RCPHN
Research in Community and Public Health Nursing

Original Article

pISSN 2983-0648 · eISSN 2288-4203
Res Community Public Health Nurs 2024;35(3):264-271
https://doi.org/10.12799/rcphn.2024.00619

Knowledge of Healthcare Workers Towards Nipah Virus: A Cross-Sectional Study

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Purpose: To evaluate the healthcare workers' (HCWs) knowledge towards Nipah virus and identify the associated variables with good knowledge.
Methods: A cross-sectional design was conducted in Najran, Kingdom of Saudi Arabia (KSA) to evaluate the knowledge of HCWs towards Nipah virus. A validated questionnaire was employed to collect the data of HCWs. It consisted of two parts: Socio-demographic characteristics of the participants and questions related to the knowledge towards Nipah virus. Percentages and median (Q1, Q3) were used to present the data and were compared by Mann-Whitney and Kruskal Wallis. The associated variables with good knowledge were identified by logistic regression.
Results: The study included 247 participants. The median (Q1, Q3) knowledge score was 45% (10%, 60%), reflecting poor knowledge. About 62% of the HCWs stated that the symptoms of Nipah virus infection could be acute respiratory distress, convulsions, and coma. Only 36.8% reported no available vaccine to prevent Nipah virus infection, and more than 50% identified the virus's main reservoir (fruit bat) as the possibility of transmission from animal to human. Roughly 57% of them reported that the virus can be transmitted among people through droplets. Less than 40% stated the Nipah virus can cause AIDS. The significantly associated variable with good knowledge was only nationality.
Conclusion: The present study showed a poor knowledge of HCWs. Good knowledge was associated with nationality. Therefore, the implementation of education and training programmes are highly recommended throughout conducting prospective and interventional studies.

Keywords: Healthcare workers; Knowledge; Nipah virus; Saudi Arabia

Introduction

Nipah Virus (NiV) is a zoonotic virus belonging to the Paramyxoviridae family. It was first identified in Malaysia and Singapore during an outbreak in 1998-1999, where it caused severe respiratory and neurological disease in human beings. The virus is named after the Malaysian village where the first outbreak occurred [1-3].

The incidence of Nipah infection in Malaysia and Singapore was very high and associated with severe encephalitis, respiratory problem. Encephalitis was a very common problem that affected people living in Malaysia and Singapore and had a high death rate. In India, this happened for the first time in the city of Kozhikode in the state of Kerala [1,2].

Received: June 20, 2024; **Revised:** August 21, 2024; **Accepted:** August 21, 2024
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NiV is transmitted to humans mostly through direct contact with infected animals, especially fruit bats, which are considered natural reservoir hosts. Human-to-human transmission of the virus has also been documented, mostly through close contact with infected people. In some cases, the virus is spread through contaminated food or drink [1,2,4]. Pteropus bats (fruit-eating species, commonly known as flying foxes) are deemed the natural host of the virus [5]. The virus has been reported in Malaysia, Singapore, Philippines, Bangladesh, and India [6].

The incubation period (the time from acquiring infection to appearing symptoms) is estimated to be between 4 and 14 days. However, incubation periods of up to 45 days have been reported. Infected individuals initially develop symptoms such as fever, headache, myalgia, sore throat, and vomiting. This may be followed by dizziness, sleepiness, altered consciousness, and neurological signs indicating acute encephalitis. Some people may also develop atypical pneumonia and severe breathing problems, including acute respiratory failure. Seizures and Encephalitis happen in severe cases, and thus proceeding to coma from about 24 to 48 hours [7].

Common diagnostic tests involve cell culture, serological testing through enzyme-linked immunosorbent assay (ELISA) or indirect fluorescent antibody (IFA), and reverse transcription polymerase chain reaction (RT-PCR). The samples include nasal and throat swabs, cerebrospinal fluid, blood, and urine. In the later stages of the disease and after recovery, ELISA is used for testing antibodies [3,8].

In 1999 outbreak in Malaysia and Singapore, this outbreak caused nearly 300 human cases and over than 100 deaths, and had a significant economic impact as more than a million pigs were slaughtered to assist in controlling the outbreak [9]. From September 12 to 15, 2023, Indian Ministry of Health (MOH) reported six laboratory-confirmed cases of NiV infection, enclosing two deaths, in Kozhikode district, Kerala. Besides the first case, the source of infection is unknown, the remaining cases are all contacts at the household and hospital of the primary case. As of September 27, 2023, 1,288 contacts of positive cases have been traced, involving high-risk contacts and healthcare workers (HCWs), who are quarantined and monitored, followed up for 21 days. Since September 12, 387 samples were tested, of which six found positive for NiV and rest of samples were negative. Since September 15, no new positive cases have been identified. This is considered the sixth NiV outbreak in India since 2001 [10].

Since there is no current treatment for the disease caused by NiV, the treatment is mostly limited to supportive care and treatment of symptoms [11].

In the Kingdom of Saudi Arabia (KSA), there is no cases of NiV reported and Saudi MOH has issued a public health guide concerning with NiV infection. The guide book demonstrated the epidemiology of the disease, agent, seasonality, mode of transmission, incubation period, clinical features, treatment, case definition, infection control in healthcare facilities, diagnosis, and public health response and reporting [12]. Since Saudi MOH was concern with preparedness of the HCWs and raise their knowledge regarding the disease, and there was no study in KSA studied the knowledge towards NiV. Therefore, this study aimed (1) to assess the knowledge of HCWs towards NiV, and (2) to identify the associated factors with good knowledge.

Methods

Study design and participants

A cross sectional study conducted at the healthcare institutions affiliated with the MOH in Najran region, KSA to assess the knowledge of HCWs towards NiV. HCWs involved in this study were physicians, dentists, pharmacists, nurses, infection prevention and control (IPC) staff, and other specialties such as Laboratory staff, Respiratory therapists, Public health staff, Physiotherapists, and psychologists.

HCWs affiliated with the MOH in Najran region, KSA were included. However, administrative workers affiliated with the MOH in Najran region, KSA were excluded. Further, HCWs and administrative workers affiliated with the MOH in other regions of KSA were also excluded.

Sampling technique and sample size

A proportionate probability stratified random sampling method was employed in this study. According to a recent study conducted in Najran, KSA, the estimated overall HCWs was 6000 [13]. The involved hospitals were ten affiliated with MOH in the region. Therefore, the sample size was 362 HCWs. Raosoft online software was used to calculate the sample size.

In addition, primary healthcare centers (PHCs) are relevant to hospitals and were involved. Healthcare settings were classified to Hospitals and PHCs during data analysis.

Measurements and instrument

A validated questionnaire was used to collect the data [14]. It is consisted of two parts: The first part includes the demographic data of the study participants; Age, gender, nationality, specialty, settings (hospital or PHC), educational level (Diploma, Bachelor, Master, Doctor of Philosophy (PhD), Board and Fellowship).

The study participants were categorized according to their specialties. The second part includes twenty questions to assess the knowledge of study participants in terms of clinical presentation, mode of transmission, risk factors, and methods of prevention of NiV. Cronbach's alpha test was carried out to measure the internal consistency. It was .95, which shows a high internal consistency.

A score of 'one' was given for 'correct answer' and '0' for 'incorrect answer'. An overall score was calculated according to the responses of each participant to each item of Knowledge in the questionnaire. The overall knowledge score was 20. The 75th percentile was used as the cut-off point [13]. The cut-off point was used to classified the performance of HCWs to questions related to the knowledge as good or poor. Thus, scores that ≥ 75th percentile of the total score for knowledge indicated good knowledge, while scores that ≤ 75th percentile indicated poor knowledge.

Statistical analysis

Median (inter-quartile range) was used to present the data. Mann-Whiteny test and Kruskal Wallis test were used to compare the data. Binary logistic regression was used to identify the associated factors with good knowledge. Age, gender, nationality, cadre, Education level, place of work, and years of experience were included. In the logistic regression, we conducted univariate analysis first, and then statistically significant factors were involved in the multivariate analysis. p-value < .05 was consider ed a statistical significant level. SPSS version 27.0 was used for the data analysis.

Ethical consideration

The ethical approval was obtained from the Institutional Review Board at the General Directorate of Najran Health Affairs (IRB Log Number 2023-2lE).

Study participants who agree to participate in this study were informed about their participations would be voluntary and then they directed to an online questionnaire after they clicked "agree". Their responses were confidential and anonymous. However, those who refused to participate clicked "disagree" and then exit the page directly.

Results

Socio-demographic characteristics of the study participants

Of the 362 participants invited to contribute in this study, the response rate was 247 (75.7%). Socio-demographic characteristics of the HCWs present in Table 2. Since the data was not normally distributed the median (IQR) was used to present the data. Median age was 38 years (Q1 = 34, Q3 = 42) and 75.9% of the HCW s were male. Two third of the participants were Saudi and majority of them were nurses (35%), while solely 2.4% and 3.6% were dentists and staff of IPC, respectively. Most of the HCWs had a bachelor degree (42.9%) and the least had a Fellowship (2.8%), Board (2.4%), and PhD (0.4%). Vast majority (86.2%) of the HCWs worked at hospitals and only 13.8% of them worked at PHCC.

Table 1. Proportionate stratified sampling method for included participants

Hospital (Governmental)	Bed capacity	Total HCWs	Sample (n)
King Khalid hospital	300	2320	92
Maternity and Children hospital	200	2000	79
New Najran general hospital	200	1600	63
Psychiatric hospital	100	400	15
Yadamah general hospital	50	300	11
Bader Alganoob general hospital	50	231	8
Sharorah general hospital	100	1500	58
Habona general hospital	70	400	15
Thar general hospital	50	280	10
Khobash general hospital	50	300	11
The total sample size			362

Table 2. Socio-demographic characteristics of the study participants (*N*=247)

Variable		n	%
Age, Median (IQR)		38	(34-42)
Gender	Female	57	23.1
	Male	190	76.9
Nationality	Saudi	173	70
	Non-Saudi	74	30
Cadre	Physician	32	13.0
	Dentist	6	2.4
	Pharmacist	13	5.3
	Nurse	104	42.1
	IPC	9	3.6
	Other	83	33.6
Education level	Diploma	97	39.3
	Bachelor	106	42.9
	Master	30	12.1
	PhD	1	0.4
	Board	6	2.4
	Fellowship	7	2.8
Place of work	Primary healthcare center	35	14.2
	Hospital	212	85.8

IQR = Interquartile range; IPC = infection prevention and control.

Responses of the participants to questions related to knowledge towards Nipah virus

The median (Q1, Q3) knowledge score of the HCWs in this study was 45% (10%-60%). Table 3 shows responses of the participants to questions related to knowledge towards Nipah virus. About 62% of the HCWs stated the symptoms of Nipah virus infection could be acute respiratory distress, convulsions, and coma. Only 36.8% of them reported no available vaccine to prevent Nipah virus infection, and more than 50% identified the main reservoir (fruit bat) of the virus, possibility of transmission from animal to human, which has been reported previously in Bangladesh. Solely 13.4% of the HCWs identified the location of first discovery of the virus. Roughly 57% of them reported that the virus can be transmitted among people through droplet. Regarding the availability of treatment, 38.9% stated yes and 42.9% didn't know. Roughly 40% stated there are many strains of the virus and the outbreaks have been occurred in Bangladesh and Malaysia.

Regarding the common risk factor for human, most of the HCWs were not able to report it correctly. Only 19.8% stated the outbreak season is mostly during summer, and approximately 31 stated the virus does not spread through mosquitos. Above 50% of them sated that people can recover from the disease. About 25% reported the possibility of virus to cause the disease among animals. Above 50% of the HCWs stated the outbreak in Kerala had high mortality rate. Less than 40% stated the Nipah virus can cause AIDS. Approximately 30% and 28% stated the infection may be asymptomatic and the virus can be transmitted via sexual intercourse. More than 72% of them stated either there is antibiotics to cure the infection or they do know.

Correct and wrong responses to questions related to knowledge of HCWs towards Nipah virus

Table 4 shows correct and wrong responses to questions related to knowledge of HCWs towards Nipah virus. Unfortunately, responses of the HCWs to 19 items showed poor knowledge. However, their knowledge was good for only one item related to symptoms of Nipah virus infection (Q1).

Differences in overall median scores by Socio-demographic characteristics

Differences in overall median scores by Socio-demographic characteristics illustrated in Table 5. Overall median score was differed significantly by gender (p=.001), nationality (p=.001), and cadre (p=.001).

Table 3. Responses of the participants to questions related to knowledge towards Nipah virus (N=247)

Statement		n	%
1. Symptoms of Nipah virus infection may acute respiratory distress, convulsions, and coma.	No	30	12.1
	Yes	154	62.3
	Don't know	63	25.5
2. A vaccine is currently available to prevent Nipah virus disease.	No	91	36.8
	Yes	65	26.3
	Don't know	91	36.8
3. Fruit bats are the main reservoir of the Nipah virus.	No	17	6.9
	Yes	134	54.3
	Don't know	96	38.9
4. The Nipah virus can be transmitted to humans from animals (such as bats or pigs).	No	27	10.9
	Yes	143	57.9
	Don't know	77	31.2
5. Human to human transmission of the Nipah virus has been reported in Bangladesh and India.	No	19	7.7
	Yes	133	53.8
	Don't know	95	38.5
6. The Nipah virus was first discovered during the 2018 outbreak in Kerala State.	No	33	13.4
	Yes	122	49.4
	Don't know	92	37.2
7. The Nipah virus can be transmitted from human to human via droplet infection.	No	31	12.6
	Yes	141	57.1
	Don't know	75	30.4
8. Currently, there is no known treatment for the Nipah virus.	No	45	18.2
	Yes	96	38.9
	Don't know	106	42.9
9. There are many strains of the Nipah virus.	No	28	11.3
	Yes	101	40.9
	Don't know	118	47.8
10. Outbreaks of Nipah virus infection has occurred in Bangladesh and Malaysia.	No	32	13.0
	Yes	106	42.9
	Don't know	109	44.1
11. Drinking date palm sap is a common risk factor for human Nipah virus infection	No	42	17.0
	Yes	77	31.2
	Don't know	128	51.8
12. Outbreaks of NiV occur most often during the summer months	No	49	19.8
	Yes	86	34.8
	Don't know	112	45.3
13. The Nipah virus can be spread through mosquitos	No	76	30.8
	Yes	77	31.2
	Don't know	94	38.1
14. It is possible to survive and recover from Nipah virus infection	No	23	9.3
	Yes	128	51.8
	Don't know	96	38.9
15. The Nipah virus does not cause disease in animals	No	69	27.9
	Yes	61	24.7
	Don't know	117	47.4

(Continued to the next page)

Table 3. (Continued)

Statement		n	%
16. The 2018 Nipah virus outbreak in in Kerala had a high mortality rate	No	22	8.9
	Yes	131	53.0
	Don't know	94	38.1
17. The Nipah virus can cause HIV/AIDS	No	97	39.3
	Yes	43	17.4
	Don't know	107	43.3
18. Nipah virus infection can be asymptomatic	No	69	27.9
	Yes	75	30.4
	Don't know	103	41.7
19. The Nipah virus can be passed on during sexual intercourse	No	69	27.9
	Yes	69	27.9
	Don't know	109	44.1
20. The Nipah virus can be cured with antibiotics	No	69	27.9
	Yes	83	33.6
	Don't know	95	38.5

Table 4. Correct and wrong responses to questions related to knowledge towards Nipah virus (*N*=247)

Statement		n	%	Statement		n	%
Q1	Wrong	93	37.7	Q11	Wrong	170	68.8
	Correct	154	62.3		Correct	77	31.2
Q2	Wrong	156	63.2	Q12	Wrong	198	80.2
	Correct	91	36.8		Correct	49	19.8
Q3	Wrong	113	45.7	Q13	Wrong	171	69.2
	Correct	134	54.3		Correct	76	30.8
Q4	Wrong	104	42.1	Q14	Wrong	119	48.2
	Correct	143	57.9		Correct	128	51.8
Q5	Wrong	114	46.2	Q15	Wrong	178	72.1
	Correct	133	53.8		Correct	69	27.9
Q6	Wrong	214	86.6	Q16	Wrong	116	47.0
	Correct	33	13.4		Correct	131	53.0
Q7	Wrong	106	42.9	Q17	Wrong	150	60.7
	Correct	141	57.1		Correct	97	39.3
Q8	Wrong	151	61.1	Q18	Wrong	172	69.6
	Correct	96	38.9		Correct	75	30.4
Q9	Wrong	146	59.1	Q19	Wrong	178	72.1
	Correct	101	40.9		Correct	69	27.9
Q10	Wrong	141	57.1	Q20	Wrong	178	72.1
	Correct	106	42.9		Correct	69	27.9

logistic regression for variables associated with good knowledge of HCWs towards Nipah virus

Univariate and multivariate analysis logistic regression for variables associated with good knowledge of HCWs towards Nipah virus is presented in Table 6. In univariate analysis, significantly associated variables with good knowledge were gender

Table 5. Correct and wrong responses to questions related to knowledge towards Nipah virus (*N*=247)

Variable		Score		*p*
		Median	(Q1-Q3)	
Gender	Female	12	(10-14)	.001†
	Male	6	(1-11)	
Nationality	Saudi	5	(1-10)	.001
	Non-Saudi	12	(10-14)	
Cadre	Physician	12	(7-14)	.001‡
	Dentist	7	(1-13)	
	Pharmacist	3	(1-8)	
	Nurse	10	(4-12)	
	IPC	12	(9-13)	
	Other	5	(1-10)	
Qualification	Diploma	7	(2-11)	.136‡
	Bachelor	10	(3-12)	
	Master	6	(2-13)	
	PhD	7	(7-7)	
	Board	9	(3-12)	
	Fellowship	7	(0-10)	
Settingsf	Primary healthcare center	9	(4-11)	.691
	Hospital	9	(2-12)	

†Kruskal-Wallis Test, ‡Mann-Whitney Test; Q1-Q3=first and third quartiles; IPC=Infection Prevention and Control.

(*p*=.001), nationality (*p*=.001), cadre (*p*=.001), and qualification (*p*=.002). In multivariate analysis model, the significantly associated variable with good knowledge was only nationality (*p*=.002). Compared with Saudi HWCs, non-Saudi were two times more likely to have good knowledge (AOR=2.33, CI=2.28-46.77, *p*=.002).

Discussion

To the best of our knowledge, this study was the first study conducted in KSA to assess the knowledge of HCWs towards Nipah virus. The study discovered that the knowledge of HCWs in Najran, KSA was poor although the Saudi MOH has sent circulation to all the healthcare facilities demonstrating the key points of the disease. Such points included epidemiology of the disease, agent, seasonality, mode of transmission, incubation period, clinical features, treatment, case definition, infection control in healthcare facilities, diagnosis, and public health response. The findings indicated a lack of proper knowledge and the need for an improvement. Moreover, this study revealed HCWs who should improve their knowledge towards Nipah virus.

The median (Q1, Q3) knowledge score of the HCWs in our study was 45% (10%-60%), which reflected a poor knowledge. This could be explained by lack of effective educational pro-

Table 6. Variables associated with good knowledge

Variable		Univariate analysis		*p*	Multivariate analysis		*p*
		COR	(95% CI)		AOR	(95% CI)	
Age	Age	-0.001	(0.999-1.001)	.940	-0.002	(0.98-1.01)	.843
Gender	Female	2.07	(4.09-15.21)	.001	1.07	(0.75-11.49)	.122
	Male	1	1.00		1	1.00	
Nationality	Non-Saudi	2.53	(6.46-24.51)	.001	2.33	(2.28-46.77)	.002
	Saudi	1	1		1	1	
Cadre Department	Physician	2.36	(3.88-29.08)	.001	1.35	(70.66-22.22)	.133
	Dentist	1.55	(0.74-29.73)	.101	1.85	(0.86-46.99)	.070
	Pharmacist	-0.25	(0.09-6.82)	.823	-0.35	(0.08-6.48)	.760
	Nurse	1.38	(1.72-9.24)	.001	-0.34	(0.23-2.22)	.558
	IPC	2.46	(2.61-52.70)	.001	0.93	(0.37-17.28)	.342
	Other	1	1		1	1	
Qualification	Fellowship	-0.09	(0.10-8.12)	.934	-3.55	(0.00-0.45)	.011
	Board	1.01	(0.46-16.28)	.269	-1.83	(0.01-1.86)	.143
	PhD	-20.00	(2.00-13.00)	> .999	-21.54	(2.00-13.00)	> .999
	Master	0.85	(0.90-6.09)	.811	-1.33	(0.05-1.47)	.128
	Bachelor	1.08	(1.49-5.79)	.002	-0.66	(0.18-1.51)	.227
	Diploma	1.00	-		1.00	1.00	
Settings	Hospital	0.13	(0.49-2.66)	.765	-0.50	(0.20-1.83)	.376
	Primary healthcare center	1.00	-		1.00	-	

COR=Crude odds ratio; AOR=Adjusted odds ratio; CI= Confidence interval; IPC=infection prevention and control.

grams. Similarly, a recent study in the same region, Najran, KSA reported a poor knowledge of the HCWs towards antibiotic resistance during coronavirus disease 2019 (COVID-19) [13]. Another study in Bangladesh, revealed that the knowledge of physicians towards Nipah virus was not profound [15]. In contrast, a recent study in India found a good knowledge among public [16].

The knowledge of HCWs in the present study regarding the symptoms of Nipah virus was good for 62% of them. Their knowledge regarding to main reservoir, transmission from animal to human, previous report of transmission from human to human in Bangladesh and it caused high mortality rate during 2018 in Bangladesh, the transmission among people through droplet, possibility of recovering from the Nipah virus infection, and the Nipah virus does not cause a disease in animals was good for 51%-57% of them. Unlike, in India the knowledge of HCWs regarding the symptoms of Nipah virus was good accounting for 89.5% of them. Their knowledge regarding to main reservoir, transmission from animal to human, previous report of transmission from human to human in Bangladesh with high rates of deaths in 2018, the transmission among people through droplet, and possibility of recovering from the Nipah virus infection was good for 75%-95% of them. However, their knowledge regarding the Nipah virus does not cause a disease in animals was good for only 52.3% of them [14]. Comparably, in Bangladesh, the knowledge of most physician regarding the Nipah virus infection was fair, roughly 78% reported correctly that the bat is main reservoir of Nipah virus, the human to human transmission was mention by approximately 45% of them [15].

The knowledge of HCWs in the present study regarding availability of vaccine, location of first discovery of the disease, availability of treatment, present of many strains, the outbreak that happed before in Bangladesh and Malaysia, risk factor, outbreak season, transmission the virus via mosquitos, Nipah virus can cause AIDS, can be transmitted via sexual intercourse, and the availability of antibiotics to cure the infection was poor, and less than 40% of them had good knowledge. This could reflect lack of implementation of periodic active educational program. Physicians in Bangladesh showed similarly in terms of epidemiological link of the disease [15]. Similarly, a study conducted in India revealed that the knowledge of HCWs regarding location of first discovery of the disease, present of many strains, risk factor, and outbreak season was only good for less than 45% of them. However, the study found the knowledge of the HCWs regarding the availability of vaccine, availability of treatment, the outbreak that happed before in Bangladesh and Malaysia, transmission the virus via mosquitos, Nipah virus can cause AIDS, can be transmitted via sexual intercourse, and the availability of antibiotics to

cure the infection was good for about 63%-90% of them [14].

Regarding the variables associated with good knowledge of HCWs towards Nipah virus in the present study, it was only nationality. Compared with Saudi HWCs, non-Saudi were two times more likely to have good knowledge. This could be explained by the non-Saudi HCWs are originally from India, Philippines, or neighbor countries to Malaysia, Bangladesh, or Singapore. Comparably, the factors associated with knowledge of HCWs in Najran, KSA regarding antibiotic resistance during COVID-19 were nationality, cadre, qualification and working place [13]. In Bangladesh, good knowledge was associated with age group between 21 and 25 years [15]. In India, the Knowledge scores were significantly higher among physicians compared to nurses [14].

The present study has strength points. First, this is the first study conducted in KSA to assess the knowledge of HCWs towards Nipah virus. Second, the study represented the knowledge of HCWs towards Nipah virus who affiliated with governmental healthcare institutions in the whole region. Third, misclassification bias was avoided using a proportionate sampling method. Lastly, associated variable with the knowledge of HCWs was identified throughout using univariate and multivariate analyses. However, the study has some limitations. First, the study was conducted in one region and thus the generalizability of the findings to all the HCWs in KSA was not possible. Second, although the response rate of the study participation was high (75%), the responses of those who disagreed to complete the questionnaire may have differed from those included in this study. This may introduce selection bias. However, those who refused to participate in this study are not likely to differ from those who participated. Last, some cofounding variables such as years of experience of the participants may have been found irrelevant. Hence, it has not been used in the regression analysis.

Conclusions

The present study showed the poor knowledge of HCWs. The associated variable with good knowledge was nationality. Therefore, the implementation of education and training programmes are highly recommended. All decision-making processes need to incorporate research, education, practice, policy, environment, climate, and sustainability considerations. In addition, to better inform such programmes, further prospective and interventional studies are highly encouraged. Moreover, HCWs who might benefit from the these programmes were identified in the present study.

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Conflict of interest

There was no conflict of interest.

Funding

None.

Authors' contributions

Hadi Al Sulayyim contributed conceptualization, data curation, formal analysis, methodology, project administration, visualization, writing - original draft, writing - review & editing, investigation, resources, software, supervision. *Manea Alsaleem contributed to* conceptualization, data curation, project administration, methodology, visualization, writing -original draft. *Ali Sherjab contributed to* conceptualization, data curation, project administration, and methodology. *Saleh Aldoghman contributed to* conceptualization data curation, and visualization. Husain Alyami contributed to conceptualization, data curation, methodology, and visualization. *Abdulaziz Al Yami contributed to* conceptualization, data curation, formal analysis, methodology, and visualization. *Mohammad Almeshl contributed to* conceptualization, data curation, methodology, project administration, and visualization. *Mohammad Altheban contributed to* conceptualization, data curation, methodology, project administration, and visualization. *Dahen Alsinan contributed to* conceptualization, data curation, formal analysis, methodology, and visualization. *Obaid Altheban contributed to* conceptualization, data curation, methodology, visualization, and investigation. *Fares Al-Mansour contributed to* conceptualization, data curation, formal analysis, methodology, project administration, visualization, writing -review & editing, investi-

gation, and supervision.

Data availability

Please contact the corresponding author for data availability.

Acknowledgments

We are thankful for all the participants in this study for their response and cooperation.

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