**Knowledge and Risk Perception of COVID-19 Nosocomial Infection among Attendees of Primary Healthcare Facilities in Federal Capital Territory (FCT) Abuja, Nigeria.**

**ABSTRACT**

Coronavirus disease 2019 (COVID-19) pandemic has posed significant challenges to healthcare systems worldwide, with the risk of nosocomial infections emerging as a critical concern. The level of knowledge and risk perception could prompt individuals to take precautionary measures and reduce the spread. This study aims to determine the knowledge and risk perception of COVID-19 nosocomial infection among attendees at primary healthcare facilities in the Federal Capital Territory (FCT) of Abuja, Nigeria. A descriptive cross-sectional study design was used in the study where an interviewer-administered semi-structured questionnaire was used to obtain information from attendees of the selected healthcare facilities. Multistage sampling methods were used to select respondents from Gwagwa, Gwarimpa and Kabusa wards of Abuja Municipal Area Council (AMAC). The questionnaire was collated and data was analyzed using SPSS Version 23. Chi-square tests was performed on respondents' socio-demographic characteristics, knowledge and risk perception of COVID-19 nosocomial infection. The result of the findings revealed that majority of the participants were female (74%), aged 25-34(57%) mostly civil servants (29.2%) with tertiary education (45%). Many of the respondents had good knowledge of COVID-19 nosocomial infection (87.7%) as all the respondents heard about COVID-19 mostly through mass media (84.8%). The respondents’ risk perception to COVID-19 nosocomial infection was high (91.6%) with high level of adherence to COVID-19 prevention measures (70.44%). Many of the respondents expressed lack of disinfectants, clean water and high prices of items to be the barriers hindering them from fully protecting themselves against COVID-19. The statistical analysis showed that knowledge and risk perception of COVID-19 nosocomial infection is affected by factors such as age, religion, level of education and occupation as they were statistically significant. The study generally showed high level of knowledge and risk perception of COVID-19 nosocomial infection as well as adherence to COVID-19 prevention measures despite the challenges by some social factors like age, education and occupation.

**Key words: COVID-19, Nosocomial Transmission, Knowledge, Risk Perception, Primary Healthcare Facilities, Abuja**

**INTRODUCTION**

There is an increasing realization by scientists and researchers that infectious diseases constitute a significant contributor of global morbidity, mortality and socioeconomic concerns. An infection refers to the invasion of an organism's body [tissues](https://en.wikipedia.org/wiki/Tissue_%28biology%29) by [disease-causing agents](https://en.wikipedia.org/wiki/Pathogen), their multiplication, and the reaction of [host](https://en.wikipedia.org/wiki/Host_%28biology%29) tissues to the infectious agents and the [toxins](https://en.wikipedia.org/wiki/Toxin) they produce [(Krämer & Hossain Khan, 2009)](https://paperpile.com/c/Apc6SZ/qtBr).  Infections can be caused by a wide range of [pathogens](https://en.wikipedia.org/wiki/Pathogen), most prominently [bacteria](https://en.wikipedia.org/wiki/Pathogenic_bacteria) and [viruses](https://en.wikipedia.org/wiki/Virus)and the hosts can fight infections using their [immune system](https://en.wikipedia.org/wiki/Immune_system). The global focus on nosocomial infections has been prominent with COVID-19 pandemic.

Nosocomial infections, also called health-care-associated or [hospital-acquired infections](https://www.osmosis.org/answers/nosocomial-infection) (HAI) are infections that occur in 48 hours of  hospital admission,  three days  after discharge from hospital  or 30  days  after  an  operation or procedure  in  whom  the  infection  was  not present  or  incubating  at  the  time  of  admission [(Giri et al., 2016)](https://paperpile.com/c/Apc6SZ/Tmvv). Again, nosocomial infections are often caused by multidrug-resistant pathogens and microorganisms obtained via invasive procedures, excessive or improper antibiotic use, surgery, indwelling medical devices, prosthetic devices and not following infection control and prevention procedures as many nosocomial infections are preventable [(Sikora & Zahra, 2022)](https://paperpile.com/c/Apc6SZ/dt3B). Pathogens that are associated with nosocomial infection mostly have different modes of transmission, but the commonest route of transmission is through contact (direct or indirect), droplet transmission or air-borne transmission [(Sikora & Zahra, 2022)](https://paperpile.com/c/Apc6SZ/dt3B).

Coronavirus disease 2019 (COVID-19), first identified in Wuhan, China in December 2019, has rapidly spread across every region of the world. COVID-19 is caused by a new type of Coronavirus called severe acute respiratory syndrome coronavirus 2 (SARSCoV-2). There are now over 500 million confirmed cases worldwide, which has resulted in about 6 million deaths as of April, 2022. The transmission of COVID-19 occurs through direct, indirect, or close contact with infected people through infected secretions like saliva and respiratory secretions or their respiratory droplets expelled when an infected person coughs, sneezes, kisses, talks[(Zhou et al., 2020)](https://paperpile.com/c/Apc6SZ/Qx9w).

In addition to its global impact, COVID-19 has alarmed the healthcare community on the danger and harm of nosocomial infection. Nosocomial infection of COVID-19 has been discovered and reported in many healthcare facilities on a global scale. It has been shown that COVID‑19 is more likely to transmit via close, unprotected contact with infected patients during stay in the heath facility causing nosocomial infection. This incurs prolonged admission, complication of cases and extra financial hardship especially with the current preventative and containment measures tend to overlook asymptomatic individuals and super-spreading events [(Du et al., 2021)](https://paperpile.com/c/Apc6SZ/HpGk).

The knowledge of any disease plays great role in the perception of its risk and belief within a community, especially rural community where level of awareness is low. If the knowledge of the disease in any community is relatively unavailable, then, risk posed by the disease, its burden in terms of morbidity, mortality and socio-economic impact tend to be high simply because there will be low risk perception and belief of the disease in the community. In order to prevent further transmission of COVID-19, the Nigerian government commenced improved public health campaigns regarding COVID-19. The Nigerian government initiated the emergency operations center in collaboration with partner agencies which are led by experts. The success of these interventions depends on the knowledge level of risk perception and public behavior which stems from individual´s knowledge of COVID-19 [(Ilesanmi & Afolabi, 2021a)](https://paperpile.com/c/Apc6SZ/WEFt).

Similarly, studies on COVID-19 in China have demonstrated that adequate knowledge of the infection could prompt individuals to take precautionary measures[(Zhang et al., 2020)](https://paperpile.com/c/Apc6SZ/FuNA). Adequate knowledge of the public is likely to contribute to its risk perception, severity and belief, hence prompt containment of nosocomial COVID-19 especially in Primary Healthcare Centers (PHCs) where the local community, including women and children, are mostly the victims as it is mostly their first health seeking center, hence the study was aimed at determining the knowledge and risk perception of COVID-19 nosocomial infection among attendees of PHC Facilities in the Federal Capital Territory, Abuja

**MATERIALS AND METHODS**

**Study Area**

The study was carried out in 6 Primary Health Care (PHC) facilities in Abuja Municipal Area Council (AMAC), namely; Gwagwa, Kuchingoro, Piwoyi , Galadimawa, Kabusa and Lugbe. Each of the PHC facilities covers a designated ward. AMAC is located between latitude 80401 and 90201 north of the equator and longitude 60401 and 70401 east of the Greenwich meridian. The Abuja FCT has a land mass of approximately 8000sq km of which the AMAC occupies about 1,476 km² with an estimated population of about 1,967,500. The predominant tribes are Gbagyi, Bassa, Gwandra, Hausa and others.

Most of the people living in Gwagwa, Gwarinpa and Kabusa wards are medium and low-income earners that rely on trading, private businesses, farming etc with few who are civil servants. All the PHCs provide essential services such as Health education, Maternal, Newborn and Child health (Antenatal and postnatal services, family planning, childhood immunizations etc), treatment of minor ailment/injuries, provision of essential drugs and other directly-related components of PHC.

**Inclusion Criteria and Exclusion Criteria**

All adults (aged 18 years and above), who are conscious, that accessed health care at the following PHC facilities: Gwagwa, Kuchingoro, Piwoyi, Galadimawa, Kabusa and Lugbe and consented to be part of the study and signed a written informed consent, were included in the study Adults admitted who are unconscious and cannot participate in the study were excluded.

**Sample Size Determination**

A sample size of 420 was used and was calculated using Fisher formula: n = Z2 P (1-P)/ d2.  A prevalence of 50% was used due to non-availability of a study to use for the sample size calculation [(Ilesanmi & Afolabi, 2021a)](https://paperpile.com/c/Apc6SZ/WEFt) at 5% 20 margin of error and 95% confidence level. To cover for of non-response, 10% of the sample was added to the calculated sample (384 sample).

**Sampling Technique**

Multistage sampling technique was used in this study. Of the six (6) area councils in FCT, AMAC was selected by simple random sampling (ballot method). Abuja Municipal Area Council (AMAC) has 12 political wards. Again, simple random sampling (ballot method) was used to select three (3) wards. These wards are: Gwagwa, Gwarimpa and Kabusa. The 3 wards selected have a total of 28 PHC facilities. Systematic sampling was used to select 6 out of 28 PHC facilities and the total sample size was distributed among the study area using sampling proportionate to size. The study was conducted within the period of one year (April, 2022 to March, 2023).

## **Study Instrument**

An interviewer-administered, pretested, structured questionnaire was used to collect data with the help of principal investigator and trained research assistants. The questions were used to collect information on patients’ knowledge and risk perception of nosocomial COVID-19 and barriers against prevention measures.The questionnaire had 5 sections: Respondent’s Sociodemographic Characteristics; Respondent’s knowledge of the on COVID-19 Nosocomial Infection; Respondent’s Risk Perception of COVID-19 Nosocomial Infection; Respondent’s Adherence to COVID-19 Preventive Measures; Barriers to Adherence of COVID-19 preventive Measures.

**Data Analysis**

The questionnaire was collated and data was analyzed using SPSS Version 23. The results were presented as frequency tables, graphs and charts. Chi-square test statistic was used at 95% level of significance to determine the factors associated with knowledge and risk perception of COVID-19.

**Ethical Considerations**

A request for ethical approval (with Approval No.: FHREC/2022/01/46/25-03-22) to carry out the study was obtained from the Federal Capital Territory Health Research Ethics Committee. The selected participants were adequately informed about the study and informed consent obtained.  They were assured of the confidentiality, voluntariness (right to decline) and withdrawal from the study at any time without any sanction.

**RESULTS**

Out of a total of 420 questionnaires administered, 407 were completed filled and returned with 13 participants abstained during the interview; giving a response rate of 96.9%. Table 1a and b showed that out of the total respondents, 301 (74%) were females while 106 (26%) were males. Two hundred and thirty-two (57%) respondents were within the ages of 25-34 years with an average age of 33years. Over half of respondents (57.7%, n=235) and 172 (42.3%) were Christians and Muslims respectively. Majority (294, 72.2%) of the respondents were married, while 66 (16.2%) were single. Concerning the respondents’ level of education, 183, (45.0%) had tertiary education while 32 (7.9%) had Islamic education. Civil servants and traders constituted 50.6% of the respondents while artisans and farmers were 16.9%. Two hundred and eighty-six (70.2%) respondents had between 2 to 5 number of people in the households while 178 (43.7%) of the respondents earned more than N35,000 as an average monthly income.

**Table 1a: Socio-demographic Characteristics of the Respondents**

|  |  |  |
| --- | --- | --- |
| Variables | Frequency (N=407) | Percentage |
| Age | 18-24 | 36 | 8.8 |
| 25-34 | 232 | 57 |
| 35-44 | 102 | 25.1 |
| 45-54 | 26 | 6.4 |
| 55-64 | 11 | 2.7 |
| 65 and above | - | - |
| Gender | Male | 106 | 26 |
| Female | 301 | 74 |
| Religion | Islam | 172 | 42.3 |
| Christianity | 235 | 57.7 |
| Traditional | 0 | 0 |
| others | 0 | 0 |
| Marital Status | Single | 66 | 16.2 |
| Married | 294 | 72.2 |
| Divorced | 15 | 3.7 |
| Widowed | 32 | 7.9 |

**Table 1b: Socio-demographic Characteristics of the Respondents**

|  |  |  |
| --- | --- | --- |
| Variables | Frequency (N=407) | Percentage |
| Educational Qualification  | Non-formal | 10 | 2.5 |
| Islamic | 32 | 7.9 |
| Primary | 24 | 5.9 |
| Secondary | 158 | 38.8 |
| Tertiary | 183 | 45 |
| Occupation | Civil Servant | 119 | 29.2 |
| Trading | 87 | 21.4 |
| Artisan | 49 | 12.0 |
| Farming | 20 | 4.9 |
| Student | 66 | 16.2 |
| Housewife | 66 | 16.2 |
| Number of people living in your household | 2-3 | 106 | 26 |
| 4-5 | 180 | 44.2 |
| 6-7 | 64 | 15.7 |
| 8-9 | 25 | 6.1 |
| More than 9 | 32 | 7.9 |
| Average household monthly income (in Naira) | 5,000 and less | 9 | 2.2 |
| 6,000-15,000 | 47 | 11.5 |
| 16,000-25,000 | 93 | 22.9 |
| 26,000-35,000 | 80 | 19.7 |
| More than 35,000 | 178 | 43.7 |

All the respondents (407, 100%) expressed that they have heard about COVID-19 from different sources as shown in Figure 1. The respondents identified mass media as the major source of information (84.8%), followed by internet/social media (48.6%). About one-third of the respondents got their information on COVID-19 through friends and family members (35.4%), health workers (31.9%) and relevant ministries (23.3%). Figure 2 above showed that majority (n=318, 78.1%) of the respondents believed the symptom of COVID-19 to be cough, then followed by sore throat (n=301, 74%). About half of the respondents also chose sneezing, fever and shortness of breath (50.4%, 48.4% and 41% respectively). Again, about half of the respondents, (n=199, 49%) believed that COVID-19 infection may show no symptom at all.

**Figure 1: Sources of information on COVID-19**

**Figure 2: Symptoms of COVID-19**

Table 2 showed that more than half of the respondents (n = 266, 65.4%) believed that COVID-19 did not having a supernatural origin. Slightly over two-third (n= 277, 68.2%,) respondents believed that COVID-19 can be transmitted by asymptomatic persons.

Three hundred and fifty-six (87.5%) respondents were aware of COVID-19 nosocomial transmission but only 194 (47.7%) knew more than one mode of transmission of COVID-19 nosocomial infection. Close to two-third (n=261, 64.1%,) respondents believed that COVID-19 can be transmitted from health workers to patients, 283 (69.5%) believed that it can be transmitted from patients to health workers while 391 (96.1%) believed that it can be transmitted from patient to patient. Over three-quarter (n= 317, 77.9%) believed that medical equipment and other health facilities could be a source of COVID-19 nosocomial infection. Generally, majority of the respondents (n = 357, 87.7%) had good knowledge of COVID-19 nosocomial infection as shown in Figure 3.

**Table 2: Knowledge of the Respondents Towards COVID-19 Nosocomial Infection**

|  |  |  |
| --- | --- | --- |
| Variables | Frequency | Percentage |
| COVID-19 has supernatural origins | Yes  | 141 | 34.6 |
|  No | 266 | 65.4 |
| COVID-19 can be transmitted by someone with no symptoms | Yes | 277 | 68.2 |
| No | 129 | 31.8 |
| I am aware that there is COVID-19 nosocomial infection | Yes | 356 | 87.5 |
| No | 51 | 12.5 |
| COVID-19 nosocomial infection be transmitted by: | One mode of transmission | 162 |  39.8 |
| More than one mode of transmission | 194 |  47.7 |
| Do not know | 51 |  12.5 |
| Health workers can transmit COVID-19 to patients | Yes | 261 | 64.1 |
| No | 85 | 20.9 |
| I do not know | 61 | 15 |
| COVID-19 can be transmitted from patients to health workers? | Yes | 283 | 69.5 |
| No | 64 | 15.7 |
| I do not know | 60 | 14.7 |
| COVID-19 can be transmitted from patients to patients? | Yes | 391 | 96.1 |
| No | 5 | 1.2 |
| I do not know | 11 | 2.7 |
| Health facility can be nexus of COVID-19 nosocomial infection | Yes | 317 | 77.9 |
| No | 90 | 22.1 |
| I do not know | - | - |

**Figure 3: Overall Knowledge of COVID-19 Nosocomial Infection**

The responses of the participants to risk perception of COVID-19 nosocomial infection showed that 370 (90.9%) of the respondents considered being infected with COVID-19 as a serious illness and 329 (80.8%) think that it is possible to die from in nosocomial infection. Majority of the of the respondents (n = 362, 88.9%) expressed that COVID-19 poses a serious threat to ones’ health job or studies of which 328 (80.6%) agree that people should be willing to give up their daily duties to stop the spread of COVID-19 nosocomial infection. Furthermore, 252 (62%) of the respondents opined that compared to most people at their age, their risk of getting COVID-19 is higher and many of the respondents, 270 (66.4%) also expressed that health workers may infect one with COVID-19 during hospital visit. About 314 (77.7%) of the respondents expressed that contact with hospital surfaces and equipment can lead to transmission of COVID-19 nosocomial infection. Again, about 362 (88.9%) of the respondents reported that COVID-19 nosocomial infection may worsen ones’ health condition, 342 (84%) said it may increase length of hospital stay, and 339 (83.3%) reported it can lead to incurring more medical expenses. Majority of the respondents reported that avoidance of cough and sneezing etiquette can prevent the transmission of COVID-19 and 301 (73.9%) expressed that administering COVID-19 vaccine will reduce the transmission of nosocomial COVID-19. See Table 3a and 3b. Figure 4 showed that, overall, 373 (91.6%) respondents had a good risk percption of COVID-19 nosocomial infection.

**Table 3a: Risk Perception of the Respondents Towards COVID-19 Nosocomial Infection**

|  |  |  |
| --- | --- | --- |
| Variable | Frequency (N=407) | Percent  |
| Being infected with COVID-19 is a serious illness | Strongly Agree | 194 | 47.7 |
| Agree | 176 | 43.2 |
| Neutral | 31 | 7.6 |
| Disagree | 1 | 0.2 |
| Strongly Disagree | 5 | 1.2 |
| Death could result from COVID-19 nosocomial infection | Strongly Agree | 177 | 43.5 |
| Agree | 152 | 37.3 |
| Neutral | 47 | 11.5 |
| Disagree | 26 | 6.4 |
| Strongly Disagree | 5 | 1.2 |
| COVID-19 poses serious threat to ones’ health, job or studies | Strongly Agree | 175 | 43 |
| Agree | 187 | 45.9 |
| Neutral | 30 | 7.4 |
| Disagree | 12 | 2.9 |
| Strongly Disagree | 3 | 0.7 |
| Giving up daily duties will stop the spread of COVID-19 nosocomial infection | Strongly Agree | 157 | 38.6 |
| Agree | 171 | 42 |
| Neutral | 45 | 11.1 |
| Disagree | 30 | 7.4 |
| Strongly Disagree | 4 | 1 |
| My age makes my risk of getting COVID-19 higher | Strongly Agree | 130 | 32 |
| Agree | 122 | 30 |
| Neutral | 55 | 13.5 |
| Disagree | 81 | 20 |
| Strongly Disagree | 18 | 4.4 |
| Health workers may infect patients with COVID-19 during hospital visit | Strongly Agree | 144 | 35.4 |
| Agree | 126 | 31.0 |
| Neutral | 60 | 14.7 |
| Disagree | 55 | 13.5 |
| Strongly Disagree | 22 | 5.4 |
| Contact with hospital surfaces and equipment can lead to of COVID-19 nosocomial infection | Strongly Agree | 148 | 36.6 |
| Agree | 166 | 41.1 |
| Neutral | 74 | 18.3 |
| Disagree | 14 | 3.5 |
| Strongly Disagree | 2 | 0.5 |

**Table 3b: Risk Perception of the Respondents towards COVID-19 Nosocomial Infection**

|  |  |  |
| --- | --- | --- |
| Variable | Frequency (N=407) | Percent  |
| COVID-19 nosocomial infection may worsen ones’ health condition | Strongly Agree | 186 | 45.7 |
| Agree | 176 | 43.2 |
| Neutral | 32 | 7.9 |
| Disagree | 13 | 3.2 |
| Strongly Disagree | - | - |
| COVID-19 nosocomial infection can increase the length of hospital stay | Strongly Agree | 158 | 38.8 |
| Agree | 184 | 45.2 |
| Neutral | 37 | 9.1 |
| Disagree | 17 | 4.2 |
| Strongly Disagree | 11 | 2.7 |
| COVID-19 nosocomial infection can lead to incurring more medical expenses | Strongly Agree | 175 | 43 |
| Agree | 164 | 40.3 |
| Neutral | 47 | 11.5 |
| Disagree | 20 | 4.9 |
| Strongly Disagree | 1 | 0.2 |
| Observance of cough and sneezing etiquette can prevent the transmission of COVID-19 nosocomial infection | Strongly Agree | 166 | 40.8 |
| Agree | 201 | 49.4 |
| Neutral | 21 | 5.2 |
| Disagree | 17 | 4.2 |
| Strongly Disagree | 2 | 0.5 |
| Administering COVI-19 vaccine will reduce the transmission nosocomial COVID-19 | Strongly Agree | 198 | 48.6 |
| Agree | 103 | 25.3 |
| Neutral | 68 | 16.7 |
| Disagree | 27 | 6.6 |
| Strongly Disagree | 11 | 2.7 |

**Figure 4: Respondents Overall Risk Perception of COVID-19 Nosocomial Infection**

Regarding the adherence to prevention measures about 250 (61.43%) expressed high level of adherence COVID-19 prevention measures where majority (n = 389, 95.6%) of the respondents reported to know how to prevent themselves from COVID-19 by adhering to the prevention measures such as avoiding handshake in hospitals and public places (n = 330, 81.1%), abiding by COVID-19 lockdown by staying at home (n = 364, 89.4%), wearing of face mask (354 87%), frequent washing of hands with sanitizer after contact with individuals or surfaces (283, 69%), observing social distancing in hospitals and public places (n = 346, 85%) and avoidance of touching door handles and staircase railing at hospitals in public places (320, 78%). Among the respondents, only (n = 120, 9.6%) have taken the COVID-19 vaccine out of which only (n = 74, 18.2%) have completed the doses. See Table 4. Figure 5 showed that, overall, 250 (61.43%) respondents had a high level of adherence COVID-19 nosocomial infection. The respondents expressed some barriers hindering or impeding their efforts in adhering to COVID-19 prevention measures. About half of the respondents (n=208, 51.1%) reported that lack of hand sanitizers or disinfectants as the major barriers militating against their effort in adhering to COVID-19 prevention measures. Similarly, slightly more than one-third of the respondents expressed high prices of items (n=151, 37.1%) and lack of clean water (n=137, 33.7%) as their barriers to practice of COVID-19 prevention measures shown by Figure 6.

**Table 4: Respondents’ Adherence to COVID-19 Prevention Measures**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable  | Response | Frequency (N=407) | Percentage |
| Do you know how to prevent COVID-19 infection? | Yes | 389 | 95.6 |
| No | 18 | 4.4 |
| Do you frequently shake hands with people in hospitals and public places? | Yes | 77 | 18.9 |
| No | 330 | 81.1 |
| Have you made any conscious effort to stay at home to prevent getting infected by COVID-19? | Yes | 364 | 89.4 |
| No | 43 | 10.6 |
| Do you wear a facemask in hospitals and public places? | Yes | 354 | 87 |
| No | 53 | 13 |
| Do you clean your hands with sanitizer when you come in contact with an individual or a surface? | Yes | 283 | 69.5 |
| No | 124 | 30.5 |
| Do you observe social distancing (of about 2m) in hospitals and public places? | Yes | 346 | 85 |
| No | 61 | 15 |
| Do you avoid touching door handles and staircase railing at hospitals and public locations? | Yes | 320 | 78.6 |
| No | 87 | 21.4 |
| Have you been vaccinated? | Yes | 120 | 29.6 |
| No | 286 | 70.4 |
| If yes to question 39, have you completed the doses? | Yes | 74 | 18.2 |
| No | 40 | 9.8 |
| Did not take the vaccine | 293 | 72 |

**Figure 5: Respondents Overall Level of Adherence to COVID-19 Prevention Measures**

**Figure 6: Respondents’ Barriers to Adherence to COVID-19 Prevention Measures**

There is a statistically significant association between the respondents’ knowledge of COVID-19 nosocomial infection and their educational level (p=0.001) and occupation (p=0.00) as shown in Tables 5a and 5b. Statistically significant association was seen between the respondents’ risk perception of COVID-19 nosocomial infection and their age (p=0.00), religion (p=0.01) and occupation (p=0.00) as shown in Tables 6a and 6b. Tables 7a and 7b shows a statistically significant association between the respondents’ level of adherence to COVID-19 prevention measures and their age (p = 0.00), level of education (p = 0.01), occupation (p = 0.00) and average monthly household income (p = 0.00).

**Table 5a: Respondents’ Factors That Influence Knowledge of COVID-19 Nosocomial Infection**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Knowledge |  Total |  P-Value |
|  Good (%) |  Poor (%) |
| Age | 18-24 | 25(69.4) | 11(30.6) | 36 | 0.08 |
| 25-34 | 205(88.4) | 27(11.6) | 232 |  |
| 35-44 | 92(90.2) | 10(9.8) | 102 |  |
| 45-54 | 24(92.3) | 2(7.7) | 26 |  |
| 55-64 | 11(100) | 0(0.0) | 11 |  |
| Gender | Male | 100(94.3) | 6(5.7) | 106 | 0.08 |
|  | Female | 257(85.4) | 44(14.5) | 301 |  |
| Religion | Islam | 150(87.2) | 22(12.8) | 172 | 0.453 |
|  | Christianity | 207(88.1) | 28(11.9) | 235 |  |
|  |  |  |  |  |  |

**Table 5b:** **Respondents’ Factors That Influence Knowledge of COVID-19 Nosocomial Infection**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Knowledge |  Total |  P-Value |
|  Good (%) |  Poor (%) |
| Marital Status | Single | 52(78.8) | 14(21.2) | 66 | 0.057 |
|  | Married | 262(89.1) | 32(10.9) | 294 |  |
|  | Divorced | 15(100) | 0(0.0) | 15 |  |
|  | Widowed | 28(87.5) | 4(12.5) | 32 |  |
| Educational Qualification  | Non-formal | 10(100) | 0(0.0) | 10 | \*0.01 |
|  | Islamic | 28(87.5) | 4(12.5) | 32 |  |
|  | Primary | 15(62.5) | 9(37.5) | 24 |  |
|  | Secondary | 135(85.4) | 23(14.6) | 158 |  |
|  | Tertiary | 169(92.3) | 14(7.7) | 183 |  |
| Occupation | Civil Servant | 119(100) | 0(0.0) | 119 | \*0.00 |
|  | Trading | 76(87.4) | 11(12.6) | 87 |  |
|  | Artisan | 30(61.2) | 19(38.8) | 49 |  |
|  | Farming | 18(90.0) | 2(10.0) | 20 |  |
|  | Student | 61(92.4) | 5(7.6) | 66 |  |
|  | Housewife | 53(80.3) | 13(19.7) | 66 |  |

**Table 6a: Respondents’ Factors That Influence Risk Perception of COVID-19 Nosocomial Infection.**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Risk Perception | Total | P-Value |
|  | Good (%) | Poor (%) |  |  |
| Age | 18-24 | 25(69.4) | 11(30.6) | 36 | \*0.00 |
| 25-34 | 213(91.8) | 19(8.2) | 232 |  |
| 35-44 | 97(95.1) | 5(4.9) | 102 |  |
| 45-54 | 26(100) | 0(0.0) | 26 |  |
| 55-64 | 11(100) | 0(0.0) | 11 |  |
| Gender | Male | 98(92.5) | 8(7.5) | 106 | 0.653 |
|  | Female | 274(91.0) | 27(9.0) | 301 |  |
| Religion | Islam | 164(95.3) | 8(4.7) | 172 | \*0.01 |
|  | Christianity | 208(88.5) | 27(11.5) | 235 |  |
|  |  |  |  |  |  |

**Table 6b: Respondents’ Factors That Influence Risk Perception of COVID-19 Nosocomial Infection.**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Risk Perception | Total | P-Value |
| Marital Status | Single | 57(86.4) | 9(13.6) | 66 | 0.87 |
|  | Married | 268(91.2) | 26(8.8) | 294 |  |
|  | Divorced | 15(100) | 0(0.0) | 15 |  |
|  | Widowed | 32(100) | 0(0.0) | 32 |  |
| Educational Qualification  | Non-formal | 10(100) | 0(0.0) | 10 | 0.235 |
|  | Islamic | 32(100) | 0(0.0) | 32 |  |
|  | Primary | 22(91.7) | 2(8.3) | 24 |  |
|  | Secondary | 140(88.6) | 18(11.4) | 158 |  |
|  | Tertiary | 168(91.8) | 15(8.2) | 183 |  |
| Occupation | Civil Servant | 117(98.3) | 2(1.7) | 119 | \*0.00 |
|  | Trading | 85(97.7) | 2(2.3) | 87 |  |
|  | Artisan | 37(75.5) | 12(24.5) | 49 |  |
|  | Farming | 19(95.0) | 1(5.0) | 20 |  |
|  | Student | 57(86.4) | 9(13.6) | 66 |  |
|  | Housewife | 57(91.4) | 9(8.6) | 66 |  |

**Table 7a: Respondents’ Factors That Influence Adherence of COVID-19 Prevention Measures**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Adherence | Total | P-Value |
| Good (%) | Poor (%) |
| Age | 18-24 | 19(52.8) | 17(47.2) | 36 | \*0.00 |
| 25-34 | 123(53.0) | 109(47.0) | 232 |  |
| 35-44 | 80(78.4) | 22(21.6) | 102 |  |
| 45-54 | 19(73.1) | 7(26.9) | 26 |  |
| 55-64 | 11(100) | 0(0.0) | 11 |  |
| Gender | Male | 66(62.3) | 40(37.7) | 106 | 0.932 |
|  | Female | 186(61.8) | 115(38.2) | 301 |  |
| Religion | Islam | 111(64.5) | 61(35.5) | 172 | 0.352 |
|  | Christianity | 141(60.0) | 94(40.0) | 235 |  |
| Marital Status | Single | 37(56.1) | 29(43.9) | 66 | 0.060 |
|  | Married | 191(65.0) | 103(35.0) | 294 |  |
|  | Divorced | 5(33.3) | 10(66.7) | 15 |  |
|  | Widowed | 19(59.4) | 13(40.6) | 32 |  |

**Table 7b: Respondents’ Factors That Influence Adherence of COVID-19 Prevention Measures**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Educational Qualification  | Non-formal | 3(30.0) | 7(70.0) | 10 | \*0.01 |
|  | Islamic | 15(46.9) | 17(53.1) | 32 |  |
|  | Primary | 16(66.7) | 8(33.3) | 24 |  |
|  | Secondary | 87(55.1) | 71(44.9) | 158 |  |
|  | Tertiary | 131(71.6) | 52(28.4) | 183 |  |
| Occupation | Civil Servant | 89(74.8) | 30(25.2) | 119 | \*0.00 |
|  | Trading | 66(75.9) | 21(24.1) | 87 |  |
|  | Artisan | 13(26.5) | 36(75.5) | 49 |  |
|  | Farming | 9(45.0) | 11(55.0) | 20 |  |
|  | Student | 37(56.1) | 29(43.9) | 66 |  |
|  | Housewife | 38(57.6) | 28(42.4) | 66 |  |
| Household Income | Less than 5,000  | 1(11.1) | 8(88.9) | 9 | \*0.00 |
|  | 6,000-15,000 | 30(63.8) | 17(36.2) | 47 |  |
|  | 16,000-25,000 | 63(67.7) | 30(32.3) | 93 |  |
|  | 26,000-35,000 | 31(38.8) | 49(61.3) | 80 |  |
|  | More than 35,000 | 127(71.3) | 51(28.7) | 178 |  |

## **Discussion**

Findings from this study indicated that 74% of the respondents were women This may be attributed to the fact that due to perception and their health seeking behaviour, women tend to utilize health care services more than men.  Generally, women utilize PHC services such as antenatal care, postnatal care, childhood immunization, treatment of minor illness/injuries and other directly-related components of PHC. That more women utilize PHC services corroborates Ilesanmi and Afolabi’s study, where most of the respondents surveyed were female [(Ilesanmi & Afolabi, 2021b)](https://paperpile.com/c/Apc6SZ/wTIj) and in contrast with Bolaji et al. (2022) which reported that majority of respondents were males. Bolaji et. al. (2022) adduced its reasons that the higher male respondents might be due to disparity in gender accessibility to internet usage in Nigeria which is currently skewed towards male.

All the respondents in this study have heard about COVID-19 and most got their information from the mass and print media and social media. This finding is in agreement with that of Adesegun et. al. (2020), The overall knowledge of the respondents on COVID-19 nosocomial infection is 87.7%, this is attributable to sustained public health awareness, sensitization and campaigns by NCDC and other relevant stakeholders both in PHC facilities by the health personnel. The high (87.5%) knowledge of COVID-19 nosocomial infection by respondents with tertiary education could be attributed to their access and comprehension about its mode of transmission in in health facility settings. Similarly, more than half of the respondents believed that COVID-19 nosocomial infection can be transmitted from health workers to patients or patient to health workers. However, some of the respondents misconceived that health facilities and health workers cannot be nexus of COVID-19 nosocomial infection. It is believed that the health facility and the health workers are free of germs and microbes. This misconception is corroborated by other studies [(Habib et al., 2021)](https://paperpile.com/c/Apc6SZ/kY8Uf). The study by Ilesanmi on knowledge of COVID-19 in Oyo State reported a score of 43.3% in spite of a high awareness of 96.3% among their respondents. This difference in finding with own study could be attributed to the study design since Ilesanmi’s study was online-based while own study is interviewer administered.

Findings from this study showed that majority of the participants (n= 373, 91.6%) had a high level of perceived risk of contracting COVID-19 nosocomial infection. The high-risk perception by these respondents might be attributed to periodic release of morbidity and mortality statistics to the public domain by NCDC.

The high-risk perception of COVID-19 nosocomial infection can also be seen from responses of the respondents as most of them agree that it can be transmitted by health workers and hospital equipment and that COVID-19 nosocomial infection may worsen one's' health condition, increase the length of hospital stay and lead to lead to incurring more medical expenses. This showed that the respondents are aware of nosocomial infections and the ability of COVID-19 to be transmitted in health facilities. Many health facilities create awareness on epidemics and pandemics and their means of transmission in order for the attendees to be cautious during their visits. Again, majority of the respondents agree that observing cough and sneezing etiquette and administration of COVID-19 vaccine can prevent the transmission of COVID-19 nosocomial infection which as well add to the high level of perception of risk.

Few among the respondents expressed low risk perception towards COVID-19 nosocomial infection. The reason that could explain the observed low risk perception as reported by some participants in this study may be due to promulgation of misconceptions and conspiracy theories about the disease, amidst the many political and health system capacity challenges to effectively handle the pandemic.

The high COVID-19 risk perception in this study corroborates the findings of Oyetunji et. al. (2021)and Bolaji et al(2022) that also reported high risk perception among their study respondents. This is in contrast to the study by Mya et. al. ([2020](https://link.springer.com/article/10.1007/s10389-021-01502-4#ref-CR21)) where less than one-fourth of respondents had high level of risk perception towards COVID-19.

Regarding the level of adherence to COVID-19 preventive measures, about two-third (61.43%) of the respondents adhered to COVID-19 prevention measures. The high level of adherence is reflected in the proportion of respondents that avoided handshake with people in hospitals and public places, adhered to lockdown guidelines, washed their hands frequently, observed social distancing, wore face mask and avoided touching of door handles and staircase railing at hospitals and public places. The high level of adherence is attributable to increased public health awareness on COVID-19 prevention measures through various channels of communication, availability of handwashing spots and disinfectants in most of the health facilities and public places and enforcement of measures like wearing face masks and observing social distancing in public places.

Concerning pharmaceutical preventive measures, less than one-third (29.6%) respondents have had one dose of COVID-19 vaccine while 18.2% had a complete dose. This finding indicates low vaccine uptake in spite of the high-risk perception and that the vaccines are freely provided. The low vaccine uptake could be due to respondents’ apprehension about vaccine safety and probable logistic challenges with accessing the vaccines [(Mya et al., 2020)](https://paperpile.com/c/Apc6SZ/TcZ3). This finding is not in agreement with an uptake of 50.7% documented by National survey of COVID-19 vaccine acceptance in Nigeria Al-mustapha et. al. (2022)`. This difference may be due to the fact that their participants are mostly government employees most of might have been vaccinated in their various ministries.

This finding agrees with findings of Kakemam et. al (2020) in a study conducted in Iran, where about 90% of the  participants  adhered  to  hand washing with  soap and  water, avoiding crowded places,  and cleaning  hands  with  other  disinfectants [(Kakemam et al., 2020)](https://paperpile.com/c/Apc6SZ/0kor9). It also contradicts the findings of Bante et al.  (2021) in Ethiopia as only 12.3% adhered to the COVID-19 preventive measures [(Bante et al., 2021)](https://paperpile.com/c/Apc6SZ/QSwB). This indicates that equal emphasis is not given for all COVID-19 prevention measures recommended by the healthcare providers even though long-lasting commitment and adherence are vital to mitigate the disease spread and minimize its impact.

Despite the fact that the results of the study revealed that knowledge and risk perception of COVID-19 nosocomial infection is high which evidently showed high level of adherence to COVID-19 prevention measures, many of the respondents expressed facing some challenges as a result of some barriers which impede them from fully adhering to the prevention measures. Based on the results, the respondents reported that lack of clean water, insufficient funds, lack of hand gloves, lack of hand sanitizers or disinfectants and high prices of items as the major barriers.

The respondents are mostly of middle and low social class, living in the outskirt of the city center where social amenities are not as much as that of the city. This may explain why water shortage is a barrier to them. Many of the respondents living in such places buy water on daily basis in limited quantities to satisfy their daily needs, therefore using clean water to frequently wash hands during the period of the pandemic seems difficult, coupled with the fact that the lockdown has made the water supply more difficult as the vendors are also at home.

The pandemic has greatly affected the global economy as the lockdown has put almost all transactions on hold and places of work closed. Again, the rate of inflation in Nigeria is on the rise in such a way that the prices of almost every item has increased, including resources needed for COVID-19 prevention. This may explain why the respondents expressed lack of hand sanitizers or disinfectants due to insufficient funds and increase in price has become a barrier hampering their practice. Similarly, lockdown prevents most people from economic activities, which will invariably increase poverty and unemployment while threatening human survival in general. The government has been struggling to handle the adverse economic effects through the distribution of food items that have been grossly inadequate and unevenly distributed, and this has made the masses to direct most of their savings and funds to foods and other items needed for daily used rather than buying sanitizers, gloves, face masks and other items needed for prevention of COVID-19 [(Amzat et al., 2020)](https://paperpile.com/c/Apc6SZ/bI98u).

This study supports the findings of Maqbool and Khan, (2020) and Xie, (2020) which showed that lack of resources such as PPE, funds, relief material etc for implementing COVID-19 prevention measures is the most influential barrier against the successful adherence to COVID-19 prevention measure as successful implementation of these measures depends on the adequate availability of resources[(Maqbool & Khan, 2020)](https://paperpile.com/c/Apc6SZ/B44PP) [(Xie et al., 2020)](https://paperpile.com/c/Apc6SZ/IvUDy).

The study showed that several factors affect knowledge and risk perception of COVID-19 nosocomial infection and level of adherence to prevention measures. These factors include Age, Religion, Level of Education and Occupation. This study showed that age was statistically significantly associated with knowledge and risk perception of COVID-19 nosocomial infection. This finding supports those of a previous study conducted in March 2020 during the early stages of the pandemic in the United States, which found that while older people perceived a greater infection-fatality risk than younger people, they also believed that they were at lower risk of becoming infected[(“Coronavirus: The First Three Months as It Happened,” 2020)](https://paperpile.com/c/Apc6SZ/6ykB). This may be consistent with the fact that while being older is indeed a risk factor for COVID-19 severe illness, older people tend to be less responsive to everyday stressors. Another explanation may be that older people are less socially active than their younger counterparts and therefore were less likely to have a perceived risk of infection.

This study also showed that level of education was statistically significantly associated with knowledge and risk perception of COVID-19 nosocomial infection. This may be because level education plays a vital role in improving the understanding and attitudes level of COVID-19. Consistently, it has been reported that a better education level is a significant predictor of appropriate knowledge, risk perception, and promote the adoption of proper infection control procedures[(Bu et al., 2022)](https://paperpile.com/c/Apc6SZ/ioUhh). This study is in line with the findings of Bu et. al. (2022) where age, sex, religion, education, knowledge, and attitude affect the knowledge and risk perception of COVID-19.

Similarly, the study also revealed that occupation of the respondents is associated with knowledge and risk perception of COVID-19 nosocomial infection. Respondents who were civil servants might have a higher knowledge and risk perception of COVID-19 infection than artisan, traders, housewives etc. This could be attributed to efforts by the government which includes training of civil servants, distribution of face masks and hand sanitizers, and enforcing other infection prevention and control (IPC) measures within the civil service system to reduce the workplace transmission of COVID-19 among government workers [(Isere et al., 2022)](https://paperpile.com/c/Apc6SZ/GFujs). This corroborates this study of Isere et. al. (2022) who also found that occupation was significantly associated with knowledge and risk perception of COVID-19 among their respondents.

 **Conclusion**

The study assessed the knowledge and risk perception of COVID-19 nosocomial infection among attendees of primary healthcare facilities in the FCT. The results of the findings showed that there is high knowledge and high risk perception of COVID-19 nosocomial infection among the study participants which has been attributed to high level of awareness on nosocomial infections, COVID-19, its mode of transmission and various prevention measures through various channels of communication. The study also revealed that there is high level of adherence to COVID-19 prevention measures among study participants which is obvious considering the high level of knowledge and Reece perception of the disease. Many of the study participants expressed some challenges and barriers in practicing or adhering to the prevention measures which is lack of adequate resources such as clean water supply, lack of hand sanitizers, soap and other disinfectant, insufficient income, high prices of commodities and in some cases lack of face mask. Statistical analysis has shown that factors such as age, educational level and occupation play vital role in affecting knowledge and risk perception of COVID-19 nosocomial infection.

Even though the level of knowledge and risk perception COVID-19 nosocomial infections are high, each health facility should provide posters, billboards, leaflets and other IEC materials for awareness in order to further increase the level of knowledge and risk perception COVID-19 nosocomial infections.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

# REFERENCES

[Adesegun, O. A., Binuyo, T., Adeyemi, O., Ehioghae, O., Rabor, D. F., Amusan, O., Akinboboye, O., Duke, O. F., Olafimihan, A. G., Ajose, O., Idowu, A. O., & Abiodun, O. (2020). The COVID-19 Crisis in Sub-Saharan Africa: Knowledge, Attitudes, and Practices of the Nigerian Public. *The American Journal of Tropical Medicine and Hygiene*, *103*(5), 1997–2004.](http://paperpile.com/b/Apc6SZ/Agtz)

[Al-Mustapha, A. I., Okechukwu, O., Olayinka, A., Muhammed, O. R., Oyewo, M., Owoicho, S. A., Abubakar, A. T., Olabisi, A., Jibril, A., Ereh, S., Fakayode, O. E., Ogundijo, O. A., Elelu, N., & Adetunji, V. O. (2022). A national survey of COVID-19 vaccine acceptance in Nigeria. *Vaccine*, *40*(33), 4726–4731.](http://paperpile.com/b/Apc6SZ/hCyYe)

[Amzat, J., Aminu, K., Kolo, V. I., Akinyele, A. A., Ogundairo, J. A., & Danjibo, M. C. (2020). Coronavirus outbreak in Nigeria: Burden and socio-medical response during the first 100 days. *International Journal of Infectious Diseases: IJID: Official Publication of the International Society for Infectious Diseases*, *98*, 218–224.](http://paperpile.com/b/Apc6SZ/bI98u)

[Bante, A., Mersha, A., Tesfaye, A., Tsegaye, B., Shibiru, S., Ayele, G., & Girma, M. (2021). Adherence with COVID-19 Preventive Measures and Associated Factors Among Residents of Dirashe District, Southern Ethiopia. *Patient Preference and Adherence*, *15*, 237–249.](http://paperpile.com/b/Apc6SZ/QSwB)

[Bu, Y., Zheng, C., Lu, M., Song, S., Luo, L., Wan, Z., & Guo, Y. (2022). Factors Associated With Knowledge, Attitudes and Risk Perception of COVID-19 Among Older People: A Cross-Sectional Study in China. *Asia-Pacific Journal of Public Health / Asia-Pacific Academic Consortium for Public Health*, *34*(6-7), 695–697.](http://paperpile.com/b/Apc6SZ/ioUhh)

[Coronavirus: the first three months as it happened. (2020). *Nature*. https://doi.org/](http://paperpile.com/b/Apc6SZ/6ykB)[10.1038/d41586-020-00154-w](http://dx.doi.org/10.1038/d41586-020-00154-w)

[Du, Q., Zhang, D., Hu, W., Li, X., Xia, Q., Wen, T., & Jia, H. (2021). Nosocomial infection of COVID‑19: A new challenge for healthcare professionals (Review). *International Journal of Molecular Medicine*, *47*(4). https://doi.org/](http://paperpile.com/b/Apc6SZ/HpGk)[10.3892/ijmm.2021.4864](http://dx.doi.org/10.3892/ijmm.2021.4864)

[Erfani, A., Shahriarirad, R., Ranjbar, K., Mirahmadizadeh, A., & Moghadami, M. (n.d.). *Knowledge, Attitude and Practice toward the Novel Coronavirus (COVID-19) Outbreak: A Population-Based Survey in Iran*. https://doi.org/](http://paperpile.com/b/Apc6SZ/0YSaQ)[10.2471/blt.20.256651](http://dx.doi.org/10.2471/blt.20.256651)

[Giri, P., Kamble, M., Kasat, V., & Phalke, D. (2016). Knowledge about hospital-acquired infections amongst nursing staff of tertiary care teaching hospital in rural western Maharashtra, India. In *International Journal of Medical Science and Public Health* (Vol. 5, Issue 5, p. 839). https://doi.org/](http://paperpile.com/b/Apc6SZ/Tmvv)[10.5455/ijmsph.2016.21082015134](http://dx.doi.org/10.5455/ijmsph.2016.21082015134)

[Habib, M. A., Dayyab, F. M., Iliyasu, G., & Habib, A. G. (2021). Knowledge, attitude and practice survey of COVID-19 pandemic in Northern Nigeria. *PloS One*, *16*(1), e0245176.](http://paperpile.com/b/Apc6SZ/kY8Uf)

[Ilesanmi, O. S., & Afolabi, A. A. (2021a). Knowledge of community members on COVID-19 in Ibadan, Oyo State, Nigeria. *The Pan African Medical Journal*, *39*, 17.](http://paperpile.com/b/Apc6SZ/WEFt)

[Ilesanmi, O. S., & Afolabi, A. A. (2021b). Knowledge of community members on COVID-19 in Ibadan, Oyo State, Nigeria. *The Pan African Medical Journal*, *39*, 17.](http://paperpile.com/b/Apc6SZ/wTIj)

[Isere, E. E., Ajayi, I., Adejugbagbe, A. M., Abiona, S. F., Omorogbe, N. E., Akinrinade, O. T., Okunade, F. T., & Folarin, T. (2022). Perceived Risk and Associated Factors towards COVID-19 infection among the residents of Ondo State, Southwest Nigeria. *Global Biosecurity*, *4*(1). https://doi.org/](http://paperpile.com/b/Apc6SZ/GFujs)[10.31646/gbio.149](http://dx.doi.org/10.31646/gbio.149)

[Kakemam, E., Ghoddoosi-Nejad, D., Chegini, Z., Momeni, K., Salehiniya, H., Hassanipour, S., Ameri, H., & Arab-Zozani, M. (2020). Knowledge, Attitudes, and Practices Among the General Population During COVID-19 Outbreak in Iran: A National Cross-Sectional Online Survey. *Frontiers in Public Health*, *8*, 585302.](http://paperpile.com/b/Apc6SZ/0kor9)

[Krämer, A., & Hossain Khan, M. M. (2009). Global challenges of infectious disease epidemiology. In *Modern Infectious Disease Epidemiology* (pp. 23–38). Springer New York.](http://paperpile.com/b/Apc6SZ/qtBr)

[Maqbool, A., & Khan, N. Z. (2020). Analyzing barriers for implementation of public health and social measures to prevent the transmission of COVID-19 disease using DEMATEL method. *Diabetes & Metabolic Syndrome*, *14*(5), 887–892.](http://paperpile.com/b/Apc6SZ/B44PP)

[Mya, K. S., Aye, Hlaing, W. A., Hlaing, S. S., Aung, T., Lwin, S. M. M., Ei, Tun, T., Lwin, K. S., & Win, H. H. (2020). Awareness, perceived risk and protective behaviours of Myanmar adults on COVID-19. *International Journal of Community Medicine and Public Health*, *7*(5), 1627.](http://paperpile.com/b/Apc6SZ/TcZ3)

[Oyetunji, T. P., Ogunmola, O. A., Oyelakin, T. T., Olorunsogbon, O. F., & Ajayi, F. O. (2021). COVID-19-related risk perception, anxiety and protective behaviours among Nigerian adults: a cross-sectional study. *Zeitschrift Fur Gesundheitswissenschaften = Journal of Public Health*, 1–9.](http://paperpile.com/b/Apc6SZ/N8ANI)

[Sikora, A., & Zahra, F. (2022). Nosocomial Infections. In *StatPearls*. StatPearls Publishing.](http://paperpile.com/b/Apc6SZ/dt3B)

[Xie, J., Tong, Z., Guan, X., Du, B., Qiu, H., & Slutsky, A. S. (2020). Critical care crisis and some recommendations during the COVID-19 epidemic in China. *Intensive Care Medicine*, *46*(5), 837–840.](http://paperpile.com/b/Apc6SZ/IvUDy)

[Zhang, M., Zhou, M., Tang, F., Wang, Y., Nie, H., Zhang, L., & You, G. (2020). Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. In *Journal of Hospital Infection* (Vol. 105, Issue 2, pp. 183–187). https://doi.org/](http://paperpile.com/b/Apc6SZ/FuNA)[10.1016/j.jhin.2020.04.012](http://dx.doi.org/10.1016/j.jhin.2020.04.012)

[Zhou, F., Yu, T., Du, R., Fan, G., Liu, Y., Liu, Z., Xiang, J., Wang, Y., Song, B., Gu, X., Guan, L., Wei, Y., Li, H., Wu, X., Xu, J., Tu, S., Zhang, Y., Chen, H., & Cao, B. (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. In *The Lancet* (Vol. 395, Issue 10229, pp. 1054–1062). https://doi.org/](http://paperpile.com/b/Apc6SZ/Qx9w)[10.1016/s0140-6736(20)30566-3](http://dx.doi.org/10.1016/s0140-6736%2820%2930566-3)