COVID-19 Vaccine Knowledge, Attitude, and Acceptance in Students of Tertiary Institutions in Central Nigeria

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Abstract

Introduction/Background: On March 11, 2020, the World Health Organization declared the COVID-19 outbreak a global pandemic. Nigeria, among African nations, has borne the highest burden of COVID-19 reporting 163,498 cases and 2,058 fatalities. Institutions of higher learning possess certain characteristics that can increase the risk of COVID-19 transmission within their campuses. These features include a sizable student population, high population density, and frequent student interactions. As a result, it is imperative to implement protective measures to mitigate the virus's spread on campus.

Aim/Objective: This research aimed to explore the connection between the knowledge, attitudes, and acceptance of COVID-19 vaccines among students in tertiary institutions located in Central Nigeria.

Methodology: An anonymous online survey was conducted among Nigerian students, gathering information related to their demographics, as well as assessing their knowledge, attitudes, and willingness to accept vaccines in the post-COVID-19 era. The collected data were subjected to analysis through descriptive and inferential statistics.

Results: Out of the 400 participants included in the survey, 140 (35.0%) reported having already received a COVID-19 vaccine, while 144 (36.0%) expressed an intention to be vaccinated. The analysis indicated that there is a positive yet very weak correlation between attitudes towards COVID-19 vaccination and the intention to get vaccinated ($r = -0.023$, $N = 365$, $p < 0.01$). Conversely, knowledge regarding COVID-19 vaccines demonstrated a significant positive correlation with the intent to be vaccinated ($r = 0.222$, $N = 367$, $p < 0.01$).

Conclusion: In conclusion, this study underscores the importance of students' knowledge and attitudes regarding vaccines in shaping their acceptance of COVID-19 vaccines. The results emphasize the critical necessity of providing comprehensive information on COVID-19 vaccines to address concerns related to unforeseen side effects, mitigate general mistrust in vaccine benefits, and alleviate apprehensions about the profitability of pharmaceutical companies.

Keywords: SARS-CoV-2, COVID-19, COVID-19 vaccine acceptance, University student, Nigeria

1. Introduction

Towards the conclusion of 2019, incidents of pneumonia cases with an unidentified origin were reported in Wuhan, China (World Health Organization, 2021). In-depth investigations by scientists unveiled the causative agent behind this malady as a new pathogenic viral agent, termed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The World Health Organization (WHO) officially categorized this ailment as coronavirus disease 2019 (COVID-19) and declared it to be a pandemic on March 11, 2020 (World Health Organization, 2021). While many COVID-19-infected individuals experience mild to slightly moderate breathing symptoms, such as pneumonia, and convalesce devoid of the need for specialised health intervention, a subset may deteriorate and necessitate critical care, particularly in the case of elderly and immunocompromised individuals, with a higher likelihood of fatality (WHO, 2023a). These pandemics compelled governments and policymakers to enact

nationwide lockdowns, either in part or entirety and impose widespread quarantines, leading to far-reaching consequences spanning psychological and economic domains. Initially, a COVID-19 modelling study suggested that Nigeria exhibited an increased risk of SARS-CoV-2 importation, increased susceptibility, and a slightly reduced ability to manage such a pandemic (Gilbert et al., 2020; Sidor & Rzymski, 2020; Prati & Mancini, 2021).

In addition to implementing lockdown measures, governments prioritized various non-pharmaceutical intervention (NPI) strategies to mitigate the virus's transmissibility. These strategies encompassed practices such as mask-wearing, hand sanitisation, social distancing, alterations in educational delivery methods, including online learning, and travel restrictions (Nicola et al., 2020).

By the conclusion of October 2023, the WHO had reported a global tally of more than 771,191,203 million confirmed cases of COVID-19, accompanied by over 6,961,014 million recorded deaths (WHO, 2023b).

Nigeria, among African nations, bears the highest COVID-19 burden to date, with 267,146 reported cases and 3,155 recorded deaths (WHO, 2023c). The unique characteristics of the university environments, marked by substantial population sizes, high population densities, and frequent student interactions, elevate the risk of transmission of the disease within campus settings, necessitating the implementation of protective measures to curb the virus's propagation.

Recognized widely in the scientific domain, vaccination represents a pivotal approach to addressing the outbreak. Vaccination is acknowledged as one key achievement in public health, averting over 20 life-threatening diseases and preserving 2-3 million lives annually (CDC, 2011; Greenwood, 2014; WHO, 2013). Historically, vaccine development timelines have been protracted; however, contemporary technological advancements have significantly shortened the development process (Van Riel & de Wit, 2020; Graham et al., 2018). These advances, coupled with previous studies on SARS-CoVs, emergency circumstances worldwide, and substantial research funding, have facilitated the rapid development of COVID-19 vaccines (Brown & Head, 2020; Zhai et al., 2020). Notably, more than 230 COVID-19 vaccine candidates have entered animal and clinical development stages, harnessing crude and next-generation approaches (Mellet & Pepper, 2021).

Numerous prophylactic vaccines of COVID-19, like those developed by Pfizer– BioNTech, AstraZeneca, Moderna, Janssen, Serum Institute of India, Gamaleya, and Sinopharm, have been created worldwide. However, of the 11 vaccines developed, only 7 have gained approval from the Nigerian government (Nigeria COVID-19 Vaccine Tracker, 2022; NAFDAC, 2023; Smit et al., 2021). While these vaccines are distributed globally, Nigeria has introduced the AstraZeneca COVID-19 vaccine for public use. Assessing the acceptability of this vaccine is crucial due to diverse global perceptions of vaccination (Lin et al., 2020). Although vaccination progress in Nigeria is limited, challenges persist in achieving comprehensive COVID-19 immunization in universities. Among these challenges, there is uncertainty regarding student's willingness to COVID-19 vaccine acceptance, which is exacerbated by the proliferation of untrue information and conflicting data on websites that may discourage vaccine use (Adetayo, Sanni, & Aborisade, 2021).

Acceptance of vaccines plays a pivotal role in gauging community perceptions of the risks of disease and the demand for vaccines, which is particularly key in making sure that an increased population are vaccinated, especially for such pathogenic viral agents of pandemic potential (Nguyen et al., 2011; Yaqub et al., 2014; Dubé & MacDonald, 2016). This data facilitates authorities in making informed decisions concerning vaccine adoption and guides the formulation of strategies to enhance acceptability, preventing the risk of disease transmission among students. Over the past decade, concerns and hesitancy revolving around the COVID-19 vaccine have grown, impacting vaccine coverage rates (Larson et al., 2014). Historical research reveals public reluctance to embrace new vaccines during pandemics (Henrich & Holmes, 2009; Prematunge et al., 2012; Giannattasio et al., 2015). Public decisions regarding vaccination are complex and influenced by factors like confidence, convenience, and complacency, according to the WHO's "3C" vaccine hesitancy paradigm (Greenberg et al., 2017; González-Block et al., 2020; Luisi, 2020; Group, 2014; MacDonald, 2015). Controlling or eradicating the pandemic through vaccination necessitates a comprehensive idea behind Nigeria's resistance to vaccines and strategies to address this hesitancy. Acknowledging diverse attitudes and knowledge about vaccines is vital, as a tailored strategy to vaccine hesitancy that addresses the worry of varied demographic populations is more effective than a one-size-fits-all strategy (Bish & Michie, 2010; Agrawal et al., 2020). Given Nigeria's recent vaccine rollout, a nuanced understanding of vaccine knowledge is especially crucial.

The study aimed to explore the connection between the knowledge, attitude, and acceptance of COVID-19 vaccines among students in tertiary institutions located in Central Nigeria. The goal was to analyze the collected data through descriptive and inferential statistics to understand the relationship between knowledge, attitude, and vaccine acceptance among the student population.

1.2 Research Questions

1) What is the level of knowledge concerning the COVID-19 vaccine among students in tertiary institutions in Central Nigeria?

2) What are the attitudes of students in tertiary institutions in Central Nigeria towards COVID-19 vaccination?

3) What is the acceptance rate of COVID-19 vaccines among students in tertiary institutions in central Nigeria?

2. Methods

2.1 Study Design

This study employed a descriptive survey approach, which serves to characterize the attributes of a population or discern distinctions between multiple populations. Researchers utilise this design to formulate predictions grounded in the gathered survey data. This approach was deemed suitable for the present study due to its reliability in safeguarding respondent anonymity, thereby fostering the provision of precise and candid responses.

2.2 Sampling Technique

In this study, the survey was conducted among students in tertiary institutions located in Central Nigeria after receiving consent from each participating institution. The students were randomly selected from different faculties in 5 randomly selected tertiary institutions in Central Nigeria to obtain an overall representative sample, minimize bias, enhance generalizability, and facilitate the application of statistical analysis. These factors contribute to the validity and reliability of the study findings.

2.3 Study Population and Sample Size Determination

The survey was conducted in five (5) randomly selected tertiary institutions in Central Nigeria: University of Jos, Plateau State (UJ), Nasarawa State University, Keffi, Nasarawa State (NSUK) College of Education, Akwanga, Nasarawa State (COE), Federal College of Medical Laboratory and Technology, Vom, Plateau State (FCMLTV) and the Federal University Lafia, Nasarawa State (FULafia).

The sample size for this study is 400 students across these universities. Using the Cochran formula ($n = Z^2 \times Pq / e^2$)

where;

N = Sample size

Z = critical z-value (1.96)

P = Estimated proportion of the population with the attribute (15%).

q = 1 - P

e = Margin of error (3.5%)

$n = 1.96 \times 0.15 \times 0.85/0.035^2$

n = 399.84 ~ **400**

2.4 Study Instrument

In this study, a structured questionnaire, denoted as "KAA" (Knowledge, Attitude, and Acceptance), was employed. While some components of the questionnaire were adapted from instruments previously used in different countries and settings, specific sections of the instrument were developed by the researchers themselves. The knowledge scale used in this study was obtained with acknowledgement from the Centers for Disease Control and Prevention (CDC, 2021), while the attitude scale was borrowed from the work of Adetayo et al. (2021) exhibiting an increased internal corroborated Cronbach's alpha values ranging from 0.908 to 0.910. Before the actual study, the questionnaires underwent a rigorous validation and authentication process, with input and evaluation from experts in the respective field.

2.5 Data Collection

A structured, self-administered paper questionnaire and an electronic survey form created through Google Forms were employed to collect responses from the study population enrolled in the chosen institutions. The survey link was disseminated via Whatsapp, a predominant social media platform extensively utilized by educators for communication with students. Respondents from these institutions provided their input in response to the survey questions.

2.6 Statistical Analysis

The data obtained were subjected to analysis involving measures such as percentages, frequency, mean, and standard deviations (SD). Additionally, the assertions were examined utilizing Person's product-moment correlation analysis, with significance testing set at the 0.01 level. Graphs were generated using GraphPad Prism 8.4.2 software.

3. Results

This study, conducted among 400 randomly selected students from tertiary institutions in Central Nigeria, provided insight into the socio-demographic features and knowledge, attitudes, and behaviours about COVID-19 and its vaccination. The study's participants were drawn from various institutions, with the highest representation from NSUK (37.5%), followed by FCVMLV (25.5%), COEA (19.8%), UJ (14.2%), and FULafia (3.0%) (**Table 1**). Most participants hailed from the science disciplines (35.5%), were predominantly female (53.0%), and aged between 21-26 years old (36.8%). The majority were single (83.2%) and identified as Christians (73.2%) as reported in Table 1. Survey findings revealed that a substantial proportion of respondents possessed knowledge regarding COVID-19 and its vaccination. Notably, 70.0% recognised that COVID-19 vaccination offers protection against the virus. However, misconceptions existed, with 38.5% not aware that COVID-19 vaccines do not alter DNA. The study indicated that 54.5% believed that COVID-19 is man-made and intentionally spread and 51.0% were unaware that prior infection did not negate the need for vaccination (**Figure 1**).

In terms of behaviours related to COVID-19 prevention, most students displayed positive compliance with National prevention guidelines, including mask-wearing, physical distancing, and avoiding social gatherings. However, there were some areas where compliance was weaker, such as using hand sanitisers and covering the mouth when coughing/sneezing (**Table 2**).

Furthermore, the study revealed an overall negative attitude among respondents regarding COVID-19 vaccines, with concerns including mistrust of vaccine benefits, preference for natural immunity, worries about unforeseen effects, and concerns about pharmaceutical company profits (**Figure 2**).

Regarding vaccine acceptance, 57.0% of students had not received the COVID-19 vaccine, likely influenced by negative attitudes. However, 36.0% expressed the intention to accept the vaccine, a more positive perspective compared to those who did not intend to receive it (20.5%) (**Figure 3**). These findings shed light on the complex landscape of COVID-19 knowledge, attitudes, behaviours, and vaccine acceptance in Nigerian students in the context of the pandemic.

Table 1. Socio-demographic characteristics of participants included in the study

Variable	N (%)
Sex	
Female	212 (53.0)
Male	188 (47.0)
Marital Status	
Single	333 (83.2)
Married	66 (16.5)
Divorced	0 (0.0)
Widow(er)	1 (0.3)
Religion	
Christian	293 (73.2)
Islam	101 (25.3)
Other	6 (1.5)
Age (years)	
<20	127 (31.7)
21-26	147 (36.8)

27-32	70 (17.5)
33-38	29 (7.3)
>39	27 (6.7)
Discipline	
Science	142 (35.5)
Basic Medical Science	90 (22.5)
Art	111 (27.7)
Social Science	41 (10.2)
Commercial	16 (4)
Institution	
UJ	57 (14.2)
NSUK	150 (37.5)
COEA	79 (19.8)
FCMLV	102 (25.5)
FULafia	12 (3.0)
Total	**400**
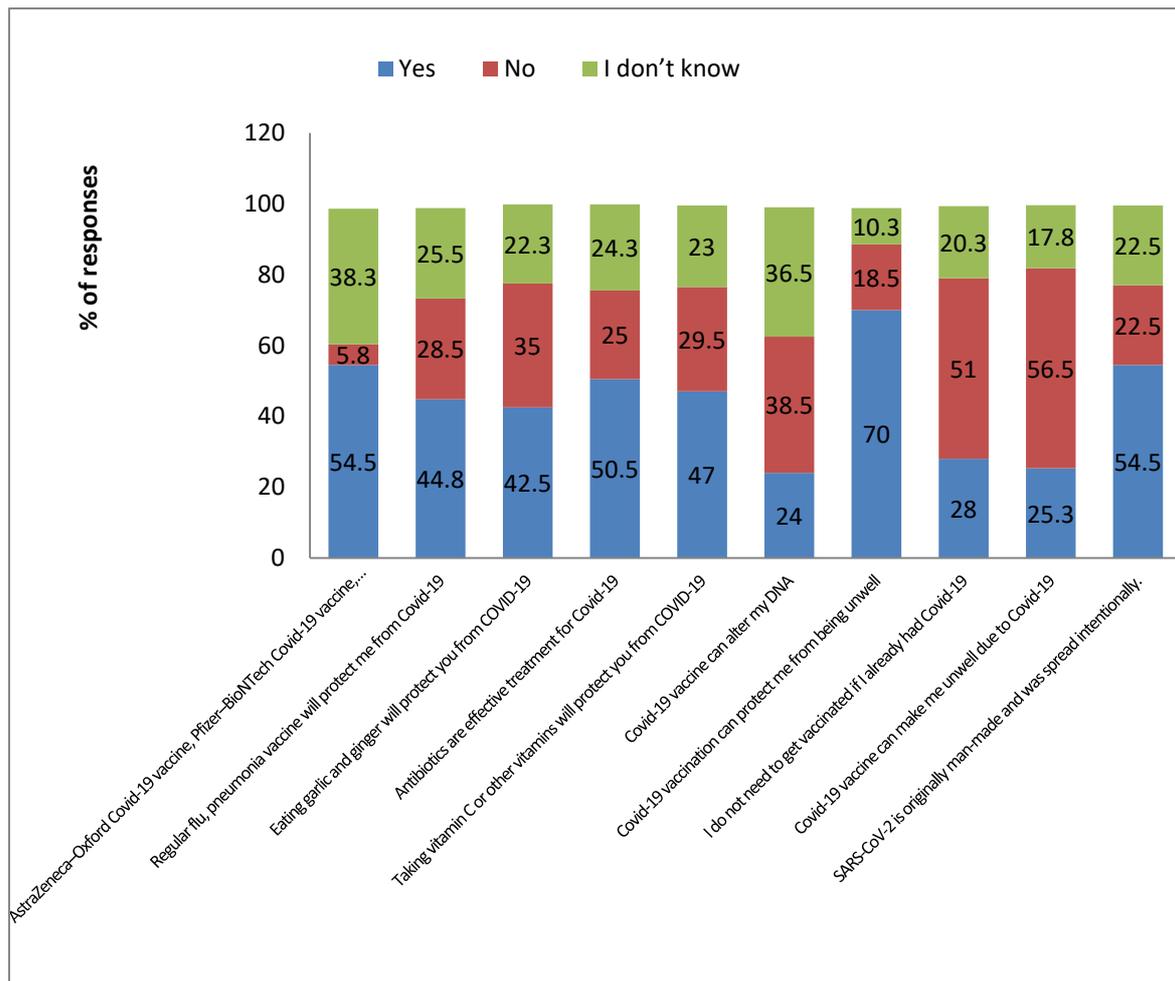
Figure 1. Study participant's responses on their knowledge of Covid-19 vaccination

Table 2. The behavioural acts of participants about National Prevention Guidelines on COVID-19

| S/N	National Prevention Guidelines	Always (%)	Usually (%)	Sometimes (%)	Hardly (%)	Never (%)	Mean	Std. D
1	I avoid social gatherings, no matter its purpose	191 (47.8)	57(14.3)	110(27.5)	9(2.3)	15 (3.8)	1.95	1.112
2	I avoid eating or gathering in public places	199 (49.8)	68(17.0)	76(19.0)	26(6.5)	15 (3.8)	1.93	1.156
3	Avoid discretionary travel, shopping trips and social visitations	181 (45.3)	72 (18.0)	90 (22.5)	23 (5.8)	18 (4.5)	2.02	1.171
4	I give 6ft of physical distance between myself and other people	191 (47.8)	69 (17.3)	67 (16.8)	35 (8.8)	17 (4.3)	1.99	1.207
5	Avoid physical touch when greeting other people	209 (52.3)	63 (15.8)	69 (17.3)	29 (7.3)	14 (3.5)	1.90	1.161
6	Avoid mouth, nose, and eye touching with dirty hands	210 (52.5)	77 (19.3)	59 (14.8)	28 (7.0)	12 (3.0)	1.85	1.117
7	I stay far away from unwell persons	227 (56.8)	68 (17.0)	52 (13.0)	17 (4.3)	11 (2.8)	1.71	1.053
8	I closed my nose and mouth with a tissue or my elbow during coughing/sneezing	278 (69.5)	58 (14.5)	37 (9.3)	6 (1.5)	5 (1.3)	1.44	.831
9	I clean and disinfect frequently touched surfaces daily	235 (58.8)	76 (19.0)	58(14.5)	16 (4.0)	4 (1.0)	1.66	.946
10	I clean and disinfect my room	248 (62.0)	82 (20.5)	41 (10.3)	13 (3.3)	3 (0.8)	1.56	.869
11	I wash my hands often, with water and soap for approximately 20 seconds	232 (58.0)	67(16.8)	64 (16.0)	20 (5.0)	1 (0.3)	1.67	.948
12	I apply hand sanitizer that is ethanol-composed	231 (57.8)	63 (15.8)	64 (16.0)	15 (3.8)	19 (4.8)	1.80	1.142
13	I put on a facemask at the university environment	212 (53.0)	62 (15.5)	67 (16.8)	34 (8.5)	12 (3.0)	1.89	1.159
14	I put on a facemask when talking to any visitors	178(44.5)	53 (13.3)	70 (17.5)	51(12.8)	39 (9.8)	2.28	1.406
15	I put on facemask on transit	226 (56.5)	46 (11.5)	74 (18.5)	34 (8.5)	8 (2.0)	1.85	1.135
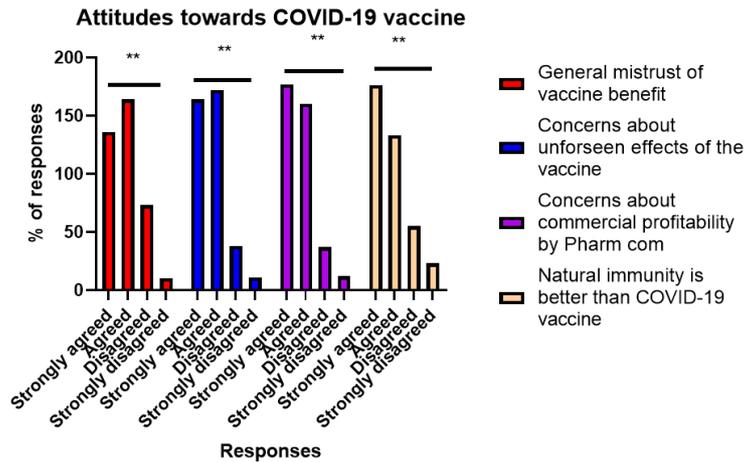
Figure 2. Respondents attitude towards COVID-19 vaccine
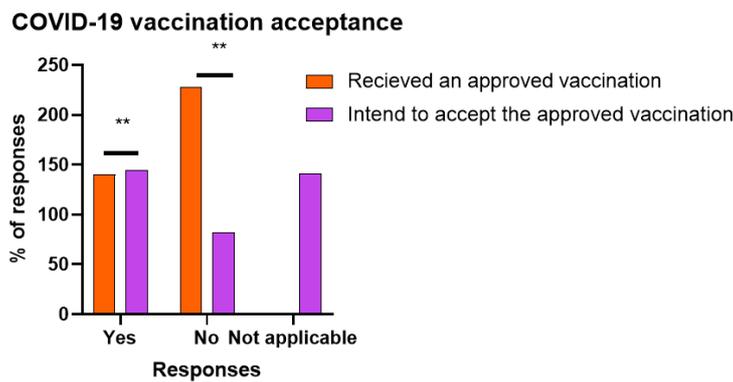
Figure 3. Respondents COVID-19 vaccination acceptance

4. Discussion

SARS-CoV-2 continues to pose a global threat, and the availability of effective vaccines is a primary avenue for combating and controlling this highly contagious virus. While numerous COVID-19 vaccines are now accessible, their success relies on their efficacy, acceptability, and suitability for a broad population. Understanding individuals' knowledge about COVID-19, their attitudes towards the virus and their willingness to accept vaccines can significantly influence vaccination efforts. The study's findings indicate that most students exhibit a good understanding of the approved COVID-19 vaccines (54.5%), with only a small proportion lacking awareness (38.3%) or expressing disagreement (5.8%) regarding the vaccines approved for use. These findings align with those of Adetayo et al. (2021) who also observed a high level of knowledge among respondents about approved COVID-19 vaccines. In contrast, our study contradicts the outcomes by Rhodes et al. (2021) who found lower understanding levels about the COVID-19 vaccine in Australian students, suggesting that students in our study may have received orientation and education about COVID-19 in their respective institutions. Additionally, our research revealed that students hold misconceptions and negative beliefs about the COVID-19 vaccine, with a significant portion believing that regular flu and pneumonia vaccines (44.8%), consumption of garlic and ginger (42.5%), and intake of vitamin C or other vitamins (47.0%) can guide them from having the disease. Furthermore, most students expressed the belief that COVID-19 was artificially created and intentionally spread (54.5%). These findings are consistent with the research of Wilson et al. (2015); AL-Mohaithef & Padhi, (2020); Olu-Abiodun et al. (2022) and Ojewale et al. (2022) which have reported that vaccines and a lack of understanding about the nature of the virus that COVID-19 vaccines can effectively prevent. The negative beliefs about COVID-19 may be attributed to denialism, characterized by the rejection of well-established scientific facts, reliance on misleading information, and the accusation of scientists engaging in conspiracy. Such denialism often involves the selective use of data and scientific literature, the promotion of unrealistic expectations regarding scientific uncertainty, and

the use of misrepresentation and logical fallacies (Diethelm & McKee, 2009).

This study underscores a notable trend of low COVID-19 immunization acceptance among students, with only 35.0% expressing willingness to be vaccinated. This aligns with research done in the United States (New Jersey) on college students, which revealed that 23% of students had been inoculated with the COVID-19 vaccine (Kecojevic et al., 2021). Similarly, Iwuagwu et al. (2023) reported a 30% vaccination rate among adults in Nigeria. The lower vaccination rates are attributed to factors like limited vaccine availability and lower economic capacity to produce to procure vaccines, especially in lower-income countries. Of the 57.0% of students who had not received the vaccine, a significant proportion expressed intentions to accept registered COVID-19 vaccines in years to come. This finding resonates with the research of Bhartiya et al., (2021) which showed a notable willingness among individuals to receive the COVID-19 vaccine. However, the intent to be vaccinated (36.0%) in this study is notably lower than that findings in various other countries, such as the USA (52.8%), Palestine (57.8%), France (58.0%), Canada (79.6%), Italy (94.7%), and other among students (Zakari et al., 2023). These variations in vaccination intentions are influenced by geographical location and the stage of the pandemic (Zakari et al., 2023; Dodd et al., 2021; Reiter, Pennell, & Katz, 2020). For instance, students from different continents have shown varying responses, with Africa (Mauritius, 67%), Asia (China, 87.42%), and Australia (Tonga, 92.88%) reporting higher levels of willingness to accept COVID-19 immunization when available (Mannan & Farhana, 2020). In the current study, 57.0% of students remained unvaccinated, while 20.5% expressed unwillingness to receive the COVID-19 vaccine. This study also observed that most students exhibited a positive attitude toward adhering to COVID-19 national prevention guidelines and followed these measures. This finding aligns with the research conducted by Roga et al., (2022) which revealed that over half of the participants (57.9%) displayed a favourable attitude toward COVID-19 preventive measures. However, it contradicts the outcomes published by Nivette et al., (2021) who reported that non-compliance with COVID-19 measures in Switzerland was high among persons in tertiary institutions. Similarly, Sherman et al., (2021) reported poor compliance with government COVID-19 prevention guidelines, in contrast to contrast to the compliance observed in this study. The students' adherence to preventive guidelines in these institutions may be attributed to measures taken by the institutional authorities to promote and enforce compliance. In contrast, the study unveiled a negative attitude toward COVID-19 vaccines among students in these institutions. Most respondents displayed either high or moderate negative attitudes towards statements related to the COVID-19 vaccine. This discovery raises significant concerns for public health and school authorities in terms of comprehending COVID-19 immunization hesitancy in these groups and enhancing health awareness for students. The implications of these negative vaccine attitudes are noteworthy, as they are likely to impact the students' uptake of COVID-19. Considering that many of these young students will soon become parents responsible for immunizing their children, building vaccine confidence in this population is crucial. Our reports indicate that the primary blockage in their attitudes to COVID-19 vaccine acceptance among students is rooted in an overall mistrust of the vaccine, a preference for natural immunity, concerns regarding unseen vaccine side effects, and suspicions regarding the profit motives of biopharmaceutical industries. This observation aligns with the results reported by Paul et al. (2021) and Babatope et al. (2023). These studies have similarly identified general mistrust in vaccine benefits, safety concerns, and worries about unforeseen side effects as significant impediments to vaccine acceptance. In our study, a substantial 79.1% of students exhibited a notably negative attitude toward vaccines in general. In comparison to research done in Kuwait, where 57.2% of participants displayed strong negative attitudes towards vaccines (Alibrahim & Awad, 2021; Zaidi et al., 2021; Martin & Petrie, 2017), our findings suggest a higher degree of negative vaccine attitudes among student population. Furthermore, our study hypothesized that understanding immunization would impact the idea of being vaccinated, a hypothesis supported by our survey findings. This finding contrasts with the results of Pogue et al. (2020) who found that understanding scores were insignificantly correlated to receiving a COVID-19 vaccine. However, our study aligns with the findings of Gallè et al. (2021) and Moltot et al. (2023) which reported a significant association between knowledge and COVID-19 vaccine acceptance. Additionally, our research revealed a positive correlation between negative attitudes regarding COVID-19 immunization and the idea of being vaccinated, highlighting the importance of addressing and altering students' attitudes toward these vaccines.

5. Conclusion

This study's findings reveal that students' COVID-19 vaccine knowledge and attitudes are strongly linked to their vaccination intent. While students displayed a varied understanding of different approved vaccines, ignorance existed regarding others. Despite compliance with prevention guidelines for COVID-19, their overall attitude towards immunization remained negative. However, their willingness to get vaccinated exceeded the average, with only a small proportion already vaccinated.

5.1 Recommendations

The results emphasize the potential for increased vaccine acceptance by enhancing students' vaccine knowledge and altering their attitudes. Addressing concerns about unforeseen vaccine effects and dispelling worries about pharmaceutical companies' profitability is crucial. The study further suggests that the Nigerian government should prioritize educational campaigns in universities, workshops, and information dissemination programs to enhance students' knowledge about COVID-19 vaccines. The Nigerian government should assure students that pharmaceutical companies prioritize saving lives over profits. Future research should explore social predictors that facilitate COVID-19 vaccine hesitancy among Nigerians, warranting qualitative investigations.

5.2 Limitations of the Study

The study is subject to limitations stemming from the unfeasibility of conducting an offline survey due to financial constraints. Employing an online survey approach may affect the representativeness of the sample. To mitigate this concern, we employed a substantial sample size and applied a simple random sampling method across diverse faculties to improve the sample's diversity and representation. Additionally, it is essential to acknowledge that as this project is hypothetical, the results might not perfectly mirror real-world experiences. Furthermore, the potential for self-reported answers might introduce bias into the information gathered.

Author Contributions

OJE, – Conceptualization, formal analysis, investigation, writing, visualization, statistical analysis; **NCN** – Literature search, methodology, writing, questionnaire development **CDA**– Literature search, methodology, writing; **BK**– Literature search, writing, manuscript editing; **VBO**–Validation, methodology, writing, visualization, statistical analysis, manuscript editing. All authors reviewed and approved the final version of the manuscript and agreed to be responsible for all aspects of this work.

Provenance and Peer Review

Not commissioned; externally double-blind peer reviewed.

Data Availability Statement

The data that support the findings of this study are available on request.

Competing Interests Statement

The authors affirm that no notable conflicts of interest, including financial, professional, or personal aspects, could have influenced the execution of the study.

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