Cross-sectional Study

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Fear of a new pandemic: perception and prediction of monkeypox among the middle east general population

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Background: Monkeypox is a zoonotic disease caused by the monkeypox virus, an Orthopox virus. The 2022 monkeypox outbreak provoked fear among the public. Public awareness about the disease could be an important factor in its control. The authors conducted this study to assess the perception and prediction of monkeypox among the Middle East public.

Methods: This cross-sectional study was conducted in August 2022. Data were conveniently collected from eight Middle Eastern countries using an online self-administered questionnaire distributed through educational and social media platforms. Statistical analysis was conducted using R software.

Results: Approximately 11 016 individuals participated in this study. The participants' overall knowledge score indicated poor knowledge about monkeypox. Most of the participants knew the causative organism (66.7%). However, numerous participants were not aware of the disease mode of transmission, symptoms, complications, and vaccination. Participants' awareness was mostly gained from social media (61.8%). The majority predicted acquiring monkeypox when protective measures are not taken (72.7%), progression to a pandemic with economic consequences (50.8 and 52%, respectively), and the ability of the Ministry of Health to control the epidemic (51.5%).

Conclusion: In the Middle East, public knowledge about monkeypox is poor. Raising awareness about monkeypox would be of benefit in controlling the epidemic. This study constitutes evidence upon which health education programs could be designed.

Keywords: monkeypox, perception, prediction, transmission, zoonotic

Introduction

The human monkeypox virus (HMPV) – previously known as the monkeypox (Mpox) virus – is a zoonotic virus that belongs to the Poxviridae family of the genus Orthopox virus[1]. Other viruses that infect humans and belong to this genus include cowpox virus, variola minor, and variola major, with the latter being the cause of the eradicated smallpox disease[2]. The natural host of HMPV is unknown; nevertheless, it has a wide range of mammalian reservoirs, including rats (the main group), squirrels, dormice, and monkeys[2].

The first case of the Mpox virus was identified in 1958 in Copenhagen, Denmark, among Asian monkeys imported from Singapore during a poliovirus vaccine experiment[3]. The Democratic Republic of the Congo reported the first human infection with HMPV in 1970[4]. Since then, it has been endemic in the country, with widespread throughout the African continent. Endemicity of the virus has been established in Central and West Africa, and two

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different genetic clades have emerged from the two areas[2]. Numerous outbreaks have occurred through the years in the Central African Republic, Liberia, Nigeria, Cameroon, and Sierra Leone[4]. Nigeria reported the largest outbreak in 2017, with a case fatality rate of 6%[5–7]. In 2003, the first outbreak in the Western world was reported in the United States (US)[8]. After that, Mpox cases were reported in the United Kingdom (UK)[9]. Moreover, in May 2022, multiple cases were reported in Europe, the US, and Australia among individuals who have no link to endemic areas[10–14].

The clinical presentation of HMPV infection is closely related to smallpox infection, with the former being less severe and not causing lymphadenopathy. Mpox presents with a viral prodrome followed by a maculopapular rash that evolves to form vesicles and pustules and then forms crusts[4]. When comparing the case fatality rates of HMPV and smallpox virus, the latter prominently exceeds (recording 30% among unvaccinated individuals)[15].

It is worth mentioning that Mpox transmission was related to sexual contact between men (MSM) in 4 cases in Italy and 54 cases in the UK[16,17]. Mpox was reported along with other concomitant sexually transmitted infections. Most of the cases suffered from anogenital skin lesions affecting more than one site, along with the aforementioned symptoms[17].

Many cases of Mpox have recently been identified in endemic countries as well as nonendemic countries[18]. The majority of the proven cases had a travel history to nonendemic countries either in Europe or North America. This has raised a concern that the recent concordant occurrence of Mpox disease might be a red flag of a worldwide health problem[19]. This outbreak, which started in May 2022 has provoked a considerable amount of fear among the population, particularly with the continuing COVID-pandemic[20]. Human lives have been affected dramatically by the COVID-19 pandemic, specifically at the health and economic levels. Therefore, the declaration of the Mpox outbreak might have disturbing consequences on the population in terms of anxiety and apprehension[21].

As for the current status of the epidemic after May 2022, Mpox has been undergoing a re-emergence with 250 reported cases globally[22]. A major threat contributing to this re-emergence is its pathogenicity, as the disease has been spreading in nonendemic countries[23]. The US Department of Health and Human Services declared Mpox as an outbreak and a public health emergency in August 2022[24].

A WHO report revealed the paucity of familiarity with Mpox among the population as a major challenge in limiting Mpox reoccurrence[25]. Raising awareness about Mpox can be the first approach to modify public attitudes and behaviors[26,27]. Previous studies in this realm were made on national levels. Most of these studies used cross-sectional surveys distributed conveniently through the media for a wider reach or on campus for studies that targeted students. A cross-sectional study conducted in the UK showed a limited understanding of Mpox[28]. Low levels of knowledge about the disease were also reported in Italy[29]. Better awareness about the disease was reported among medical students in the UAE[30]. Unfortunately, there are very limited studies illustrating the perception and level of awareness of the general population about Mpox on regional levels. This study aims to provide a larger-scale regional insight into Mpox awareness by assessing the perception and prediction of the public in eight Middle Eastern countries.

HIGHLIGHTS

- There is now an increasing fear among the public that monkeypox disease could be the next emerging pandemic.
- In this cross-sectional study, data were conveniently collected from eight Middle Eastern countries using an online self-administered questionnaire.
- We found that the majority of Middle East population had never seen a case of monkeypox before and would avoid countries with declared cases.
- More studies assessing the impact of monkeypox on the mental status, lifestyle, and economy.

Methodology

A multinational cross-sectional study was carried out between the 7 August 2022, and the 15 August 2022 using a self-administered questionnaire. The questionnaire was distributed conveniently through online educational and social media platforms (e.g. Facebook, WhatsApp, Twitter, and Instagram). Data were collected from the general population of eight countries within the Middle East, including Egypt, Iraq, Palestine, Saudi Arabia, Sudan, Sultanate Oman, Syria, and Yemen.

The questionnaire was prepared, designed, and distributed using Google Forms in both Arabic and English languages. The goals of the questions were adjusted according to the audience, formality, domain, tone, and intent. The audience and domain were selected as 'general', whereas the formality, tone, and intent were adjusted as 'neutral', 'analytical', and 'descriptive', respectively. The questionnaire was critically revised and edited by senior experts from the Department of Public Health and Community Medicine, Bakht Alruda University, Sudan.

An introduction page was added to provide information about the principal investigators' identity, official profile links, and contact details and to explain the study's objective and importance to the scientific community. A pilot study of 30 participants was then performed to evaluate their perception of the questions. Participants' feedback, if any, was taken into consideration to make improvements to the questionnaire. Data of the pilot study were used to test the reliability of the questionnaire and a Cronbach's alpha value of 0.49 was calculated.

The questionnaire was developed based on existing facts about Mpox from the US Center for Disease Control and Prevention (CDC) and the available literature[31–35]. The questionnaire was divided into four sections, which are as follows:

1. Sociodemographic data included age, sex, country, residence, and educational level; Assessed by explanatory questions.
2. Questions assessing knowledge of human Mpox. The possible responses to each knowledge item were (yes vs. no vs. I do not know). Correct responses were scored as 1, incorrect responses were scored as – 1, and 'I do not know' was given a score of zero. The sum was used to represent the Mpox knowledge score (MPX K-score). This section included:
   The disease onset (old or new), causative organism, first-time country appearance, presence in your country, source of the outbreak in 2022, did you see a previous case or not, source of information, mode of transmission, disease symptoms, early and late symptoms of infection, common sites for the rash, incubation period, complications of the disease, mortality,

management, passive and acquired immunity, and preventive methods.
3. Conspiracy beliefs regarding Mpox were assessed (yes vs. no), including getting infected with the disease, declaration of a pandemic, traveling lockdown and restrictions, economic situation, and education process.

The rationale behind the method

The study's sampling method is convenience sampling. Although bias is expected, it could be a convenient technique to conduct such a wide range study across the region. As for the distribution of the study – and to support the sampling technique as much as possible –, media was chosen as the most suitable method for the distribution of the questionnaire.

Statistical analysis

The data were analyzed using R software. We presented continuous variables as medians (interquartile ranges) and categorical variables as percentages. We used the χ^2test, Fisher's exact test, Mann–Whitney *U* test, and Kruskal–Wallis test to find differences in variables.

Ethical considerations

On the introduction page of the questionnaire, the participants were asked for their consent to participate. To ensure anonymity and confidentiality, participants' IP addresses were not collected, and only the principal investigator had access to the survey account.

This work has been reported in line with the strengthening the reporting of cohort, cross-sectional, and case–control studies in surgery (STROCSS) criteria[36].

Results

A total of 11 016 individuals from eight Middle Eastern countries participated in this study. Most of the participants were from Sudan (22.5%) and Saudi Arabia (18.6%), and females constituted the majority of the sample (59.4%). The predominant age group was 18–24 years (53.7%), followed by 25–34 years (25.8%), while elderly individuals above 65 years were the least represented group (0.5%). Furthermore, the highest proportion of our participants were bachelor's degree holders (65.9%) residing in urban areas (84.4%). Participants' demographic data are further described in Table 1.

Table 1
Participants' demographic factors

Characteristic	Overall $N = 11\ 016$[a]
Age (years)	
< 18	577 (5.2%)
18–24	5,912 (53.7%)
25–34	2,844 (25.8%)
35–44	872 (7.9%)
45–54	566 (5.1%)
55–65	187 (1.7%)
> 65	58 (0.5%)
Country	
Egypt	1056 (9.6%)
Palestine	1077 (9.8%)
Qatar	1045 (9.5%)
Saudi Arabia	2054 (18.6%)
Sudan	2478 (22.5%)
Sultanate Oman	898 (8.2%)
Syria	1089 (9.9%)
Yemen	1319 (12.0%)
Sex	
Female	6544 (59.4%)
other	33 (0.3%)
Male	4439 (40.3%)
Residence	
Rural	1715 (15.6%)
Urban	9301 (84.4%)
Educational level	
Not educated	203 (1.8%)
Primary	292 (2.7%)
Secondary	1993 (18.1%)
Bachelor	7256 (65.9%)
Higher degree	1272 (11.5%)
Are you willing to travel to a country that has declared itself as epidemic of Monkeypox? (Yes)	1821 (16.5%)
Have you ever seen a case of Monkeypox before? (Yes)	1084 (9.8%)
From where have you heared about this disease?	
Friends/family members	734 (6.7%)
From medical staff	800 (7.3%)
Magazines and newspapers	289 (2.6%)
Official medical records	699 (6.3%)
Social media	6806 (61.8%)
TV/Radio	1319 (12.0%)
Other	369 (3.3%)
Is monkeypox present in your country?	
Yes	3630 (33.0%)
No	4463 (40.5%)
I do not know	2923 (26.5%)

[a]*n* (%).

Regarding participants' perception of Mpox, the greater majority had not seen a case of Mpox before (90.2%); yet, they were not willing to travel to a country that has declared a Mpox epidemic (83.5%). Social media was the widest source of information about Mpox as reported by 61.8% of our participants. Approximately, 26.5% of the subjects did not know whether monkeypox was present in their countries (Table 1).

Less than half of the participants identified Mpox as a disease that existed before 2022 (43.3%), whereas a higher number could identify the causative organism (66.7%). Only 22% of the participants knew where Mpox was initially discovered and where it was first reported in the 2022 outbreak. A similar proportion (27.6%) knew the incubation period of the disease. A small proportion of the subjects were aware of the disease modes of transmission; 48.1% identified contact with body fluids, 41.8% identified contact with infected animals, 34.4% identified transmission between homosexual individuals, and only 8.6% could exclude transplacental transmission. Nearly 39% of our participants were not aware of the symptoms of Mpox. However, fever was the most frequently known symptom (49.3%), followed by headache (37.9%), severe fatigability (30.1%), and lymph node swelling (30%). Diarrhea was the least known symptom of Mpox (17.2%). Approximately, half of the participants could identify the early and late signs of Mpox infection (46.9 and 44%, respectively). In addition, the participants were asked about the common sites for the appearance of rash; 42.8%

Table 2

Participants' knowledge about monkeypox.

Characteristic	Overall, $N = 11\ 016$[a]	Sex			P[b]
		Female, $N = 6544$[a]	other, $N = 33$[a]	Male, $N = 4439$[a]	
Monkeypox is:					0.15
Correct	4769 (43.3%)	2878 (44.0%)	13 (39.4%)	1878 (42.3%)	
Do not know	1688 (15.3%)	993 (15.2%)	9 (27.3%)	686 (15.5%)	
Incorrect	4559 (41.4%)	2673 (40.8%)	11 (33.3%)	1875 (42.2%)	
Causative organism					
Correct	7348 (66.7%)	4340 (66.3%)	14 (42.4%)	2994 (67.4%)	0.005
Do not know	2336 (21.2%)	1382 (21.1%)	6 (18.2%)	948 (21.4%)	
Incorrect	1332 (12.1%)	822 (12.6%)	13 (39.4%)	497 (11.2%)	
Monkey pox was first identified in?				**0.006**	
Correct	2433 (22.1%)	1374 (21.0%)	11 (33.3%)	1048 (23.6%)	
Do not know	5108 (46.4%)	3059 (46.7%)	11 (33.3%)	2038 (45.9%)	
Incorrect	3475 (31.5%)	2111 (32.3%)	11 (33.3%)	1353 (30.5%)	
The first reported Outbreak in 2022 was reported in				**< 0.001**	
Correct	2483 (22.5%)	1363 (20.8%)	12 (36.4%)	1108 (25.0%)	
Do not know	3937 (35.7%)	2413 (36.9%)	8 (24.2%)	1516 (34.2%)	
Incorrect	4596 (41.7%)	2768 (42.3%)	13 (39.4%)	1815 (40.9%)	
Incubation period is less than 2 weeks?				**0.001**	
Correct	3037 (27.6%)	1838 (28.1%)	9 (27.3%)	1190 (26.8%)	
Do not know	6150 (55.8%)	3587 (54.8%)	12 (36.4%)	2551 (57.5%)	
Incorrect	1829 (16.6%)	1119 (17.1%)	12 (36.4%)	698 (15.7%)	
Mode of transmission:					
I do not know	2821 (25.6%)	1632 (24.9%)	9 (27.3%)	1180 (26.6%)	0.15
Contact with infected animals				**0.016**	
Correct	4608 (41.8%)	2799 (42.8%)	9 (27.3%)	1800 (40.5%)	
Do not know	6408 (58.2%)	3745 (57.2%)	24 (72.7%)	2639 (59.5%)	
Contact with infected body fluids				0.1	
Correct	5298 (48.1%)	3168 (48.4%)	10 (30.3%)	2120 (47.8%)	
Do not know	5718 (51.9%)	3376 (51.6%)	23 (69.7%)	2319 (52.2%)	
Homosexuals					**< 0.001**
Correct	3795 (34.4%)	2044 (31.2%)	13 (39.4%)	1738 (39.2%)	
Do not know	7221 (65.6%)	4500 (68.8%)	20 (60.6%)	2701 (60.8%)	
During pregnancy through placenta				**0.007**	
Do not know	10 070 (91.4%)	5968 (91.2%)	25 (75.8%)	4077 (91.8%)	
Incorrect	946 (8.6%)	576 (8.8%)	8 (24.2%)	362 (8.2%)	
Symptoms of this disease includes					
I do not know	4315 (39.2%)	2486 (38.0%)	11 (33.3%)	1818 (41.0%)	**0.006**
Fever					0.3
Correct	5428 (49.3%)	3210 (49.1%)	12 (36.4%)	2206 (49.7%)	
Do not know	5588 (50.7%)	3334 (50.9%)	21 (63.6%)	2233 (50.3%)	
Headache					**0.031**
Correct	4170 (37.9%)	2437 (37.2%)	7 (21.2%)	1726 (38.9%)	
Do not know	6846 (62.1%)	4107 (62.8%)	26 (78.8%)	2713 (61.1%)	
Back pain					> 0.9
Correct	2334 (21.2%)	1394 (21.3%)	7 (21.2%)	933 (21.0%)	
Do not know	8682 (78.8%)	5150 (78.7%)	26 (78.8%)	3506 (79.0%)	
Diarrhea					**0.006**
Correct	1902 (17.3%)	1078 (16.5%)	10 (30.3%)	814 (18.3%)	
Do not know	9114 (82.7%)	5466 (83.5%)	23 (69.7%)	3625 (81.7%)	
Lymph nodes swelling					0.5
Correct	3308 (30.0%)	1991 (30.4%)	9 (27.3%)	1308 (29.5%)	
Do not know	7708 (70.0%)	4553 (69.6%)	24 (72.7%)	3131 (70.5%)	
Severe fatigability					0.14
Correct	3320 (30.1%)	2013 (30.8%)	7 (21.2%)	1300 (29.3%)	
Do not know	7696 (69.9%)	4531 (69.2%)	26 (78.8%)	3139 (70.7%)	
Muscular pain					0.2
Correct	3172 (28.8%)	1845 (28.2%)	10 (30.3%)	1317 (29.7%)	
Do not know	7844 (71.2%)	4699 (71.8%)	23 (69.7%)	3122 (70.3%)	
The presence of these symptoms represents an early sign of infection					
Correct	5163 (46.9%)	3122 (47.7%)	14 (42.4%)	2027 (45.7%)	
Do not know	4757 (43.2%)	2739 (41.9%)	11 (33.3%)	2007 (45.2%)	
Incorrect	1096 (9.9%)	683 (10.4%)	8 (24.2%)	405 (9.1%)	

Table 2

(Continued)

Characteristic	Overall, $N = 11\ 016$[a]	Sex			P[b]
		Female, $N = 6544$[a]	other, $N = 33$[a]	Male, $N = 4439$[a]	
The presence of rash is considered to be a late sign of infection					**< 0.001**
Correct	4848 (44.0%)	2924 (44.7%)	8 (24.2%)	1916 (43.2%)	
Do not know	4393 (39.9%)	2470 (37.7%)	12 (36.4%)	1911 (43.1%)	
Incorrect	1775 (16.1%)	1150 (17.6%)	13 (39.4%)	612 (13.8%)	
What are the common sites for presence of rash?					
I do not know	4871 (44.2%)	2900 (44.3%)	8 (24.2%)	1963 (44.2%)	0.068
Face					0.3
Correct	4718 (42.8%)	2764 (42.2%)	15 (45.5%)	1939 (43.7%)	
Do not know	6298 (57.2%)	3780 (57.8%)	18 (54.5%)	2500 (56.3%)	
Mucocutaneous (mouth and nose)				0.5	
Do not know	8925 (81.0%)	5325 (81.4%)	27 (81.8%)	3573 (80.5%)	
Incorrect	2091 (19.0%)	1219 (18.6%)	6 (18.2%)	866 (19.5%)	
Legs					0.079
Correct	2612 (23.7%)	1532 (23.4%)	13 (39.4%)	1067 (24.0%)	
Do not know	8404 (76.3%)	5012 (76.6%)	20 (60.6%)	3372 (76.0%)	
Groin area					0.071
Do not know	9108 (82.7%)	5436 (83.1%)	23 (69.7%)	3649 (82.2%)	
Incorrect	1908 (17.3%)	1108 (16.9%)	10 (30.3%)	790 (17.8%)	
Perianal area					**< 0.001**
Do not know	10 191 (92.5%)	6100 (93.2%)	26 (78.8%)	4065 (91.6%)	
Incorrect	825 (7.5%)	444 (6.8%)	7 (21.2%)	374 (8.4%)	
What are the complications of the disease?					
I do not know	5941 (53.9%)	3532 (54.0%)	12 (36.4%)	2397 (54.0%)	0.13
Pneumonia					0.5
Correct	2099 (19.1%)	1272 (19.4%)	6 (18.2%)	821 (18.5%)	
Do not know	8917 (80.9%)	5272 (80.6%)	27 (81.8%)	3618 (81.5%)	
Brain infection					**0.039**
Correct	1380 (12.5%)	780 (11.9%)	6 (18.2%)	594 (13.4%)	
Do not know	9636 (87.5%)	5764 (88.1%)	27 (81.8%)	3845 (86.6%)	
Sepsis					**< 0.001**
Correct	1573 (14.3%)	831 (12.7%)	6 (18.2%)	736 (16.6%)	
Do not know	9443 (85.7%)	5713 (87.3%)	27 (81.8%)	3703 (83.4%)	
Inflammation of the eyes					**0.001**
Correct	1567 (14.2%)	888 (13.6%)	11 (33.3%)	668 (15.0%)	
Do not know	9449 (85.8%)	5656 (86.4%)	22 (66.7%)	3771 (85.0%)	
Disfigurement					0.2
Correct	3050 (27.7%)	1785 (27.3%)	13 (39.4%)	1252 (28.2%)	
Do not know	7966 (72.3%)	4759 (72.7%)	20 (60.6%)	3187 (71.8%)	
The mortality rate of the disease?					
I do not know	6049 (54.9%)	3608 (55.1%)	14 (42.4%)	2427 (54.7%)	0.3
Less than COVID-19					**0.021**
Correct	3783 (34.3%)	2184 (33.4%)	9 (27.3%)	1590 (35.8%)	
Do not know	7233 (65.7%)	4360 (66.6%)	24 (72.7%)	2849 (64.2%)	
Less than malaria					**< 0.001**
Correct	1107 (10.0%)	588 (9.0%)	5 (15.2%)	514 (11.6%)	
Do not know	9909 (90.0%)	5956 (91.0%)	28 (84.8%)	3925 (88.4%)	
Less than flu					**< 0.001**
Correct	1010 (9.2%)	551 (8.4%)	7 (21.2%)	452 (10.2%)	
Do not know	10 006 (90.8%)	5993 (91.6%)	26 (78.8%)	3987 (89.8%)	
Less than tuberculosis					**< 0.001**
Correct	857 (7.8%)	443 (6.8%)	3 (9.1%)	411 (9.3%)	
Do not know	10 159 (92.2%)	6101 (93.2%)	30 (90.9%)	4028 (90.7%)	
Less than chickenpox					**< 0.001**
Correct	1178 (10.7%)	662 (10.1%)	11 (33.3%)	505 (11.4%)	
Do not know	9838 (89.3%)	5882 (89.9%)	22 (66.7%)	3934 (88.6%)	
Does getting infected with Monkeypox provide immunity against reinfection?					
Correct	1660 (15.1%)	1023 (15.6%)	12 (36.4%)	625 (14.1%)	
Do not know	6352 (57.7%)	3782 (57.8%)	12 (36.4%)	2558 (57.6%)	
Incorrect	3004 (27.3%)	1739 (26.6%)	9 (27.3%)	1256 (28.3%)	
The treatment of Monkeypox is through				**0.029**	
Correct	2179 (19.8%)	1296 (19.8%)	5 (15.2%)	878 (19.8%)	

Table 2

(*Continued*)

Characteristic	Overall, $N = 11\ 016$[a]	Sex			P[b]
		Female, $N = 6544$[a]	other, $N = 33$[a]	Male, $N = 4439$[a]	
Do not know	4547 (41.3%)	2631 (40.2%)	12 (36.4%)	1904 (42.9%)	
Incorrect	4290 (38.9%)	2617 (40.0%)	16 (48.5%)	1657 (37.3%)	
Is there a specific vaccine for Monkeypox?				0.079	
Correct	2386 (21.7%)	1445 (22.1%)	6 (18.2%)	935 (21.1%)	
Do not know	5040 (45.8%)	2921 (44.6%)	17 (51.5%)	2102 (47.4%)	
Incorrect	3590 (32.6%)	2178 (33.3%)	10 (30.3%)	1402 (31.6%)	
Methods for prevention and control should include					
I do not know	2454 (22.3%)	1352 (20.7%)	9 (27.3%)	1093 (24.6%)	**< 0.001**
Isolation of infected persons				**0.003**	
Correct	6786 (61.6%)	4075 (62.3%)	12 (36.4%)	2699 (60.8%)	
Do not know	4230 (38.4%)	2469 (37.7%)	21 (63.6%)	1740 (39.2%)	
Notifying health authorities					0.079
Correct	5444 (49.4%)	3250 (49.7%)	10 (30.3%)	2184 (49.2%)	
Do not know	5572 (50.6%)	3294 (50.3%)	23 (69.7%)	2255 (50.8%)	
Wearing personal protective equipment				**0.002**	
Correct	4845 (44.0%)	2929 (44.8%)	6 (18.2%)	1910 (43.0%)	
Do not know	6171 (56.0%)	3615 (55.2%)	27 (81.8%)	2529 (57.0%)	
Care of the environment					**0.003**
Correct	5358 (48.6%)	3267 (49.9%)	18 (54.5%)	2073 (46.7%)	
Do not know	5658 (51.4%)	3277 (50.1%)	15 (45.5%)	2366 (53.3%)	
Health education					0.087
Correct	5782 (52.5%)	3435 (52.5%)	11 (33.3%)	2336 (52.6%)	
Do not know	5234 (47.5%)	3109 (47.5%)	22 (66.7%)	2103 (47.4%)	

[a] n (%).

[b] Pearson's χ^2 test; Fisher's exact test.

identified the face, 23.7% identified the legs, whilst a greater proportion (55.8%) did not know (Table 2).

A higher proportion of our participants were not aware of the complications of Mpox (53.7%), and a minor proportion could identify the correct complications. Disfigurement was the most frequently identified complication (27.7%), while brain infection was the least frequently identified complication (12.5%). Moreover, the majority of the subjects had no idea about Mpox mortality (54.9%), but 34.3% stated that Mpox is less fatal than COVID-19. Only 19.8% of our participants knew the correct treatment for Mpox. Almost 27% knew that a Mpox infection is not protective against subsequent Mpox infection, and 22% knew about Mpox-specific vaccines. Generally, the participants' knowledge about protective measures against Mpox was better than their knowledge about the aforementioned disease aspects. Isolation of the infected individuals was the most frequently identified preventive measure (61.6%), followed by health education (52.5%), notification of health authorities (49.4%), care of the environment (48.6%), and wearing personal protective equipment (44%) (Table 2).

The participants' overall knowledge score was 8.0 with a range (of 3.0–13.0), indicating poor knowledge about Mpox. The level of knowledge was found to differ significantly by the participant's country ($P < 0.001$), with participants from Sultanate Oman having the highest knowledge and those from Egypt having the lowest knowledge (12 vs. 5). Likewise, participants' knowledge varied by their age ($P < 0.001$), with participants aged 45–54 years having the highest knowledge and those aged under 18 having the poorest knowledge (10 vs. 7). We also found a significant variation in this knowledge by sex ($P = 0.037$) and educational level ($P < 0.001$), with females and higher degree holders being more knowledgeable. No significant difference in knowledge was detected between rural and urban residents ($P = 0.0064$) (Table 3).

Finally, the participants were asked about their predictions about Mpox. The majority of the participants thought they would contract Mpox if they did not take the appropriate preventive measures (72.7%). Although over half the participants thought their Ministry of Health could control Mpox (51.5%), a similar proportion predicted that Mpox could become a worldwide pandemic and affect their economy (50.8 and 52%, respectively). A smaller proportion of our participants thought that Mpox could affect their education (47.9%), and a much smaller proportion predicted a lockdown and sanction (38.9%) (Table 4).

The participants' predictions about Mpox differed significantly by their countries ($P < 0.001$ for all questions). Participants from Qatar were more confident that their Ministry of Health could control the Mpox pandemic (86.8%), in contrast to those from Yemen (17.5%). Without adopting the appropriate preventive measures, more participants from Sultanate Oman predicted acquiring the disease (85.7%). More participants from Sudan predicted that Mpox would spread and become a worldwide pandemic (61.1%), whereas more participants from Sultanate Oman predicted a lockdown and sanction (55.3%). Participants from Sudan more frequently predicted that Mpox would affect their economy and education (64.4 and 61.4%, respectively) (Table 5).

Discussion

In total, 11 016 individuals from eight Arab nations participated in this study. The majority of participants were females, aged

Table 3

Difference in overall knowledge score.

	Countries								
Overall knowledge score	**Egypt, N = 1,056[a]**	**Palastine, N = 1,077[a]**	**Qatar, N = 1,045[a]**	**Saudi Arabia, N = 2,054[a]**	**Sudan, N = 2,478[a]**	**Sultanate Oman, N = 898[a]**	**Syria, N = 1,089[a]**	**Yemen, N = 1,319[a]**	***P*-value[b]**
	5.0 (1.0, 12.0)	7.0 (1.0, 13.0)	9.0 (4.0, 14.0)	8.0 (3.0, 13.0)	8.0 (3.0, 14.0)	12.0 (6.0, 16.0)	8.0 (3.0, 14.0)	6.0 (2.0, 11.0)	**< 0.001**
Age									
	18-24, N = 5,912[a]	25-34, N = 2,844[a]	35-44, N = 872[a]	45-54, N = 566[a]	55-65, N = 187[a]	Less than 18 years, N = 577[a]	Over 65 years, N = 58[a]		
	7.0 (2.0, 12.0)	9.0 (3.0, 15.0)	8.5 (3.0, 14.0)	10.0 (4.0, 13.0)	8.0 (3.0, 13.0)	7.0 (1.0, 12.0)	9.0 (5.0, 13.8)		**< 0.001**
Gender									
	Female, N = 6,544[a]	Other, N = 33[a]	Male, N = 4,439[a]						
	8.0 (3.0, 13.0)	4.0 (0.0, 10.0)	8.0 (2.0, 13.0)						**0.037**
Residence									
	Rural, N = 1,715[a]	Urban, N = 9,301[a]							
	7.0 (2.0, 13.0)	8.0 (3.0, 13.0)							0.064
Educational level									
	Bachelor, N = 7,256[a]	Higher degree, N = 1,272[a]	Not educated, N = 203[a]	Primary, N = 292[a]	Secondary, N = 1,993[a]				
	8.0 (3.0, 13.0)	9.0 (3.0, 16.0)	9.0 (4.0, 13.0)	7.0 (1.8, 12.0)	6.0 (2.0, 11.0)				**< 0.001**

[a]Median (IQR).

[b]Man whitney U test; Kruskal-Wallis rank sum test.

from 18 to 24 years, bachelor's degree holders, and living in urban areas mostly in Sudan and Saudi Arabia. Previous similar studies had a much smaller sample size. In a study conducted on the general population of Saudi Arabia, participants were mostly females, with a mean age of 30 years, single, bachelor's degree holders, and residing in urban areas[37]. In another study conducted in Bangladesh, the majority of participants were men between 18 and 35 years of age, graduated, and living in urban areas[38].

Most of the participants in our study had poor knowledge about Mpox etiology, mode of transmission, symptoms, complications, and fatality. Similarly, a poor level of knowledge was observed in other studies among individuals from Bangladesh, Indonesia, Jordan, Iraq, and Italy[38–41]. According to 61.8% of our participants, the most common source of knowledge about Mpox was social media. Another study also stated that social media and the internet were the most common sources of knowledge in Saudi Arabia[37].

More than half of our participants correctly identified the Mpox causative organism. In a cross-sectional study in Bangladesh, the participants could correctly classify Mpox as a viral disease, although they were unclear about its specific causative organism[38]. As in our study, participants from Bangladesh had a low knowledge score regarding Mpox transmission[38]. More participants in the Saudi Arabian study identified Mpox transmission through contact with infected animals and body fluids as well as human-to-human transmission[35]. Likewise, more participants in the Saudi Arabian study could identify skin rash, fever, and viral prodrome as symptoms of Mpox[35].

In our study, the participants' understanding of defenses against Mpox was superior to their understanding of the

Table 4

Participants' predictions about monkeypox.

		Gender			
Characteristic	**Overall, *N* = 11 016[a]**	**Female, *N* = 6544[a]**	**other, *N* = 33[a]**	**Male, *N* = 4439[a]**	***P*[b]**
Do you think that you will contract monkey pox in the coming year if you did not take any preventive measures? (Yes)	8008 (72.7%)	4873 (74.5%)	20 (60.6%)	3115 (70.2%)	**< 0.001**
Do you think the ministry of health in your country is able to control this pandemic? (Yes)	5678 (51.5%)	3299 (50.4%)	12 (36.4%)	2367 (53.3%)	**0.002**
Do you think that monkey pox can become a worldwide pandemic? (Yes)	5597 (50.8%)	3505 (53.6%)	15 (45.5%)	2077 (46.8%)	**< 0.001**
Do you predict there is going be a lockdown and sanction? (Yes)	4285 (38.9%)	2851 (43.6%)	11 (33.3%)	1423 (32.1%)	**< 0.001**
Do you predict that the pandemic will affect your country/family's economy? (Yes)	5728 (52.0%)	3676 (56.2%)	14 (42.4%)	2038 (45.9%)	**< 0.001**
Do you think this disease will affect you/or your family's education? (Yes)	5280 (47.9%)	3375 (51.6%)	15 (45.5%)	1890 (42.6%)	**< 0.001**

[a]*n* (%).

[b]Pearson's χ^2test; Fisher's exact test.

Table 5

Difference in prediction according to countries.

Characteristic	Overall, N = 11,016[1]	Countries								P-value[2]
		Egypt, N = 1,056[1]	Palastine, N = 1,077[1]	Qatar, N = 1,045[1]	Saudi Arabia, N = 2,054[1]	Sudan, N = 2,478[1]	Sultanate Oman, N = 898[1]	Syria, N = 1,089[1]	Yemen, N = 1,319[1]	
Prediction section										
Do you think that you will contract monkey pox in the coming year if you did not take any preventive measures? (Yes)	8,008 (72.7%)	749 (70.9%)	718 (66.7%)	663 (63.4%)	1,361 (66.3%)	2,019 (81.5%)	770 (85.7%)	831 (76.3%)	897 (68.0%)	< 0.001
Do you think the ministry of health in your country is able to control this pandemic? (Yes)	5,678 (51.5%)	533 (50.5%)	417 (38.7%)	907 (86.8%)	1,775 (86.4%)	593 (23.9%)	719 (80.1%)	503 (46.2%)	231 (17.5%)	< 0.001
Do you think that monkey pox can become a worldwide pandemic? (Yes)	5,597 (50.8%)	528 (50.0%)	510 (47.4%)	553 (52.9%)	893 (43.5%)	1,513 (61.1%)	520 (57.9%)	487 (44.7%)	593 (45.0%)	< 0.001
Do you predict there is going be a lockdown and sanction? (Yes)	4,285 (38.9%)	451 (42.7%)	371 (34.4%)	364 (34.8%)	616 (30.0%)	1,143 (46.1%)	497 (55.3%)	386 (35.4%)	457 (34.6%)	< 0.001
Do you predict that the pandemic will affect your country/family's economy? (Yes)	5,728 (52.0%)	614 (58.1%)	536 (49.8%)	559 (53.5%)	683 (33.3%)	1,597 (64.4%)	508 (56.6%)	558 (51.2%)	673 (51.0%)	< 0.001
Do you think this disease will affect you/or your family's education? (Yes)	5,280 (47.9%)	535 (50.7%)	453 (42.1%)	481 (46.0%)	670 (32.6%)	1,521 (61.4%)	503 (56.0%)	414 (38.0%)	703 (53.3%)	< 0.001

aforementioned illness aspects. In contrast, participants' poor knowledge about the disease transmission routes subsequently led to poor knowledge about its preventive methods in the Bangladeshi study[38]. Infected individuals' isolation and health education were the most frequently identified preventive methods in our study, whereas face masks and hand sanitizers were the most frequently identified in the Saudi Arabian study[35]. More participants from Bangladesh knew about the presence of a vaccine against Mpox when compared to our participants and the Saudi Arabian study participants[36,38].

Participants' level of knowledge about Mpox was found to have associations with their age and educational attainment. Age and knowledge score had a favorable relationship that grew as participants aged, and postgraduate degree holders had the best knowledge score. These findings were consistent with the previous studies[36,38].

In regards to participants' predictions about the epidemic, over half of our participants predicted that Mpox could become a global epidemic and have an impact on their economy. A previous study concluded a correlation between the projected impact of Mpox on social and economic lives and the knowledge score, with those who anticipated the same impact as COVID-19 having poor knowledge scores[35].

Strengths and limitations

To the best of our knowledge, this is the first study to investigate public awareness and predictions about Mpox across the Middle East. Our study is strengthened by the large sample size across various sociodemographic data within eight countries. Thus, we ensured the better representability of the target population. This diversity has also allowed for making comparisons across the included countries and finding associations between the studied variables and the sociodemographic factors. Directing our study toward the general population is another powerful point that makes our scope wide for assessing the patterns of perceptions and prediction. However, the use of convenience sampling is expected to add bias in our study, yet, it enabled us to conduct our investigation among the public on a regional level. This study has a possibility of selection bias, as responding to the questionnaire requires the availability of a smart device, an internet connection, and an account on social media or an educational platform. In addition, the unequal representation across demographics in the sample is considered another limitation, since most participants lived in urban areas and had higher education. It was expected that this unequal representation would have consequences on the findings.

Conclusion

This study aimed to assess public awareness and predictions about Mpox in eight Middle East countries. Our participants had poor knowledge about Mpox etiology, symptoms, complications, and fatality. Participants' knowledge about Mpox was associated with their age, sex, and educational attainment. The majority of the participants believed that Mpox can become an epidemic. Opinions about the ability to control Mpox varied largely according to the country. The findings of this study could represent a scientific base upon which awareness campaigns and educational programs could be designed.

Recommendations

Future research can be directed to assess the knowledge, attitude, and practices of the public against Mpox using different methods of data collection not limited to the online platforms to achieve generalizability of the results. Also, research about the spread of Mpox from asymptomatic individuals is required. More studies assessing the impact of Mpox on the mental status, lifestyle, and economy to realize the current status from different aspects of the community and hence, policies and regulations can be implemented.

Ethical approval and Consent to participate

Informed consent was obtained from all the participants and also from parents/legal guardians of minors and illiterates.

The protocol of this study was approved (No: 25-22) on 23 of July 2022 by the Institutional Review Board of the Faculty of Medicine, University of Gezira, Wad Medani, Sudan.

Consent

Written informed consent was obtained from the participants for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request. Written informed consent was obtained from the participants' parents/legal guardians for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Availability of data and materials

The data set used and/or analyzed during the study are available from the corresponding author on reasonable request.

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