-year (n=58)	12	20.0	48	80.0		
	Fifth year (n=90)	56	60.9	36	39.1		
	Sixth year (n=64)	28	43.8	36	56.3		
University	Mut'ah (n=276)	108	39.1	168	60.9	36.5	<0.001 HS
	JUST (n=84)	20	23.8	64	76.2		
	Yarmouk (n=65)	8	12.3	57	87.7		
	BAU (n=52)	12	23.1	40	76.9		
	JU (n=48)	4	8.3	44	91.7		
	HU (n=40)	8	20.0	32	80.0		
Source of information about Monkeypox disease	Social media (n=465)	136	29.3	329	70.7	1.1	0.3
	TV (n=92)	44	47.8	48	52.2	20.6	<0.001(HS)
	At university (n=48)	14	29.2	34	70.8	0.02	0.9
	Family (n=8)	4	50.0	4	50.0	1.9	0.2

DISCUSSION

This study examined the level of knowledge about Monkeypox among medical students across Jordan. No similar studies evaluating the level of knowledge and awareness of Monkeypox among medical students in Jordan exist so far. This study aims to understand better the student's general knowledge and the factors contributing to increased awareness of the multi-country monkeypox outbreak.

Results of the current study revealed insufficient knowledge of Monkeypox among the majority of medical students surveyed. Less than one-third of the participants (28.3%) had sufficient awareness of the monkeypox outbreak. Participants' knowledge about the different aspects of the monkeypox disease showed varying levels. Interestingly, medical students in this study had sufficient knowledge about the signs and symptoms, the incubation period, and the disease duration.

According to data published by the World Health Organization (WHO) on Monkeypox, symptoms of Monkeypox typically include fever, headache, malaise, muscle aches, swollen lymph nodes, and skin rash. As for the duration of the disease, symptoms typically last between 2 to 4 weeks. (10(As portrayed by the participants' answers, this series of information is more familiar to medical students than other details regarding monkeypox disease. This can be explained by the fact that the presentation of Monkeypox is very similar to that of the more recognized and studied smallpox disease (11).

On the other hand, participants showed shallow levels of awareness regarding the natural host of the virus, mode of transmission, complications, and vulnerable age groups. Concerning the most vulnerable age groups, the population with the highest risk of infection is the younger generation (ages below 50-40), unlikely to have been vaccinated against smallpox (12).Anyone with the smallpox vaccine will likely have immunity against monkeypox infection (13).Nonetheless, the original smallpox vaccine is no longer available; it was back then given to the public, but since the eradication of smallpox in 1980, the need for the vaccine has subsided (12). Therefore, recognition of this information is critical to public health awareness of monkeypox disease.

Moreover, good knowledge regarding the prevention methods of the monkeypox virus is crucial as it is one of the first steps taken in the direction of public health awareness of the monkeypox outbreak. As the Center for Disease Control and Prevention (CDC) recommended, several measures could be implemented to prevent infection with the monkeypox virus. These measures include avoiding contact with animals that could harbor the virus, limiting contact with infected patients and people who have suspected Monkeypox, practicing good hand hygiene, and using personal protective equipment (PPE) (14). In this study, only 31% of participants showed adequate knowledge of the prevention methods for Monkeypox. Medical students' understanding of the correct methods to protect their community from the monkeypox risk would be of great help to the Jordanian public and would serve as a significant source of awareness. That is why more effort should be directed towards better medical awareness, especially among medical students and other healthcare professionals.

When it comes to the psychosocial impact, the vast majority of medical students surveyed are not aware of the stigma surrounding the monkeypox infection. As stated by WHO, stigmatizing messages around this outbreak have been propagated (12).These messages falsely associate monkeypox infection with the specific population of homosexual men. These associations focus exclusively on one population when, in fact, anyone in close physical contact with someone who has Monkeypox is at risk (15).Unfortunately, such a stigma is only likely to threaten the community's health and hinder the detection and treatment of the disease. Awareness in this sense is vital, and communicating accurate information on Monkeypox in an appropriate way is essential to the health of all. Therefore, medical students' knowledge in this aspect should be a target for further improvement.

Regarding the characteristics of the study participants, the results of this study revealed that male medical students were more knowledgeable about the monkeypox outbreak than female students. The explanation for this result could be supported by the raised concern among males, especially since social stigma is primarily targeting the male population. Furthermore, most students participating in the study (61.8%) were in the pre-clinical (first, second, and third) years, whereas 38.2% were in the clinical (fourth, fifth, and sixth) years. Although our data reports that the overall level of perception of Monkeypox is quite stunted among the participants, fifth- and sixth-year medical students showed a high level of awareness compared to their younger fellow students. The reduced level of knowledge among medical students in their lower academic years can be best justified by the reality of having limited clinical knowledge as these students are still at the beginning of their medical studies.

When asked about the source of information, participants recorded that social media (82.3%) was the most popular platform to attain knowledge on this new and rising medical issue. However, although most students received knowledge about the disease from social media, TV had the highest statistical association with adequate awareness (47.8%) compared to other sources and compared to social media. This finding is consistent with the results of a Nigerian study that assessed media reportage of Monkeypox in southern Nigeria and concluded that social media failed to raise effective awareness campaigns on Monkeypox (16).Even though research studies suggest that social media is a useful source for attaining information and raising public health awareness (17), social media has not proved to be an efficient awareness method for the monkeypox outbreak.

We recommend also holding webinars, regular journal clubs, conferences, and scientific days in collaboration with other health institutes to help improve awareness of emerging health problems. This will improve understanding of the monkeypox outbreak and maintain adequate awareness among medical students, healthcare professionals, and the community.

CONCLUSION

Overall, medical students' awareness in different Jordanian universities regarding the monkeypox disease is low (28.3%). Higher academic years and the male gender are more aware of monkeypox disease. We recommend introducing webinars, journal clubs, and conferences to increase awareness of emerging health problems.

AUTHORS CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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