

Knowledge and Practice of COVID-19 Preventive Strategies among Nurses

Abstract

Background: Knowledge of COVID-19 preventive measures, in addition to appropriate practices of such measures, remains a necessity for the prevention of contracting COVID-19 by nurses. This study assessed nurses' knowledge and practice of COVID-19 preventive strategies. It also determined the influence of sociodemographic variables on the knowledge of preventive measures for COVID-19 among nurses. **Materials and Methods:** The study adopted a descriptive cross-sectional survey design using multi-stage sampling to recruit 344 nurses. **Results:** The results showed that 92% of the nurses had adequate knowledge of COVID-19 preventive measures. The practice of COVID-19 preventive measures among nurses showed that 98.80% had sufficient knowledge of the infection preventive measures. Nurses with Registered Nurse/Registered Midwife (RN/RM-AOR 12.30; CI 4.79–31.63; $p = 0.001$) and Bachelor of science in nursing (BScN-AOR 37.60; CI 7.644–184.95; $p = 0.001$) were more knowledgeable about the COVID-19 preventive compared to other nurses with higher degree qualifications. **Conclusions:** The nurses in the study had good knowledge of the preventive measures for COVID-19 despite not being trained as frontline staff. It is essential to transform theory into practice by ensuring that the preventive measures they know are implemented to halt the spread of the disease in the face of minimal vaccine coverage.

Keywords: COVID-19, general practice, knowledge, nurses, prevention and control

Introduction

Coronavirus Disease 2019 (COVID-19) is a highly contagious and acute respiratory syndrome that has an enormous negative impact on people's health and well-being.^[1] It was first identified in Wuhan, China, and now spreads to almost all countries, including Nigeria. World Health Organization declared the virus a pandemic on March 11, 2020, and there are more than 296,496,809 confirmed cases of COVID-19, including 5,462,631 deaths globally. 246195 cases have been confirmed, 217509 patients have been discharged, and 3066 deaths have been recorded in 36 states and the Federal Capital Territory of Nigeria.^[2,3] The COVID-19 virus spreads through contact with infected persons' respiratory droplets in coughing or sneezing or by touching contaminated surfaces or objects and then touching their mouth, nose, or eyes^[4,5] of which practice of preventive measures as identified by World Health Organization (WHO) (2020) and Nigeria Centre for Disease Control (NCDC) (2020) required

health workers to be prepared and ready to respond to an outbreak, in particular, limit human-to-human transmission by way of implementing WHO recommended infection prevention and control interventions and identify, isolate, and report suspect and confirmed cases.^[5]

There have been a wide variety of studies globally on knowledge and practice for COVID-19 among healthcare workers and the general public.^[6-8] Studies have mostly focused on identifying which demographic and other variables are associated with different levels of knowledge and practice of COVID-19 preventive measures. Some of the studies include a study by Zhou *et al.*^[9] on healthcare workers' knowledge regarding COVID-19 preventive measures, which shows that healthcare workers across ten hospitals in Henan, China, 89% of HCWs had sufficient knowledge of COVID-19 preventive measures. Furthermore, other studies on knowledge and preventive practices for COVID-19 among Chinese women showed that most Chinese residents are knowledgeable about COVID-19, hold

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optimistic attitudes, and have appropriate practices toward COVID-19.^[10,11]

In Nigeria, however, the high infection and death rate of health workers due to COVID-19 and its related complications call for concern by various stakeholders in the health sector. Some studies have emerged on COVID-19 in Nigeria, including those by Olapegba *et al.*,^[12] Odikpo *et al.*,^[13] and a few others that were not specifically on COVID-19 knowledge practice preventive strategies for COVID-19 among nurses in Anambra State. Currently, preventive strategies are the critical intervention for controlling the spread in the face of limited vaccine coverage. Consequently, nurses are among the high-risk groups. They are to prevent the disease from spreading by carrying out basic measures while discharging their duties, such as hand hygiene, respiratory etiquette, social distancing, and proper Personal Protective Equipment (PPE).^[14] Therefore, understanding the need for change in behavior due to the current pandemic will go a long way in managing and controlling the spread of the disease. This study, therefore, assessed the knowledge and practice of preventive strategies for COVID-19 among nurses in Anambra State. It also determined the influence of sociodemographic data on knowledge and practice of preventative measures for COVID-19.

Materials and Methods

The study adopted a cross-sectional survey design. The study was conducted in Nnamdi Azikiwe University Teaching Hospital, Nnewi (NAUTH) and Chukwuemeka Odimegwu Ojukwu Teaching Hospital, Awka (COOUTH); these are the tertiary health institutions in Anambra State, Nigeria. The study was conducted in 2020, and the authors conducted data gathering between May 2020 and November 2020. Nurses were the target population. The sample size of 344 nurses for the study was determined using the Cochran (1977) formula^[15] for calculating categorical variables, $n_0 = (t)^2 \times (p)(q)/(d)^2$ where n_0 = required return sample size; t = value for the selected alpha level (type I error) which was set at 0.05. The t-value for alpha level of 0.05 is 1.96; p = maximum possible proportion is 0.5; $q = 1 - p$ (estimate of variance); d = acceptable margin of error for proportion being estimated = 0.05. This yielded a sample of 344 nurses; 121 from Chukwuemeka Odimegwu Ojukwu University Teaching Hospital, Awka, and 223 from Nnamdi Azikiwe University Teaching Hospital, Nnewi. The researchers adopted multi-stage sampling technique; in the first stage, proportionate sampling was used to allocate the number of nurses to be included in the study from various departments for proper representation. After that, a simple random sampling method was used by the researchers for the selection of respondents until each unit's required size was achieved. Researchers administered a questionnaire to the participants to obtain information on sociodemographic characteristics

such as age, sex, marital status, religion, qualification, cadre, and years of experience. Also, knowledge and practice of preventive measures for COVID-19 were assessed by the researchers among respondents using the researchers' questionnaire. Face and content validity of the instrument was done by research experts consisting of a microbiologist, health educationist, and medical statistician to evaluate the appropriateness of the content of the survey instrument. After the validation, the researchers used the validator's comments to adjust the tool before using it for data collection. For reliability, a pilot study was conducted using thirty randomly selected nurses at the University of Nigeria Teaching Hospital, Enugu, by the test-retest method to ascertain the instrument's reliability. The researchers subjected the data generated from the pilot study to the Cronbach alpha reliability test, and a reliability coefficient (r) of 0.87 was obtained. This result showed that the instrument is reliable. The questionnaire administered was completed in a self-report manner by the participants. Data were analyzed using Statistical Package for Social Sciences (SPSS) window version 25.0, manufactured by IBM software company at Stanford, Chicago. The data results were analyzed using mean and percentages and presented in tables and charts based on the research questions for straightforward interpretation.

Ethical considerations

The researchers obtained ethical approval for the study from Nnamdi Azikiwe University Teaching Hospital Research Ethics Committee with reference code NAUTH/CS/66/VOL. 13/VER 111/50/2020/035. The study participants were given adequate information on the study and only those who signed the consent forms participated. The study participants were assured of confidentiality, and the data set was anonymized to ensure privacy.

Results

The result of the demographic profile shows that majority of the respondents were within the age of 26–35 years 214 (62.20%), females 324 (94.20%), married 265 (77%), Christians 339 (98.50%), RN/RM double qualified 240 (69.70%), and senior nursing officers and nursing officer's 153 (44.50%) and 96 (26.70%). Years of experience for many nurses were 11–20 years 197 (57.30%). Result also shows that the majority of the nurses in the hospitals had no formal training on COVID-19 303 (88.10%).

Knowledge of nurses on preventive measures toward COVID-19 shows that they have the knowledge that COVID-19 can be spread through droplets and touching of contaminated surfaces 223 (64.80%), facemasks and goggles can be used to prevent COVID-19 207 (60.20%), and that appropriate disinfection and disposal of PPEs gown is a preventive measure to COVID-19 168 (48.80%). Also, following guidelines by WHO and NCDC could help one prevent COVID-19 202 (58.70%) and 245 (71.20%)

strongly agreed that COVID-19 could lead to pneumonia, respiratory failure, and possibly death [Table 1].

The majority of the nurses, 316 (92%), had adequate knowledge of COVID-19 preventive measures [Figure 1], and 163 (47.40%) were satisfied with the knowledge acquired so far on COVID-19, as depicted in Figure 2. Their sources of information on preventive measures for COVID-19 were mainly from health institutions (30.50%) [Figure 3].

On the practice of COVID-19 preventive measures among nurses [Table 2], the result shows that 340 nurses (98.80%) know all the infection preventive measures against coronavirus. A total of two hundred and twenty-four (65.10%) nurses maintained approximately 2 meters distance around an infected individual; hand washing was carried out mainly after any contact that resulted in hand contamination 335 (97.40%). Institutionally, availability of running water and soap for hand hygiene 308 (89.50%), availability of hand sanitizer 328 (95.30%), availability and use of surgical face mask when caring for patient 312 (90.70%), availability of isolation ward to admit confirmed COVID-19 cases 231 (67.20%), and use of privacy curtains between beds to prevent close contact 189 (46.20%) and also decontamination of patient wards, hospital environment, and high-touched areas were always done 62 (92.50%) as reported by the few that claimed to be involved in the decontamination process of their ward 67 (19.50).

The significantly associated variables were entered into a multivariate logistic regression model [Table 3], and analysis showed that nurses who had RN/RM (AOR12.30; CI 4.79–31.630; $p = 0.001$) and BScN (AOR 37.60; CI 7.644–184.95; $p = 0.001$) were more knowledgeable when compared to nurses with MSN/Ph.D. Similarly, senior nursing officers (SNO) had more knowledge than other cadres studied (AOR 36.20; CI 7.65–171.71; $p = 0.001$). Nurses with 11 to 20 years of experience had more

knowledge when compared to others (AOR 57.30 CI 7.65–428.60; $p = 0.001$).

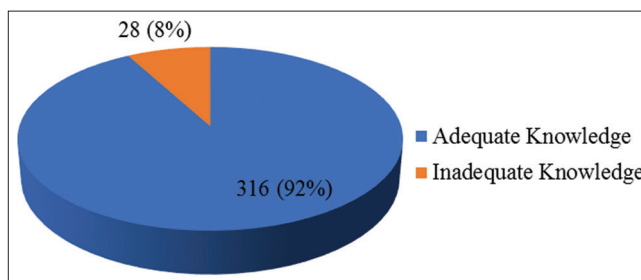


Figure 1: Knowledge status of the respondents on COVID-19 preventive measures

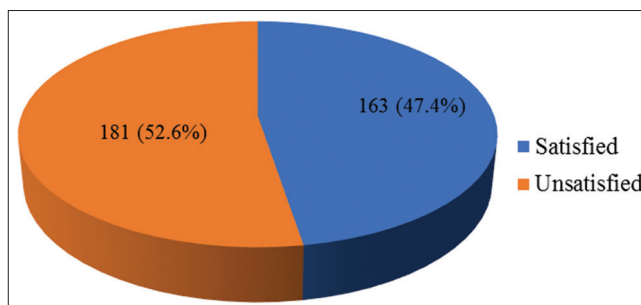


Figure 2: Satisfaction with knowledge acquired so far on COVID-19

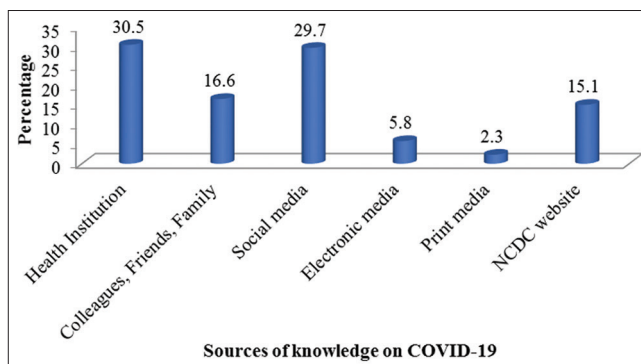


Figure 3: Sources of knowledge on preventive measures for COVID-19

Table 1: Knowledge of preventive measures for COVID-19 among the respondents

Questions	True		False	
	Agree	Strongly Agree	Disagree	Strongly disagree
	n (%)	n (%)	n (%)	n (%)
1. SAR COV-2 is the major cause of COVID-19	185 (53.80)	117 (34.00)	4 (1.20)	38 (11.00)
2. COVID-19 can be spread through droplets and touching contaminated surfaces	121 (35.20)	223 (64.80)	0 (0.00)	0 (0.00)
3. Facemasks and goggles can be used to prevent COVID-19	207 (60.20)	96 (27.90)	13 (3.80)	28 (8.10)
4. Wearing protective booths can be used to prevent COVID-19	201 (58.40)	68 (19.80)	37 (10.80)	38 (11.00)
5. Wearing a protective gown is a preventive measure against COVID-19	214 (62.20)	81 (23.50)	18 (5.20)	31 (9.00)
6. Appropriate disinfection and disposal of PPEs gown is a preventive measure against COVID-19	168 (48.80)	112 (32.60)	29 (8.40)	35 (10.20)
7. Following guidelines by WHO* and NCDC** can help one prevent COVID-19	202 (58.70)	142 (41.30)	0 (0.00)	0 (0.00)
8. Appropriate hand hygiene, physical distancing, and avoiding touching the face, eyes, and nose are preventive measures against COVID-19	175 (50.90)	169 (49.10)	0 (0.00)	0 (0.00)
9. COVID-19 can lead to pneumonia, respiratory failure, and possibly death and require to be prevented	99 (28.80)	245 (71.20)	0 (0.00)	0 (0.00)

Table 2: Practice of COVID-19 preventive measures among respondents

Questions	Yes n (%)	No n (%)
Know all the infection preventive measures against COVID	340 (98.80)	4 (1.20)
The distance that should be maintained around an infected individual		
Approximately 2 meters	224 (65.10)	-
Approximately 5 meters	21 (6.10)	-
Approximately 6 meters	70 (20.30)	-
All of the above	29 (8.40)	-
Washing of hands		
Before every episode of direct patient care	334 (97.10)	10 (2.90)
After any contact that results in to hand being contaminated	335 (97.40)	9 (2.60)
After removing of Proper Personal Protective Equipments (PPEs)	334 (97.10)	10 (2.90)
Any time	122 (35.50)	222 (64.50)
Availability of running water and soap for hand hygiene	308 (89.50)	36 (10.50)
Availability of hand sanitizers	328 (95.30)	16 (4.70)
Availability and use of face mask		
Availability of surgical face mask when needed	163 (47.40)	181 (52.60)
Use of surgical face mask when caring for a patient	312 (90.70)	32 (9.30)
Physical distancing in inpatient settings		
Availability of isolation wards in your unit to admit confirmed cases of COVID-19	231 (67.20)	113 (32.80)
Maintain recommended distance from patients	267 (77.60)	77 (22.40)
Use privacy curtains between beds to prevent close contact.	159 (46.20)	185 (53.80)
Environmental decontamination of highly touched surfaces		
Involvement in decontamination of the hospital	67 (19.50)	277 (80.50)
Decontamination of patient wards, hospital environment, and high-touched areas		
Always	62 (92.50)	-
Once a week	3 (4.50)	-
Once a month	0 (0.00)	-
Only when it's dirty	2 (3.00)	-
Linen		
All linen used in the direct care of patients with possible and confirmed cases of COVID-19 should be managed as "Infectious linen."	215 (62.50)	129 (37.50)
Linen must be handled, transported, and processed by following stipulated guidelines.	341 (99.10)	3 (0.90)
Disposable gloves and an apron should be worn when handling infectious linen.	337 (98.00)	7 (2.00)
A laundry receptacle should be readily available for the immediate disposal of linens.	344 (100.00)	0 (0.00)

*World Health Organization **Nigeria Centre for Disease Control

Discussion

The study assessed if the nurses were trained as frontline workers in the respective hospital before they started attending to patients as the outbreak became a global concern; the study revealed that the majority of the nurses in the hospitals had no formal training on COVID-19, which may increase the risk of transmitting the disease to their contacts. COVID-19 became an emergency in most countries, making them unprepared to face the pandemic; healthcare providers had to work with their fundamental knowledge on standard precautions. The disease nature and fatalities associated with COVID-19 would have motivated the nurses to seek knowledge through various media where information was readily available to protect themselves,

their patients, and communities while carrying out their duties. Studies have identified lapses in infection prevention and control in healthcare settings as significant drivers of uninterrupted transmission of certain diseases, especially infectious diseases like COVID-19.^[16,17] This could lead to failure to adhere to proper infection prevention practices as stipulated by WHO^[14] and may expose nurses to increased risk of contracting the disease, especially in Nigerian Hospitals where PPEs have been reported to be inadequate with little capacity to deal with the disease compared to other developed countries.^[18]

Findings from the study on the knowledge of nurses on preventive measures toward COVID-19 showed that nurses are knowledgeable about the means of contacting

Table 3: Sociodemographic characteristics influencing knowledge of COVID-19 preventive measures among the respondent

Variable	Knowledge		AOR*	Confidence interval	p
	Good n=316	Poor n=28			
Age category (years)					
16–25	38 (12.00)	10 (35.70)	-	-	-
26–35	200 (63.30)	14 (50.00)	3.80	1.56–9.09	0.003
36–45	58 (18.40)	3 (10.70)	5.10	1.31–19.70	0.018
46 and above	20 (6.40)	1 (3.60)	5.20	0.63–44.10	0.126
Gender					
Male	18 (5.70)	2 (7.10)	-	0.28–5.79	0.754
Female	298 (94.30)	26 (92.90)	1.30		
Qualification/level of education					
Registered Nurse/midwife	215 (68.00)	25 (89.30)	12.30	4.79–31.63	<0.001
Bachelor of science	94 (29.70)	2 (7.10)	37.60	7.64–184.95	<0.001
Masters of science/doctor of philosophy in nursing	7 (2.20)	1 (3.60)	5.60	0.60–52.00	0.130
Cadre					
Nursing officer 11	25 (7.90)	12 (42.90)	-	-	-
Nursing officer 1	80 (25.30)	12 (42.90)	3.20	1.28–8.01	0.013
Senior nursing officer	151 (47.80)	2 (7.10)	36.20	7.65–171.71	<0.001
Principal nursing officer	23 (7.30)	1 (3.60)	11.00	1.33–91.71	0.026
Assistant chief nursing officer-assistant director nursing services	37 (11.70)	1 (3.60)	17.80	2.17–145.34	0.007
Years of experience					
1–10	89 (28.20)	26 (92.90)	-	-	-
11–20	196 (62.00)	1 (3.60)	57.30	7.649–428.60	<0.001
21–30	31 (9.80)	1 (3.60)	3.40	1.179–69.56	0.034

*AOR: Adjusted odd ratio

the disease, they have the knowledge that COVID-19 can be spread through droplets and touching of contaminated surfaces, that facemasks and goggles can be used to prevent COVID-19, and that appropriate disinfection and disposal of PPEs gown is a preventive measure to COVID-19. Also, following the guidelines of WHO and NCDC could help one prevent COVID-19, and nurses strongly agree that COVID-19 could lead to pneumonia, respiratory failure, and possibly death. Most of the nurses had adequate knowledge of COVID-19 preventive measures and were satisfied with the knowledge acquired so far on COVID-19. These findings are comparable with Zhou *et al.*^[9] on the understanding of healthcare workers regarding COVID-19 preventive measures, which showed that healthcare workers had sufficient knowledge of COVID-19 preventive measures. In their study, Zhong *et al.*^[10] also observed that most Chinese residents of relatively high socioeconomic status, particularly women, were knowledgeable about COVID-19. In the same vein, Odikpo *et al.*,^[13] Giao *et al.*,^[11] and Farah *et al.*^[7] also discovered the majority of healthcare workers in a similar study had good knowledge of COVID-19 and its preventive measures. A good understanding of COVID-19 preventive measures was also reported by Ejeh *et al.*^[19] and Tsiga-Ahmed *et al.*^[20]; Maude *et al.*^[21]

On the sources of knowledge on preventive measures for COVID-19, the nurses reported having obtained COVID-19

knowledge primarily from health institutions. This finding is similar to that reported by Maude *et al.*,^[21] which showed information sources most used by health workers were the workplace, work colleagues, health workers, and television. Contradicting this report, Olapegba *et al.*^[12] reported in Nigeria that information about COVID-19 is mainly derived from traditional media, which was not the case in this study.

The practice of COVID-19 preventive measures among nurses showed that nurses are knowledgeable about all the infection preventive measures against coronavirus, which are necessary to prevent the disease.^[14] Most of the nurses maintained approximately 2 meters distance around an infected individual, and handwashing was carried out mainly after any contact that resulted in to hand being contaminated, which did not follow the moments of handwashing strictly as stipulated in other to prevent infections. The nurses also stated that their institution had an isolation ward to admit confirmed COVID-19 cases. Also, decontamination of patient wards, hospital environments, and high-touched areas was always done, as reported by the few who claimed to be involved in the decontamination process of their ward. COVID-19 is a global pandemic in which the primary means to protect themselves from being infected is the practice of preventive measures. The report shows that the nurses are acquainted with the appropriate

preventative measures and practice the same as in the study. The finding is similar to an account by Limbu *et al.*,^[8] where the health workers in their study had good preventive practices for COVID-19. WHO^[14] and Nigerian Center for Disease Control^[4] require health workers to be prepared and ready to respond to an outbreak, in particular, the one due to COVID-19, and should implement WHO recommended infection prevention and control interventions, including identifying, isolate and report suspect and confirmed cases.^[14] Similarly, Zhou *et al.*^[9] findings on preventive measures for COVID-19 revealed that nurses followed correct practices regarding COVID-19. Contrary to the finding in this report, Farah *et al.*^[7] study discovered overall good knowledge of COVID-19 but a relatively low level of practice. These contradictions found in some reports may be a result of environmental factors.

The sociodemographic characteristics influencing knowledge of COVID-19 preventive measures among the respondent showed that nurses who had RN/RM and BScN were more knowledgeable when compared to nurses with M.ScN/Ph.D. Similarly, Senior Nursing Officers (SNO) with 11 to 20 years of experience had more knowledge when compared to other cadres studied. This result revealed practically oriented educational qualifications and increased years of professional experience; there is a tendency to have more knowledge as events unfold, especially in the face of epidemics like COVID-19. This result is comparable with the findings of Wen *et al.*^[6] who discovered that nursing staff with working experience ≤ 10 years scored lower than those with working experience ≥ 20 years, with OR values of 0.490 (95% CI: 0.412–0.583) and 0.654 (95% CI: 0.551–0.775). Similar report was also found in another similar study with AOR values of 0.747 (95% CI: 0.629–0.886).^[22] Also, Tsiga-Ahmed *et al.*^[20] also identified that having a bachelor's or medical degree an influence on good knowledge of COVID-19 (aOR = 4.60, 95% CI: 1.3-16.50)

The study's primary limitation was the limited area and sample covered by the survey. The researchers could have covered more expansive areas and added other hospitals in the state but resorted to two tertiary institutions due to the COVID-19 restrictions placed by the government, including restrictions on movement; hence, the study result may need to be generalized to a broader population. Another area for improvement of the study was utilizing the researchers' developed tool as a standardized tool was not utilized for data collection by the researchers.

Conclusion

The nurses in the study had good knowledge of the preventive measures for COVID-19 despite not being trained as frontline staff; it is essential to transform theory into practice by making sure that the preventive measures they know are put into practice as a means to halt the spread of the disease in the face of minimal vaccine coverage.

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Conflicts of interest

Nothing to declare.

References

1. WHO. Coronavirus disease 2019 (COVID-19): World Health Organization. 2020. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. [Retrieved on 2020 Oct 29, Last accessed on 2022 Jan 01].
2. CDC. Coronavirus disease 2019 (COVID-19). 2020. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/about/transmission.html>. [Retrieved on 2020 Sep 11, Last accessed on 2022 Jan 01].
3. WHO. Coronavirus disease 2019 (COVID-19) situation: World Health Organization. 2020. Available from: <https://www.who.int/countries/nga/>. [Retrieved on 2020 Oct 29, Last accessed 2022 Jan 07].
4. NCDC. Public health advisory to Nigerians on coronavirus disease. 2020. Available from: <https://ncdc.gov.ng/news/244/18th-march-2020%7C-public-health-advisory-to-nigerians-on-coronavirus-disease-%28%236%29>. [Last accessed 2020 May 09].
5. World Health Organization. Guidance for health workers. 2020. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-Guidance/health-workers>. [Last accessed on 2020 Jul 13].
6. Xin W, Fan W, Xiuyang L, Hua G. Study on the knowledge, attitude, and practice (KAP) of nursing staff and influencing factors on COVID-19. *Front Public Health* 2021;8:966.
7. Farah AM, Nour TU, Obsiye M, Adan MA, Ali OM, Hussein MA, *et al.* Knowledge, attitude, and practice toward COVID-19 among healthcare workers in public health facilities, Eastern Ethiopia. *medRxiv* 2021. doi: 10.1101/2021.01.02.21249137.
8. Limbu DK, Piryani RM, Sunny AK. Healthcare workers' knowledge, attitude, and practices during the COVID-19 pandemic response in a tertiary care hospital of Nepal. *PLoS One* 2020;15:e0242126. doi: 10.1371/journal.pone.0242126.
9. Zhang M, Zhou M, Tang F, Wang Y, Nie H, Zhang L, You G. Knowledge, attitude and practice regarding COVID-19 among health care workers in Henan, China. *J Hosp Infect* 2020;10:183-7.
10. Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, *et al.* Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise of the COVID-19 outbreak: A quick online cross-sectional survey. *Int J Biol Sci* 2020;16:1745-52.
11. Giao H, Thi N, Han N, Khanh TV, Ngan VK, Tam V. Knowledge and attitude toward COVID-19 among healthcare workers at District 2 Hospital, Ho Chi Minh City. *Asian Pac J Trop Med* 2020;13:260-5.
12. Olapegba PO, Ayandele O, Kolawole SO, Oguntayo R, Gandi JC, Dangiwa AL, *et al.* A preliminary assessment of novel coronavirus (COVID-19) knowledge and perceptions in Nigeria. *MedRxiv* 2020. doi: 10.13140/RG.2.2.11053.44008.

13. Odikpo LC, Abazie HO, Emon D, Mobolaji-Olajide MO, Gbahabo DD, Musa-Malikki A. Knowledge and reasons for anxiety among nurses towards COVID -19 in Nigeria. *Afr J Infect Dis* 2021;15:16-23.
14. WHO. Infection Prevention and Control (IPC) for Novel Coronavirus (COVID-19). Available from: <https://openwho.org/courses/COVID-19-IPC-EN>. [Last accessed on 2020 May 08].
15. Cochran WG. *Sampling Techniques*. 3rd ed. New York: John Wiley & Sons; 1977.
16. Mackay IM, Arden KE. MERS coronavirus: Diagnostics, epidemiology, and transmission. *Virology* 2015;12:222. doi: 10.1186/s12985-015-0439-5.
17. Desta M, Ayenew T, Sitotaw N, Tegegne N, Dires M, Gertie M. Knowledge, practice and associated factors of infection prevention among healthcare workers in Debre Markos referral hospital, Northwest Ethiopia. *BMC Health Serv Res* 2018;18:1-10.
18. Gilbert M, Pullano G, Pinotti F, Valdano E, Poletto C, Boëlle P-Y, *et al.* Preparedness and vulnerability of African countries against importations of COVID-19 modelling study. *Lancet* 2020;14:871-7.
19. Ejeh FE, Saidu AS, Owoicho S, Maurice NA, Jauro S, Madukaji L, Okon KO. Healthcare workers' knowledge, attitude, and practice toward COVID-19 outbreak in Nigeria. *Heliyon* 2020;6:e05557. doi: 10.1016/j.heliyon.2020.e05557.
20. Tsiga-Ahmed FI, Amole TG, Musa BM, Nalado AM, Agoyi OB, Galadanci HS, *et al.* COVID-19: Evaluating healthcare knowledge, attitude, and preventive practices workers in northern Nigeria. *Int J MCH AIDS* 2021;10:88-97.
21. Maude RR, Jongdeepaisal M, Skuntaniyom S, Muntajit T, Blacksell SD, Khuenpetch W, *et al.* Improving knowledge, attitudes, and practice to prevent COVID-19 transmission in healthcare workers and the public in Thailand. *BMC Public Health* 2021;21:749. doi: 10.1186/s12889-021-10768-y.
22. C OL, C EO, O OE, Chiedu EM, Ilo CI, Helen OI, *et al.* Study on knowledge and compliance to the practice of preventive measures to covid-19 among nurses in a selected tertiary hospital in south-south, Nigeria. *Afr J Infect Dis* 2022;16:55-62.