# Knowledge and attitude regarding monkeypox virus among physicians in Saudi Arabia, a cross-sectional study

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## Abstract

# Objectives

The aim of this study was to assess the knowledge and attitudes towards monkeypox infection among physicians, a frontline healthcare worker group, in Saudi Arabia.

# Methods

A cross-sectional, online survey assessing knowledge and attitudes towards monkeypox infection on multiple-item scales was sent to physicians in Saudi Arabia. The associations between independent factors and either knowledge or attitude were assessed.

# Results

The final analysis included 398 participants. Approximately 57% of the participants were under 30 years old, and 56.8% were male. Only 18.6% of the surveyed participants had ever received information about monkeypox in their medical education. A substantial proportion of assessed physicians lack knowledge regarding the endemicity of monkeypox, its transmission, clinical differences with smallpox, chickenpox, and influenza, as well as the clinical evolution and the main associated findings. In addition, there is a significant knowledge gap between the therapeutic management of monkeypox and its vaccination. Such poor knowledge is influenced by various factors.

# Conclusions

Physicians' knowledge and attitudes regarding monkeypox infection are inadequate. Training and knowledge assessment is important, as demonstrated by previous epidemics and pandemics such as Zika and COVID-19, especially when studies show significant improvement in related and specific knowledge.

## Introduction

The second half of the twentieth century saw unprecedented population growth, unparalleled mobility, and unrestricted urbanization; however, with these advances came an increase in the spread of zoonotic diseases (Keusch et al., 2009). Many of these diseases begin as zoonotic and later mutate into a strain that can only infect humans, such as HIV. Others are reoccurring outbreaks, such as the Ebola virus. In recent years, SARS-CoV-2 caused the still circulating COVID-19 pandemic. Zoonotic diseases may be bacterial, viral, or parasitic and could spread to humans through drinking water, food, or direct contact(Rahman et al., 2020). The sheer versatility of these diseases represents a significant public health problem and should be monitored, studied, and prevented well in advance. Knowledge and

awareness could be the deciding factors in limiting their spread before they become the next major pandemic. Monkeypox, a currently circulating zoonotic disease, could signify how our public health system has changed since the last pandemic and how physician knowledge plays a crucial role in that change.

Human monkeypox (MPX), a zoonotic infectious disease caused by the monkeypox virus (MPXV) of the genus Orthopoxvirus, causes smallpox-like symptoms in humans(Kuhn et al., 2019)(Ladnyj et al., 1972). It is a predominantly endemic disease in Western and Central Africa(Durski et al., 2018). The name, monkeypox, originates from the first reported discovery of the virus as an outbreak of a pox-like disease in monkeys at an animal research facility in Copenhagen, Denmark(Sehuminstitut, 1958). The first human MPXV case in medical history was recorded in 1970 at a hospital in the Democratic Republic of Congo, when a nine-month-old child manifested smallpox-like symptoms(Ladnyj et al., 1972). In 2003, multiple cases of MPXV were reported within the U.S., representing the first confirmed cases of MPXV outside the African continent(Bartlett, 2004). Fourteen years later, one of the most significant monkeypox outbreaks was reported in Nigeria, with 197 suspected cases and sixty-eight confirmed cases(Durski et al., 2018). In May of 2022, the largest outbreak of MPXV outside of endemic regions was confirmed by the World Health Organization (WHO)(Jamil et al., 2022). As of July 10, 2022, WHO had received reports of 8,238 confirmed cases from 57 non-endemic countries(Jamil et al., 2022)(Article et al., 2022). The 2022 outbreak marks the first time MPXV spread extensively outside of Western and Central Africa. Many of these cases have reportedly presented with a vesicular rash illness in men who have sex with men (MSM)(Article et al., 2022).

Monkeypox can be transmitted mainly via contact with respiratory secretions, infected skin lesions, or contaminated materials(Vaughan et al., 2020). The incubation period of monkeypox usually lasts from six to thirteen days but can range from five to twenty-one days(Reynolds et al., 2006). The disease is often self-limiting, with symptoms occurring spontaneously within fourteen to twenty-one days (Vaughan et al., 2020)(Ladnyj et al., 1972)(Manifestations, 2002). Symptoms can range from mild to severe, and lesions can be very itchy or painful. The animal reservoir remains unknown, although it is likely among rodents (Parker et al., 2007). Contact with live and dead animals through hunting and consumption of wild game or bush meat are known risk factors(Reynolds et al., 2007). The disease's clinical manifestations are comparable to but less severe than smallpox(Manifestations, 2002). Lymphadenopathy seems to be one of the key differentiating factors between monkeypox and smallpox(Brown & Leggat, 2016). Monkeypox's symptoms include fever, generalized headache, fatigue, lymphadenopathy, back pain, myalgia, and rash (Vaughan et al., 2020)(Manifestations, 2002). On the other hand, a study done to assess the knowledge of monkeypox among general practitioners showed that more than a third of them had good knowledge about it(Harapan et al., 2020).

Historically, vaccination against smallpox was shown to be protective against monkeypox, reported to be 85%(Fine et al., 1988). However, while one vaccine (MVA-BN) and one specific treatment (tecovirimat) were approved for monkeypox in 2019 and 2022, respectively, these countermeasures are not yet widely

available, and populations worldwide under the age of 40 or 50 years no longer benefit from the protection afforded by prior smallpox vaccination programs (Volkmann et al., 2021).

The increased number of human monkeypox cases demonstrates healthcare workers' importance of prevention, early detection, and quick response/management. However, a report by the WHO showed that one of the challenges faced in preventing the reemergence of monkeypox was a lack of knowledge of monkeypox, particularly among healthcare workers(*Monkeypox - United Kingdom of Great Britain and Northern Ireland*, n.d.) .Therefore, healthcare workers must be knowledgeable and prepared for monkeypox cases in different regions, including the Middle East. In this region, especially in Saudi Arabia, there are the Hajj and Omrah destinations, which could increase its vulnerability to the importation of human monkeypox. Hence, we sought to assess physicians' knowledge and attitude toward monkeypox in Saudi Arabia.

## Methods

# Study design and setting

An analytical cross-sectional study was conducted among physicians in Saudi Arabia from March 26, 2022, to May 27, 2022. This study recruited registered Saudi physicians who practice various medical specialties and work in multiple Saudi regions. Non-Saudi physicians who work outside of Saudi Arabia and participants who did not provide informed consent were excluded. We calculated the sample size by using the Raosoft calculator. We determined the sample size based on recent data, estimating the total number of physicians in Saudi Arabia to be 1047752. Since no previous studies in Saudi Arabia examined physician knowledge of monkeypox, a conservative estimate of 50 per cent was used. The minimum sample size required for a 95% confidence interval with a margin of error of 5% was 383(Al-Hanawi et al., 2019). The size of the sample was increased because it was thought that fewer people would fill out an online questionnaire.

# Data collection process

We used the convenience sample technique to recruit participants; no monetary benefit was offered to any participant. The participants were invited to participate in the questionnaire using Google Template, and participants were approached using social media platforms (WhatsApp and Twitter). A brief description of the research and a request for participation were presented at the beginning of the questionnaire. Completing the online questionnaire was considered to indicate consent for the survey.

# Data collection tools

This study was conducted using a self-administered questionnaire adapted based on current information from the Centers for Disease Control and Prevention in the United States (CDC) and a previously published study(Harapan et al., 2020) (*Monkeypox | Poxvirus | CDC*, n.d.). Then the questionnaire was modified to fit the objectives and scope of the current research by two preventive medicine consultants.

Finally, in a pilot study with 18 people, the questions' validity was tested, and the final version of the questionnaire was made based on the feedback from the pilot test.

The questionnaire was divided into four sections. The first two sections addressed sociodemographic factors such as age, gender, marital status, level of work, medical specialty, and work sector, followed by medical practice experience. The third section covered monkeypox knowledge, which included 23 multiple choice questions (MCQs) with a score of one for a correct answer and a score of zero for an incorrect answer. When the scores were added up, a total score from 0 to 23 was given. Higher scores showed more knowledge. The fourth section was about physicians' attitudes towards monkeypox and was assessed by ten statements. These statements were answered on a 3-point Likert scale (the answers were either agree, natural, or disagree). These statements included their opinions about the ability of the world's populations to control the monkeypox epidemic, the presence of suitable preventive and control measures, and whether they had bad feelings towards monkeypox. They were also asked how interested they were in learning more about monkeypox, emerging disease epidemiology, and travel medicine.

# Ethical consideration

This study was ethically reviewed and approved by Research Ethics Committee at Security Forces Hospital Program in Holy Capital (HAP-02-K-052). The approval number is ECM#0488-220522. This study was conducted according to the Declaration of Helsinki. Participants were also assured of anonymity and the confidentiality of their responses to the questionnaire.

# Data analysis

The data was extracted, cleaned, coded, and analyzed using IBM SPSS version 21 (SPSS version 21.0; IBM Corporation, Armonk, NY, USA) statistical software. Statistical significance was set at a 0.05 level. Continuous variables were presented in mean and standard deviation (S.D.). Frequency distribution was performed for categorical variables expressed in numbers and percentages. We used the mean score of 14 as a cut point; a mean score of 14 or above was considered high, while less than 14 was considered low. Pearson's Chi-square test was used to compare response variables and explanatory variables. P-value was set at $< 0.05$ for statistical significance.

## Results

During the survey, 450 responses to the questionnaire were received, and 52 answers had to be excluded due to incomplete information or refusal to participate. The final analysis included 398 participants, with a response rate of 88.4%. Approximately 57% of the participants were under 30 years old, and 56.8% were male. More than half (51%) of the participants were single. Approximately 36.9% of respondents were residents, followed by general practitioners (28.9%), and regarding their medical specialties, 24.4% of participants were general medical, followed by other specialties (21.4%), and preventive medicine (17.8%). Most participants (84.2%) worked in the governmental sector. Approximately 39.4% of the study participants had medical experience of 1–5 years. More than a third of participants (34.7%) work in the western region of Saudi Arabia, followed by the central area (25.4%). Only 18.6% of the surveyed

participants had ever received information about monkeypox in their medical education. There were 380 (95.5%) participants who had heard of human monkeypox before the survey, of which 51% had received the information relatively recently "within several days or weeks before the survey" (Table 1).

Table 1
Sociodemographic characteristics of physicians who participated in the study (n = 398).

| Variable | Total | |
|---|---|---|
| | n | (%) |
| **Age** | | |
| Under 30 years | 227 | 57% |
| 30 years and above | 171 | 43% |
| **Gender** | | |
| Male | 226 | 56.8 |
| Female | 172 | 43.2 |
| **Marital Status** | | |
| Single | 203 | 51% |
| Married | 195 | 49% |
| **Level of work** | | |
| General practitioner | 115 | 28.90% |
| Resident | 147 | 36.90% |
| Specialist | 64 | 16.10% |
| Consultant | 72 | 18.10% |
| **Medical Specialty** | | |
| General medical | 97 | 24.4% |
| Family medicine | 60 | 15.1% |
| Pediatrics | 33 | 8.3% |
| Internal medicine | 36 | 9% |
| Emergency medicine | 4 | 1% |
| Preventive medicine | 71 | 17.8% |
| Dermatology | 12 | 3% |
| Other | 85 | 21.4% |
| **Work Sector** | | |
| Governmental | 335 | 84.20% |

| Variable | Total | |
|---|---|---|
| | n | (%) |
| Private | 63 | 15.8% |
| **Medical Practice Experience** | | |
| Less than one year | 107 | 26.9% |
| 1–5 years | 157 | 39.4% |
| More than five years | 134 | 33.7% |
| **Region of work in Saudi Arabia** | | |
| Southern | 58 | 14.6% |
| Northern | 36 | 9% |
| Central | 101 | 25.4% |
| Western | 138 | 34.7% |
| Eastern | 65 | 16.3% |
| **Information about human monkeypox during medical education** | | |
| No | 324 | 81.4% |
| Yes | 74 | 18.6% |
| **Heard about human monkeypox before** | | |
| No | 225 | 56.5% |
| Yes | 173 | 43.5% |
| **First time you heard information about monkeypox** | | |
| I did not hear about it | 18 | 5% |
| Within several days or weeks ago | 203 | 50.5% |
| Within the last month or later | 177 | 44.5% |

# Physicians' knowledge about monkeypox and associated determinants

We utilized the average of all scores. We assumed that a score of 14 or higher indicated good knowledge, while a score below 14 indicated poor knowledge. Only 219 (55%) out of 398 respondents had a good knowledge of monkeypox. Across some dimensions, most participants had an accurate knowledge of

monkeypox. The majority of respondents' answers (87.5%) stated that monkeypox is not prevalent in Middle Eastern countries.

On the other hand, 75.2% of the participants indicated that monkeypox was not prevalent in Western and Central Africa. Almost all (94.7%) said a virus causes monkeypox, and more than 57.9% said the signs and symptoms of monkeypox and smallpox are not the same. However, other questions were answered incorrectly. Approximately 95% stated that a human monkeypox case had not been reported in Saudi Arabia. Besides symptomatic treatment, 50.6% of physicians mentioned that an antiviral is required in monkeypox management. Although almost all respondents correctly answered that a virus causes monkeypox, 15.3% stated that an antibiotic is necessary for human monkeypox management (Table 2).

Table 2
Responses of physicians who participated in the study to the knowledge questions about the monkeypox virus (n = 398).

| Knowledge Questions | Correct n (%) | Incorrect n (%) |
|---|---|---|
| Q1. Is monkeypox prevalent in middle eastern countries? | 349 (87.5) | 50 (12.5) |
| Q2. Is monkeypox prevalent in Western and Central Africa? | 99 (24.8) | 300 (75.2) |
| Q3. There are many human monkeypox cases in Saudi Arabia? | 379 (95.0) | 20 (5.0) |
| Q4. Is monkeypox a viral disease infection? | 378 (94.7) | 21 (5.3) |
| Q5. Is monkeypox a bacterial disease infection? | 374 (93.7) | 25 (6.3) |
| Q6. Is monkeypox easily transmitted human-to-human? | 162 (40.6) | 237 (59.4) |
| Q7. Could monkeypox be transmitted through a bite of an infected monkey? | 193 (48.4) | 206 (51.6) |
| Q8. Travellers from America and Europe are the primary source of imported cases of monkeypox? | 167 (41.9) | 232 (58.1) |
| Q9. Do monkeypox and smallpox have similar signs and symptoms? | 168 (42.1) | 231 (57.9) |
| Q10. Do monkeypox and chickenpox have similar signs and symptoms? | 169 (42.4) | 230 (57.6) |
| Q11. A flu-like syndrome is one of the early signs or symptoms of human monkeypox? | 79 (19.8) | 320 (80.2) |
| Q12. Rashes on the skin are one of the signs or symptoms of human monkeypox? | 37 (9.3) | 362 (90.7) |
| Q13. Papules on the skin are one of the signs or symptoms of human monkeypox? | 74 (18.5) | 325 (81.5) |
| Q14. Vesicles on the skin are one of the signs or symptoms of human monkeypox? | 117 (29.3) | 282 (70.7) |
| Q15. Pustules on the skin are one of the signs or symptoms of human monkeypox? | 157 (39.3) | 242 (60.7) |
| Q16. Is diarrhoea one of the signs or symptoms of human monkeypox? | 215 (53.9) | 184 (46.1) |
| Q17. Lymphadenopathy (swollen lymph nodes) is one clinical sign or symptom that could be used to differentiate between monkeypox and smallpox cases? | 84 (21.1) | 315 (78.9) |

| Knowledge Questions | Correct n (%) | Incorrect n (%) |
|---|---|---|
| Q18. One management option for symptomatic monkeypox patients is to use paracetamol? | 52 (13.0) | 347 (87.0) |
| Q19. Are antivirals required in the management of human monkeypox patients? | 197 (49.4) | 202 (50.6) |
| Q20. Are antibiotics required in the management of human monkeypox patients? | 61 (15.3) | 338 (84.7) |
| Q21. People who got the chickenpox vaccine are immunized against monkeypox? | 264 (66.2) | 135 (33.8) |
| Q22. There is a specific vaccine for monkeypox? | 278 (69.8) | 120 (30.2) |
| Q23. There is a specific treatment for monkeypox? | 65 (16.4) | 332 (83.6) |

Table 3 shows the relationship between Saudi physicians' sociodemographic characteristics and their knowledge of human monkeypox. The mean score's standard deviation was 5.44 points. As a result, 14 was chosen as the cutoff, with a score of 14 or higher indicating good knowledge and a score of less than 14 indicating poor knowledge. A 'good knowledge' score for monkeypox was associated with age under 30 years ($p = 0.13$), female gender ($p < 0.01$), being a general practitioner ($p = 0.04$), working in the private sector ($p < 0.01$), and having information on human monkeypox during medical school or residency years ($p = 0.01$). Age under 30 was correlated with a knowledge score (60%). High knowledge scores of monkeypox were more common among female physicians (65.1%). Regarding the level of work, general practitioners (64.3%), residents (55.8%), consultants (47.2%), and lastly, (45.3%) specialists were correlated with higher scores, whilst working in the private sector compared to government workers (74.6% and 51.3%). Physicians who learned about human monkeypox during medical school or residency had higher knowledge scores than others (67.6%, 52.2%).

Table 3
Association between sociodemographic variables and knowledge score among Saudi physicians who participated in the study (n = 398).

| **Sociodemographic variables** | **Good knowledge** | **Poor knowledge** | **$\chi^2$** | **P** |
|---|---|---|---|---|
| | **n (%)** | **n (%)** | | |
| | **219 (55)** | **179 (45)** | | |
| **Age** | 137 (60%) | 90 (40%) | 6.06 | 0.013* |
| Under 30 years | 82 (48%) | 89 (52%) | | |
| 30 years and above | | | | |
| **Gender** | 107 (47.3%) | 119 (52.7%) | 12.46 | < 0.01* |
| Male | 112 (65.1%) | 60 (34.9%) | | |
| Female | | | | |
| **Marital** Status | 120 (59.1%) | 83 (40.9%) | 2.79 | 0.09 |
| Single | 99 (50.2%) | 96 (49.8%) | | |
| Married | | | | |
| **Level of work** | 74 (64.3%) | 41 (35.7%) | 8.28 | 0.04* |
| General practitioner | 82 (55.8%) | 65 (44.2%) | | |
| Resident | 29 (45.3%) | 35 (54.7%) | | |
| Specialist | 34 (47.2%) | 38 (52.8%) | | |
| Consultant | | | | |
| **Medical Specialty** | 60 (61.9%) | 37 (38.1%) | 8.32 | 0.30 |
| General medical | 33 (55%) | 27 (45%) | | |
| Family Medicine | 12 (36.4%) | 21 (63.6%) | | |
| Pediatrics | 23 (63.9%) | 13 (36.1%) | | |
| Internal Medicine | 2 (50%) | 2 (50%) | | |
| Emergency Medicine | 36 (50.7%) | 35 (49.3%) | | |
| Preventive Medicine | 6 (50%) | 6 (50%) | | |
| Dermatology | 47 (55.3%) | 38 (44.7%) | | |
| Other | | | | |

χ2 = Chi-squared test; P = P-value; *Statistically significant.

| Sociodemographic variables | Good knowledge n (%) 219 (55) | Poor knowledge n (%) 179 (45) | $\chi^2$ | P |
|---|---|---|---|---|
| **Work Sector** | 172 (51.3%) | 136 (48.7%) | 7.61 | < 0.01* |
| Governmental | 47 (74.6%) | 16 (25.4%) | | |
| Private | | | | |
| **Medical practice experience** | 67 (62.6%) | 40 (37.4%) | 3.46 | 0.18 |
| Less than 1 year | 83 (52.9%) | 74 (47.1%) | | |
| 1 – 5 years | 69 (51.5%) | 65 (48.5%) | | |
| More than 5 years | | | | |
| **Region of work in Saudi Arabia** | 35 (60%) | 23 (40%) | 6.42 | 0.17 |
| Southern | 14 (38.9%) | 22 (61.1%) | | |
| Northern | 53 (52.5%) | 48 (47.5%) | | |
| Central | 76 (55.1%) | 62 (44.9%) | | |
| Western | 41 (63.1%) | 24 (63.9%) | | |
| Eastern | | | | |
| **Information on human monkeypox during medical school or residency years education** | 169 (52.2%) | 155 (47.8%) | 5.78 | 0.01* |
| No | 50 (67.6%) | 24 (32.4%) | | |
| Yes | | | | |
| **Heard about human monkeypox before** | 8 (44%) | 10 (56%) | 2.56 | 0.11 |
| No | 103 (27.1%) | 277 (72.9%) | | |
| Yes | | | | |
| **First time you heard information about monkeypox** | 8 (44%) | 10 (56%) | 2.04 | 0.36 |
| I did not hear about it | 118 (58%) | 85 (42%) | | |
| Within several days or weeks ago | 93 (52.5%) | 84 (47.5%) | | |
| Within the last month or later | | | | |

χ2 = Chi-squared test; P = P-value; *Statistically significant.

# Physicians' attitude toward the monkeypox virus

The attitudes of physicians towards monkeypox are presented in Table 4. More than half of the participants (56%) agreed that monkeypox could add a new burden to the healthcare system worldwide. Moreover, most physicians (78.6%) were confident that the Saudi MOH and local population could control the monkey pox locally. Nearly two-thirds of the study sample (64.6%) agreed that monkeypox could be easily transmitted to Saudi Arabia, that the mass media may influence its prevention, and that the world's populations can control the monkeypox epidemic. 44.5% of those polled said they had no negative feelings about monkeypox disease. More than half of the participants (59.3%) agreed that travelling to monkeypox epidemic countries would be risky. Half of the participants (49.7%) agreed that monkeypox has enough prevention and control measures. Most participants wanted to know more about monkeypox, the epidemiology of emerging diseases, and travel medicine (71.1%, 70.9%, and 71.9%, respectively).

Table 4
Attitudes about monkeypox virus, emerging diseases and travel epidemiology among Saudi physicians who participated in the study (n = 398).

| Sentence | Agree n (%) | Natural n (%) | Disagree n (%) |
|---|---|---|---|
| I am confident that the world's population can control monkeypox worldwide | 223 (56) | 136 (34.2) | 39 (9.8) |
| I am confident that the Saudi MOH and local population can control the monkeypox locally | 313 (78.6) | 66 (16.6) | 19 (4.8) |
| I think that there are currently enough prevention and control measures for monkeypox | 198 (49.7) | 119 (29.9) | 81 (20.4) |
| I have bad feelings toward the monkeypox virus that it might become a worldwide pandemic | 100 (25.1) | 121 (30.4) | 177 (44.5) |
| I think that monkeypox can add a new burden on the healthcare system of the affected countries | 190 (47.7) | 131 (32.9) | 77 (19.3) |
| I think monkeypox can be transmitted to Saudi Arabia | 256 (64.6) | 98 (24.6) | 43 (10.8) |
| I think that mass media coverage of monkeypox may influence its worldwide prevention | 244 (61.3) | 131 (32.9) | 23 (5.8) |
| I am interested in learning more about monkeypox | 283 (71.1) | 82 (20.6) | 33 (8.3) |
| I am interested to learn more about the epidemiology of the new emerging diseases | 282 (70.9) | 85 (21.4) | 31 (7.8) |
| I am interested in learning more about Travel Medicine | 286 (71.9) | 80 (20.1) | 32 (8) |
| I think that it is dangerous to travel to the country's epidemic with monkeypox? | 236 (59.3) | 111 (27.9) | 51 (12.8) |

# Discussion

Monkeypox represents a new challenge for physicians worldwide. Especially in regions where still cases have not been reported. For example, in the Middle East, and especially close to Saudi Arabia, only the United Arab Emirates has reported cases, 13 patients until July 10, 2022. Israel and Lebanon have also reported cases (59 and 1, respectively). Spreading of emerging diseases, including zoonoses and potentially new sexually transmitted infections, such as monkeypox, seems a never-ending story, especially after the COVID-19 pandemic(León-Figueroa et al., 2022)(Farahat et al., 2022).

Beyond that, Saudi Arabia is a highly relevant global destination for business, sports, tourism, and religion, among other aspects. Then, imported cases will be eventually observed and confirmed over the course of the next following weeks. For these reasons, attending physicians in this country need to be prepared regarding clinical and epidemiological aspects of this emerging viral disease. Preparedness in different countries and regions is critical (Rodriguez-morales et al., 2022). In this setting, the results of this study are concerning. A significant proportion of the assessed physicians are not clear regarding the endemicity of monkeypox, also about transmission, clinical differences with smallpox, chickenpox, and influenza, as well as the clinical evolution (e.g., skin lesion evolution) and the main associated findings. Also, there is a large gap regarding therapeutic management of disease and vaccination. Such poor knowledge is influenced by age (worse in physicians older than 30 years), gender (worse in males), level of work (specialists and consultants), work sector (worse in governmental areas), previous medical training (worse in those that have not received information on monkeypox during medical school or residency years); and with no significant differences according to the specialty, years of experience, region of the country, if heard before about the disease, and if it was the first time heard about it.

This means that massive continuing medical education on monkeypox in Saudi Arabia is critical at this moment, as revealed from this study. As previously showed during other epidemics and pandemics, such as the Zika and COVID-19, respectively (Sabogal-Roman et al., 2016)(Escalera-Antezana et al., 2020), training and knowledge assessment is highly important, especially when such studies demonstrated significant improvement in the related and specific knowledge(Sabogal-Roman et al., 2016)(Escalera-Antezana et al., 2020).

Even more, as has been demonstrated in recent clinical reports (Girometti et al., 2022)(Adler et al., 2022), the presentation of monkeypox relatively differs from the expression that was previously reported in African endemic-countries (Benites-zapata et al., n.d.). Then, it is clear that physicians, with confirmed and without confirmed cases, need to be not just prepared but aware of such differences that include the importance of sexual contact and the high occurrence of monkeypox among men who have sex with men, including people living with HIV, among other risk factors(Rodriguez-Morales & Lopardo, 2022). Also, over the course of May–July 2022, the assessment of monkeypox virus as a sexual pathogen is under careful assessment. Some reports have identified it in sexual fluids, but still, confirmation of replication in cell cultures and transmission is needed (Antinori et al., 2022)(Rodriguez-Morales & Lopardo, 2022). These findings also have significant implications for prevention and control that should be known by attending physicians in Saudi Arabia, as well as elsewhere.

Finally, as this is a relatively new disease outside Africa, even with a lack of research prior to 2022 (Rodríguez-Morales et al., 2022), research in different aspects is needed, including treatment and prevention, which also include the use of vaccines against this virus. The development of national clinical guidelines is key, as occurred with COVID-19 (Gutiérrez et al., 2020). Then, evidence-based guidelines for monkeypox should be developed, and these should be implemented and widely promoted among physicians in Saudi Arabia and other countries, in order to provide the best available clinical management, especially because, although most monkeypox cases will evolve without complications, these may occur, and even fatal cases, in Africa, have been reported, reaching a case fatality rate up to 10% (Kalthan et al., 2016) Early diagnosis, identification of risk factors, and prompt management of monkeypox are critical in reducing the risk of complicated cases and fatal outcomes.

# Declarations

### Conflict of Interest

The authors declare no conflict of interest.

### Funding Source

This research received no external funding.

### Ethical Approval statement

This study was ethically reviewed and approved by the Research Ethics Committee at Security Forces Hospital Program in Holy Capital (HAP-02-K-052). The approval number is ECM#0488-220522. This study was conducted according to the Declaration of Helsinki.

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