

COVID-19 Knowledge and Vaccine Acceptability among Adults in a Selected Community of the Federal Capital Territory, Abuja, Nigeria

Apagu DG¹, Momoh J², Esomonu S¹, Yusuf NH¹, Okonkwo F,¹ Samson R³, Kaloma M³, Iwot N¹, Wamakko R¹, Umeh C¹, Vatsa IY,¹ Ladipo E¹

¹FCT Primary Health Care Board, No. 8 Orlu Street, Area 3, Garki-Abuja

²World Health Organization, Rivers House, Central Business District, Abuja

³United Nations Children's Fund (UNICEF), United Nations House, FCT Abuja

Corresponding author: Apagu Dan Gadzama, Federal Capital Territory Primary Health Care Board, No. 9 Orlu Street, Area 3, Garki-Abuja
Email: dannyabuth@yahoo.com Phone number: +2348036182337

Abstract

Background: COVID-19 is a pandemic disease that has ravaged the health systems of the developed and the developing countries. At the time of writing this article, Nigeria had recorded about 254 thousand cases and 3,141 mortalities. The Federal Capital Territory Abuja accounts for 12.4% of the total cases in Nigeria with a mortality rate of 0.9%. This study aimed at assessing the knowledge, risk perception and level of uptake of the vaccine among adult population in Abuja.

Methods: This was a descriptive cross-sectional study carried out among 180 consenting adults from November to December 2021 in a selected community in Abuja. It was an operational research conducted by the Advocacy and Social Mobilization Unit of the Primary Health Care Board.

Results: Majority; 131(72.8%) of participants were aware of COVID-19 and 145 (80.6%) thought the disease was very dangerous. Over half, 91 (50.6%) felt they were at risk of contracting the disease. The most reported preventive measures taken were hand hygiene, cough etiquette and social distancing. Three out of every ten persons, 57 (31.7%) had been fully or partially vaccinated against COVID-19. Over a third, 26 (38.8%), of those who were unwilling to get vaccinated reported safety concerns. We therefore recommend to the Advocacy and Social Mobilization Unit of the Federal Capital Territory Primary Health Care Board to develop clear messages that address vaccine safety issues.

Key words: Covid-19, knowledge, prevention, vaccine, Federal Capital Territory

Introduction

The Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) infection, which causes the Corona Virus Disease

2019 (COVID-19) is a global pandemic that ravaged the health system of both developed and developing countries; destroying the economies of many nations.

The disease was first discovered in Wuhan, China in December 2019.^{1,2,3} Over 420 million people were infected worldwide with a death toll of about 5,882,251 as of 18 February, 2022. At the same time, Nigeria had recorded over 254,000 cases and 3,141 mortalities.⁴ The Federal Capital Territory (FCT) accounted for over 12.4% of the total cases in Nigeria with a mortality rate of 0.9%.⁴

Good knowledge and practice of infection prevention and vaccine acceptability are essential to achieve control of the pandemic. A community-based cross-sectional study conducted among adults in Ethiopia showed that majority of the population had good knowledge, less than half had positive attitude while about 60% had intention of being vaccinated.⁵ In addition, an online survey conducted in China revealed that 90% had correct knowledge of the disease.⁶

Vaccine hesitancy affects the uptake of vaccination and achieving the desired herd immunity. In a peer review of 31 published studies on final COVID-19 vaccine acceptance estimates from 33 different countries, the highest acceptance rates among adults were found in Ecuador (97.0%), Malaysia (94.3%), Indonesia (93.3%) and China (91.3%). However, the lowest COVID-19 vaccine acceptance rates were found in Kuwait (23.6%), Jordan (28.4%), Italy (53.7), Russia (54.9%), Poland (56.3%), US (56.9%), and France (58.9%). Low rates of COVID-19 vaccine acceptance were also reported in the Middle East, Africa and several European countries. ————^{7,8} Other studies done among key populations in the USA showed that black and white communities are less likely to accept vaccination when compared with the Latinos and Asians.⁹

In another study, vaccine acceptance was also positively associated with the level of COVID-19 knowledge, worry/fear

regarding COVID-19, higher income, younger age, and testing negative for COVID-19. However, chronic disease and female gender reduced the odds for vaccine acceptance. The main reasons underpinning vaccine refusal were fear of side effects and lack of confidence in vaccine effectiveness.^{10,5} An online study conducted among the general public in China also showed 55% believed that the COVID-19 vaccination will be safe while only 46.2% believed that it will be effective. Majority of the participants were planning to get COVID-19 vaccination, whereas 13.7% admitted hesitancy. However, only 65.8% of the participants responded that they would receive vaccination as soon as possible whenever the vaccine is available.¹¹ A scoping review showed the following as predictors of vaccine acceptance: gender, age, education, and occupation, trust in authorities, risk perception of COVID-19 infection, vaccine efficacy, current or previous influenza vaccination, and vaccine safety.¹²

In Nigeria, several phases of COVID-19 vaccination have occurred including a mass vaccination campaign which began late 2021. Yet, the uptake is still below 11% as at the first quarter of 2022.¹³ This study was done in a selected community of FCT as an operational research to understand the dynamics of uptake of the COVID-19 vaccination among the adult population. This was necessary to provide the requisite information needed to inform decision making to improve the overall COVID-19 response in the FCT.

Methodology

Study settings, design, and sample size

This was a descriptive cross-sectional study carried out from November to December 2021 in FCT. The FCT is the seat of government in Nigeria and experiences influx of people both locally

and internationally. The estimated total population is 5,338,550 with a landmass of 1769km². It has 6 Area Councils (AC), namely Abuja Municipal, Abaji, Bwari, Gwagwalada, Kwali and Kuje ACs, and 62 political wards.¹⁴

FCT operates a 3-tier health system of primary, secondary, and tertiary levels of care spread over rural and urban areas. There are 754 accredited health facilities made up of 500 private health facilities and 254 public health facilities. The tertiary hospitals are owned and funded by the Federal Government, the secondary facilities are managed by the Hospitals Management Board (HMB), while the Primary Health Care (PHC) facilities are managed by the FCT Primary Health Care Board (PHCB) and Area Council Health Commission.¹⁵ The minimum sample size of 133, which was adjusted to 180 for nonresponse, was calculated using the formula for a cross-sectional study ($n = Z^2pq/d^2$) where z = standard normal deviate at 95% confidence interval, taken as 1.96, prevalence (p) = 98.6% from a previous study,⁵ and $q = 1-p$ while $d =$ (the acceptable error margin) 5% = 0.05. The power of the test was 80%.

Study population and sampling techniques

The study population consisted of consenting adults aged 18 years and above residing in the FCT for at least six months. Abuja Municipal Area Council (AMAC) was purposively selected for the study because of its high population density, accounting for about 60% of the total FCT population. From the list of the settlements in AMAC, Karu was purposefully selected because of its strategic location- bordering Nasarawa and the FCT. The list of households in Karu, obtained from immunization micro-plan, a sampling interval of 10 was calculated. First household was selected using a computer generated random number. Subsequent

selection was through systematic sampling technique by selecting every 10th household. One person was interviewed per household until the sample size was reached.

Study instrument and data collection

A semi-structured interviewer-administered questionnaire adapted from the Extended Parallel Process Model based on risk perception assessments of other infectious diseases, WHO and Nigeria Center for Disease Control infection prevention and control (IPC) checklist were used.^{16,17} The questionnaire was pretested among 10% of the total sample size in Zuba, Gwagwalada Area Council. Information was collected on socio-demographics, knowledge of COVID-19, Sources of information on COVID-19, willingness to be vaccinated and those vaccinated.

Measurement of variables

The dependent variables were knowledge, risk perception and vaccine uptake while socio-demographic characteristics were the independent variables.

Data analysis

All the data generated was entered and analyzed using the IBM Statistical Products and Service Solutions (SPSS) version 23. Mean and standard deviations were used to summarize the quantitative variables. Chi-square was done to describe associations between socio-demographic features and vaccination status. A $p < 0.05$ was considered statistically significant for all statistical tests.

Ethical clearance and informed consent

This study was an operational research conducted by the Advocacy and social Mobilization Unit of the FCT Primary Healthcare Board which is the coordinating agency of all vaccination activities in the FCT. It is part of wider research on COVID-19 in the FCT where ethical clearance was obtained from the

Federal Capital Territory Administration's Ethics Committee. In the community visited, permission for the research was sought from the chief and individual informed written consent obtained from the participants before the questionnaire was administered.

Results

The mean age of respondents was 35.7 ± 11 years and 65 (36.1%) of them were within the age group 30-39 years. Males constituted the majority; 105 (58.3%) among the study population. One hundred and twelve (62.2%) of them were married and 80 (44.4%) had tertiary education. Most were Christians; 119 (66.1%) and married; 112 (62.2%). Table 1.

Majority of respondents; 131 (72.8%) knew that corona virus can cause a disease and 115 (63.9%) of them knew how to protect themselves from the disease. One hundred and sixteen (64.4%) had heard about the disease from television. Majority; 144 (80.0%) of respondents chose cough as symptom of coronavirus disease. This was followed by fever; 122 (67.8%) and headache; 77 (42.8%). Table 2.

Table 3 shows that 145 (80.6%) respondents believed that the virus is very dangerous while 13 (7.2%) thought that the virus is not so dangerous. Ninety eight (54.4%) respondents believed that elderly people are at the highest risk of getting coronavirus infection while 91 (50.6%) perceived themselves to be at risk of

becoming sick with the virus. Twenty-five (29.8%) of those who thought they would not become sick with corona virus did not have any reason for their belief. In addition, 118 (32.1%) respondents thought that coronavirus spreads by direct contact with infected persons.

Most respondents; 105 (58.3%) thought that those infected with coronavirus are being stigmatized and 160 (88.9%) were aware that there are vaccines to prevent the disease. One hundred and thirty-two (73.3%) respondents used regular hand washing with soap to prevent sickness from coronavirus, followed by those who used sanitizers; 116 (64.4%). As many as 118 (65.6%) knew that adults are those eligible to receive the vaccine, followed by those who choose elderly persons, 108 (60%). Most of the respondents; 123 (68.3%) were not vaccinated at the time of the survey. Fifty six (45.5%) of those who had not received the vaccine were willing to receive it when it is made available to them. The major reason given by the respondents, 26 (38.8%) who were not willing to receive the vaccine was their doubt of the vaccine safety. Many respondents; 95 (52.8%) knew the COVID-19 vaccination sites in their communities and 50 (52.6%) of those who knew vaccination sites found it very easy to get to the vaccination sites. Table 4. Educational status and occupation were the only factors significantly associated with respondent's vaccination status ($p < 0.002$ and < 0.001 respectively). Table 5.

Table 1: Socio-demographic characteristics of respondents

Variables	Frequency (n=180)	Percent
Age groups (years)		
<30	52	28.9
30-39	65	36.1
40-49	42	23.3
50 and Above	21	11.7
Mean Age = 35.7 ± 11 SD		
Sex		
Male	105	58.3
Female	75	41.7
Marital Status		
Single	60	33.3
Married	112	62.2
Divorced	2	1.1
Widowed	5	2.8
Others	1	0.6
Occupation		
Civil Servant	32	20.0
Private Sector	7	4.4
Business	60	37.5
Artisan	19	11.9
Student	21	13.1
Others ^a	21	13.1
Educational Status		
None	6	3.3
Primary	9	5.0
Secondary	75	41.7
Tertiary	80	44.4
Others ^b	26	14.4
Religion		
Christianity	119	66.1
Islam	61	33.9

^a house wife, teachers

^b. Qur'anic education

Table 2: Knowledge of Corona Virus and COVID-19

Variables	Frequency	Percent
Knowledge of corona virus		
	(n=180)	
I don't know anything	26	14.4
It's a virus that can cause a disease	131	72.8
It's government programme	9	5.0
It is a TV/Radio campaign	5	2.8
Others	9	5.0
Source of information about coronavirus		
Radio	112	62.2
TV	116	64.4
WhatsApp	43	23.9
Social Media (Not WhatsApp)	66	36.7
Family Members	37	20.6
Friends	55	30.6
Health workers	47	26.1
Traditional/Religious leaders	19	10.6
Town announcers	15	8.3
Others	7	3.9
Mode of spread of COVID -19		
Blood transfusion	10	5.6
Droplets from infected people	81	45.0
Airborne	70	38.9
Direct contact with infected people	118	65.6
Touching contaminated objects/surfaces	57	31.7
Sexual intercourse contact	7	3.9
Contact with contaminated animals	5	2.8
Mosquito bites	2	1.1
Eating contaminated fo od	2	1.1
Drinking unclean water	1	0.6
Don't know	15	8.3
Symptoms of c oronavirus disease		
Fever	122	67.8
Cough	144	80.0
Shortness of breath and Diff breathing	76	42.2
Muscle pain	23	12.8
Headache	77	42.8
Diarrhoea	11	6.1
Don't know	9	5.0
No symptoms	4	2.2
Others ^a	20	11.1

a: loss of smell and taste

Table 3: Risk Perception

Variables	Frequency	Percent
Perceived danger of coronavirus		
	(n=180)	
Very dangerous	145	80.6
Not so dangerous	13	7.2
Not dangerous	10	5.6
Others ^a	12	6.7
Population at highest risk of coronavirus		
Children <5 years old	10	5.6
Adolescents up to 15 years	4	2.2
Youths	13	7.2
Adults	38	21.1
Elderly persons	98	54.4
Pregnant women	14	7.8
Health workers	43	23.9
Everybody	60	33.3
Risk of contracting COVID-19		
	(n=180)	
Yes	91	50.6
No	84	46.7
Don't know	5	2.8
Reason/s for low risk perception		
	(n=84)	
I don't trust the government	7	8.3
I don't believe there is coronavirus	11	13.1
The disease is for the rich	4	4.8
The disease is not in Nigeria	4	4.8
I have no reason	25	29.8
Others ^b	33	39.3

^a Don't know

^b I have strong immune system

Table 4: Stigma, preventive practices, vaccine awareness and acceptance

Variables	Frequency	Percent
Stigmatization of corona vi rus	(n=180)	
Yes	105	58.3
No	48	26.7
Don't know	27	15.0
Preventive practices		
Wash hands regularly with soap and water	132	73.3
Sanitize hands regularly with sanitizers	116	64.4
Cover mouth and nose when coughing and sneezing	77	42.8
Avoid close contact with anyone with fever and cough	73	40.6
Awareness on COVID -19 Vaccine	(n=180)	
No	20	11.1
Yes	160	88.9
Vaccine eligibility	(r)	
Children <5 Years	23	12.8
Adolescent <18 Years	37	20.6
Adults (18 and Above)	118	65.6
Elderly Persons	108	60.0
Pregnant women	31	17.2
Health workers	77	42.8
Vaccinated	(n=180)	
Yes	57	31.7
No	123	68.3
COVID-19 Vaccine acceptance	(n=123)	
Yes	56	45.5
No	40	32.5
Not sure	27	22
Reasons for not receiving vaccine	(n=67)	
I don't trust the government	10	14.9
I don't believe the vaccine is safe	26	38.8
My religion is against vaccination	4	6.0
I don't believe there is coronavirus	6	9.0
I have no reason	12	17.9
Others	9	13.4

Table 5: Factors associated with vaccination against Covid-19

Variables	Vaccination against Covid-19 infection (n=180)		X ²	p-value
	Yes n(%)	No n(%)		
Age groups				
<30	12 (21.1)	40 (32.5)	2.533	0.469
30-39	23 (40.4)	42 (34.1)		
40-49	15 (26.3)	27 (22.0)		
50 and Above	7 (12.3)	14 (11.4)		
Sex				
Male	39 (68.4)	66 (53.7)	3.492	0.062
Female	18 (31.6)	57 (46.3)		
Marital Status				
Single	13 (22.8)	47 (38.2)	4.971	0.290
Married	41 (71.9)	71 (57.7)		
Divorced	1 (1.8)	1 (0.8)		
Widowed	2 (3.5)	3 (2.4)		
Others	0 (0.0)	1 (0.8)		
Occupation				
Civil Servant	24 (42.1)	9 (7.3)	36.762	<0.001
Private Sector	3 (5.3)	4 (3.3)		
Business	19 (33.3)	47 (38.2)		
Artisan	2 (3.5)	22 (17.9)		
Student	4 (7.0)	20 (16.3)		
Others	5 (8.8)	21 (17.1)		
Educational Status				
None	0 (0.0)	6 (4.9)	17.381	0.002
Primary	1 (1.8)	8 (6.5)		
Secondary	15 (26.3)	60 (48.8)		
Tertiary	36 (63.2)	44 (35.8)		
Others	5 (8.8)	5 (4.1)		
Religion				
Christianity	30 (52.6)	89 (72.4)	6.765	0.09
Islam	27 (47.4)	34 (27.6)		

Discussion

This study was done to assess the risk perception towards COVID-19 disease, the knowledge and the level of uptake of the COVID-19 vaccination among the adult population in the FCT. The study findings suggest that majority of participants knew about COVID-19 as a significant proportion of the participants could identify the cause of COVID-19 and most correctly knew the symptoms of COVID-19 and its mode of transmission. The most cited symptoms included cough, fever, headache and shortness of breath while the most cited means of transmission included direct contact with or droplets from infected persons. These findings are in tandem with those of another study conducted in Nigeria which found a high level of awareness of the participants on mode of transmission of the disease, however with poor knowledge of its symptoms.¹⁸ This implies that majority of Nigerians may have good knowledge of the cause of the disease and its mode of transmission but may not be clear on the symptoms. This gap needs to be filled as the ability to recognize symptoms is pertinent for early reporting and improved response to the pandemic. The most reported information received on COVID-19 were on how to protect themselves against the disease, its mode of transmission and symptoms. The most cited source of information on the disease was the media with television leading, followed by radio channels, social media and healthcare workers. These were also cited by the study participants as the most preferred source of information. These findings are similar with the findings of another Nigerian study which also found the media as the most reported source of information on COVID-19. This has significant implication for communication and social mobilization activities which in Nigeria relies heavily on traditional

structures. This may call for prioritization of resources to the media with emphasis on TV stations to intensify COVID-19 related information dissemination to the general public.

The most reported preventive measures mentioned in this study were hand hygiene, cough etiquette and social distancing. Similar measures have also been cited by other studies as the most frequent measures taken. For instance, a study done in southwest Nigeria reported the use of face masks and social distancing as the commonest preventive action taken.²³ Similarly, a study in Saudi Arabia noted that over 80% and 70% of the study participants adhered to social distancing and hand washing respectively.²⁴ Another study in China reported that majority of the respondents avoided crowded places and used the face masks.²⁵ The results imply that adherence to the outlined measures of the COVID-19 protocol in FCT vary with type of measure. However, one recurrent measure reported in the above studies was adherence to social distancing which at this level may not be entirely under the control of the participants as government has insisted on the implementation and enforcement of social distancing by placing a ban or decreasing the size of social or religious gathering especially during the various waves.

We found that majority of the participants thought the disease was very dangerous and over half felt they were at risk of contracting the disease. This is in keeping with findings from a study done in Ethiopia where over 90% of the respondents perceived that COVID-19 was a serious disease and they were susceptible to the disease.²⁰ However, this is in contrast to another Nigerian study conducted across the six geopolitical zones which found that close to half of the participants in both the first and 2nd waves of the pandemic in Nigeria did not consider themselves to be

at risk of the disease,²¹ and another study in Libya which also found that close to half of the participants considered the potential threat of COVID-19 to be low.²² The findings of this study maybe due to the fact that our study area, being considered as one of the epicenters for COVID-19 in Nigeria has more cases and death reported which may be responsible for respondents' perception of the severity and their susceptibility to the disease.

The level of uptake of COVID-19 vaccination in this study shows that only one third had been partially or fully vaccinated which mirrors the high level of vaccine hesitancy in the FCT. A similar study in Kenya also recorded a low uptake of the COVID-19 vaccine at December, 2021.—²⁶ However, these findings are in contrast to that in the US where the proportion of those who were partially or fully vaccinated was above 70%. These findings suggest rather slow vaccination rates fueled by a high level of vaccine hesitancy in the FCT. This is further corroborated by another study in the FCT prior to the introduction of the COVID-19 vaccine which found the hesitancy level to be above 60%.²⁷ However, that FCT finding was in contrast to another Nigerian study, which found a high proportion of adults were willing to accept the vaccine prior to the roll-out of the vaccines as well.—²⁸

Over a third of those who were unwilling to get vaccinated reported that it was because they did not think the vaccines were safe. Other reasons included lack of trust in the government while a significant proportion had no clear reason. Similar concerns as those reported in our study have also been cited in other studies across the world. For instance, a study in US reported the drivers of hesitancy as concerns about safety and efficacy of the vaccines.²⁹ A study in Japan reported fear of side effects as the most mentioned reason amongst persons

unwilling to be vaccinated,³⁰ and another study in Europe reported similar concerns.³¹ This implies that these concerns are world-wide.

An important limitation of this study is the small sample size used. The study was designed as an operational research to improve the roll-out of the COVID 19 vaccination following the phase 1 and phase 2 roll-outs, and as such results should be interpreted with caution. Nonetheless, this study has provided valuable information which can still be used to improve vaccination rates in the FCT.

Conclusion

This study found high knowledge of COVID-19, high risk perception, a low vaccination uptake, and high vaccine hesitancy due to safety concerns. We recommend to the Advocacy and Social Mobilization Unit of the FCT PHCB to develop clear messages that address vaccine safety issues prioritizing the use of media such as television and radio as channels of information dissemination. We also recommend the need to target this information to persons with low educational status and civil servants with government playing the role of enforcing the vaccine mandate in the FCT.

Conflict of interest: The authors declare that we have no conflict of interest to declare.

Source of Funding: United Nations Children's Fund (UNICEF)

References

1. Huang X, Wei F, Hu L, Wen L, Chen K. Epidemiology and clinical characteristics of COVID-19. *Arch Iran Med*. 2020; 23(4). doi:10.34172/aim.2020.09
2. Kim GU, Kim MJ, Ra SH, Lee J, Bae S, Jung J, et al. Clinical characteristics of asymptomatic and symptomatic

- patients with mild COVID-19. *Clin Microbiol Infect.* 2020;26(7):948.e1-948.e3. doi:10.1016/j.cmi.2020.04.040
3. Shereen MA, Khan S, Kazmi A, Bashir N, Siddique R. COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. *J Adv Res.* 2020;24. doi:10.1016/j.jare.2020.03.005
 4. World Health Organization. Worldometer, corona virus cases. Available from: <https://www.worldometers.info/coronavirus/>
 5. Abebe H, Shitu S, Mose A. Understanding of COVID-19 vaccine knowledge, attitude, acceptance, and determinates of COVID-19 vaccine acceptance among adult population in Ethiopia. *Infect Drug Resist.* 2021;14:2015-2025. doi:10.2147/IDR.S312116
 6. 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 period of the COVID-19 outbreak: A quick online cross-sectional survey. *Int J Biol Sci.* 2020;16(10). doi:10.7150/ijbs.45221
 7. Ditekemena JD, Nkamba DM, Mutwadi A, Mayoko HM, Fodjo JN, Luhata C, et al. Covid-19 vaccine acceptance in the democratic republic of congo: A cross-sectional survey. *Vaccines.* 2021;9(2). doi:10.3390/vaccines9020153
 8. Sallam M. Covid-19 vaccine hesitancy worldwide: A concise systematic review of vaccine acceptance rates. *Vaccines.* 2021;9(2). doi:10.3390/vaccines9020160
 9. da Silva DT, Biello K, Lin WY, Valente PK, Mayer KH, Weidman LH, et al. Covid-19 vaccine acceptance among an online sample of sexual and gender minority men and transgender women. *Vaccines.* 2021;9(3). doi:10.3390/vaccines9030204
 10. Bono SA, Villela EF, De M, Siau CS, Chen WS, Pengpid S, et al. Factors affecting COVID-19 vaccine acceptance: an international survey among low-and middle-income countries. *Vaccines.* 2021;9(5). doi:10.3390/vaccines9050515
 11. Sharun K, Faslu RCK, Haritha C V, Jose B, Tiwari R, Dhama K. Covid-19 vaccine acceptance: Beliefs and barriers associated with vaccination among the general population in india. *J Exp Biol Agric Sci.* 2020;8(Special Issue 1). doi:10.18006/2020.8(Spl-1-SARS-CoV-2).S210.S218
 12. Joshi A, Kaur M, Kaur R, Grover A, Nash D, El-Mohandes A. Predictors of COVID-19 Vaccine Acceptance, Intention, and Hesitancy: A Scoping Review. *Front Public Heal.* 2021;9. doi:10.3389/fpubh.2021.698111
 13. Global Change Data Lab (GCDL). Our world in data. Available on: https://ourworldindata.org/covid-vaccinations?country=OWID_WRL.
 14. Elleh N. Abuja : the single most ambitious urban design project of the 20th century. *New World Encycl.* Published online 2001:97.
 15. Federal Capital Territory Administration. Annual health and statistical bulletin 2016. Federal Capital Territory, Abuja-Nigeria.
 16. Popova L. Regular Articles The Extended Parallel Process Model: Illuminating the Gaps in Research. *Heal Educ Behav.* 2012;39(4):455-473. doi:10.1177/1090198111418108
 17. Leila J, Parvin S, Parvin R, Sirous S, Zahara S, Mahmoud TA. Developing and validating the risk perceptions questionnaire for COVID-19 (Risk Precept COVID-19): an application of the extended parallel process model |

- Research Square.
18. Eze UA, Ndoh KI, Ibisola BA, Onwuliri CD, Osiyemi A, Ude N, et al. Determinants for Acceptance of COVID-19 Vaccine in Nigeria. *Cureus*. 2021; 13(11). doi:10.7759/cureus.19801
 19. Adedeji AH, Adeosun SA. Factors influencing COVID-19 vaccine uptake among adults in Nigeria. Published online 2022. doi:10.1371/journal.pone.0264371
 20. Asnakew Z, Asrese K, Andualem M. Community Risk Perception and Compliance with Preventive Measures for COVID-19 Pandemic in Ethiopia. Published online 2020. doi:10.2147/RMHP.S279907
 21. Ochu CL, Onoja M, Olatunji D Okusanya BO, Usuwa IS, Akeju DO, et al. Public risk perception and behaviours towards COVID-19 during the first and second waves in Nigeria: a secondary data analysis. *BMJ Open*. 2022;12:58747. doi:10.1136/bmjopen-2021-058747
 22. Jahan A, Mohamed M, Alabani E, Almaziq A, Elarriesh H, Alagelli F, et al. Awareness, knowledge, attitudes, and behaviors related to COVID-19 in Libya: A nation-wide online survey. *Pan Afr Med J*. 2021;40. doi:10.11604/pamj.2021.40.156.29455
 23. Ilesanmi O, Afolabi A. Perception and practices during the COVID-19 pandemic in an urban community in Nigeria: a cross-sectional study. *PeerJ*. 2020; 8. doi:10.7717/PEERJ.10038
 24. Ahmad AM, Sahal AN, Al-Hanawi MK, Oattan AM, Helmy HZ, Abudawood Y, et al. Knowledge, Attitude and Practice Toward COVID-19 Among the Public in the Kingdom of Saudi Arabia: A Cross-Sectional Study. *Front Public Heal* | www.frontiersin.org. 2020;1:217. doi:10.3389/fpubh.2020.00217
 25. Bao-Liang Z, Wei L, Hai-Mei L, Qian-Qian Z, Xiao-Ge L, Wen-Tian L, et al. Knowledge, attitude and practice towards COVID-19. *Int J Biol Sci*. 2020;2020(10):1745-1752. doi:10.7150/ijbs.45221
 26. Muchiri SK, Muthee R, Kiarie H, Siteinei J, Agweyu A, Atkinson PM, et al. Unmet need for COVID-19 vaccination coverage in Kenya. *Vaccine*. 2022;40(13):2011-2019. doi:10.1016/J.vaccine.2022.02.035
 27. Adigwe OP. COVID-19 vaccine hesitancy and willingness to pay: Emergent factors from a cross-sectional study in Nigeria. *Vaccine X*. 2021; 9. doi:10.1016/J.JVACX.2021.100112
 28. Adedeji-Adenola H, Olugbake OA, Adeosun SA. Factors influencing COVID-19 vaccine uptake among adults in Nigeria. *PLoS One*. 2022; 17(2 February). doi:10.1371/JOURNAL.PONE.0264371
 29. Yasmin F, Najeeb H, Moeed A, Naem U, Asghar MS, Chughtai NU, et al. COVID-19 Vaccine Hesitancy in the United States: A Systematic Review. *Front Public Heal*. 2021;9. doi:10.3389/FPUBH.2021.770985
 30. Yoda T, Katsuyama H. Willingness to receive covid-19 vaccination in japan. *Vaccines*. 2021;9(1):1-8. doi:10.3390/VACCINES9010048
 31. Neumann-Böhme S, Varghese NE, Sabat I, Barros PP, Brouwer W, van Excel J, et al. Once we have it, will we use it? A European survey on willingness to be vaccinated against COVID-19. *Eur J Heal Econ*. 2020; 21(7): 977-982. doi:10.1007/S10198-020-01208-6/figures/5