

# Knowledge and Attitude Regarding Human Monkeypox Virus Infection among Nurses: A Cross-Sectional Study

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## Abstract

**Introduction:** Monkeypox (Mpox) is an infectious illness that can spread to humans through infected humans, animals, or contaminated objects. In 2022, the monkeypox virus spread to over 60 countries, raising significant public health concerns. Nurses play a vital role in patient care and have critical responsibilities in managing infected patients and being aware of the potential impact on the general population.

**Objective:** This study aimed to investigate the knowledge and attitudes (KAs) of Bangladeshi nurses regarding monkeypox infectious disease.

**Methods:** A cross-sectional study was conducted between October 2022 and March 2023 to evaluate the KA of nurses. Semi-structured and self-administered questionnaires were used, distributed via Google Form, and a convenient sampling technique was implemented. The dataset was analyzed using the Chi-square test, multivariable logistic regression, and Pearson correlation coefficient.

**Results:** A total of 1047 datasets were included in the final analysis. Overall, 57.97% of the participants demonstrated good knowledge, and 93.12% of the respondents had a positive attitude towards monkeypox disease. Female nurses exhibited better knowledge (adjusted odds ratio (AOR) 1.36; 95% confidence interval (CI) 0.88–1.98) and a more positive attitude (AOR 1.64; 95% CI 1.12–3.00) than male nurses. Furthermore, a strong correlation was observed between good knowledge of monkeypox disease and a positive attitude ( $r = 0.76, p < 0.001$ ), while poor knowledge moderately correlated with a negative attitude ( $r = 0.53, p < 0.001$ ).

**Conclusions:** Given the need for further improvement in KA, we recommend implementing additional training programs to enhance the abilities and motivation of nurses in effectively managing patients affected by monkeypox.

## Keywords

knowledge, attitude, monkeypox, infection, nurses

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## Introduction

Human monkeypox (Mpox) is a rarely fatal and infectious disease caused by the monkeypox virus (Sklenovská & Van Ranst, 2018). Children infected with the monkeypox virus are much more likely to develop complications and, consequently, have a higher mortality rate than adults (Adler et al., 2022). Monkeypox and smallpox viruses belong to the same family called Poxviridae (Xiang & White, 2022). Monkeypox virus infection is unrelated to chickenpox, but symptoms are similar (CDC, 2022a). Symptoms of monkeypox

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disease include chills, fever, headache, swollen lymph nodes, muscle aches, exhaustion, rashes, etc. (Minhaj et al., 2022; Saputra et al., 2022). The monkeypox virus can spread from an infected animal to a human or from an infected human to another human through direct contact with body fluids, rashes, and scabs (Chowdhury et al., 2022; Hasan et al., 2023). Additionally, the virus can spread through kissing, cuddling, touching contaminated clothes, or linen items, and from a pregnant woman to her fetus through the placenta (CDC, 2022a; Isidro et al., 2022).

Monkeypox virus was first identified in central and western African countries in 1970 (Durski et al., 2018), and it has received growing global attention due to sporadic outbreaks and the potential for international spread (Ahmed et al., 2023; Berdida, 2023). Particularly, the widespread international travels and the movement of people across countries have contributed considerably to the global spread of this virus (Baker et al., 2022). So far, the number of reported monkeypox cases reached at least 85,000 in 2022, spanning over 60 countries (CDC, 2022b). While the virus remains prevalent in Africa, it has also been detected in regions such as the USA and EU/EEA countries (Our World in Data, 2023).

## Review of Literature

Several studies have assessed the knowledge and attitudes (KAs) of healthcare workers (HCWs) about human monkeypox virus infection. A study by Das et al. (2023) revealed that HCWs who had studied monkeypox during their professional education had a considerably more favorable attitude towards its control and prevention and a greater desire to learn about new emerging diseases. Another study explored whether demographic variables were significantly associated with HCWs' good knowledge (Sobaikhi et al., 2023). In addition, a study by Alshahrani et al. (2022) highlighted that many medical professionals knew little about monkeypox, its transmission, or the clinical differences between it and other common diseases.

Nurses, as an integral part of the healthcare workforce, are involved in counseling patients and their attendants to prevent the transmission of infectious diseases. Their knowledge, attitudes, and practices greatly impact patient outcomes and the overall control of infectious disease outbreaks. Nurses at the forefront of direct patient care require accurate and up-to-date knowledge about emerging infectious diseases to provide appropriate care and implement infection control measures (Ibrahim et al., 2022).

Given the highly contagious nature of monkeypox, it is imperative to assess the KAs of nurses on its transmission, symptoms, preventive measures, and appropriate protocols for isolation and treatment. This will ensure the safety of HCWs and enhance the effective management and containment of potential outbreaks, safeguarding both patients and the broader community. Research specifically focused on

the KAs of nurses regarding monkeypox disease in endemic areas. In comparison, there is limited evidence on low- and middle-income countries, including Bangladesh. Therefore, the present study aimed to investigate the KAs of Bangladeshi nurses regarding the monkeypox infectious disease.

Understanding the KAs of nurses about monkeypox is crucial for several reasons. Firstly, it helps identify potential gaps in knowledge, allowing for targeted training and educational interventions to improve their preparedness in managing monkeypox cases (Ahmed et al., 2022). Secondly, assessing attitudes can provide insights into nurses' perceptions, beliefs, and willingness to adopt preventive measures and implement best practices. This information can guide the development of strategies to enhance infection control measures and promote effective communication with patients and their families. Thirdly, by understanding the factors influencing nurses' KAs, policymakers and healthcare institutions can design interventions and develop policies to support and empower nurses as frontline responders to infectious diseases.

## Methods and Materials

### Study Design and Setting

A cross-sectional online survey questionnaire was administered to Bangladeshi nurses between October 2022 and March 2023, to measure their KAs surrounding monkeypox virus disease. All registered nurses licensed by the Bangladesh Nursing Council were considered eligible. It took roughly 25–30 min to complete the survey.

**Sample size:** The sample size was determined using the following statistical formula:

$$\begin{aligned} n &= \frac{Z^2 pq}{d^2} \\ &= \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2} \\ &= 384.16 \approx 384 \end{aligned}$$

Here,

$n$  = desired sample size

$Z$  = 1.96 (95% confidence interval)

$p$  = Prevalence estimates 50% = 0.5 (unknown)

$q$  = 1 -  $p$

$d$  = proportion of sampling error = (0.05)

By assuming a 10% non-response rate, the sample size is  $384 + 10\% = 424$  respondents were required for the minimum sample size.

## Data Collection and Management

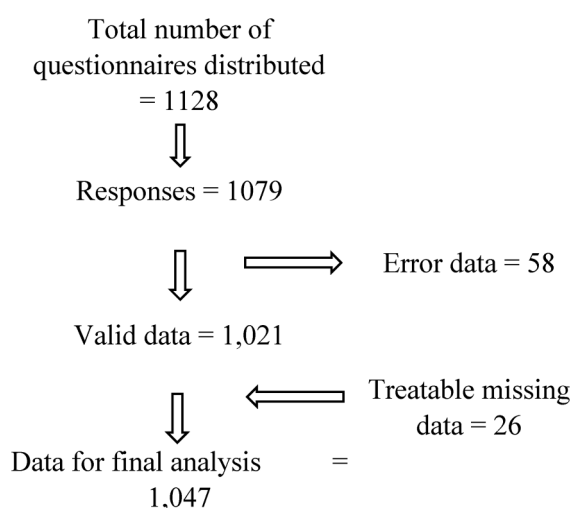
The surveys were kept in English because the nursing curriculum in Bangladesh is taught in English. Using convenient sampling techniques, semi-structured and self-administered questionnaires via Google Forms were used to collect data. Several WhatsApp and Facebook groups for nurses were sent with a link to the questionnaire, which took about 25 to 30 min to complete. In addition, over 976 email addresses were obtained from different healthcare organizations, and they were invited by email to participate. The dataset was exported into Excel to be imported into STATA version 16 (Figure 1).

## Study Variables

Demographic variables include participants' age, sex, marital status, highest education level, monthly salary, employer type, employer location (urban/rural), working environment (tertiary/general/community clinic/other healthcare settings), working experience, monkeypox virus known or unknown, attendance at national/international conferences, and education about the monkeypox virus.

**Knowledge variables:** Nurses' knowledge was assessed using 29 (Yes/No) questions. The questions were adapted from existing Centers for Disease Control and Prevention sources (CDC, 2022a). Questionnaires were graded from 0 to 29 points. Each question answered correctly is worth one point; 0 to 11 points indicate poor, 12 to 21 points indicate medium, and 22 to 29 points indicate good knowledge.

**Attitude variables:** Nine questions were developed to assess the positive or negative attitudes of nurses. The scores for the questions varied from 1 to -1. Agree = 1, Neutral = 0, and disagree = -1. A score of less than five indicates a negative attitude, whereas five or more indicates a positive attitude.



**Figure 1.** Data cleaning procedure.

## Validity and Reliability

Two nurse practitioners and two senior medical consultants in medicine reviewed the questionnaires. The content validity ratio (CVR) formula,  $CVR = (N_e - n/2) / (n/2)$ , was used to determine whether the questionnaires were relevant or not or needed revision or elimination (Almanasreh et al., 2019). The CVR scored 0.81 for knowledge and 0.78 for attitude, respectively.

The questionnaires were distributed among 30 nurses for a pilot study to determine the internal consistency of the variables by calculating Cronbach alpha. The values of knowledge were 0.84, and attitudes were 0.79.

## Statistical Analysis

The dataset was tabulated and examined for consistency and completeness using STATA 16. Data obtained from the pilot study were excluded from the final analysis. The acquired data were analyzed for descriptive and inferential statistics. Continuous variables were reported as means and standard deviations, while categorical variables were presented as frequencies and percentages. The descriptive analysis encompassed all demographic characteristics and responses to questions regarding nurses' KAs. The inferential analysis included: (a) the chi-square test to compare expected and observed findings, (b) multivariable logistic regression to model the relationship between predictor and outcome variables, and (c) the Pearson correlation coefficient was used to assess the association between continuous variables.

## Ethical Approval

The Mahbubur Rahman Memorial Hospital & Nursing Institutional Review Board approved this study (reference number: HRM/MRMH/302/10/04/2022). Prior to participating in the study, online informed consent was obtained from those who completed the online survey, and written informed consent was received from those who completed the hard copy survey. The identities of the participants were kept confidential.

## Results

A total of 1047 respondents completed the questionnaire. Participants' ages ranged from 23 to 47 years: 55.3% of participants age were between 23 to 28 years; 83% of participants were female, and 60.93% of participants were married. The highest percentage (44.22%) of the participants had a diploma in nursing. The highest number of 74.88% of respondents' salary was less than 35 thousand takas per month. In addition, 58.45% of respondents were employed at private/international organizations. Among the participants, 55.68% were from urban areas. Moreover, 32.09% of the participants were working at tertiary hospitals;

**Table 1.** Demographic Characteristics of Participants.

Variables	N	%
<b>Age</b> (mean = 32.59 years; SD = 7.45)		
23–28 years	579	55.3
29–34 years	293	27.99
35–40 years	96	9.17
41–46 years	58	5.54
≥ 47 years	21	2
<b>Gender</b>		
Male	178	17
Female	869	83
<b>Marital status</b>		
Married	638	60.93
Unmarried	376	35.91
Divorced/undisclosed	33	3.16
<b>Highest education level</b>		
Diploma	463	44.22
Bachelor degree	413	39.45
Master degree	164	15.66
PhD	7	0.67
<b>Monthly salary</b>		
< 35 thousand takas	784	74.88
36–45 thousand takas	178	17
> 45 thousand takas	85	8.12
<b>Employer type</b>		
Government	341	32.57
Private/international	612	58.45
Non-government institution	94	8.98
<b>Employer location</b>		
Urban area	583	55.68
Rural area	464	44.32
<b>Working environmental</b>		
Tertiary hospital	336	32.09
General hospital	289	27.6
Community clinic	257	24.55
Other healthcare settings	165	15.76
<b>Working experience</b>		
Less than 3 years	411	39.26
4 to 7 years	542	51.77
More than 7 years	94	8.97
<b>Did you hear about the monkeypox virus?</b>		
Yes	873	83.38
Never	174	16.62
<b>When did you first hear information about monkeypox?</b>		
Several weeks ago	642	61.32
2 months ago	137	13.08
Within 1 year	94	8.98
Not applicable	174	16.62
<b>Did you attend any national conferences regarding monkeypox viral infection?</b>		
Yes	136	12.99
No	911	87.01
<b>Did you attend any international conferences regarding monkeypox viral infection?</b>		
Yes	82	7.83
No	965	92.17

(continued)

**Table 1.** Continued.

Variables	N	%
<b>Did you receive any information about the monkeypox virus during your nursing education?</b>		
Yes	301	28.75
No	746	71.25

SD=standard deviation.

51.77% of the participants had 4 to 7 years of working experience; 87.01% and 92.17% of respondents had not attended any national and international conference regarding monkeypox viral infection, respectively. However, 71.25% of the participants did not receive any information about the monkeypox virus during their nursing education (Table 1).

### Knowledge

Out of the total participants (n = 607), 57.97% demonstrated good knowledge, while 15.57% showed medium knowledge, and 26.46% had poor knowledge about the monkeypox virus. Among the participants with good knowledge, a significant portion (66.89%) fell within the age range of 23 to 28 years. Most participants were female, accounting for 79.57%, and 59.97% were married. When considering the participants' educational background, it was found that 49.26% of nurses holding a bachelor's degree exhibited good knowledge of the monkeypox virus. Additionally, the highest percentage of nurses with good knowledge (61.45%) were those working in private/international organizations. Furthermore, the study analyzed the knowledge of nurses based on their work settings. It was observed that 67.87% of nurses working in urban areas displayed good knowledge, while 42.34% of nurses in tertiary hospitals also demonstrated good knowledge (Table 2).

### Attitude

Among the total respondents (n = 975), an overwhelming majority (93.12%) demonstrated a positive attitude towards preventing monkeypox diseases. Within the group of respondents with a positive attitude, the age range of 23 to 28 constituted the largest percentage (56.92%). Furthermore, a significant proportion of female respondents (86.97%) displayed a positive attitude towards preventing monkeypox diseases. Regarding marital status, it was found that 61.33% of respondents with a positive attitude were married. Concerning educational background, respondents with nursing diplomas accounted for 45.03% of those who held a positive attitude towards monkeypox diseases. Additionally, a substantial percentage (57.85%) of respondents working in private/international organizations exhibited a positive attitude. Moreover, the study analyzed the

**Table 2.** Distribution of Knowledge and Attitude Regarding Human Monkeypox Viral Infection among Nurses.

Question	Correct answer	No. (%)	Mean score (SD)
<b>Knowledge</b>			<b>25.39 (1.95)</b>
1. Monkeypox is prevalent in Southeast Asian countries	Yes	523 (49.95)	
2. Monkeypox is prevalent in Central and West Africa.	Yes	831 (79.37)	
3. Are there any human monkeypox cases in your country?	No	798 (76.22)	
4. Are there any human monkeypox cases in USA/Canada/UK/Europe?	Yes	845 (80.7)	
5. Recently, monkeypox cases have spread in more than 21 countries?	Yes	692 (66.09)	
6. Monkeypox is a viral disease infection	Yes	730 (69.72)	
7. Monkeypox is a bacterial disease infection	No	348 (33.24)	
8. Monkeypox is easily transmitted from human to human.	Yes	576 (55.01)	
9. Monkeypox can be transmitted through the bite of an infected monkey.	Yes	649 (61.99)	
10. Monkeypox and smallpox have similar signs and symptoms.	Yes	733 (70)	
11. Monkeypox and smallpox have the same signs and symptoms.	No	460 (44.13)	
12. The incubation period (time from infection to symptoms) for monkeypox is usually 7–14 days but can range from 5 to 21 days.	Yes	580 (55.4)	
13. Monkeypox illness typically lasts for 2–4 weeks.	Yes	537 (51.29)	
14. Monkeypox virus can spread when a person comes into contact with the virus from an infected animal.	Yes	782 (74.89)	
15. Monkeypox virus can be spread when a person comes into contact with the virus from an infected person.	Yes	819 (78.22)	
16. Monkeypox virus can spread through materials contaminated with the virus.	Yes	965 (92.17)	
17. Monkeypox virus can cross the placenta from the mother to her fetus.	Yes	643 (61.41)	
18. Monkeypox virus may also be spread through direct contact with body fluids or sores on an infected person or with materials that have touched body fluids or sores, such as clothing or linens.	Yes	827 (78.99)	
19. Monkeypox can spread during intimate contact between people, including during sex and activities like kissing, cuddling, or touching parts of the body with monkeypox sores.	Yes	863 (82.43)	
20. A flu-like syndrome is one of the human monkeypox's early signs or symptoms.	Yes	693 (66.19)	
21. Rashes (an area of irritated or swollen skin) on the skin are one of the signs or symptoms of human monkeypox.	Yes	837 (79.94)	
22. Papules (which look like tiny, raised bumps on the skin) on the skin are one of the signs or symptoms of human monkeypox.	Yes	753 (71.92)	
23. Vesicles (a thin-walled sac filled with a fluid, usually clear and small) on the skin are one of the signs or symptoms of human monkeypox.	Yes	887 (84.72)	
24. Pustules (a bulging patch of skin full of a yellowish fluid called pus) on the skin are one of the signs or symptoms of human monkeypox.	Yes	791 (75.55)	
25. Lymphadenopathy (enlargement of one or more lymph nodes) is one clinical sign or symptom that could be used to differentiate between monkeypox and smallpox cases.	Yes	529 (50.53)	
26. One management option for symptomatic monkeypox patients is to use paracetamol.	Yes	736 (70.30)	
27. Antivirals are required in the management of human monkeypox patients.	Yes	845 (80.71)	
28. Antibiotics are required in the management of human monkeypox patients.	No	861 (82.23)	
29. Diarrhea is one of the signs or symptoms of human monkeypox.	Yes	525 (50.14)	
<b>Attitude</b>		<b>Positive attitude</b>	<b>6.98 (1.02)</b>
1. I will avoid contacting animals that could harbor the virus.	Agree	1036 (98.95)	
2. I am ready to deal with monkeypox infected patients as a frontline fighter.	Agree	748 (71.44)	
3. I am confident in maintaining standard precautions to prevent monkeypox virus transmission.	Agree	827 (78.99)	
4. Adequate information related to the monkeypox virus is essential for nurses.	Agree	1021 (97.52)	
5. If I get infected, I will adequately maintain medical advice/isolation.	Agree	1047 (100)	
6. Appropriate nursing care with proper patient handling is crucial to prevent monkeypox virus transmission from patient to patient or patient to employee/attendant.	Agree	1043 (99.62)	
7. Nurses' proper counseling to patients and attendants can reduce the viral disease prevalence rate.	Agree	1038 (99.14)	
8. I want training on monkeypox before findings new cases in our country.	Agree	1047 (100)	

SD=standard deviation.

**Table 3.** Distribution of Good Knowledge, and Positive Attitude Based on the Demographics and Characteristics of the Nurses.

Variables (n = 1047)	Good knowledge (n = 607)		Positive attitude (n = 975)	
	N (%)	p*	N (%)	p*
<b>Age</b>				
23–28 years	406 (66.89)	<b>&lt;0.001</b>	555 (56.92)	<b>&lt;0.001</b>
29–34 years	128 (21.09)	0.761	274 (28.10)	0.637
35–40 years	41 (6.75)	0.562	83 (8.51)	1.63
41–46 years	23 (3.79)	0.453	45 (4.62)	0.432
≥ 47 years	9 (1.48)	0.243	18 (1.85)	0.098
<b>Gender</b>				
Male	124 (20.43)	<0.372	127 (13.03)	<0.183
Female	483 (79.57)	0.087	848 (86.97)	0.425
<b>Marital status</b>				
Married	364 (59.97)	0.571	598 (61.33)	0.762
Unmarried	227 (37.40)	0.424	357 (36.62)	0.983
Divorced/undisclosed	14 (2.63)	1.83	20 (2.05)	0.132
<b>Highest education level</b>				
Diploma	172 (28.34)	0.614	439 (45.03)	<0.263
Bachelor degree	299 (49.26)	1.72	389 (39.90)	0.564
Master degree	132 (21.75)	0.763	144 (14.75)	0.163
PhD	3 (0.49)	0.674	3 (0.32)	0.472
<b>Monthly salary</b>				
< 35 thousand takas	437 (71.99)	0.093	731 (74.97)	<0.464
36–45 thousand takas	117 (19.28)	0.204	168 (17.23)	0.654
> 45 thousand takas	53 (8.73)	0.087	76 (7.79)	0.678
<b>Employer type</b>				
Government	195 (32.13)	0.213	328 (33.23)	0.591
Private/international	373 (61.45)	0.374	564 (57.85)	0.901
Non-government institution	39 (6.43)	0.674	83 (8.51)	0.536
<b>Employer location</b>				
Urban area	412 (67.87)	<b>&lt;0.001</b>	573 (58.77)	<b>&lt;0.001</b>
Rural area	195 (32.13)	0.463	402 (41.23)	1.65
<b>Working environmental</b>				
Tertiary hospital	257 (42.34)	<b>&lt;0.001</b>	321 (32.92)	<b>&lt;0.001</b>
General hospital	110 (18.12)	0.243	266 (27.28)	0.435
Community clinic	124 (20.43)	0.654	249 (25.53)	0.183
Other healthcare settings	116 (19.11)	0.837	139 (14.26)	0.753
<b>Working experience</b>				
Less than 3 years	297 (48.93)	<b>&lt;0.001</b>	382 (39.18)	<b>&lt;0.001</b>
4 to 7 years	264 (43.49)	0.847	512 (52.51)	3.84
More than 7 years	46 (7.58)	0.637	81 (8.31)	0.284

Values in bold represent significant results.

\*p-values were from Chi-square test.

attitudes of participants based on their geographical locations. It was observed that 58.77% of respondents from urban areas displayed a positive attitude towards preventing monkeypox infection (Table 3).

### KA Based on the Demographic Characteristics of the Participants

This study found that nurses with less experience (less than 3 years) ( $p$ -value <0.001), aged between 23 and 28 years ( $p$ -value <0.001), exhibited good knowledge and a positive

attitude toward monkeypox disease compared to more experienced and older nurses. Additionally, urban area nurses demonstrated good knowledge ( $p$ -value <0.001) and a positive attitude ( $p$ -value <0.001) compared to nurses in rural areas. Furthermore, nurses in tertiary hospitals displayed good knowledge ( $p$ -value <0.001) and a positive attitude ( $p$ -value <0.001) compared to nurses in general hospitals, community clinics, and other healthcare settings (Table 3).

After adjusting for the interrelated effect of all variables on knowledge and attitude (KAP), the multivariable logistic regression revealed that female nurses had better knowledge

**Table 4.** Multivariable Logistic Regression for the Good Knowledge, and Positive Attitude Based on the Demographics and Characteristics of the Nurses.

Variables	Good knowledge AOR (95%CI)	Positive attitude AOR (95%CI)
<b>Age</b>		
23–28 years	Reference	Reference
29–34 years	0.96 (0.48–2.36)	1.23 (0.62–2.97)
35–40 years	0.64 (0.38–1.12)	0.54 (0.22–0.78)
41–46 years	0.80 (0.48–1.54)	0.75 (0.49–1.32)
≥ 47 years	0.56 (0.28–0.89)	0.82 (0.52–1.81)
<b>Gender</b>		
Male	Reference	Reference
Female	<b>1.36 (0.88–1.98)</b>	<b>1.64 (1.12–3.00)</b>
<b>Marital status</b>		
Married	Reference	Reference
Unmarried	<b>0.48 (0.22–0.82)</b>	<b>0.63 (0.35–1.27)</b>
Divorced/undisclosed	0.52 (0.30–0.98)	0.65 (0.35–1.02)
<b>Highest education level</b>		
Diploma	Reference	Reference
Bachelor degree	<b>0.73 (0.17–1.68)</b>	<b>0.32 (0.08–0.88)</b>
Master degree	<b>0.90 (0.12–1.83)</b>	<b>0.42 (0.11–0.87)</b>
PhD	<b>5.21 (2.20–9.37)</b>	<b>4.47 (2.58–8.80)</b>
<b>Monthly salary</b>		
< 35 thousand takas	Reference	Reference
36–45 thousand takas	2.10 (1.30–4.23)	1.78 (1.13–3.45)
> 45 thousand takas	<b>3.61 (1.78–6.46)</b>	<b>2.21 (1.63–4.37)</b>
<b>Employer type</b>		
Government	Reference	Reference
Private/international	<b>0.82 (0.44–1.56)</b>	<b>0.66 (0.23–1.39)</b>
Non-government institution	<b>1.38 (0.66–2.94)</b>	<b>1.75 (0.98–3.20)</b>
<b>Employer location</b>		
Urban area	Reference	Reference
Rural area	2.57 (1.42–5.18)	1.76 (1.10–2.63)
<b>Working environmental</b>		
Tertiary hospital	Reference	Reference
General hospital	0.48 (0.28–0.84)	0.78 (0.42–1.44)
Community clinic	0.63 (0.26–1.49)	0.33 (0.09–1.20)
Other healthcare settings	0.83 (0.33–2.04)	0.81 (0.43–1.51)
<b>Working experience</b>		
Less than 3 years	Reference	Reference
4 to 7 years	1.32 (0.37–4.88)	1.48 (0.09–3.51)
More than 7 years	0.94 (0.18–4.94)	0.76 (0.16–4.83)
<b>Did you hear about the monkeypox virus?</b>		
Yes	Reference	Reference
Never	0.61 (0.12–4.06)	0.52 (0.10–2.07)
<b>When did you first hear information about monkeypox?</b>		
Several weeks ago	Reference	Reference
2 months ago	1.34 (0.54–2.50)	0.71 (0.45–1.55)
Within 1 year	0.66 (0.32–1.52)	0.87 (0.51–1.85)
Not applicable	0.43 (0.14–1.48)	0.63 (0.32–1.99)
<b>Did you attend any national conferences regarding monkeypox viral infection?</b>		
No	Reference	Reference
Yes	<b>3.14 (1.83–7.86)</b>	<b>2.61 (1.17–6.59)</b>
<b>Did you attend any international conferences regarding monkeypox viral infection?</b>		
No	Reference	Reference
Yes	<b>0.94 (0.18–2.76)</b>	<b>0.60 (0.08–1.58)</b>

(continued)

**Table 4.** Continued.

Variables	Good knowledge AOR (95%CI)	Positive attitude AOR (95%CI)
<b>Did you receive any information about the monkeypox virus during your nursing education?</b>		
No	Reference	Reference
Yes	<b>4.73 (2.41–10.87)</b>	<b>2.62 (1.51–6.38)</b>

AOR (Adjusted odds ratio), 95% CI, 95% confidence interval. Values in bold represent significant results.

**Table 5.** Correlation Between Knowledge, and Attitude (Good Knowledge vs Positive Attitude, and Poor Knowledge vs Negative Attitude).

Scales	Good knowledge	Poor knowledge	Positive attitude	Negative attitude
Good knowledge			<b><math>r = 0.76, p &lt; 0.001</math></b>	
Poor knowledge				<b><math>r = 0.53, p &lt; 0.001</math></b>
Positive attitude				
Negative attitude				

(adjusted odds ratio (AOR) 1.36; 95% confidence interval (CI) 0.88–1.98) and a positive attitude (AOR 1.64; 95% CI 1.12–3.00) compared to male nurses. Unmarried nurses exhibited better knowledge (AOR 0.48; 95% CI 0.22–0.82) and attitudes compared to married or nurses with undisclosed marital status. Nurses with the highest level of education (Ph.D. holders) significantly demonstrated better knowledge (AOR 5.21; 95% CI 2.20–9.37) and a positive attitude (AOR 4.47; 95% CI 2.58–8.80) compared to those with a bachelor's or diploma degree. Bachelor's degree holders also exhibited better knowledge (AOR 0.73; 95% CI 0.17–1.68) and a more positive attitude (AOR 0.32; 95% CI 0.08–0.88) compared to diploma degree holders.

Likewise, nurses with higher salaries (> 45 thousand takas) displayed good knowledge (AOR 3.61; 95% CI 1.78–6.46) and a more positive attitude (AOR 2.21; 95% CI 1.63–4.37) compared to other income categories. Private/international healthcare nurses (good knowledge: AOR 0.82, 95% CI 0.44–1.56; positive attitude: AOR 0.66, 95% CI 0.23–1.39) and non-government healthcare nurses (good knowledge: AOR 1.38, 95% CI 0.66–2.94; positive attitude: AOR 1.75, 95% CI 0.98–3.20) exhibited considerable good knowledge and a more positive attitude compared to government-employed nurses. Participants who attended national and international monkeypox conferences demonstrated significantly better knowledge and a more positive attitude than those who did not participate in such conferences. Moreover, respondents who received information about the Monkeypox virus during their nursing education exhibited better knowledge (AOR 4.73; 95% CI 2.41–10.87) and a positive attitude (AOR 2.62; 95% CI 1.51–6.38) compared to those who did not (Table 4).

### Association and Correlation of KA on Monkeypox Disease

The findings of the correlation analysis show that good knowledge regarding monkeypox disease is highly correlated with a positive attitude ( $r = 0.76, p < 0.001$ ), and poor knowledge is moderately correlated with a negative attitude ( $r = 0.53, p < 0.001$ ). The results of the correlation are presented in Table 5.

### Discussion

To the author's knowledge, this study is the first in Bangladesh to report on the KAs of nurses regarding human monkeypox virus infection. This study found that only 57.97% of nurses who are young age (23 to 28 years), female, unmarried, receiving a higher salary (>45 thousand takas), have a higher degree (master's, Ph.D.), working in a private/international organization, or a tertiary hospital had a higher level of knowledge. These findings align with previous studies conducted in other countries. For example, the study by Miraglia Del Giudice et al. (2023) in Italy reported similar knowledge gaps among HCWs, emphasizing the need for targeted educational interventions. On the other hand, studies conducted in different geographical regions, such as Lebanon (Malaeb et al., 2023) and Indonesia (Harapan et al., 2020), also highlighted limited knowledge among medical professionals regarding monkeypox. Therefore, the current study's findings support that there is a global need for improved knowledge among nurses regarding monkeypox.



Regarding attitudes, most respondents (93.12%) displayed a positive attitude towards monkeypox diseases. This positive attitude was also higher among younger nurses, females, married women, and those working in private/international organizations. The high percentage of participants with a positive attitude is encouraging, as positive attitudes are essential for effective disease control and prevention measures. When examining the association between KA, this study found a strong positive correlation between good knowledge and a positive attitude toward monkeypox. Comparable findings were observed in another study conducted in China. For example, Peng et al. (2023) found that HCWs' exemplary level of knowledge significantly influences a generally positive attitude toward diseases. In addition, Hasan et al. (2023) revealed that HCWs with better knowledge of monkeypox are more likely to adopt positive attitudes, which can contribute to improved disease prevention and control efforts. This emphasizes enhancing nurses' knowledge through targeted educational programs and interventions to promote positive attitudes and improve overall preparedness.

While a high percentage of respondents had heard about the monkeypox virus before the study, many had not received information about it during their nursing education. However, understanding the clinical manifestations, transmission mechanisms, incubation period, treatment procedures, and effective preventive measures is crucial when dealing with viral diseases (Berdida, 2023; Wang et al., 2023). Although there have been no reported cases of monkeypox illness in Bangladesh, 23.78% of the respondents stated that monkeypox is prevalent in the country. In addition, 11.16% of the nurses gave an inaccurate answer, considering monkeypox a bacterial and viral disease. Besides, 13.20% of the participants incorrectly stated that treating monkeypox disease requires both antivirals and antibiotics. These responses indicate that many nurses have knowledge gaps in managing patients affected by bacterial and viral diseases. Regarding this, Qureshi et al. (2022) mentioned that continuous training on emerging and non-emerging diseases gives nurses the confidence to deal with new illnesses competently. However, the findings of this survey determined a close correlation between KA. These findings suggest that gender, marital status, educational attainment, income level, and participation in educational conferences shape nurses' KAs toward monkeypox.

### Implications of This Study

This study emphasized the importance of educational campaigns and regular updates on emerging infectious diseases to improve nurses' preparedness and response capabilities. It adds to the growing literature on infectious disease management and highlights the importance of healthcare professionals' role in disease prevention and control. However, from a practical standpoint, the study's results would help guide the development of targeted training programs and educational

interventions to address the identified knowledge gaps among nurses. It can inform the design of educational materials and resources specific to monkeypox, enabling nurses to provide accurate information, implement appropriate preventive measures, and deliver quality care to affected patients.

In terms of policy implications, the study underscores the need for healthcare institutions and policymakers to prioritize infectious disease preparedness and response. This study emphasizes the importance of investing in the training and continuous professional development of nurses to enhance their knowledge and skills in managing infectious diseases like monkeypox. The findings can inform policy decisions related to workforce planning, resource allocation, and the implementation of standardized protocols and guidelines for disease control and prevention.

### Study Limitations

Studying possesses several limitations. Firstly, convenient sampling may have introduced selection bias, as the respondents may not fully represent all Bangladeshi nurses. Consequently, the generalizability of the findings could be limited. Secondly, relying on self-reported data in online surveys might have introduced recall and social desirability biases, potentially affecting the accuracy of the participants' reported KAs. Additionally, the study's cross-sectional design only provides a snapshot of the participant's KAs at a specific time. Moreover, the survey being conducted in English could have posed a language barrier for some participants, impacting their comprehension, and potentially influencing their responses.

### Recommendations

Several recommendations can be proposed to address the limitations mentioned and guide future research. Firstly, future studies should adopt a more rigorous sampling strategy, such as random sampling, to ensure the selection of a representative sample of Bangladeshi nurses. This would bolster the external validity of the findings. Additionally, employing a mixed-methods approach, combining quantitative surveys with qualitative interviews, would provide a more comprehensive understanding of nurses' perceptions and experiences regarding monkeypox. This approach would shed light on the context and underlying reasons behind their KAs, enhancing the study's depth and richness of data. Finally, it is strongly recommended to strengthen the healthcare system and prevent the emergence of new epidemics by developing a skilled and competent health workforce through adequate planning and intervention.

### Conclusion

The study shed light on the current level of KAs of nurses towards monkeypox disease, emphasizing the need for

further research and training to bridge the knowledge gaps identified among healthcare professionals. It was observed that factors such as age, gender, education, marital status, salary, and workplace influenced nurses' KAs. Therefore, continuous education and training programs are essential to keeping healthcare professionals updated on emerging infectious diseases and their management. Finally, by addressing the identified knowledge gaps and promoting a positive attitude towards disease prevention and control, healthcare systems might improve their preparedness and response to outbreaks, ultimately safeguarding public health.

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### References

- Adler, H., Gould, S., Hine, P., Snell, L. B., Wong, W., Houlihan, C. F., Osborne, J. C., Rampling, T., Beadsworth, M. B., Duncan, C. J., Dunning, J., Fletcher, T. E., Hunter, E. R., Jacobs, M., Khoo, S. H., Newsholme, W., Porter, D., Porter, R. J., & Ratcliffe, L., ... D. E. Hruby (2022). Clinical features and management of human monkeypox: A retrospective observational study in the UK. *The Lancet Infectious Diseases*, 22(8), 1153–1162. [https://doi.org/10.1016/S1473-3099\(22\)00228-6](https://doi.org/10.1016/S1473-3099(22)00228-6)
- Ahmed, S. K., Abdulqadir, S. O., Omar, R. M., Abdullah, A. J., Rahman, H. A., Hussein, S. H., Mohammed Amin, H. I., Chandran, D., Sharma, A. K., Dhama, K., Sallam, M., Harapan, H., Salari, N., Chakraborty, C., & Abdulla, A. Q. (2023). Knowledge, attitude and worry in the kurdistan region of Iraq during the Mpox (monkeypox) outbreak in 2022: An online cross-sectional study. *Vaccines*, 11(3), 610. <https://doi.org/10.3390/vaccines11030610>
- Ahmed, S. K., Ahmed Rashad, E. A., Mohamed, M. G., Ravi, R. K., Essa, R. A., Abdulqadir, S. O., & Khdir, A. A. (2022). The global human monkeypox outbreak in 2022: An overview. *International Journal of Surgery*, 104, 106794. <https://doi.org/10.1016/j.ijssu.2022.106794>
- Almanasreh, E., Moles, R., & Chen, T. F. (2019). Evaluation of methods used for estimating content validity. *Research in Social and Administrative Pharmacy*, 15(2), 214–221. <https://doi.org/10.1016/j.sapharm.2018.03.066>
- Alshahrani, N. Z., Algethami, M. R., Alarifi, A. M., Alzahrani, F., Alshehri, E. A., Alshehri, A. M., Sheerah, H. A., Abdelaal, A., Sah, R., & Rodriguez-Morales, A. J. (2022). Knowledge and attitude regarding monkeypox virus among physicians in Saudi Arabia: A cross-sectional study. *Vaccines*, 10(12), 2099. <https://doi.org/10.3390/vaccines10122099>
- Baker, R. E., Mahmud, A. S., Miller, I. F., Rajeev, M., Rasambainarivo, F., Rice, B. L., Takahashi, S., Tatem, A. J., Wagner, C. E., Wang, L.F., Wesolowski, A., & Metcalf, C. J. E. (2022). Infectious disease in an era of global change. *Nature Reviews Microbiology*, 20(4), 193–205. <https://doi.org/10.1038/s41579-021-00639-z>
- Berdida, D. J. E. (2023). Population-based survey of human monkeypox disease knowledge in the Philippines: An online cross-sectional study. *Journal of Advanced Nursing*, 79(7), 2684–2694. <https://doi.org/10.1111/jan.15635>
- CDC. (2022a). About monkeypox. Retrieved from <https://www.cdc.gov/poxvirus/monkeypox/about.html>
- CDC. (2022b). 2022 Mpox Outbreak Global Map. Retrieved from <https://www.cdc.gov/poxvirus/mpox/response/2022/world-map.html>
- Chowdhury, S. R., Datta, P. K., & Maitra, S. (2022). Monkeypox and its pandemic potential: What the anaesthetist should know. *British Journal of Anaesthesia*, 129(3), e49–e52. <https://doi.org/10.1016/j.bja.2022.06.007>
- Das, S. K., Bhattarai, A., Kc, S., Shah, S., Paudel, K., Timsina, S., Tharu, S., Rawal, L., Leon-Figueroa, D. A., Rodriguez-Morales, A. J., Barboza, J. J., & Sah, R. (2023). Socio-demographic determinants of the knowledge and attitude of Nepalese healthcare workers toward human monkeypox: A cross-sectional study. *Frontiers in Public Health*, 11, 1161234. <https://doi.org/10.3389/fpubh.2023.1161234>
- Durski, K. N., McCollum, A. M., Nakazawa, Y., Petersen, B. W., Reynolds, M. G., Briand, S., Djingarey, M. H., Olson, V., Damon, I. K., & Khalakdina, A. (2018). Emergence of

- monkeypox—West and Central Africa, 1970–2017. *MMWR. Morbidity and Mortality Weekly Report*, 67(10), 306–310. <https://doi.org/10.15585/mmwr.mm6710a5>
- Harapan, H., Setiawan, A. M., Yufika, A., Anwar, S., Wahyuni, S., Asrizal, F. W., Sufri, M. R., Putra, R. P., Wijayanti, N. P., Salwiyadi, S., Maulana, R., Khusna, A., Nusrina, I., Shidiq, M., Fitriani, D., Muharrir, M., Husna, C. A., Yusri, F., & Maulana, R., ... M. Mudatsir (2020). Knowledge of human monkeypox viral infection among general practitioners: A cross-sectional study in Indonesia. *Pathogens and Global Health*, 114(2), 68–75. <https://doi.org/10.1080/20477724.2020.1743037>
- Hasan, M., Hossain, M. A., Chowdhury, S., Das, P., Jahan, I., Rahman, M. F., Haque, M. M. A., Rashid, M. U., Khan, M. A. S., Hossian, M., Nabi, M. H., & Hawlader, M. D. H. (2023). Human monkeypox and preparedness of Bangladesh: A knowledge and attitude assessment study among medical doctors. *Journal of Infection and Public Health*, 16(1), 90–95. <https://doi.org/10.1016/j.jiph.2022.11.032>
- Ibrahim, P. K., Abdulrahman, D. S., Ali, H. M., Haji, R. M., Ahmed, S. K., Ahmed, N. A., Abdulqadir, S. O., Karim, S. A., & Mohammed Amin Kamali, A. S. (2022). The 2022 monkeypox outbreak—Special attention to nurses' protection should be a top priority. *Annals of Medicine & Surgery*, 82. <https://doi.org/10.1016/j.amsu.2022.104615>
- Isidro, J., Borges, V., Pinto, M., Sobral, D., Santos, J. D., Nunes, A., Mixão, V., Ferreira, R., Santos, D., Duarte, S., Vieira, L., Borrego, M. J., Nuncio, S., de Carvalho, I. L., Pelerito, A., Cordeiro, R., & Gomes, J. P. (2022). Phylogenomic characterization and signs of microevolution in the 2022 multi-country outbreak of monkeypox virus. *Nature Medicine*, 28(8), 1569–1572. <https://doi.org/10.1038/s41591-022-01907-y>
- Malaeb, D., Sallam, M., Salim, N. A., Dabbous, M., Younes, S., Nasrallah, Y., Iskandar, K., Matta, M., Obeid, S., Hallit, S., & Hallit, R. (2023). Knowledge, attitude and conspiracy beliefs of healthcare workers in Lebanon towards monkeypox. *Tropical Medicine and Infectious Disease*, 8(2), 81. <https://doi.org/10.3390/tropicalmed8020081>
- Minhaj, F. S., Ogale, Y. P., Whitehill, F., Schultz, J., Foote, M., Davidson, W., Hughes, C. M., Wilkins, K., Bachmann, L., Chatelain, R., Donnelly, M. A. P., Mendoza, R., Downes, B. L., Roskosky, M., Barnes, M., Gallagher, G. R., Basgoz, N., Ruiz, V., & Kyaw, N. T. T., ... M. Wong (2022). Monkeypox outbreak—nine states, May 2022. *Morbidity and Mortality Weekly Report*, 71(23), 764–769. <https://doi.org/10.15585/mmwr.mm7123e1>
- Miraglia Del Giudice, G., Della Polla, G., Folcarelli, L., Napoli, A., & Angelillo, I. F., & The Collaborative Working Group. (2023). Knowledge and attitudes of health care workers about monkeypox virus infection in Southern Italy. *Frontiers in Public Health*, 11, 1091267. <https://doi.org/10.3389/fpubh.2023.1091267>
- Our world in data. (2023). Mpox (monkeypox). Retrieved from <https://ourworldindata.org/monkeypox>
- Peng, X., Wang, B., Li, Y., Chen, Y., Wu, X., Fu, L., Sun, Y., Liu, Q., Lin, Y.F., Liang, B., Fan, Y., & Zou, H. (2023). Perceptions and worries about monkeypox, and attitudes towards monkeypox vaccination among medical workers in China: A cross-sectional survey. *Journal of Infection and Public Health*, 16(3), 346–353. <https://doi.org/10.1016/j.jiph.2023.01.010>
- Qureshi, M. O., Chughtai, A. A., & Seale, H. (2022). Recommendations related to occupational infection prevention and control training to protect healthcare workers from infectious diseases: A scoping review of infection prevention and control guidelines. *BMC Health Services Research*, 22(1), 272. <https://doi.org/10.1186/s12913-022-07673-4>
- Saputra, H., Salma, N., & Anjari, S. R. (2022). Monkeypox transmission risks in Indonesia. *Public Health of Indonesia*, 8(3), 68–74. <https://doi.org/10.36685/phi.v8i3.634>
- Sklenovská, N., & Van Ranst, M. (2018). Emergence of monkeypox as the most important orthopoxvirus infection in humans. *Frontiers in Public Health*, 6, 241. <https://doi.org/10.3389/fpubh.2018.00241>
- Sobaikhi, N. H., Alshahrani, N. Z., Hazazi, R. S., Al-Musawa, H. I., Jarram, R. E., Alabah, A. E., Haqawi, N. F., Munhish, F. A., Shajeri, M. A., Matari, M. H., Salami, R. M., Hobani, A. H., Yahya, N. A., & Alhazmi, A. H. (2023). Health workers' knowledge and attitude towards monkeypox in southwestern Saudi Arabia: A cross-sectional study. *Diseases (Basel, Switzerland)*, 11(2), 81. <https://doi.org/10.3390/diseases11020081>
- Wang, B., Peng, X., Li, Y., Fu, L., Tian, T., Liang, B., Sun, Y., Chen, Y., Wu, X., Liu, Q., Lin, Y.F., Meng, X., & Zou, H. (2023). Perceptions, precautions, and vaccine acceptance related to monkeypox in the public in China: A cross-sectional survey. *Journal of Infection and Public Health*, 16(2), 163–170. <https://doi.org/10.1016/j.jiph.2022.12.010>
- Xiang, Y., & White, A. (2022). Monkeypox virus emerges from the shadow of its more infamous cousin: Family biology matters. *Emerging Microbes & Infections*, 11(1), 1768–1777. <https://doi.org/10.1080/22221751.2022.2095309>