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Assessment of Knowledge and Acceptance of Covid-19 Vaccinations among Healthcare Workers in Kano State, Nigeria

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Abstract

Coronavirus is an ongoing global viral disease firstly identified in Wuhan, China in December 2019, hence its name Covid-19. The World Health Organization (WHO) declared Covid-19 as a pandemic with Public Health Emergency of International Concern (PHEIC). People get infected when they inhale small airborne particles or droplets exhaled by a Covid-19 infected person. Some of the recommended preventive measures include social or physical distancing, covering the mouth when sneezing or coughing, wearing of face masks and regular hand wash. A multi-stage sampling method was used to select the study locations, hospitals, healthcare departments and survey groups. A quantitative method - using structured questionnaires was used. Statistical analysis was conducted using Statistical Package for Social Science (SPSS) version 26. Out of the 1004 participants that were surveyed, 864 responses were retrieved. The bulk of the respondents (59%) were male. Knowledge of Covid–19 was poor, 24.3%, while acceptance of Covid-19 vaccination was high (74.2%). Important predictors of Covid-19 vaccination are the number of years in service, marital status, designated work, and type of medical facility. Knowledge of Covid-19 is low, but acceptance of its vaccination was high among the study population. This could be due to fear of contacting the disease early plus the associated high mortality among the study population. There is a need for an enlightenment campaign to increase knowledge and further improve acceptance of the Covid-19 vaccination.

Keywords*: Acceptance, Covid –19, Knowledge, Vaccination.*

Introduction

Coronavirus is a viral infectious disease affecting the respiratory tract. It has been reported to first started in Wuhan, China, in December 2019, hence the name Covid-19 [1]. The virus spread from Wuhan throughout the globe, affecting millions of people with more than 177 million cases, 3.8 million deaths, and 161 million recovered worldwide, making it one of the deadliest pandemics in history [2]. The infection was declared a pandemic of public health emergency by World Health Organization (WHO) on 30th January 2020, and its official name 'Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2)' was also declared [3].

The first case of Covid-19 in Africa was reported in Egypt on 14th February 2020 [4]. Other African countries have followed suites with so far, all the 55 African Union Member States have been infected. Mortality is not as high as it is in America and Europe. In Europe, there are more than 4,695,132 confirmed cases with about 126,394 deaths [5]. In Nigeria, Covid-19 was first reported on 27th February 2020 by a 44-year-old Italian [6]. The index case ultimately results in the spread of the virus

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in Nigeria. Despite vigorous community transmission, decaying health sector, and lack of preparedness for public health emergencies, the country still recorded a relatively small number of cases, with about 167,095 confirmed cases, 2,117 deaths, and 163,483 recovered as of 16th June 2021 [7].

A vaccine is a biochemical agent that stimulates the body's natural defence mechanism against infectious agents when introduced to the body. Thus, any attempt towards the development of a safe and effective Covid-19 vaccine is a public health necessity with a global concern [8]. Finding a safe and effective vaccine against Covid-19 will create a serious breakthrough in the fight against the pandemic. Scientists all over the world are working tirelessly on this, with some level of success recorded. Covid-19 vaccines are already available since 18th February 2021 all over the world, and the vaccine is now targeted at vulnerable population (elderly people) and prioritize those at the highest risk (healthcare workers) [9]. At least seven different vaccines under three different platforms have been rolled out, with more than 200 types on the way. The Covid-19 Vaccines Global Access Facility (COVAX) is one of the three major backbones of the access to COVID-19 Tools (ACT) accelerator, launched in April 2021 by the WHO, the European Commission and France as a response to the ongoing Covid-19 pandemic [10]. Covax was aimed at clearing the acute phase of the infection by speeding up the process of development and distribution of safe and effective vaccines against Covid-19 in addition to supporting the building of manufacturing capabilities and work with government and manufacturers to ensure fair and equitable allocation of the vaccines globally [11]. There is no doubt that vaccines are one of the effective preventive tools against Covid-19, although several other preventive measures including social or physical distancing, covering the mouth when sneezing or coughing, wearing face masks, hand washing regularly among others have been recommended by the WHO. Millions of doses of the Covid-19 vaccine are being produced and distributed globally. Africa and Nigeria, in particular, is not left out. On the 2nd of March 2021, Nigeria received nearly 4million doses of Covid-19 vaccines, shipped via the Covax facility, a partnership between CEPI, Gavi, UNICEF and WHO [11]. Both the frontline healthcare workers and the elderly ones have started receiving the first dose, and a few have received the second dose of the vaccine, though with a lot of myths and misconceptions about its integrity. Such healthcare workers' misconception about the Covid-19 vaccine might be discouraging others from accepting the vaccination, which will have serious implications in containing the pandemic. It is, therefore, essential to conducting an exploratory study to assess the knowledge and acceptance of Covid-19 vaccination among frontline healthcare workers in Kano State, Nigeria. Part of the aims of this study is to identify the causes of misconceptions therein and inform relevant policymakers to take appropriate action.

Methodology

This section presents the methodology that was employed in this study. The following aspects of the research were briefly presented (and will be reported in detail later): research study location; research philosophy and paradigm; research planning and implementation; research design and methods of data collection; research strategy and sampling methods; method of data analysis. The adopted methodology is quantitative.

The research was conducted in Kano State, in the Federal Republic of Nigeria. Kano State is one of the 36 States in Nigeria and was created on 27th May 1967 from the part of the then northern region. Kano State borders Katsina State to the northwest, Kaduna State to the southwest, Bauchi State to the southeast and Jigawa State (which was initially part of Kano

State until 1991) to the northeast. The historic and ancient city of Kano is the capital of Kano State. Kano State is for long been known as the centre of commerce since during trans-Sahara trade and is the most industrialized State in northern Nigeria and the second-largest commercial centre nationwide. Agricultural activities at both subsistence and commercial capacities and during the rainy and dry (irrigation) seasons are being practised in the State. The official language, like in other parts of the country, is English, although Hausa and Fulani are the predominant tribes in the State.

Kano State has a total landmass of 20,760 km^2, 44 Local Government Areas and 484 wards. The state is also enriched with numerous healthcare institutions, including three Teaching hospitals, namely: Aminu Kano Teaching Hospital, Muhammad Abdullahi Wase Teaching Hospital and Yusuf Maitama Sule University Teaching Hospital. Kano State, like other States in Nigeria, has had a history of epidemics and pandemics diseases, including Influenza, Yellow fever, and Lassa fever, and presently experiencing the Covid-19 outbreak like the rest parts of the world [12]. Industrialization and urbanization have posed unique challenges to the waste management in Kano city, and these, among other reasons, resulted in water, air, and soil pollution [13]. Kano State, like other parts of Nigeria, has a poor healthcare system with a poor average life expectancy of 47 years [14].

Respondents were given either a web-based or paper-based validated and refined structured questionnaire. The questions were developed using simple and unambiguous statements or terms for easy understanding. The questionnaires were refined to facilitate a better understanding before the survey was shared among the respondents. The developed questionnaires were distributed to 1004 randomly selected healthcare workers of the randomly selected hospitals of the randomly selected LGAs. The survey instrument comprises of 60 questions and requires about 15 minutes to participate. The questions were divided into 4 parts, 15 questions each. The first part contained the introductory aspects, including the title of the study, the aim of the study and options for respondents to indicate their consent to participate in the survey and demographic questions. The remaining parts were made to assess the healthcare workers' knowledge and acceptance or readiness to participate in the Covid-19 vaccination exercise.

A multi-stage sampling method was used to select the study subjects. One (1) Local Government Area (LGA) was selected each from the three senatorial zones (Kano Central, Kano North and Kano South) of Kano State, making a total of three (3) LGAs. The selection of the LGA was conducted randomly from the list of 15, 13 and 16LGAs of Kano Central, Kano North and Kano South senatorial zones, respectively. The list of hospitals from the 3 selected local governments served as the sampling frame for the second stage. Two (2) hospitals were selected randomly from each of the LGA by drawing lots; the list of hospitals in each of the LGA was written separately on small pieces of paper, then folded and mixed up on a table, a random selection was then made. Depending on the population of each of the selected LGAs and hospitals, sampling was done proportionately. In addition, three (3) tertiary health centres in Kano city (Aminu Kano Teaching Hospital, Murtala Mohammed Specialist Hospital and Muhammad Abdullahi Wase Teaching Hospital) were also selected, totalling 3 x 2 + 3 = 9 hospitals. Another multi-stage sampling technique was done where all the health departments or units were listed, and a random selection was made to identify the survey groups. The identified departments or units in such health centres were surveyed.

Only frontline healthcare workers that consent to participate in the study and work in the selected hospitals and departments were allowed to participate in the survey. These include doctors, nurses, midwives, pharmacists,

laboratory technicians and attendants and record officers. While healthcare workers that refused to consent to participate in the study even if they were working in the selected hospitals and departments were excluded, administrative staff were also excluded from the study.

The validity and reliability of the study depend largely on the nature of the research problem at hand, the general methodology and the nature of the data that was collected [15]. Some of the validity and reliability strategy that were used in this study include.

1. A quantitative method using structured questionnaires was used.
2. To further test the validity and reliability of research instruments, a pilot study was also conducted to refine the questionnaire so that respondents will have no problems in answering the questions and the researcher would have no problems in recording the data.

Results

A total of 1,004 participants were surveyed, 864 healthcare workers responded accordingly, putting the response rate at 86.4%. The majority of the respondents were male, 510 (59%) and the age group of 18 – 25 years account for the highest, 308, 35.6%. Most of the respondents have 1 – 5 years in service, 423 (49.0%).

Fourty-seven (5.4%) of the respondents have a postgraduate degree, and there were 57 (6.6%) medical doctors and nurses, and midwives were 275 (31.8%), there were more respondents from the secondary healthcare facilities, which amounted to 438 (50.7%), and the majority of them were adherents of the Islamic religion 829 (95.9%). Further details are found in Table 1.

Table 1. Demographic Characteristics of the Respondents

Variable	Frequency (N)	Percent (%)
Gender		
Male	510	59.00
Female	354	41.00
Age group (years)		
18-25	308	35.6
26-35	280	32.4
36-45	175	20.3
46-55	82	9.5
>55	19	2.2
Number of years in service		
1-5	423	49.0
6-10	153	17.7
11-15	122	14.1
16-20	89	10.3
>20	76	8.8
Marital status		
Single	370	42.8
Married	466	53.9
Divorced/separated	18	2.1
Widow	9	1.0
Number of children		
0	389	45.1

1-3	241	27.9
4-6	138	16.0
7-9	61	7.1
>9	34	3.9
Level of education		
Certificate	103	11,9
Diploma	461	53.4
Higher diploma	92	10.6
Bachelor's degree	161	18.6
Postgraduate	47	5.4
Designated work		
Medical doctor	57	6.6
Pharmacist	87	10.1
Radiographer	37	4.3
Medical laboratory scientist	9	1.0
Nurse and midwife	275	31.8
Medical laboratory technician	85	9.8
Community health practitioner	7	0.8
Community health extension worker	112	13.0
Community health officer	15	1.7
Public health	3	0.3
Environmental health officer	20	2.3
Environmental health technician	10	1.2
Health educator	10	1.2
Junior community health extension worker	6	0.7
Physiotherapist	8	0.9
Medical record officer	13	1.5
Dental technologist	9	1.0
Dental surgery technician	7	8
X-ray technician	7	0.8
Nutrition and dietetic officer	4	0.5
Others	83	9.6
Type of medical facility		
Primary healthcare	222	25.7
Secondary healthcare	438	50.7
Tertiary healthcare	204	23.6
Religion		
Christianity	25	2.9
Islam	829	95.9
Others	10	1.2
Total for each variable	864	100%

Source: Field data

Table 1 shows a demographic characteristic of the respondents, and male respondents were 510 (56%) while female 354 (41%). The age group, 18-25 years, accounted for the highest

308 (35.6%), followed by 26 – 35years, which were 280 (32.4%). The majority of the respondents, 423 (49%), have 1 – 5years in service.

Table 2. Association between Socio-demographic Data and the Knowledge of Covid-19 Infection among Healthcare Workers in Kano State

Variables	Knowledge of Covid-19		p-value
	Good knowledge, n (%)	Poor knowledge, n (%)	
Gender			
Male	122 (14.1)	387 (44.8)	.764
Female	88 (10.2)	266 (30.8)	
Age group (years)			
18-25	74 (8.6)	234 (27.1)	.676
26-35	72 (8.3)	208 (24.1)	
36-45	38 (4.4)	137 (15.9)	
46-55	23 (2.7)	59 (6.8)	
>55	3 (0.3)	16 (1.9)	
Number of years in service			
1-5	113 (13.1)	310 (35.9)	.308
6-10	31 (3.6)	122 (14.1)	
11-15	23 (2.7)	99 (11.5)	
16-20	23 (2.7)	66 (7.6)	
>20	19 (2.2)	57 (6.6)	
Marital status			
Single	92 (10.6)	278 (32.2)	.849
Married	112 (13.0)	354 (41.0)	
Divorced/separated	3 (0.3)	15 (1.7)	
Widow	3 (0.3)	6 (0.7)	
Number of children			
0	95 (11.0)	294 (34.1)	.455
1-3	67 (7.8)	174 (20.2)	
4-6	30 (3.5)	108 (12.5)	
7-9	11 (1.5)	50 (5.8)	
>9	7 (0.8)	27 (3.1)	
Level of education			
Certificate	22 (2.5)	81 (9.4)	.322
Diploma	104 (12.0)	357 (41.3)	
Higher diploma	22 (2.5)	70 (8.1)	
Bachelor’s degree	48 (5.6)	113 (13.1)	
Postgraduate	14 (1.6)	33 (3.8)	
Designated work			
Medical doctor	18 (2.1)	39 (4.5)	.627
Pharmacist	19 (2.2)	68 (7.9)	
Radiographer	9 (1.0)	28 (3.2)	
Medical laboratory scientist	2 (0.2)	7 (0.8)	
Nurse and midwife	71 (8.2)	204 (23.6)	

Medical laboratory technician	23 (2.7)	62 (7.2)	
Community health practitioner	3 (0.3)	4 (0.5)	
Community health extension worker	27 (3.1)	85 (9.8)	
Community health officer	3 (0.3)	12 (1.4)	
Public health	2 (0.2)	1 (0.1)	
Environmental health officer	3 (0.3)	17 (2.0)	
Environmental health technician	1 (0.1)	9 (1.0)	
Health educator	3 (0.3)	7 (0.8)	
Junior community health extension worker	1 (0.1)	5 (0.6)	
Physiotherapist	0 (0.0)	8 (0.9)	
Medical record officer	2 (0.2)	11 (1.3)	
Dental technologist	1 (0.1)	8 (0.9)	
Dental surgery technician	1 (0.1)	6 (0.7)	
X-ray technician	0 (0.0)	7 (0.8)	
Nutrition and dietetic officer	0 (0.0)	4 (0.5)	
Others	21 (2.4)	62 (7.2)	
Type of medical facility			
Primary healthcare	47 (5.4)	175 (20.3)	.163
Secondary healthcare	104 (12.0)	334 (38.7)	
Tertiary healthcare	59 (6.8)	145 (16.8)	
Religion			
Christianity	6 (0.7)	627 (72.6)	.949
Islam	202 (23.4)	19 (2.2)	
Others	2 (0.2)	8 (0.9)	

Source: Field data

Table 2 above shows the association between socio-demographic characteristics of respondents and knowledge of Covid -19 infections among the health care workers in Kano state. Knowledge of the infection appears to be generally low; of the 864 respondents surveyed, only 122 (14.1%) males have good knowledge of Covid -19 infection, while the knowledge is good in only 88 (10.2%) of the female respondents. Knowledge is poor in 387 (44.8%) and 266 (30.8%) of the male and female respondents, respectively. There is no statistically significant association between socio-demographic characteristics of respondents and knowledge of Covid-19 infection.

Table 3. Association between Socio-demographic Data and Level of the Acceptance of Covid-19 Vaccination among Healthcare Workers in Kano State

Variables	**Have you received the Covid-19 vaccine?**		**p-value**
	Yes, n (%)	**No, n (%)**	
Gender			
Male	389 (45.2)	120 (13.9)	.061
Female	249 (28.9)	103 (12.0)	
Age group (years)			
18-25	209 (24.2)	97 (11.3)	.069
26-35	215 (24.9)	65 (7.5)	

36-45	137 (15.9)	38 (4.4)	
46-55	64 (7.4)	18 (2.1)	
>55	14 (1.6)	5 (0.6)	
Number of years in service			
1-5	292 (33.9)	129 (15.0)	.028*
6-10	121 (14.1)	32 (3.7)	
11-15	99 (11.5)	23 (2.7)	
16-20	69 (8.0)	20 (2.3)	
>20	58 (6.7)	18 (2.1)	
Marital status			
Single	256 (29.7)	114 (13.2)	.024*
Married	358 (41.5)	106 (12.3)	
Divorced/separated	17 (2.0)	1 (0.1)	
Widow	7 (0.8)	2 (0.2)	
Number of children			
0	272 (31.6)	117 (13.6)	.053
1-3	178 (20.7)	61 (7.1)	
4-6	109 (12.7)	29 (3.4)	
7-9	51 (5.9)	10 (1.2)	
>9	28 (3.3)	6 (0.7)	
Level of education			
Certificate	81 (9.4)	22 (2.6)	.400
Diploma	341 (39.6)	118 (13.7)	
Higher diploma	72 (8.4)	20 (2.3)	
Bachelor's degree	112 (13.0)	49 (5.7)	
Postgraduate	33 (3.8)	14 (1.6)	
Designated work			
Medical doctor	33 (3.8)	24 (2.8)	.022*
Pharmacist	61 (7.1)	26 (3.0)	
Radiographer	27 (3.1)	10 (1.2)	
Medical laboratory scientist	5 (0.6)	5 (0.5)	
Nurse and midwife	188 (21.8)	85 (9.9)	
Medical laboratory technician	65 (7.5)	20 (2.3)	
Community health practitioner	5 (0.6)	2 (0.2)	
Community health extension worker	92 (10.7)	20 (2.3)	
Community health officer	12 (1.4)	3 (0.3)	
Public health	2 (0.2)	1 (0.1)	
Environmental health officer	19 (2.2)	1 (0.1)	
Environmental health technician	9 (0.1)	1 (0.1)	
Health educator	9 (0.1)	1 (0.1)	
Junior community health extension worker	4 (0.5)	2 (0.2)	
Physiotherapist	8 (0.9)	0 (0.0)	
Medical record officer	9 (1.0)	4 (0.5)	
Dental technologist	8 (0.9)	1 (0.1)	

Dental surgery technician	6 (0.7)	1 (0.1)	
X-ray technician	7 (0.8)	0 (0.0)	
Nutrition and dietetic officer	3 (0.3)	1 (0.1)	
Others	67 (7.8)	16 (1.9)	
Type of medical facility			
Primary healthcare	181 (21.0)	41 (4.8)	.001*
Secondary healthcare	337 (39.1)	101 (11.7)	
Tertiary healthcare	121 (14.0)	81 (9.4)	
Religion			
Christianity	16 (1.9)	9 (1.0)	.463
Islam	615 (71.3)	212 (24.6)	
Others	8 (0.9)	2 (0.2)	

*Statistical significance, p <0.05

Source: Field data

The acceptance level for Covid-19 vaccinations is good as 389 (45.2%), and 249 (28.9%) male and female have received the vaccination respectively. The remaining 120 (13.9%) and 103 (12%) male and female are yet to receive their vaccination, respectively. Statistically, a significant association exists between years in service, marital status, designated work, type of medical facility, and acceptance of Covid-19 vaccinations. See Table 3.

Table 4. Independent Predictors of Knowledge of Covid-19 Infection among Healthcare Workers in Kano State

Variables	**B**	**aOR**	**95% CI**	**p-value**
Gender	-0.41	0.960	0.664, 1.389	.764
Age group (years)	-0.586	0.557	0.110, 2.804	.676
Number of years in service	-0.086	0.918	0.388, 2.172	.308
Marital status	0.640	1.897	0.350, 10.268	.849
Number of children	-0.190	0.827	0.255, 2.676	.455
Level of education	0.606	1.832	0.767, 4.379	.322
Designated work	-0.113	0.893	0.398, 2.004	.627
Type of medical facility	0.288	1.333	0.797, 2.230	.163
Religion	0.088	1.092	0.202, 5.889	.949

Dependent variable: Knowledge of Covid-19 infection; aOR=adjusted odd ratios; CI= confidence interval; *p<0.05

On the predictors of knowledge of Covid-19 infections among health care workers, there is no statistically significant association between knowledge of Covid-19 infections and gender, age groups, marital status, number of years in service, etc. See Table 4.

Table 5. Independent Predictors of the Level of the Acceptance of Covid-19 Vaccination among Healthcare Workers in Kano State

Variables	**B**	**aOR**	**95% CI**	**p-value**
Gender	-0.088	0.916	0.637, 1.317	.061
Age group (years)	-0.111	0.895	0.195, 4.115	.069
Number of years in service	-0.114	1.121	0.462, 2.717	.028*
Marital status	-19.179	0.000	0.000,	.024*

Number of children	0.854	2.349	0.674, 8.191	.053
Level of education	-0.482	0.617	0.254, 1.501	.400
Designated work	0.844	2.325	1.020, 5.298	.022*
Type of medical facility	-0.653	0.521	0.313, 0.867	.001*
Religion	-0.0502	0.605	0.107, 3.432	.463

Dependent variable: Level of the acceptance of Covid-19 vaccination; aOR=adjusted odd ratios; CI= confidence interval; *p<0.05

Independent predictors of the level of acceptance of Covid-19 vaccinations among healthcare workers in Kano State include a number of years in service, marital status, designated work, and type of medical facility. See Table 5.

Discussion

Active health system and the general well-being of the populace rests on the shoulder of knowledgeable health care workers who have expert knowledge and training to contain, treat and aid in the prevention and/or controlling of infectious diseases, especially the newly emerged, deadly Coronavirus disease 2019 (Covid-19). The emergence of this new disease is associated with a lot of disinformation, misinformation and myths that have no scientific evidence. In addition to innovative interventions to contain the dreadful Covid-19 pandemic, it has become necessary to investigate behavioral response to guide context-specific solutions to fast tract achievement of the goal of the public health response. The objective of this study was to assess the knowledge and acceptance of COVID-19 vaccination among healthcare workers in northwestern Nigeria.

The majority of respondents were male, 510 (59.0%), which is comparable to a study conducted in north-central Nigeria, 59.6% [16]. In addition, there were more Muslim respondents in this study than Christians, about 829 (95.9%). This is in tandem with a similar study carried out in Kano, where 93.68% of the participants were Muslims [17]. The Muslim majority may be due to the fact that the State is predominantly inhabited by Muslims. Additionally, there were 57 (6.6%) medical doctors and 275 (31.8%) nurses, which is inconsistent with a study in Egypt which examined 137 (31.2%) medical doctors and 102 (25.1%) nurses [18]. The results of a similar study conducted in Bangladesh showed that the majority of respondents had more than five years of service [19]. This is in line with the finding of the present study 440 (51%).

Of the respondents surveyed in this study, 210 (24.3%) demonstrated good knowledge of COVID-19, almost similar to that of a study conducted among the state-wide population of Kano, which reported that 270 (30.47%) had good knowledge of Covid-19 [17]. Surprisingly, the level of knowledge in this research is far below the level of knowledge reported in South Ethiopia and Uganda, were 74.9% and 69% had good knowledge of Covid-19 infection, respectively [20, 21]. In another study to assess public knowledge, attitudes and practices regarding Covid-19 in Malaysia [22], respondents' knowledge of Covid-19 infection was also rated good (77.2%). The finding of this study is contrary to that of a study conducted to assess knowledge and perceptions of Covid-19 among the general public in the United States and the United Kingdom, where knowledge (especially of the mode of transmission and symptoms) of Covid-19 infection is high, but the study highlighted several misconceptions on how to prevent acquisition of Covid-19 infection including believing in the falsehood that has circulated the social media, [23]. The cut-off points used in the categorization of knowledge may differ from study to study, possibly reflecting the observed differences. Similarly, the level of severity of the pandemic is not the same in all

countries; this could have been responsible for the gap in knowledge of the infection. Despite the huge population of Kano, the perceived seriousness of the disease coupled with communication for development activities has not gained traction among state residents. This could prompt healthcare workers to refresh their knowledge of Covid-19 vaccines.

This poor knowledge can be attributed to the fact that most of the respondents are not directly involved in patient care and have attained only a diploma level of education 461 (53.4%). Similarly, most respondents work in secondary healthcare facilities, 438 (50.7%) and primary healthcare facilities, 222 (25.7%) where workers are less informed. As a result, tertiary health care institutions, with supposedly better equipment, in addition to highly qualified clinicians, serve as reference centres for Covid-19 management. They would likely have greater knowledge about Covid-19 infection and vaccines.

There is no correlation between the socio-demographic characteristics of the respondents with their knowledge of Covid-19 infection in this study. In contrast, working in a comprehensive specialized hospital, having a master's degree, and prior training on Covid-19 infection was found to be strongly associated with the knowledge of health care workers in a study conducted in Ethiopia [20].

Nevertheless, this study found a statistically significant association between knowledge of Covid-19 and the level of acceptance of its vaccines. This demonstrates that good knowledge of Covid-19 disease leads to a better perception of the vaccines and increased willingness and acceptance.

While knowledge of Covid-19 is essential for taking its vaccination, and despite the respondents' poor knowledge of Covid-19, there is a high level of acceptance of its vaccine as the majority, 641 (74.2%), have already taken the vaccine. This is likely because health care workers are more likely to be infected with Covid-19 and therefore need protection from this infection. Moreover, it is easily accessible to them because their vaccination has been prioritized by the National Agency for the Development of Primary Healthcare, the agency responsible for the distribution of vaccines.

It is worthy of noting too, that in Nigeria, taking the vaccine is mandatory for frontline healthcare workers and some other civil servants. Consequently, the acceptance of the Covid-19 vaccination has become significantly high among healthcare workers. Similar strategies could favour acceptance by the general public and will aid in concretizing their advocacy for the vaccination since in another study, respondents were willing to take the vaccines if the campaigns were led by healthcare workers [16].

The reasons for the reluctance/hesitancy to receive the Covid-19 vaccine among these healthcare workers are majorly, religious/personal beliefs (24.9%), lack of information and awareness (38.0%), accessibility and cost-related factors (5.7%), side effects and pain related to injection (31.4%). This underscores the need for more information and awareness about Covid-19 and its vaccination.

The Covid-19 vaccine hesitancy among the public in a study in Nigeria was found to be high as only 36% were willing to take the vaccine [24]. Similar results were reported among medical science students in northwestern Nigeria, including Kano, where only 40% were willing to take the vaccine [25]. In an internet-based cross-sectional survey that was conducted in Egypt, willingness to accept Covid-19 vaccination was 26%, hesitancy was 41.9%, and vaccination refusal was 32.1% [26]. Willingness to accept Covid-19 vaccination was far less than the finding of this particular study in which 74.2% of the respondents have already been vaccinated arguably, willingness is what was reported in this survey which is unlikely to be exact with real acceptance of Covid-19 vaccination, this means that the

number of people that will ultimately accept the vaccines will be lower than 26%. Acceptance of Covid-19 vaccinations was higher (96%) in a study conducted in Malaysia [27]. Essential factors influencing vaccination decisions were vaccine convenience and doctor's recommendation; respondents' age less than 24yrs, Malay race, living in urban areas, tertiary education, single marital status, students, and family income were significantly associated with acceptance of Covid-19 vaccination. The higher acceptance level couple with some of the predictors of acceptance of Covid -19 vaccination is similar to the finding of this study. In a global survey to assess perceived Covid-19 vaccine effectiveness, acceptance, and drivers of vaccination decision-making among the general adult population across 20 different countries [28]; it was gathered that acceptance of Covid-19 vaccination is highest in Malaysia, Bangladesh, and Iraq, 96.0%, 93.6% and 91.8% respectively, a little higher than a report from other countries including Nigeria where this study was conducted. The high level of Covid 19 vaccine acceptance in this study which was conducted among frontline health care workers, implies that the general population will equally accept the same, as it was reported that doctors' recommendation is a strong factor for accepting the vaccination in Malaysia, Philippine, and Indonesia [28]. Thus, the utilization of healthcare workers in creating awareness/sensitization and carrying out the vaccination cannot be understated. Resultantly, the more people take the vaccine the more the propensity to achieve herd immunity against Covid-19. In a national cross-sectional survey conducted in 31 provinces in Mainland China, the vaccination acceptance rate is 89.4%, [29] a little higher than the finding of this study. Important predictors of vaccinations were lack of religious affiliations, having the same occupational status as a result of the coronavirus epidemic, being a non-smoker, always engaging in physical activity, having a lower social status, perceiving Covid-19 to be easily curable and having easier access to vaccination which is contrary to the finding of this study. In another study conducted in Austria, [30] willingness to accept Covid-19 vaccines was (55%) less than the finding of this study, where 74.2% of the study population had already been vaccinated. This could be because the study populations in the index study are frontline healthcare workers whose vaccinations fall among the priority group. In a similar study conducted in Germany, the vaccination acceptance rate was 91.7%, [31] higher than the finding of this study.

Even though, findings from this study indicate that 74.2% of the respondents tested negative for Covid-19 infection, 60.2% were willing to take the vaccine even if they had to pay to take it. In the same vein, 70.7% were willing to take the vaccine even if it is not compulsory for healthcare workers. Likewise, 80.9% of them have received vaccination aside from routine childhood vaccinations. Perhaps the high willingness may be as a result of the conference, seminar, or training program on vaccination that 64.9% of them have attended in the last two years. From the data set, personal decisions (35.8%) and government (32.5%) were influential in the acceptance of the vaccine by the study respondents. And a large percentage (76.3%) of the respondents have recommended and advocated for Covid-19 vaccination in their workplaces or homes.

Furthermore, there is a statistical association between the level of the acceptance of Covid-19 vaccination and the number of years in service, marital status, designated work, and the type of medical facility. This finding is contrary to the finding of a study conducted in Nigeria, where it was reported that a significant association exist between vaccine acceptance or uptake and gender, tribe/ethnicity, religion, and place of residence [33]. On the other hand, a study revealed that increasing age, the influence of heads of the institution, trust in the government, and readiness to pay for the vaccine were associated with acceptance of the Covid-19

vaccine among health science students [25]. The finding of this study is similar to that of a descriptive cross-sectional survey that was also conducted among healthcare workers in Ghana, where important predictors of Covid-19 vaccination acceptance include sex, category of healthcare workers, relative being diagnosed with Covid-19, and trust in the accuracy of measures taken by the government [34]. In an online cross-sectional survey conducted in the Kingdom of Saudi Arabia, factors associated with acceptance of Covid-19 vaccination were a source of health information about Covid 19, perceptions of whether the vaccine is effective on other variants of the virus, previous uptake of the influenza vaccine and potential mandatory of vaccination in order to travel internationally [35]. This is contrary to the finding of this study; as outlined earlier, these predictors or factors affecting uptake of Covid-19 vaccinations differs among countries due to so many reasons, for example, it is compulsory for all intending pilgrimage to ensure they take the Covid-19 vaccine before arriving in Saudi Arabia.

Strength and Limitations

The main strength of this study is that the knowledge and level of acceptance of Covid-19 vaccines have been adequately explored, resulting in important recommendations for other researchers and policymakers.

The major limitations are as follows:

First, it was a cross-sectional study and thus does not establish the cause(s). Second, the study was carried out in Kano, although the country's most populated state, and the results cannot be used for generalization. Third, there were no identification tools for respondents on the survey questionnaire, so health care workers might have given multiple or false submissions. Lastly, it was initially a web-based survey, but due to poor participation, printouts were later introduced, which was costlier and time-consuming.

Conclusion

Healthcare workers in Kano have poor knowledge of Covid-19 infection (24.3%), but the vaccination rate was high (74.2%). The relation between knowledge and acceptance of Covid 19 vaccination is inverse in this study; normally, one will expect the poor knowledge to translate to a poor vaccination rate, but this is not so probably due to fear of contacting the new infection early and its resultant consequences. Similarly, there is no statistically significant association between respondents' socio-demography and knowledge of Covid–19 infections. Respondents' years of service, marital status, designated work, and type of medical facility show statistically significant association with acceptance of Covid-19 vaccines.

Conflict of Interest

Author declares that there is no conflict of interest.

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