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Monkeypox caused less worry than COVID-19 among the general population during the first month of the WHO Monkeypox alert: Experience from Saudi Arabia

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ABSTRACT

Background: Monkeypox re-emerged in May 2022 as another global health threat. This study assessed the public's perception, worries, and vaccine acceptance for Monkeypox and COVID-19 during the first month of WHO announcement.

Methods: A large-scale, cross-sectional survey was conducted between May 27 and June 5, 2022, in Saudi Arabia. Data were collected on sociodemographic characteristics, previous infection with COVID-19, worry levels regarding Monkeypox compared to COVID-19, awareness, and perceptions of Monkeypox, and vaccine acceptance.

Results: Among the 1546 participants, most respondents (62%) were more worried about COVID-19 than Monkeypox. Respondents aged 45 years and above and those with a university degree or higher had lower odds of

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agreement with Monkeypox vaccination (OR 0.871, p-value 0.006, OR 0.719, p-value <0.001), respectively. Respondents with moderate to a high level of self and family commitment to infection control precautionary measures and those who expressed self and family worry of Monkeypox infection had significantly higher odds of vaccination agreement (OR 1.089 p-value = 0.047, OR 1.395 p-value = 0.003) respectively. On the other hand, respondents who previously developed COVID-19 were significantly more worried about the Monkeypox disease (1.30 times more, p-value = 0.020).

Conclusion: Worry levels amongst the public are higher from COVID-19 than Monkeypox. Perception of Monkeypox as a dangerous and virulent disease, worry from contracting the disease, and high commitment to

Abbreviations

CDC	Centers for Disease Control and Prevention
COVID-19	Coronavirus disease 2019
MOH	Ministry of Health
MOXV	Monkeypox virus
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
WHO	World Health Organization

infection precautionary measures were predictors of agreement with Monkeypox vaccination. While advanced age and high education level are predictors of low agreement with vaccination.

1. Introduction

The emergence of the Monkeypox disease in May 2022 across the globe has caused significant worry among the public, especially with the still ongoing Coronavirus Disease 2019 (COVID-19) pandemic [1]. It has previously been demonstrated that the level of worry and concern about the evolving COVID-19 has been exemplified by the different variants, such as the Delta and Omicron [2,3]; therefore, the co-emergence of a new virus potentially might complicate the anxiety and worry levels across the different sectors of the public.

The Monkeypox virus is an enveloped DNA virus, that is a member of the genus Orthopoxvirus, which includes the Smallpox virus (variola major) that was eradicated globally in 1980 by mass vaccination, and this may have resulted in the increased numbers of Monkeypox virus (MOXV) cases due to the loss of the partial protective activity of the Smallpox vaccine, due to halt of mandatory vaccination [4].

Recently, Monkeypox disease has increased among travelers to Western and Central African countries, resulting in secondary transmissions from person-to-person [5,6]. Coinciding with the surge of the Omicron variant of COVID-19, the World Health Organization reported the occurrence of 92 laboratory-confirmed Monkeypox cases from the UK, Europe, Australia, Canada, and the USA, mainly among homosexual males. Currently, there are two potential vaccines that could be used in the case of MOXV infection: ACAM2000 orthopoxvirus and JYNNEOS vaccines [7,8].

With the recent re-emergence of the Monkeypox disease global outbreaks, we aimed to assess and compare the Saudi public's perceptions about the disease, worries, and vaccine acceptance for Monkeypox disease during the first month of the WHO announcement of the 2022 Monkeypox outbreak, compared to the recent pandemic that stroke the human, namely (COVID-19) during the first month of WHO announcement of the 2022 Monkeypox epidemic.

2. Method

2.1. Data collection

A structured questionnaire comprising 21 items was used. The survey tool was adopted from our previously published research on COVID-19 with modifications related to the new Monkeypox outbreak [9–13]. The questionnaire (Appendix 1) was translated into Arabic by an expert from

the research team and back translated to English to ensure accuracy. The final survey version was piloted among ten members of the general community for clarity and consistency. Modifications were implemented based on the experts' recommendations. The questionnaire took 8 min to complete. The research team experts approved the final version of the survey for language accuracy, clarity, and content validity.

Variables surveyed included their sociodemographic characteristics, levels of worries from Monkeypox compared to COVID-19 and sources of the worries, previous COVID-19 infection status, readiness for Monkeypox disease vaccination, and their knowledge about the Monkeypox disease, which was assessed by nine questions assessing their knowledge of modes of transmission and period of contagiousness, the effectiveness of smallpox and chickenpox vaccines against Monkeypox disease.

Also, we assessed their compliance with precautionary measures against COVID-19, and finally, their Generalized Anxiety Disorder (GAD7) score [14,15]. GAD7 is a self-reported, 7-item validated scale. Respondents indicated how frequent they were bothered during the previous two weeks by symptoms of feeling nervous, not being able to stop worrying, worrying about different things, trouble relaxing, restless, irritable, and afraid that something awful may happen. Responses were "not at all," "several days," "more than half the days," and "nearly every day," and scored as 0, 1, 2, and 3. GAD7 score of ≥ 10 identified cases of anxiety, with 89% sensitivity and 82% specificity, good internal consistency (Cronbach $\alpha = 0.92$), and test-retest reliability (intraclass correlation = 0.83) [14]. GAD7 scores were totaled and classified as minimal (0–4), mild (5–9), moderate (10–14), and severe (15–21).

A large-scale, online, cross-sectional survey of adults in the Kingdom of Saudi Arabia (KSA) was conducted over ten days (from May 27, 2022, until June 5, 2022). Participants were invited by convenience sampling techniques through various social media platforms (Twitter and WhatsApp groups) and email lists. Participants were asked to complete the online survey through the SurveyMonkey® platform, with each response allowed once from each unique IP address to ensure single entries. The first page of the survey explained the research objectives and assured confidentiality.

2.2. Ethical approval

Participants were informed of the purpose of the study, and their voluntary participation was obtained at the beginning of the electronic survey. Ethical approval was granted by the institutional review board (IRB) at King Saud University (22/0416/IRB) before the collection of

data.

2.3. Statistical analysis

Means and standard deviations were used to describe continuous variables and frequencies and percentages for categorically measured variables. The histogram and the Kolmogorov-Smirnov test were applied to test the assumption of normality, and the Levene's test was used to test the homogeneity of variance statistical assumption. Cronbach's alpha test was used to assess the internal consistency of the measured questionnaires. The Multivariate Binary Logistic Regression Analysis was used to assess what factors could explain people's worry over Monkeypox and their support for vaccination against Monkeypox. The association between predictors with the outcome dependent variables in the multivariate Logistic Binary regression analysis was expressed as a multivariate-adjusted Odds Ratio (OR) with their associated 95% confidence intervals. The SPSS IBM statistical analysis program was used for statistical data analysis [16]. The statistical Alpha significance level was considered at 0.050 level.

3. Results

The online survey was completed by 1546 individuals. Table 1 displays the descriptive analysis of participants' sociodemographic characteristics. Most participants were 44 years and under (65%) and had a university degree (64.9%). Almost half of the respondents (46.1%) were employed, with the most reported household monthly income (HHI) between 10,000 and 15,000 Saudi Riyals (2667.4000 USD).

About half of the respondents (49.8%) had previously been infected with COVID-19. Participants' and family members' compliance with COVID-19 pandemic precautions revealed that 8.5% were rarely committed, while 48.9% were always committed. The results showed that 62.6% of respondents perceived the COVID-19 pandemic as more worrying than Monkeypox, while 37.4% indicated they were more worried about Monkeypox. More than half of respondents (51.3%) perceived Monkeypox as a dangerous and virulent disease warranting a rapid call for respiratory and contact precautions, as shown in Table 2.

The average knowledge score from the nine questions assessing respondents' knowledge regarding Monkeypox was used as a cutoff point

Table 1 Sociodemographic characteristics of participants (N = 1546).

Variable	Frequency	Percentage
Sex		
Female	896	58
Male	650	42
Age groups		
18-34 years	444	28.7
35-44 years	561	36.3
45-54 years	346	22.4
55-64 years or older	195	12.6
Educational level		
High school or less education	353	22.8
University	1003	64.9
Master/PhD	190	12.3
Employment state		
Unemployed	833	53.9
Employed	713	46.1
Household size (family size)		
1-3 members	358	23.2
4-6 persons	798	51.6
7-10 persons or more	390	25.2
Households Monthly Income (HHI)		
Less than 10000 SR	329	21.3
10000-15000 SR	397	25.7
15001-20000 SR	196	12.7
More than 20000 SR	287	18.6
Prefer not to answer	337	21.8

SR: Saudi Riyals.

Table 2

Respondents' attitudes, perceptions, and beliefs about Monkeypox disease (N = 1546).

Variable	Frequency	Percentage
Have you been affected by the COVID-19 disease?		
No	776	50.2
Yes	770	49.8
Participant's and family members compliance with COVID-19 pandemic precautions		
Rarely committed	131	8.5
Medium commitment	659	42.6
Always committed	756	48.9
Worry from Monkeypox compared to COVID-19		
Much worried with the COVID-19	968	62.6
More worried with Monkeypox	578	37.4
Main reasons for your worry from Monkeypox disease		
Self and family worry of Monkeypox infection	882	57.8
Worry from another worldwide pandemic	923	60.4
Worried that Monkeypox might surge to cause a national lockdown	363	23.8
Concerned that an international flight suspension happens	242	15.8
Other worries	105	6.9
Do you perceive Monkeypox as a dangerous and virulent disease that calls for respiratory and contact precautions?		
No	753	48.7
Yes	793	51.3
(GAD7) score, mean (SD)		6.14 (5.53)
Very low Anxiety	720	46.6
Mild Anxiety	447	28.9
Moderate Anxiety	233	15.1
High Anxiety	146	9.4
Overall Monkeypox Disease Knowledge score, mean (SD) maximum score = 9		4.88 (1.49)
Low score	681	44
High score	865	56

to categorize the respondents' knowledge scores into high or low. The average knowledge score was 4.88 out of 9 SD 1.49, with 56% of respondents achieving a high score. Respondents indicated that they sought information from an official local and international sources, social networks, and other websites.

Respondent's Overall Generalized Anxiety was measured with the GAD7 scale, their overall mean score was 6.14/21 SD 5.53 points highlighting mild anxiety levels. Table 2.

3.1. Worries from Monkeypox Disease and vaccination readiness

Most respondents (60.4%) were worried about the progression of the disease into a global pandemic (Fig. 1). This was followed by worry about themselves and their family's contracting the disease (57.8%), followed by worry about national lockdown (23.8%) and domestic and international flight shutdowns (15.8%). A minority of respondents (6.9%) perceived other worries from the Monkeypox disease, such as the disfiguring scarring, risks to children and pregnant women, risks of travel restrictions, or requirements of additional mandatory vaccines.

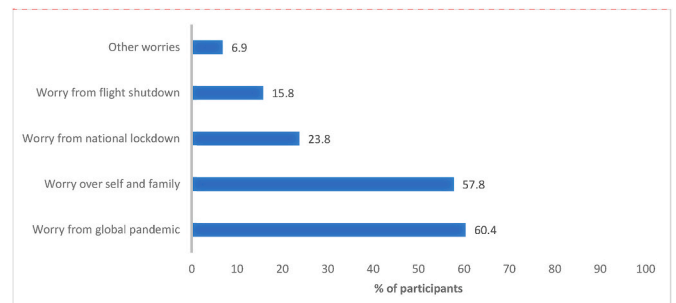


Fig. 1. Respondent's worries from the Monkeypox Disease.

3.2. Respondents' agreement with Monkeypox vaccination

In relation to the agreement with Monkeypox vaccination in the current stage of the disease, almost half of respondents (50.6%) favor vaccination. In response to whom participants thought should be vaccinated against Monkeypox disease, 77.7% of respondents felt that immunodeficient persons should be vaccinated, followed by the elderly (62.1%), young children (61.1%), chronically ill patients (59.7%), and healthcare workers (59.4%) (Fig. 2).

As shown in Table 3, the Multivariate Binary Logistic Regression Analysis identified variables associated with higher odds of respondents' agreement with vaccination against Monkeypox in the current stage of the disease. Respondents aged 45 years and over were significantly less likely to support vaccination against Monkeypox (OR 0.871, $p = 0.006$). Respondents who perceived Monkeypox disease as dangerous and virulent were 45.6% more likely to support vaccination $p = 0.001$.

Additionally, those who perceived Monkeypox to be more worrisome than COVID-19 had higher odds of agreeing to vaccinate against Monkeypox (OR 1.391 $p = 0.004$). We analyzed the correlation between age and the mean predicted probability of agreement with vaccination against Monkeypox in the two groups of respondents, those who perceived Monkeypox as a dangerous and virulent disease and those who didn't. In general, increasing age was associated with decreased probability of agreement with vaccination (Fig. 3). Still, the probability was higher for those who perceived Monkeypox as a dangerous and virulent disease, while those aged 55 years and above and who perceived Monkeypox as a virulent disease had a close probability to those who did not.

Those who held university degree or higher had significantly lower odds of supporting vaccination in the current stage (28.1% less OR 0.719, $p < 0.001$). Respondents' moderate to high level of self and family commitment to infection control precautionary measures correlated significantly and positively with their agreement to receive Monkeypox vaccination (OR 1.089 $p = 0.047$). Additionally, self and family reported worry about Monkeypox infection were significant predictors of agreement with Monkeypox vaccination (OR 1.395 $p = 0.003$), and respondents who showed greater interest in reading and searching further about Monkeypox had higher odds of supporting vaccination (OR 1.629 p -value <0.001). Those who used the (MOH) website as a source of information compared to those who used other sources of information were significantly more likely to agree with vaccination (OR 1.28 $p = 0.025$). No significant correlation was found between the knowledge score of Monkeypox and the (GAD7) measure of anxiety regarding the agreement to vaccinate against Monkeypox in the current stage.

We assessed variables associated independently with higher worry

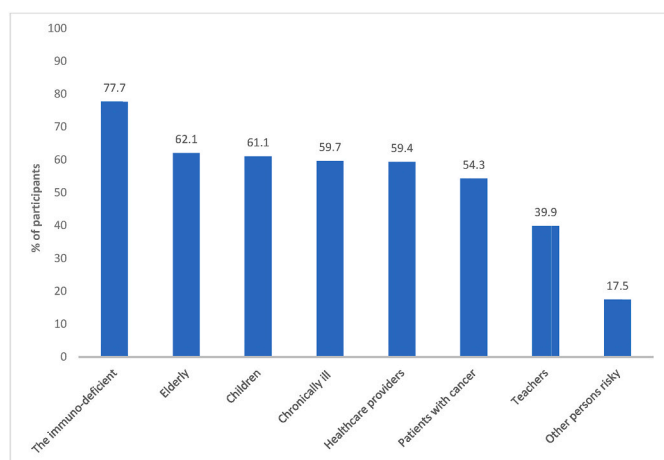


Fig. 2. Respondent's perceptions of Monkeypox vaccine candidates.

Table 3

Multivariate Binary Logistic Regression Analysis of people's odds of agreement to vaccinate against Monkeypox Disease.

	Multivariate adjusted Odds Ratio (OR)	95% C.I. for (OR)		p-value
		Lower	Upper	
Age group ≥ 45 years	.871	.790	.961	.006
Perceives Monkeypox as dangerous & virulent	1.456	1.165	1.820	.001
Educational Level	.719	.618	.838	<0.001
University degree or higher education				
Households' monthly income	.959	.893	1.031	.258
Knowledge score of Monkeypox	1.048	.974	1.127	.210
Higher Family compliance level to precautions to COVID-19	1.089	1.001	1.184	.047
Moderate to high compliance				
Self and family worry from contracting Monkeypox infection	1.395	1.121	1.735	.003
(GAD7) Score	1.053	.945	1.173	.349
Read and search more about Monkeypox after the survey	1.629	1.310	2.026	<0.001
More worried from Monkeypox compared to COVID19	1.391	1.109	1.746	.004
Relies on MOH as a source of Monkeypox information	1.282	1.032	1.592	.025
Relies on other internet sources for Monkeypox information	1.543	.904	2.633	.112

DV = agreement to vaccinate against Monkeypox Disease.

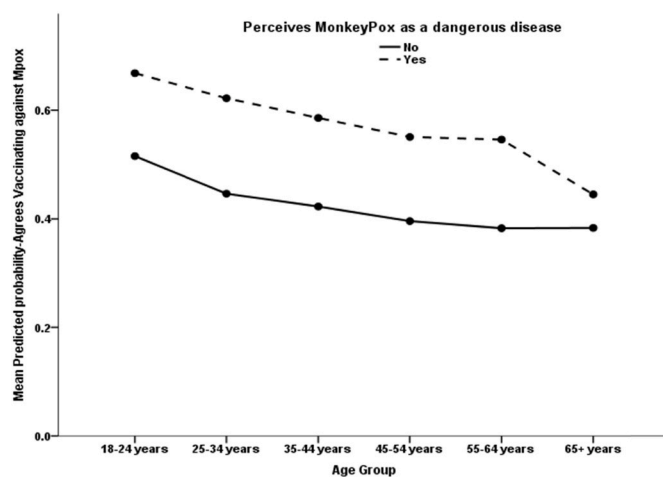


Fig. 3. The association between people's age and their mean predicted probability of supporting the Monkeypox vaccines accounting for their perceived danger of Monkeypox.

levels about Monkeypox disease compared to COVID-19 using multivariate logistic regression (Table 4). Age, educational level, employment status, and Monkeypox knowledge score, all did not reveal any significant associations. Participants who perceived Monkeypox as highly dangerous and virulent were found to be significantly more worried about it compared to COVID-19 (OR 3.61, p -value <0.001). It was found that those with moderate to high compliance with infection control precautions were significantly less likely (17.3%) to experience high levels of worry about Monkeypox (OR = 0.827 $p < 0.001$). While those

Table 4

Multivariate Binary Logistic Regression Analysis of respondents' odds of higher worry level from Monkeypox disease compared to COVID-19.

	Multivariate adjusted Odds Ratio (OR)	95% C.I. for (OR)		p-value
		Lower	Upper	
Age group	1.000	.903	1.109	.994
Educational Level	.918	.779	1.082	.308
Households' monthly income	1.061	.984	1.143	.124
Employed	.866	.685	1.095	.231
Monkeypox Knowledge score	.974	.903	1.050	.488
Perceives Monkeypox as dangerous & virulent	3.609	2.863	4.551	<0.001
Family compliance with universal precautionary level to COVID-19 Moderate or high	.827	.757	.903	<0.001
Agreement with Monkeypox vaccination	1.372	1.095	1.719	.006
Self and family worry from contracting Monkeypox infection	1.245	.986	1.573	.066
Previous exposure to COVID-19 Disease Yes	1.300	1.042	1.623	.020
(GAD7) Score	1.051	.939	1.176	.385

DV = higher worry level from Monkeypox disease compared to COVID-19.

who agreed with the Monkeypox vaccination were significantly more worried about it (OR = 1.372, $p = 0.006$). Those who were worried about themselves or their families from contracting the infection had slightly higher odds of being more worried; however, this was not statistically significantly (OR 1.245, $p = 0.066$). On the other hand, respondents who previously had COVID-19 were found to be significantly more worried from the Monkeypox disease compared to COVID-19 (OR = 1.30 $p = 0.020$).

4. Discussion

During the last two years, the world faced the burden of the COVID-19 pandemic. Though it was not the largest pandemic in the modern history, it had peculiarity due to its occurrence during an era of broad transportation networks and interaction among all nations, concurrently with great development in infection prevention measures compared to previous pandemics, and sophisticated levels of information technology and telecommunication [17]. The pandemic caused major disruption for humans, at least health and economic levels. Therefore, with the recent recovery of the international systems from the pandemic consequences and loosening of the tight measures that were applied on travelling and personal communication, the announcement of the reemergence of the Monkeypox disease might potentially have detrimental effect on the societies regarding worry and anxiety [1].

The results of this study depended mainly on the participants' level of knowledge of the modes and factors of transmission of Monkeypox virus in the epidemic occurring in 2022 in non-endemic areas. The available information about Monkeypox had not yet gained international concern. However, 60.4% of our participants indicated their higher worry about the current Monkeypox virus outbreak becoming a global pandemic. This worry is probably related to their recent experience with the COVID-19 pandemic.

In line with the current COVID-19 pandemic, it is assuring to note that 42.8% of our participants had medium and 48.9% had constant compliance with infection control measures. This is an important aspect for the continued messaging and education that authorities could build on as we go through the alert of Monkeypox. In a commentary, authors called for calls for immediate long-term public and travel health planning [18]. The main transmission route of Monkeypox is close and extended contacts with infected individuals [19]. Thus, the current precautions in place are of paramount to build on for future plans and

interventions.

Vaccination against Monkeypox in the current stage of the disease is a challenging decision for healthcare policy makers, international health societies and local authorities. Public perception regarding the need and acceptance of such decision if taken, for specific groups of the population or most of the population like what happened with COVID-19 deserves studying at the current stage considering the COVID-19 vaccine hesitancy the public went through. Especially after receiving 2 doses of COVID-19 vaccines and the emergence of the Omicron variant with its mild disease nature and questionable vaccines effectiveness against it and other variants. Our cohort has shown that those aging 45 years and above were significantly less supporting vaccination against Monkeypox, the same phenomenon has been reported in public with COVID-19 vaccine even after 2 years of the pandemic.

While public perception of the Monkeypox significantly affected their agreement with vaccination, those who perceived Monkeypox disease as dangerous and virulent (51.3%), Self and family worry of Monkeypox infection (57.8%) and those who perceived it more worrisome compared to COVID-19 (37.4%) had higher odds of agreement with vaccination. That mirrors others work in that regard as perceiving the disease severe was associated with increased willingness for vaccination [20–24]. Furthermore, respondents who had moderate to high level of self & family commitment with infection control precautionary measures (91.5%) also showed significant agreement with vaccination against Monkeypox which echoes their healthy infection prevention behavior and is similar to what was observed with COVID-19 vaccines [25]. Respondents eager to read about the Monkeypox disease also was a significant predictor of vaccination agreement which translates their perception of disease risk, complacency and collective responsibility toward their families and society.

Meanwhile, only 37.4% of our cohort were more worried of the reemerging Monkeypox compared to COVID-19, 51.3% perceived Monkeypox as a dangerous and virulent disease. From a recent report of 528 Monkeypox infections (April 27 to June 24, 2022) in 16 countries, the majority (98%) were men having sex with men; with the median age of 38 years [26]. Mostly (95%) presented with a rash, 73% had lesions in the anogenital areas, and 41% with lesions in the mucosa. The systemic features were fever (62%), lymphadenopathy (56%), fatigue (41%), myalgia (31%), and headaches (27%). Only 70 patients (13%) were hospitalized, mainly for pain management, and no deaths were reported.

In our study, participants who perceived Monkeypox as a dangerous disease had significant worry from it compared to COVID-19. The nature of perception of any disease affects public worry, fear and anxiety levels as all these cognitive attitudes are interconnected [27]. On the other hand, those who had moderate to high compliance with infection control precautions (91.5%) had significantly less worry from Monkeypox, which is an expected feeling having decent self-protective behavior that feeds their cognition with safety feelings from reemerging infectious diseases [28]. That did not echo the healthy behavior of the respondents who agreed with vaccination against Monkeypox (50.6%), who had significant higher worry levels from it. Seeking vaccination may correlate with higher worry levels generally [21,29]. Almost half of our cohort had developed COVID-19 already at the time of the survey, and the majority had a minor disease, even though they had significantly higher worry levels from Monkeypox disease compared to COVID-19, that high worry level can be understood considering the high rates of PTSD, higher perceived life threat and anxiety in COVID-19 survivors [21,30,31], while those who had self and family worry from contracting Monkeypox infection had only slight high worry levels from Monkeypox that did not reach statistical significance.

4.1. Study limitations and strengths

At the time of data collection, it was not clear whether this Monkeypox epidemic was occurring mainly among men who have sex with men, particularly those with multiple recent partners, as was

demonstrated in the subsequent research [26,32]. However, we did not collect this data in our survey, as this was not initially communicated in a clear and documented manner in the evolving literature. Our research is also subject to the limitation of cross-sectional surveys, such as convenience sampling, variable response rates, and possible recall biases. While this study is among the first to explore perceptions and worries among the public considering the newly reported cases of Monkeypox outside African countries, the respondents' experiences and perceptions are likely to change as the situation evolves. Moreover, it is noteworthy that there were no cases of Monkeypox reported in Saudi Arabia at the time of data collection, as the first case was reported by the Saudi MOH on 14 July 2022 [33], although it was reported in neighboring countries, like the UAE and Jordan. As perceptions may differ from one setting to another, future research could explore this further. Future research could seek older participants' variola vaccination status, as this may have some protection against Monkeypox.

5. Conclusions

Worry levels amongst the public were higher regarding COVID-19 than Monkeypox during the first month of the WHO alert about emerging cases of Monkeypox in several countries outside Africa. Perception of Monkeypox as dangerous and virulent disease, worry from contracting the disease and high commitment with infection precautionary measures were predictors of agreement with Monkeypox vaccination. While advanced age and high education level are predictors of low agreement with vaccination. Future research seeking the public perceptions about the emergence of the international spread of Monkeypox clusters just after the COVID-19 pandemic crisis would allow more understanding of the public perceptions of both diseases at this point in time. This could pave the foundation for policy makers on how to promote Monkeypox vaccination campaigns if needed, and how to address potential vaccine hesitancy.

Ethics approval and consent to participate

The study was approved by the institutional review board of King Saud University (approval 22/0416/IRB).

CRedit authorship contribution statement

Mohamad-Hani Temsah: Conceptualization, Formal analysis, Data curation, Writing – original draft, conceptualized the study, analyzed the data, and wrote the manuscript. **Fadi Aljamaan:** Conceptualization, Formal analysis, Data curation, Writing – original draft, conceptualized the study, analyzed the data, and wrote the manuscript. **Shuliweeh Alenezi:** Conceptualization, Formal analysis, Data curation, Writing – original draft, conceptualized the study, analyzed the data, and wrote the manuscript. **Khalid Alhasan:** Conceptualization, Formal analysis, Data curation, Writing – original draft, conceptualized the study, analyzed the data, and wrote the manuscript. **Basema Saddik:** Conceptualization, Formal analysis, Data curation, Writing – original draft, conceptualized the study, analyzed the data, and wrote the manuscript. **Ahmad Al-Barag:** Conceptualization, Formal analysis, Data curation, Writing – review & editing, contributed to the study design; collected, analyzed, interpreted data; and edited the manuscript. **Ali Alhaboob:** Writing – review & editing, contributed to the study design; collected, analyzed, interpreted data; and edited the manuscript. **Nezar Bahabri:** Writing – review & editing, contributed to the study design; collected, analyzed, interpreted data; and edited the manuscript. **Fati-mah Alshahrani:** Writing – review & editing, contributed to the study design; collected, analyzed, interpreted data; and edited the manuscript. **Abdulkarim Alrabiaah:** Writing – review & editing, contributed to the study design; collected, analyzed, interpreted data; and edited the manuscript. **Ali Alaraj:** Writing – review & editing, contributed to the study design; collected, analyzed, interpreted data; and edited the

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Declaration of competing interest

None declared.

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Appendix A. Supplementary data

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