



Knowledge of human monkeypox viral infection among general practitioners: a cross-sectional study in Indonesia

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ABSTRACT

After the first, imported, laboratory-confirmed case of monkeypox in human was reported in Singapore on May 2019, countries in Asia started to strengthen disease surveillance systems. One challenge in preventing monkeypox is a lack of knowledge, particularly among healthcare workers. The aim of this study was to assess the knowledge of monkeypox among general practitioners (GPs) in Indonesia. A cross-sectional online survey was conducted. The survey collected participants' knowledge on a 21-item scale and explanatory variables. A two-step logistic regression analysis was employed to assess the predictors of knowledge of monkeypox. A total of 432 GPs were included; 10.0% and 36.5% of them had a good knowledge using an 80% and 70% cutoff point for knowledge domain, respectively. No explanatory variables were associated with knowledge when using 80% cutoff point. Using the lower cutoff, there was lower knowledge among GPs who graduated from universities located in Sumatra or other islands versus Java (adjusted odds ratio (aOR): 0.53; 95%CI: 0.28–0.97, $p = 0.041$) and among those were older than 30 years compared to younger GPs (aOR: 0.61; 95%CI: 0.39–0.96, $p = 0.033$). GPs working in private clinics had less knowledge compared to GPs in community health centers (aOR: 0.55; 95%CI: 0.31–0.99, $p = 0.047$). In conclusion, knowledge of monkeypox among GPs in Indonesia is relatively low in all groups. Increasing knowledge of monkeypox will be key to improving the capacity of GPs to respond to human monkeypox cases and to report into a disease surveillance system.

KEYWORDS

Monkeypox; knowledge; general practitioner; healthcare provider; online survey; Indonesia

Background

Human monkeypox, known simply as monkeypox and caused by monkeypox virus (MPXV), is a zoonotic infection and is most commonly found in Western and Central Africa [1,2]. The clinical manifestation of the disease is similar to but less severe than smallpox [1,2]. The symptoms include fever, headache, lymphadenopathy, back pain, myalgia, and skin rash [1,2]. Skin lesions, which evolve from maculopapules to vesicles, pustules, followed by crusts, are often found in extremities, but can be found on the whole body in more severe cases [1]. The main difference between monkeypox and smallpox is that monkeypox causes

lymphadenopathy while smallpox does not. The duration of illness can last up to 4 weeks until the skin lesions subside [3].

MPXV was first identified in 1958 during an outbreak of monkeypox in the Asian monkey *Macaca fascicularis* which was used for polio vaccine research at an animal facility in Copenhagen, Denmark [4]. The first monkeypox case in humans was reported in the Democratic Republic of the Congo (previously known as Zaire) in 1970, and the disease remains endemic in the country [1]. Monkeypox has also been reported in other African countries. Since 2016, cases have appeared

in the Central African Republic, Liberia, Nigeria, and Sierra Leone [1]. In 2017, the largest outbreak of monkeypox was reported in Nigeria with 197 suspected cases and 68 confirmed cases [2,5]. Human monkeypox cases have been reported in the United States [6–8], the UK [9], and Israel [10]. In the United States, MPXV has been transmitted from infected native prairie dogs that were housed with infected exotic pets imported from Africa [6,7], while in the UK [9] and Israel [10] the patients were travelers who had returned from Nigeria.

As a country endemic with monkeypox, the Democratic Republic of the Congo conducts routine monkeypox surveillance [11,12]. One of the important aspects of the surveillance system is to enhance the capacity of healthcare workers to identify cases and improve patient management [12]. Healthcare workers, particularly medical doctors, should be knowledgeable about the clinical symptoms of monkeypox to be able to quickly identify, report, and manage new cases to prevent further transmission.

The first monkeypox case in Asia was reported in Singapore, in May 2019, when a tourist from Nigeria who attended a conference was confirmed positive for MPXV [13,14]. The government of Singapore took precautions by isolating the patient, contacting and quarantining people who were in contact with the patient during his stay in the country, activating the surveillance system and conducting a risk analysis [14]. After the news of the first monkeypox case in Singapore, the government of Indonesia started to strengthen its surveillance system by tightening screening for visitors, particularly people who came from Singapore as well as those from Nigeria [15]. This screening was specifically conducted in Batam Island, the closest hub in Indonesia to Singapore. The government of Batam prepared two hospitals to care for patients with monkeypox, and installed a thermal scanning system to screen passengers for fever in five ports that connect the island with Singapore [16].

The increased number of human monkeypox cases demonstrates the importance of prevention, early detection, and quick response and management from healthcare workers. However, a report by World Health Organization (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 [2]. Although monkeypox has yet to be reported in Indonesia, it is crucial for healthcare workers to be knowledgeable and prepared for monkeypox cases since Indonesia is a tourist destination, which could increase its vulnerability to the importation of human monkeypox. Hence, we sought to assess the knowledge of monkeypox among general practitioners (GPs) in Indonesia.

Materials and methods

Study design and setting

A cross-sectional online survey was conducted from 25 May 2019 to 25 July 2019 to assess knowledge of monkeypox among GPs – frontline healthcare providers in Indonesia. The design and setting of this study followed previous studies [17–19]. The study was a self-administered survey with the target population of 50,198 GPs in Indonesia (2019); all GPs registered with the Indonesian Medical Council were considered eligible. In this survey, 382 respondents were required for the minimum sample size based on conservative assumption that 50% GPs would have a good knowledge with a 5% margin of error and a confidence interval of 95%. The survey required approximately 7–10 min to be completed. To ensure anonymity and confidentiality, the name of participants was not collected, and only the principal investigator had access to the survey account. At the end of the survey, the raw data were extracted and imported into statistical software for analysis.

Survey instrument

The questionnaire consisted of questions to assess the knowledge on monkeypox and to collect a range of potential explanatory variables. A questionnaire related to knowledge, consisting of 21 multiple choice questions, was developed based on existing facts from the United States Centers for Disease Control and Prevention (CDC) [20] (see Appendix). The questions were developed in the national language of Indonesia, Bahasa Indonesia, and two medical microbiologists and a family medicine doctor who had a preexisting research interest in emerging infectious diseases were appointed to evaluate their validity. The reliability of the questions was tested among 15 GPs in a pilot study and the questionnaire was finalized using feedback gained in the pilot test.

Data collection

Invitations to complete an anonymous online survey were distributed by social media (WhatsApp, Facebook and Instagram) and sent by e-mail to the members of doctor organizations or groups (Indonesian Medical Association and Indonesian General Practitioner Association). Up to two reminders were sent after the initial message. An introduction page consisted of information on the identity of the principal investigators, contact details, aims of the study, and its expected benefits. The survey was estimated to take approximately 7–10 min to be completed.

Study variables

The response variable in this study was knowledge of monkeypox among GPs in Indonesia. To assess the knowledge, 21 questions were used in which a correct response was given a score of one and an incorrect response was given a score of zero. The scores were summed to give a total score ranging from 0 to 21, in which higher scores indicated better knowledge.

Four main groups of explanatory variables that could plausibly affect knowledge were assessed: sociodemographic characteristics, workplace characteristics, characteristics of the medical professional and exposure to monkeypox-related information. Sociodemographic characteristics included current location, gender, age, educational attainment, type of job and monthly income. Location was divided into western and central-eastern part of Indonesia. Age was dichotomized (30 years old or younger vs more than 30 years old). Educational attainment, defined as the highest level of formal education completed, was grouped into two groups (medical doctor and medical doctor with master or doctorate degree) while type of job was divided into GP and GP with residency. Monthly income, the average amount of money earned by participants each month in Indonesian Rupiah (IDR), was grouped into two groups at roughly the median (less than IDR 5 million and IDR 5 million or more, equivalent to less than 356 US\$ 3 and 356 US\$ 3 or more, using a November 2019 exchange rate). Workplace characteristics included type of workplace (community health center, private clinic, private hospital and public hospital) and location of workplace (capital city of district (rural), regency (sub-urban) and province (urban)). To assess the characteristics of the medical professional, the GPs were asked about the location of their alma mater, their medical experience (in years) and whether they had attended local, national and international conferences in the last 5 months. To assess exposure to monkeypox-related information, the participants were asked whether they had ever received monkeypox information during their medical education, whether they had heard about monkeypox prior to the interview and when was the first time they had heard it. For those who had heard about monkeypox prior to the survey, they were also asked about this information source. The source of information was divided into the following categories: colleagues, medical journals, online media, printed media, television and radio.

Statistical analysis

This was an exploratory study. Therefore, for statistical analysis, the levels of knowledge were dichotomized

into good and poor based on two modified Bloom's cutoff points: a 70% and 80% of the total score (i.e. if a participant answered correctly 15 and 17 out of the total 21 questions, respectively). The associations between the explanatory variables and the dependent variable were assessed using a two-step logistic regression for both cutoff points. Initially, all explanatory variables were analyzed separately, and variables with $p \leq 0.25$ in this step were included in the multivariable analysis as described elsewhere [18,21,22]. To make interpretation of results easier, the estimated crude odds ratio (OR) of unadjusted analyses and the adjusted OR (aOR) were interpreted in relation to a reference category. Significance was assessed at $\alpha = 0.05$ and analyses were conducted using Statistical Package of Social Sciences 17.0 software (SPSS Inc., Chicago, IL, USA).

Ethical consideration

An introduction page was provided informing that the participants could exit the survey at any point, and, before enrolled, they were asked to provide their consent to participate. To ensure participant anonymity and confidentiality, the IP addresses of participants were not collected, and only the principal investigator had access to the survey account. The protocol of this study was approved by the Institutional Review Board of the Faculty of Medicine and Health Sciences, Maulana Malik Ibrahim State Islamic University of Malang, Indonesia (055/EC/KEPK-FKIK/2019).

Results

Respondents' characteristics

During the survey, 510 responses were received, and 78 responses had to be excluded. Responses were excluded due to incomplete information or because they had a very long or very short time of completion, i.e. more than 50% from the expected completion time of 7–10 min (i.e. less than 3.5 min or more than 15 min). The final analysis included 432 (84.7%) participants. The characteristics of the surveyed GPs are presented in Table 1. Approximately 70% of the participants were from the western part of Indonesia (Sumatra Island) while about 30% were from Java and other islands in the central-eastern part of the country (Table 1). Nearly 70% of the participants were female and 67.8% were 30 years old or younger. Less than 10% of GPs had a master's or doctoral degree. Approximately 50% of respondents worked in a private or public hospital, and an approximately equal proportion worked at the district, regency or province level (31.7%, 37.3% and 31.0%, respectively). Less than 20% of the surveyed GPs had ever received information of monkeypox in their medical education. There were 397 (91.9%)

Table 1. Unadjusted and multivariable logistic regression analysis showing predictors of knowledge about human monkeypox infection among general practitioner in Indonesia (good vs. poor) (*n* = 432).

Variable	<i>n</i> (%)	Good knowledge <i>n</i> (%)	Unadjusted		Multivariable	
			OR (95% CI)	<i>P</i> -value	OR (95% CI)	<i>P</i> -value
Location of university						
Java (R)	49 (11.3)	24 (49.0)	1		1	
Sumatera and others	383 (88.7)	134 (35.0)	0.56 (0.31–1.02)	0.058	0.53 (0.28–0.97)	0.041
Location						
Western Indonesia (R)	303 (70.1)	107 (35.3)	1		1	
Central and Eastern Indonesia	129 (29.9)	51 (39.5)	1.20 (0.78–1.83)	0.405		
Gender						
Male (R)	140 (32.4)	49 (35.0)	1		1	
Female	292 (67.7)	109 (37.3)	1.11 (0.73–1.68)	0.638		
Age group (year)						
30 or less (R)	293 (67.8)	116 (39.6)	1		1	
More than 30	139 (32.2)	42 (30.2)	0.66 (0.43–1.02)	0.060	0.61 (0.39–0.96)	0.033
Education						
General practitioner (R)	408 (94.4)	151 (37.0)	1		1	
GP with master or doctoral degree	24 (5.6)	7 (29.2)	0.70 (0.28–1.73)	0.440		
Monthly income						
Less than 5 million (R)	229 (53.0)	83 (36.2)	1		1	
Five million or more	203 (47.0)	75 (36.9)	1.03 (0.70–1.53)	0.880		
Type of job						
General practitioner (R)	376 (87.0)	141 (37.5)	1		1	
Residency	56 (13.0)	17 (30.4)	0.73 (0.40–1.33)	0.302		
Type of workplace						
Community health center (R)	109 (25.2)	48 (44.0)	1		1	
Private clinic	95 (22.0)	30 (31.6)	0.59 (0.33–1.04)	0.069	0.55 (0.31–0.99)	0.047
Private hospital	73 (16.9)	28 (38.4)	0.79 (0.43–1.45)	0.447	0.67 (0.35–1.28)	0.230
Public hospital	155 (35.9)	52 (33.5)	0.64 (0.39–1.06)	0.084	0.63 (0.37–1.06)	0.079
Location of workplace						
District (R)	137 (31.7)	47 (34.3)	1		1	
Regency	161 (37.3)	61 (37.9)	1.17 (0.73–1.88)	0.522		
Province	134 (31.0)	50 (37.3)	1.14 (0.69–1.87)	0.606		
Attended province conference						
No (R)	143 (33.1)	49 (34.3)	1		1	
Yes	289 (66.9)	109 (37.7)	1.16 (0.76–1.77)	0.484		
Attended national conference						
No (R)	270 (62.5)	105 (38.9)	1		1	
Yes	162 (37.5)	53 (32.7)	0.76 (0.51–1.15)	0.198	0.80 (0.52–1.23)	0.310
Attended international conference						
No (R)	409 (94.7)	148 (36.2)	1		1	
Yes	23 (5.3)	10 (43.5)	1.36 (0.58–3.17)	0.481		
Medical practice experience (years)						
Less than 5 year (R)	309 (71.5)	116 (37.5)	1		1	
Five year or more	123 (28.5)	42 (34.1)	0.86 (0.56–1.34)	0.509		
Had you ever received information of human monkeypox during medical education						
Never (R)	357 (82.6)	134 (37.5)	1		1	
Yes	75 (17.4)	24 (32.0)	0.78 (0.46–1.33)	0.366		
Had you ever heard about human monkeypox before						
Never (R)	35 (8.1)	13 (37.1)	1		1	
Yes	397 (91.9)	145 (36.5)	0.97 (0.48–1.99)	0.942		
When for the first time you heard information about monkeypox						
Within several days or weeks ago (R)	226 (52.3)	81 (35.8)	1		1	
Within last month or later	171 (39.6)	64 (37.4)	1.07 (0.71–1.62)	0.745		
N/A	35 (8.1)	-	-	-	-	-

participants who had heard of human monkeypox prior to survey of which 52.3% received the information relatively recently – within several days or weeks prior to the survey.

Source of information

In this study, 73.6% of those who had heard about monkeypox received their information from online media. Approximately 10% of participants gained their information from colleagues, followed by medical journals (9.6%), printed media such as newspapers or magazines (3.5%), and television (2.8%). No respondent received the monkeypox information from the radio.

Knowledge and associated determinants

The mean and median score of knowledge was 13.7 and 14, respectively, and the score ranged between 9 and 19. Using an 80% cutoff, only 39 (9.0%) out of 432 respondents had a good knowledge of monkeypox. When the cutoff was reduced to 70%, 36.5% (158 out of 432) of participants had a good knowledge.

Across some dimensions, a majority of participants had accurate knowledge of monkeypox. Almost all (97.6%) stated that monkeypox is caused by a virus, and more than 85% stated that monkeypox and smallpox have similar signs and symptoms. However, there were other questions which were answered incorrectly. Approximately 26.8% stated that a human monkeypox case had been reported in Indonesia. Apart from symptomatic treatment, 74.1% of GPs mentioned that an antiviral is required in monkeypox management. Although almost all respondents correctly answered that monkeypox is caused by a virus, 23.1% of them stated that an antibiotic is required in human monkeypox management.

The association of four domains of explanatory variables were assessed using both cutoff points of knowledge domain (i.e. 70% and 80% out of 21 total questions). None of the explanatory variables were associated with knowledge using an 80% cutoff. However, using a lower cutoff, multivariable analysis indicated that location of university, age and type of workplace were associated with level of knowledge (Table 1). GPs who graduated from universities located in Sumatra or other islands had lower knowledge compared to those who graduated from universities in Java (aOR: 0.53; 95%CI: 0.28–0.97, $p = 0.041$). Participants who were >30-year-old also had lower knowledge compared to those ≤30 years old (aOR: 0.61; 95%CI: 0.39–0.96, $p = 0.033$). GPs who were working in private clinics had lower level of knowledge compared to those who were working in the community health centers (aOR: 0.55; 95%CI: 0.31–0.99, $p = 0.047$). But there was not a significant difference between those

working in private or public hospitals compared to those at community health centers.

Discussion

Responding to a monkeypox outbreak will require strong collaboration of the government and front line health care workers. Beyond the government strengthening the surveillance system, GPs will be responsible for detecting cases and clinically managing them in health facilities. To achieve this, GPs should have an adequate understanding of the disease to be able to comprehensively identify, diagnose and manage cases. This study sought to assess how knowledgeable GPs in Indonesia were of monkeypox.

Our data indicate that the level of knowledge of monkeypox among GPs in Indonesia is very low. Less than 10% were able to answer 80% of 21 questions correctly. Using an 80% cutoff, none of the explanatory variable were associated with the level of knowledge indicating a uniformly low level of knowledge on monkeypox across the studied characteristics. This uniformity in lack of knowledge is not surprising because monkeypox is a reemerging infectious disease and cases have never been reported in Indonesia. Exposure to the actual cases is critical to have good knowledge, better perception and cognition toward a disease in medical setting [18,23]. A previous study also found uniformly low knowledge among GPs in Indonesia for an emerging infection, Zika, which has not been reported in the country [19]. In contrast, the level of knowledge is quite high when it related to endemic diseases in Indonesia; 50.3% of the healthcare personnel had a good knowledge of diseases transmitted by *Aedes aegypti* [24] and even 66.5% of community members have a good knowledge on dengue [25]. In addition, monkeypox is not listed as a compulsory disease in the Indonesian Standard of Medical Doctor Competency (*Standar Kompetensi Dokter Indonesia*) [26], meaning that the disease is not uniformly taught to medical students.

An exploratory analysis was then conducted by reducing the cutoff of knowledge domain into 70%. A multivariable analysis indicated that GPs who graduated from universities located in Java, a relatively economically developed part of the country, had better knowledge compared those from Sumatra or other islands. It is inevitable that there is variation in the implementation of curriculum in medical schools across universities in Indonesia [27]. Due to time constraints, medical schools in Indonesia focus on common infectious diseases that are compulsory based on the Standard of Medical Doctor Competency and the time allocated to teach about emerging infectious diseases such as monkeypox might vary across universities. Nevertheless, when we compared GPs who received information on monkeypox during their

medical education and those who never received it, there was no significant difference in their level of knowledge (Table 1). Because it is not compulsory to be taught and medical graduates are not expected to be able to treat or manage this disease comprehensively, the information offered during medical school may not be complete. Another possible reason is a difference in information access. During medical school, those who lived in Java, a more economically developed area, may have had better access to information compared to other islands including more seminars, news, as well as better internet connections, giving students more access to information to monkeypox. This could be particularly important as this study found that almost 75% of respondents received information of monkeypox via online media. Finally, it is also important to highlight the difference in quality of education between islands in Indonesia. Most medical schools in Java are A-accredited (i.e. are the top medical schools based on the National Accreditation Board for Higher Education of Indonesia) have better quality, and good academic reputation. This may lead them to attract more competitive students [28], who are predisposed to learning more about emerging infectious diseases like monkeypox.

This study also found that younger GPs had higher odds of having good knowledge compared to the older group. The younger generation is more familiar with the internet and therefore has better access to information regarding monkeypox that is mainly available through the internet. In addition, older doctors may rely more on experiences rather than information from other sources [29]. Interestingly, our study also indicated that GPs who were working in community health centers had better knowledge compared to those who were in private clinics. In Indonesia, there is a tendency that new GPs will work in community health centers, the front-line healthcare facility which provides both curative and preventive services to the general population. This result is similar to a study about Zika, an emerging infection, where GPs who were working in community health centers had higher odds of having a good knowledge compared to GPs who were working in private clinics or private hospitals [17].

There are some limitations in this study. The completion rate of this study was only 85.7%, although this is much higher compared to previous similar online studies [17–19]. Due to nature of an online survey that requires internet connection, there is potential for biases in geographical selection related to availability of internet access [19]. Dishonesty can be an issue where participants may have looked up the correct responses. To avoid this, a clear statement asking the participants to respond to the questions based on their current knowledge was provided at the beginning of the survey.

After the first monkeypox case in Singapore was reported in May 2019, ministries of health in Asia started to strengthen their surveillance systems indicating their concern about this disease. This is justifiable because every country now is inter-connected through international air transport which can result in a disease being easily introduced into a country [3]. In addition, although most human monkeypox cases are introduced from animal reservoirs [30] and a modeling study performed suggested it would be highly improbable the infection to become established in human populations [31], there is evidence of human-to-human transmission of MPXV [32–36]. This evidence suggest that the virus has the potential to spread, including through Southeast Asia, medical education about the infection therefore will increase in importance and be relevant for prevention and control efforts. Strategies for enhancing the knowledge capacity of healthcare providers and increasing the level of their competency in clinically managing monkeypox may be needed.

Conclusions

Knowledge of human monkeypox among GPs in Indonesia is uniformly low across sociodemographic, workplace, and medical professional characteristics and different levels of previous exposure to monkeypox information. However, GPs who graduated from universities located in Java, younger GPs, and those who are working in community health centers seem to be more informed about monkeypox compared to those graduating from universities outside Java, who are older and who work for private health facilities. Systematic strategies for enhancing the capacity of GPs to gain knowledge about the human monkeypox will be important to prepare for any response to a future outbreak.

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The authors declare that they have no competing interests.

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Appendix

Questions used to measure the knowledge on monkeypox among general practitioners in Indonesia

Questions used to measure knowledge

No.	Question	Yes	No
1	Monkeypox is prevalent in Southeast Asia countries		
2	Monkeypox is prevalent in Western and Central Africa		
3	There are many human monkeypox cases in Indonesia		
4	There is an outbreak of human monkeypox in Singapore		
5	Monkeypox is a viral disease infection		
6	Monkeypox is a bacterial disease infection		
7	Monkeypox is easily transmitted human-to-human		
8	Monkeypox could transmitted through a bite of an infected monkey		
9	Travelers from America continent are the main source of imported cases of monkeypox		
10	Monkeypox and smallpox have similar signs and symptoms		
11	Monkeypox and smallpox have the same signs and symptoms		
12	Flu-like syndrome is one of the early signs or symptoms of human monkeypox		
13	Rashes on the skin are one of the signs or symptoms of human monkeypox		
14	Papules on the skin are one of the signs or symptoms of human monkeypox		
15	Vesicles on the skin are one of the signs or symptoms of human monkeypox		
16	Pustules on the skin are one of the signs or symptoms of human monkeypox		
17	Lymphadenopathy (swollen lymph nodes) is one clinical sign or symptom that could be used to differentiate monkeypox and smallpox cases		
18	One management option for monkeypox patients who are symptomatic is to use paracetamol		
19	Antivirals are required in the management of human monkeypox patients		
20	Antibiotics are required in the management of human monkeypox patients		
21	Diarrhea is one of the signs or symptoms of human monkeypox		