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Pattern and Incidence of Covid-19 Vaccine Reactions among Adult Clients in a Tertiary Health Facility in a North-Central State of Nigeria

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ABSTRACT

Introduction: As a result of the rapid development and approval of the COVID-19 vaccine during the pandemic, there was serious misinformation about the safety of the COVID-19 vaccine. Providing evidence-based proof of the safety of the COVID-19 vaccine could dispel this scepticism. The study aimed to assess the pattern and incidence of COVID-19 vaccine reactions among adult clients in a tertiary health facility following immunization. **Methods:** The cross-sectional study was conducted in a tertiary care institute among recipients of the first dose of the of the COVID-19 vaccine between April and July 2021. Study populations were adults above 18 years. Participants were assessed for any reactions four times. Immediately after vaccination and later, same day one, day 2, day 3, and on/after day 7. A telephone interview was conducted, and the recipients were assessed according to the time and type of reactions, actions taken following reactions, and severe forms of reactions. **Results:** A total of 1535 participants were assessed post-COVID-19 vaccination reactions, and 805 (52.4%) reported at least one of the COVID-19 vaccine reactions following vaccination, and less than a percent reported perceived severe adverse reactions. Pain at the injection site (5.0%), myalgia (2.8%), and headache (1.6%) were the common adverse events reported immediately after vaccination. The majority of the respondents (93.4%) were willing to take the second dose of the of the COVID-19 vaccine. The major factor associated with COVID-19 vaccine reactions following vaccination was the age group. **Conclusion:** Many people still experience a certain type of discomfort after vaccinations; this discomfort is often mild to moderate and is more prevalent in young adults. Most of the reactions resolve after a few days without intervention.

Keywords: Adverse Events; COVID-19; Vaccines and Vaccine Reactions

INTRODUCTION

The COVID-19 outbreak, caused by the SARS-CoV-2 virus, has become a major global health crisis, impacting millions globally (Kamoka & Elengoe, 2024). In the background of the extensive health and economic consequences of the COVID-19 pandemic, efforts were made to swiftly offer safe and effective vaccines to prevent severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections. The need for reliable and efficient COVID-19 vaccines prompted the advancement and application of innovative vaccine production methods for human use. Before the COVID-19 outbreak, some of these methods were only sparingly utilized or viewed as experimental in the realm of human vaccination (Gee *et al*., 2024). Vaccines are expected to continue to be crucial in combating the pandemic caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) (Stamm *et al*., 2023). Vaccination was considered the most promising and practical approach to curbing the pandemic, among other preventive measures (Mathieu *et al*.,

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2021). Since the pandemic started, researchers and pharmaceutical companies have been racing to develop and test vaccines against COVID-19 (Karlsson *et al.*, 2021). Although the vaccines brought the promise of a global rescue from the coronavirus pandemic, unfortunately, there were a lot of myths, misinformation, and conspiracy theories surrounding the vaccines. The international COVID-19 containment efforts through the administration of vaccines suffered an initial setback because of the negative perceptions and attitudes consequential to myths, misinformation, and infodemics (Demuyakor, Nyatuame, & Obiri, 2021; Hernandez *et al*., 2021). After the initial hesitancy, global COVID vaccine advocacy with a rigorous campaign started. The results of COVID vaccine clinical trials and other efficacy studies proved effective and safe. This thereby got the vaccines expedited but with temporary approval from countries worldwide. Although myriad adverse events have been reported in individuals following vaccine administration, no other severe events have been clearly reported after hundreds of millions of doses administered globally (Wesselink *et al.*, 2022). Vaccine hesitancy has three components that influence an individual's refusal, delay, or reluctance to vaccinate even though having active concerns; these are behaviors, beliefs, and attitudes (Soelar & Mustaffa, 2022).

The COVID-19 vaccines developed so far are in four primary categories (Nagy & Alhatlani, 2021). Whole-virus vaccines are an inactivated or attenuated (weakened) form of SARS-CoV-2 to initiate protective immunity (Byrne & McLellan, 2022). At least two SARS-CoV-2 inactivated candidate vaccines have been approved for emergency use (WHO, 2021). Protein-based vaccines are of two types: subunit and virus-like particle vaccines (Callaway, 2020). It contains viral antigenic fragments manufactured by recombinant protein techniques (Hsieh *et al*., 2020). The viral vector provides a means to invade the cell and insert the code for SARS-CoV-2 antigens that can trigger immune responses (Byrne & McLellan, 2022). Nucleic acid vaccines use deoxyribonucleic acid (DNA) or ribonucleic acid (RNA) as genetic instructions for a SARS-CoV-2 protein to trigger an immune response (Ndwandwe & Wiysonge, 2021). In Nigeria, Oxford AstraZeneca (viral vector vaccine), Johnson and Johnson (viral vector vaccine), Pfizer-BioNTech (mRNA vaccine), Moderna (mRNA vaccine), Indian Oxford/AstraZeneca (viral vector vaccine), Gamalaya (viral vector vaccine), and China-Sinopharm (whole virus inactivated) are currently licensed for use at a dose of 0.5 ml intramuscularly at the upper arms (NPHCDA, 2023).

The uneven distribution of vaccines worldwide also impacted their acceptance in economically disadvantaged nations (Arsenault *et al.*, 2024). About 12.8 billion COVID-19 vaccine doses have been administered globally. In low-income countries, only 23.3% of people have received at least a dose (Nigeria CDC, 2022). Since the introduction of the vaccines to all states in Nigeria in the year 2021, a total of 39.2% of the eligible population have had a complete dose of the vaccines, while 11.5% were partially vaccinated as of October 2022 (NPHCDA, 2023). The vaccine coverage varied widely among the 36 states of Nigeria. From the available records of October 2022 in Kwara State, a north-central state in Nigeria, 65% of the target population (1,836,181) is fully vaccinated irrespective of the type of vaccine, while 9% are partially vaccinated with only the first dose, and about 13.4% have received their booster shot (NPHCDA, 2023).

Vaccine hesitancy is defined as the reluctance or refusal to accept vaccination even when vaccination services are readily available (Ingram *et al*., 2023). The development of herd immunity to COVID-19 is hindered by vaccine hesitancy, with no guarantee that the vaccine will be fully accepted even though it is provided at no cost. Earlier evidence from Nigeria has reported a significant link between vaccine rejection and fear of the vaccine, adverse events, and safety concerns (Odeigah et al., 2022; Oriji *et al*., 2021). Globally, there has been widespread concern regarding the safety of COVID-19 vaccines, leading to fears surrounding potential adverse effects (Dele-Ojo *et al*., 2024). Adverse events following immunity (AEFI) have been reported with the COVID vaccine, although the non-serious AEFI constitutes the highest majority (86.3%) (NPHCDA, 2023). Aside from the health system records available on the vaccine reactions, only a few pragmatic African studies, one of which is a retrospective study conducted in Kwara State, reported that most of the severe adverse events (95.8%) were systemic and mild (81.1%), which necessitated no further therapeutic intervention (Odeigah *et al*., 2022). A prospective single-cohort study design from Ethiopia also reported that non-serious vaccine reactions are commonest among people who were vaccinated with the AstraZeneca vaccine (33.3%) and concluded that AEFIs are commonly reported after the first dose of the Oxford/AstraZeneca COVID vaccine. Age, female gender, and comorbidity are independent predictors (Tequare *et al.*, 2021).

In this study, the authors retrospectively assessed the trend, pattern, and prevalence of COVID vaccine reactions among the clients at the University of Ilorin Teaching Hospital in Kwara State, Nigeria. This is to provide evidence on the COVID vaccine reactions for use in behavioural change communication, health counselling, and education, and for healthcare professionals to use in advocacy and vaccine acceptance campaigns. The COVID pandemic era is over; however, there are pockets of positive COVID cases still in our environment. This study will also give an insight into preparing for future pandemics and their expectations.

METHODOLOGY

Study Site: The University of Ilorin Teaching Hospital (UITH) has its main site located in the Oke-Ose area of Ilorin, Kwara State. The hospital provides preventive, primary, and tertiary healthcare services to the populations of the state and the neighboring states. The epidemiology department of the hospital is saddled with the responsibility of vaccinating both children and adults in the target populations. The department led the COVID-19 response to contain the outbreak within the hospital in 2020 and 2021. It also supported Kwara State in terms of disease outbreak control expertise, capacity building, data collection, and the deployment of human resources. Four sites within the UITH facility were used to ease access and reduce waiting time for clients. The National Primary Health Care Development Agency (NPHCDA), through the Kwara State Primary Health Care Development Agency (KWSPHCDA), and the Kwara State Ministry of Health (KWMOH), have supplied the COVID vaccines to the hospital since 2021. Throughout the entire study period, only the AstraZeneca vaccine was deployed and supplied to the hospital.

Study Design and Population: This study was a cross-sectional study of recipients of the first dose of the of the COVID-19 vaccine between April and July 2021. The study populations were eligible adults aged 18 years and older, categorized as young adults, middle-aged adults, and elderly adults.

Sample Size and Recruitment: A total of 1,535 consenting adults (Table 1) who received the first dose of the COVID-19 vaccine during the study period were included in the study. They were recruited on the first day of vaccination, during which the biodata and tracking identities, like a phone number with or without a residential address, were obtained. The clients were advised to take note of any unusual symptoms they experienced, and actions taken (as advised by the health workers) after immunization, as they will be contacted post-vaccination. The clients were specifically asked to make a note of their experience immediately, later the same day, on days two, three, and seven post-vaccinations.

Table 1: Showing List of Vaccination Points in UITH and the Number of Adults Vaccinated During the Period of Study

Vaccination Points	Total Number of Adults Vaccinated	Total Number of Consenting Vaccinated Adults
ENT Clinic area Main Hospital	446	399
NCDC Building, Main Hospital	517	350
NPI Clinic, Amilegbe Annex	371	363
NPI Clinic, Main Hospital	517	423
Total	**1851**	**1535**

Data Collection and Tools

The data was collected using an interviewer-administered, semi-structured questionnaire. It comprised both open-ended and closed-ended questions. The interview was administered through phone calls to consented recipients of the first dose of COVID vaccines (AstraZeneca) at any of the four vaccination points in UITH. To reduce interobservers' variations, the interviewers followed structured guidelines on courtesy, greetings, and study information. The short questionnaire had four sessions measuring the short biodata of respondents, vaccine reactions, experiences and actions following vaccination, and willingness to take the second dose of the COVID vaccine. The questionnaire could be administered within 15 minutes through a phone conversation. It was validated by the epidemiologists, public health nurses, clients at the immunization

clinics, and language experts. Twelve research assistants were trained for the data collection. Two research assistants were assigned to a vaccination point, with a member of the research team serving as a supervisor at each of the four vaccination points. The demographic details of recipients of vaccines were retrieved from the vaccination registers, and every adult who had received the first dose of the COVID-19 vaccine and had consented on the day of the first dose of vaccination was called. Only those who consented again over the phone were interviewed.

Data Analysis

The data was screened for inconsistencies and missing values. The collected data was entered into a computerized database after coding using IBM SPSS (version 28). The respondents were categorized by gender as well as age as young adults (18–29), middle-aged adults (30–59), and elderly adults (60 years and older). Vaccine reactions following vaccination were recorded for days 1, 2, 3, and 7, and perceived severe reactions were summarized. Respondents' actions following vaccination, willingness to take the second dose, and reasons for willingness were described. Associations between vaccine reactions and biodata were tested using the chi-square test, while associations between vaccine reactions and willingness were tested using the Mc-Nemar test.

Ethical Consideration

Ethical approval was obtained as part of the multiple outcome COVID-19 survey from the Ethical unit of the University of Ilorin, Nigeria with reference number ERC PAN/2020/08/0041 on 6th August 2020.

RESULTS

The mean age of the respondents in this study was 41 ± 12.6. More than half (52.8%) of the respondents were female, and those within the middle-aged adult age group 30-59 were of a higher proportion (73.3%) (Table 2).

Table 2: Socio-Demographics of Covid 19 Vaccine Recipient

Variables	Freq. (*n*= 1535)	Percentage (%)
Gender		
Male	725	47.2
Female	810	52.8
Age Group in Years		
18-29	288	18.8
30-59	1125	73.3
≥60	122	7.9
Mean Age	41± 12.6	

In general, the trend of COVID vaccine reactions showed females reporting a higher incidence than males over the first seven days. The female-to-male incidence pattern at immediate reaction (7.4%; 6.1%), later day one (20.8%; 17.1%), day two (18.6%; 14.8%), day three (7.4%; 5.8%), and day seven (1.2%; 0.7%) consistently showed a higher preponderance of reactions among females. The vaccine reaction incidence peaked hours after vaccination on the first day and tapered down over time until the 7th day post-vaccination (Fig 1).

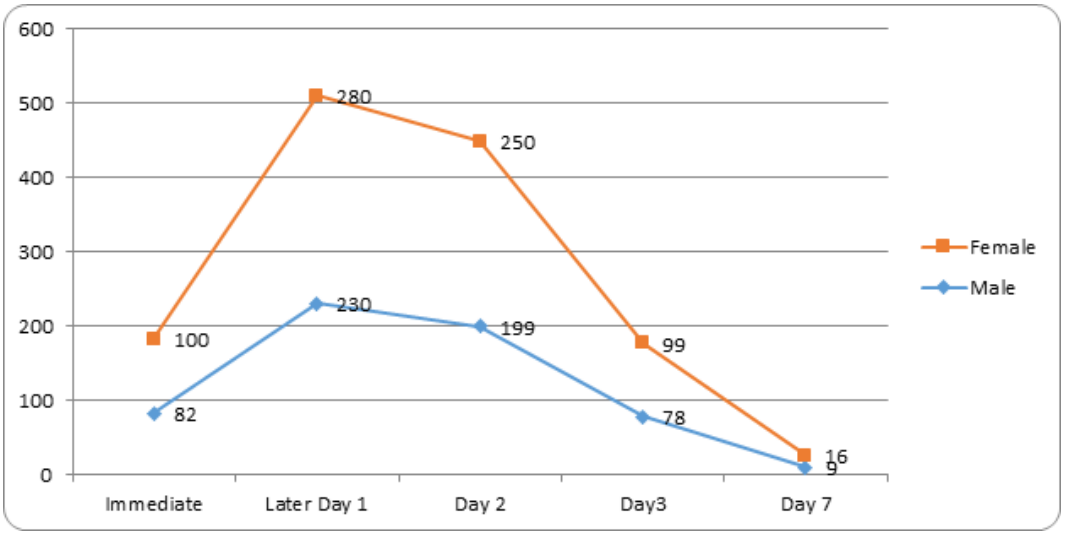

Figure 1: Pattern Of Reported COVID-19 Vaccine Recipient's Reaction

The initial (day 1 and later day 1) vaccine reactions were mainly local, including pain at the site of injection, myalgia, and swelling, soreness, or redness of the injection site (Table 3). Later, on day 1 post-vaccination, the incidence of systemic reactions like fever, headache, chills/rigor, dizziness/light-headedness, increased appetite, and blurred vision increased. This was sustained until the third day post-vaccination. Most of the systemic reactions had disappeared by the 7th day post-vaccination (Table 3).

Table 3: Pattern of COVID-19 Vaccine Reactions from Immediate to 7th Day Post-Vaccination Reported by Clients

Variables	**Yes Freq. (%)**		**No Freq. (%)**		
Vaccine reactions among recipients	805 (52.4)		730 (47.6)		
Vaccine reactions	**Immediate**	**Later**			
	DAY 1 (*n*= 182) Freq. (%)	**DAY 1 (*n*=510) Freq. (%)**	**DAY 2 (*n*=449) Freq. (%)**	**DAY 3 (*n*=177) Freq. (%)**	**DAY ≥7 (*n*=25) Freq. (%)**
(*n*= multiple responses)					
Pain at injection site	77 (5.0)	195 (12.7)	190 (12.4)	75 (4.9)	6 (0.4)
Myalgia (Body ache / Pain)	43 (2.8)	181 (11.8)	176 (11.5)	61 (4.0)	0 (0.0)
Headache	25 (1.6)	142(9.3)	138 (9.0)	45 (2.9)	1 (0.1)
Chills/rigour	19 (1.2)	86 (5.6)	70 (4.6)	22 (1.4)	2 (0.1)
Dizziness / Light Headedness	18 (1.2)	39 (2.6)	18 (1.2)	2 (0.1)	0 (0.0)
Swelling/sore/redness of injection site	13 (0.8)	25 (1.6)	17 (1.1)	11 (0.7)	0 (0.0)
Blurred vision	9 (0.6)	31 (2.0)	8 (0.5)	3 (0.2)	0 (0.0)
Increase appetite	9 (0.6)	28 (1.9)	10 (0.7)	2 (0.1)	0 (0.0)
Fever	5 (0.3)	122(7.9)	115 (7.5)	36 (2.3)	0 (0.0)
Body Itch	3 (0.2)	13 (0.8)	2 (0.1)	1 (0.1)	0 (0.0)
Nausea	1 (0.1)	15 (1.0)	16 (1.0)	8 (0.5)	0 (0.0)

Catarrh	1 (0.1)	12 (0.8)	8 (0.5)	8 (0.5)	1 (0.1)
Chest Pain	1 (0.1)	11 (0.7)	1 (0.1)	0 (0.0)	0 (0.0)
Sleeplessness (Insomnia)	1 (0.1)	17 (1.1)	6 (0.4)	2 (0.1)	1 (0.1)
Body Rash	1 (0.1)	10 (0.7)	1 (0.1)	2 (0.1)	1 (0.1)
Eye Ache	0 (0.0)	12 (0.8)	5 (0.3)	1 (0.1)	0 (0.0)
Loss of Appetite	0 (0.0)	16 (1.0)	11 (0.7)	2 (0.1)	0 (0.0)
Vomiting	0 (0.0)	14 (0.9)	2 (0.1)	0 (0.0)	0 (0.0)
Diarrhea	0 (0.0)	12 (0.8)	8 (0.5)	4 (0.3)	1 (0.1)
Abdominal Pain	0 (0.0)	12 (0.8)	2 (0.1)	0 (0.0)	0 (0.0)
Dry Cough	0 (0.0)	9 (0.6)	7 (0.5)	7 (0.5)	1 (0.1)
Sore Throat	0 (0.0)	11 (0.7)	6 (0.4)	2 (0.1)	1 (0.1)
Breathlessness	0 (0.0)	10 (0.7)	3 (0.2)	1 (0.1)	0 (0.0)
Loss of Taste	0 (0.0)	10 (0.7)	4 (0.3)	0 (0.0)	0 (0.0)
Loss of Smell	0 (0.0)	9 (0.6)	1 (0.1)	2 (0.1)	0 (0.0)
Fainting / Loss of Consciousness / Coma	0 (0.0)	10 (0.7)	2 (0.1)	1 (0.1)	0 (0.0)
Abnormal Bleeding	0 (0.0)	9 (0.6)	1 (0.1)	0 (0.0)	0 (0.0)
Others unrelated symptoms	25 (1.6)	113 (7.4)	122 (7.9)	48 (3.1)	8 (0.5)

Only 15 respondents (0.9%) perceived severe reactions. Blurred vision (33.3%) and chills and rigor (33.3%) were mostly reported (Table 4). More than two-thirds (69.1%) of the respondents did nothing in response to the vaccine reaction (Table 5). Of those who took actions, 27% took self-prescribed drugs, 2.7% consulted a health worker, 0.7% rested, and 0.5% (who experienced increased appetite) ate food more frequently. Acetaminophen was taken by the majority (95.6%) of those who self-prescribed drugs; a few others (2.6%) took diclofenac (a non-steroidal anti-inflammatory drug); and 2.1% took a combination of acetaminophen, loratadine, and vitamin C. Other unrelated drugs reported were antimalarials (2.1%), antibiotics, loratadine, and herbs (0.5%). Of those who consulted a health worker, 41.5% were admitted to the hospital, 39.0% were prescribed drugs, and 19.5% were reassured (Table 5).

Table 4: Perceived Severity of Vaccine Reactions after COVID Vaccination

Variable	**Freq (*n*=1535)**	**(%)**
Yes	15	(0.9)
No	1520	(99.1)
Yes (*n*=15)		
Blurred vision	5	(33.3)
Chills/rigour	5	(33.3)
Loss of Appetite	2	(13.3)
Myalgia (Body ache / Pain)	2	(13.3)
Pain at injection site	1	(6.8)

Table 5: Experiences and Actions Taking by Recipients Following Vaccination

Variables	Freq *n*=1535	(%)
Main Actions Taking by Recipients		
Did nothing	1061	(69.1)
Took medicine (self-prescribed)	415	(27.0)
Consult health worker	41	(2.7)
Rested	10	(0.7)
Ate food	8	(0.5)
Drugs Taking by Recipients (*n*=415)**		
Paracetamol only	397	(25.9)
Diclofenac only	11	(0.7)
Paracetamol, Loratadine & Vitamin-C	9	(0.6)
ACT	9	(0.6)
Antibiotic only	2	(0.1)
Loratidine only	2	(0.1)
Herbs	2	(0.1)
ORS	1	(0.1)
Care by Health Worker Consulted (*n*=41)		
Admitted to the hospital	17	(41.5)
Prescribed drugs	16	(39.0)
Reassurance	8	(19.5)

*** multiple response*

Most of the respondents (93.4%) were willing to take the second dose of the of the COVID-19 vaccine. The common motivations for the reported willingness were to complete the dosage (52%), boost immunity (19.4%), and perceive the safety of the vaccine (13.8%). More than half (57.8%) of those unwilling to take the second dose had no reasons, but 31.7% were due to vaccine reaction reasons (Table 6).

Table 6: Willingness to Take the Second Dose of Covid 19 Vaccine

Variables	Freq (*N*=1535)	(%)
Willingness		
Yes	1433	93.4
No	102	6.6
Reasons for not willing to take second dose		
None	59	57.8
Reactions from the first dose	32	31.4
Migration	6	5.9
Afraid of Fake Vaccines	2	2.0
Pregnancy	2	2.0
Tested positive after 1st jab of Covid vaccine	1	0.9
Reasons for willing to take second dose**		
To complete dosage	744	52.0
To boost immunity	278	19.4
It's safe	198	13.8
Counseled to take it	112	7.8
None	96	6.7
Had Covid before	3	0.2
Travel reasons	2	0.1

*** multiple response*

There was a significant association between willingness to take the second dose and reactions to the vaccine among respondents (Table 7).

Table 7: Association Between Reactions to Vaccine and Willingness to Take 2nd Dose

Reactions to vaccine	Not willing to take 2nd dose (*n*= 102)				
	Frequency	%	Chi square	Mc-Neimer value	*p*-value
Day 1			1,474446	1226.529	0.000
Symptoms	13	12.7			
No Symptom	65	63.7			
Later Day 1			1,489.805		0.000
Symptoms	33	32.3			
No Symptom	45	44.1			
Day 2			1,481.050		0.000
Symptoms	34	33.3			
No Symptom	44	43.1			
Day 3			1,486.486		0.000
Symptoms	20	19.6			
No Symptom	58	56.9			
Day ≥ 7			1,489.805		0.000
Symptoms	6	5.9			
No Symptom	72	70.6			

Of the 102 that were not willing to take the 2nd dose, only 13 (12.7%) had reactions on day one, which had (p>0.001), 32.3 % had reactions later day one (p>0.001), 33.3% had reactions on day 2 (p>0.001) 19.6% had reactions on day 3 (p>0.001), and 5.9% (p>0.001) had reactions on day 7. Reactions to the vaccine on days two and seven reported a significant association with age group. On day 2, more than a third (36.1%) of the young adults had reactions, while above a quarter (28.6%) of middle-aged adults had reactions (p=0.001). Day 7 reported a significant association, but only a few had reactions, with the highest reported among the elderly (2.5%) and the lowest (0.7%) among young adults (Table 8).

Table 8: Association between Reactions to Vaccine and Age Group

Variables	Age Group				
Reactions to Vaccine	18-29 years (young adults)	30-59 years (middle age)	≥ 60 years (elderly)		
	Freq. (%)	**Freq. (%)**	**Freq. (%)**	**Chi Square**	***p*-value**
Immediate Day 1				10.000	0.040
Yes	30 (10.5)	146 (13.0)	6 (4.9)		
No	258 (89.5)	979 (87.0)	116 (95.1)		
Later Day 1				13.655	0.034
Yes	114 (39.6)	358 (31.8)	38 (31.1)		
No	174 (60.4)	767 (68.2)	84 (68.9)		
Day 2				26.278	0.001
Yes	104 (36.1)	322 (28.6)	23 (18.9)		
No	184 (63.9)	803 (71.4)	99 (81.1)		
Day 3				5.001	0.544
Yes	33 (11.5)	135 (12.0)	9 (7.4)		
No	255 (88.5)	990 (88.0)	113 (92.6)		
Day ≥ 7				24.602	0.002
Yes	2 (0.7)	20 (1.8)	3 (2.5)		
No	286 (99.3)	1105 (98.2)	119 (97.5)		

DISCUSSION

The COVID-19 vaccines bring the promise of a global rescue from the coronavirus pandemic. Unfortunately, there have been many myths and misinformation surrounding vaccines and their development. Despite this, 43,821,728 out of the 111,776,503 eligible population have been fully vaccinated in Nigeria, while as of October 2022, only 65% of the target population (1,836,181) have been vaccinated in Kwara,

North Central Nigeria (NPHCDA, 2023). It thus became imperative to look at the pattern and prevalence of the COVID-19 vaccine reaction, as this study was set out in a health facility in north-central Nigeria. The respondents who were interviewed using a phone call method were more female and within the average adult's age group (mean age of 41 ± 12.6). The higher female gender finding is similar to other studies from north-central Nigeria (Odeigah *et al*., 2022) and the US (Malik *et al*., 2020). However, a US study reported a higher age group. This difference may be due to geographical differences and healthcare service availability.

Local vaccine reactions following COVID vaccinations were reported by more than half of the recipients. Less than a quarter reported immediate reactions, which increased to more than one third late on the day the vaccine was received. By the second day, the number reporting reactions had reduced by 4%, and this was further reduced by the third day to approximately eight. Since the 7th day, most of the vaccine reactions have subsided. It can be said that the reactions to the vaccine peaked later, the first day it was received. However, perceived severe reactions were reported in less than a percent of this study. Studies in north-west Nigeria (Adamu *et al*., 2022) reported 79.7%, the Czech Republic (Riad *et al*., 2021) reported 93.1%, and Odeigah *et al*. in north-central Nigeria reported a difference with a vast variation of 1.6% (Odeigah *et al*., 2022). These similarities are not that surprising, as many vaccines come with mild reactions (WHO, 2022). There are, however, some reports of moderate to severe reactions in other studies; 15.2% were reported in Sokoto (Adamu *et al.*, 2022) and 4.6% in Rivers State (Harry *et al*., 2022). All the variations in people reporting reactions and adverse reactions may also be due to how individuals perceive their response to vaccination.

This pattern of reactions following vaccination reported in this study has been observed commonly among recipients of the Astrazeneca vaccine, as seen in previous studies (Adamu *et al*., 2022; Harry *et al*., 2022; Odeigah *et al.*, 2022; Riad *et al.*, 2021). The reactions reported were local *et al*. pain at the site of injection, myalgia, and soreness or redness at the injection site. Other systemic, non-severe reactions were recorded, like headaches, fever, chills or rigor, dizziness or light-headedness, and blurred vision and increased appetite. A similar pattern of reaction was seen in a study conducted in China (Kadali *et al*., 2021). A major inference from this trend and pattern of vaccine reactions in our study is that local reactions are immediate symptoms of COVID reactions with non-life-threatening systemic vaccine reactions a few days post-vaccination. Most of the reported vaccine reactions will subside by the 7th day. These findings will be useful for further vaccine advocacy and for population-based health communication to reduce COVID vaccine misinformation and epidemics.

In response to reactions following vaccinations, more than half of the vaccine recipients who had reactions did nothing. This is not so different from Nigerian studies in Rivers State (Harry *et al*., 2022) and Sokoto State (Adamu *et al.*, 2022). The similarity could be attributed to the general campaign and awareness of COVID vaccines in the country. For those who took action, about a third prescribed drug for themselves without consulting any health workers. This is similar to a study in India (Sharma, Jain, & Vigarniya, 2022) that reported that two-thirds of the respondents took no action, while the remaining one-third took self-prescribed drugs. Only a few visited the health worker, of whom not up to half were hospitalized, and the remaining two-thirds were either prescribed drugs or reassured. This is attributed to the reactions being mostly mild, local in nature, and resolving within a few days following vaccination.

A high proportion of the recipients were willing to take the second dose of the COVID-19 vaccine. The high willingness in this study is similar to the study done in Ethiopia among health professionals (Ahmed *et al.*, 2021), which reported a 95% willingness to take a second dose of the COVID vaccine. Our result was in contrast with other studies reported in Yenoga, Nigeria (Allagoa *et al.*, 2021), which reported 75.4% unwillingness to take the COVID vaccine. Tobin et al. in Nigeria reported 50.2% of respondents willing to take the COVID vaccine (Tobin *et al*., 2021). A good number of respondents in this study wished to have the second dose for completion of the dosage, to boost their immunity and their previous history of COVID infection, which paves the way for travel and the safety of the vaccine. The few that showed unwillingness to complete the vaccine dose were afraid of the vaccines and side effects. Chu *et al*. in Vietnam (Chu *et al.*, 2023),

Olu-Abiodun, Ol in Nigeria (Olu-Abiodun, Abiodun, & Okafor, 2022), and Rzymski, Poniedziałek, and Fal (2021) in Poland had similar findings.

The high level of willingness adduced implied a good outcome for herd immunity in the population. This could be one of the factors responsible for the early control of COVID infection in the state and in Nigeria. The findings from the study report an association between age group and reactions to the vaccine at the early onset following vaccination. Other studies have reported a similar pattern of association with age. A study done in Korea (Jeon *et al*., 2021) also reported less severity in the older age group; also in India, Parida *et al*. (2022) reported the younger population had more AEFI than the older ones. Another study in Malaysia (Elnaem *et al*., 2021) concluded that younger people had a higher risk of experiencing side effects than the older population (≥60 years). Further studies to determine this association may be needed.

Limitations

This study focuses solely on adult clients in a tertiary health facility within a specific region of Nigeria, which may not accurately represent the broader population of the country. The sample may not fully capture the diversity of demographic, socioeconomic, and geographic factors that could influence vaccine reactions. As a result, generalising the findings to other regions or populations may be limited, and further research involving more diverse samples is needed to enhance the generalizability of the study's conclusions.

CONCLUSION

The article confirms how important it is to get the COVID-19 vaccine. It says the vaccine works well and is safe, like other vaccines. Even though some people might feel a bit unwell after getting the vaccine, especially young adults, most of the bad reactions are not serious and go away quickly. This helps people feel more confident about getting vaccinated. The way they studied the vaccine in the article can also be helpful for making other vaccines in the future, especially for new diseases. This article is like a starting point for more research on vaccine safety and how to deal with any bad reactions. It gives important ideas for making vaccine campaigns better and dealing with new vaccines.

Recommendation

It is crucial to reassure and educate individuals about the expected reactions following vaccination in preparation for receiving COVID-19 vaccines, like other vaccines. However, if post-vaccine symptoms persist beyond a few days or are severe, it is recommended to seek medical assistance immediately.

Conflict of Interest

The authors declared that they have no competing interests.

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