World Journal of Preventive Medicine, 2023, Vol. 11, No. 1, 1-9
Available online at http://pubs.sciepub.com/jpm/11/1/1
Published by Science and Education Publishing
DOI:10.12691/jpm-11-1-1

COVID-19 Vaccination in Pregnancy: Acceptance and Challenges amongst Pregnant Women in Adena, North-Central Nigeria

Gloria Chijiogor Okeke[1], Ifesinachi Kevin Okeke[1], Aloysius Obinna Ikwuka[2,*], Francis Chigozie Udeh[2]

[1]Department of General Practice, Rehoboth Mercy Clinic, Adena, Nigeria
[2]College of Medicine and Health Sciences, American International University West Africa, Banjul, The Gambia
*Corresponding author: aloysiussweet@yahoo.com

Received May 16, 2023; Revised June 19, 2023; Accepted June 28, 2023

Abstract **Background:** The emergence of COVID-19 threatened the normal existence of humans with its associated health implications, and COVID-19 vaccine development served as the rescue. With the recommendation for women to get vaccinated during pregnancy, the response to vaccination particularly against COVID-19 disease varies widely in parts of Nigeria. **Objective:** The objective was to study COVID-19 vaccination acceptance and the challenges of accepting the COVID-19 vaccine amongst pregnant women in Adena, North-Central Nigeria. **Materials and Methods:** A total sample of two hundred and thirty (230) respondents was incorporated into this study. Biodata and questions relating to the research objectives were retrieved using a well-structured questionnaire. Chi-square technique (χ^2) of SPSS version 23 statistical software was used to analyze the data. The Chi-square test was used for the comparative analysis of the socio-demographic data with respect to acceptance and challenges of COVID-19 vaccine acceptance amongst pregnant women, and to test the research hypotheses at a significant level of $p<0.05$. **Results:** Mean age of the women was 29.3±6.14 years, while mean parity was 2.3±1.6. Among the respondents, 12% had no formal education, and 59.1% were Muslims. 133 (57.8%) confirmed they would accept the vaccine. The major challenges were fear of the side effects on the fetus and insufficient time for feedback on the side effects and efficiency of the vaccine. The hypotheses tested showed there was no significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena based on their educational qualification (p=3.22221E-11) and religion (p=0.23), but there was a significant difference based on age (p=0.001473). There exists no significant difference in the challenges of pregnant women in Adena to COVID-19 vaccination based on their educational qualification (p=6.28578E-05) and religion (p=0.1463), but a significant difference was observed based on their age (p=0.00043). **Conclusion:** There is a need for sensitization of the general public on COVID-19 and any related viral infections. A national surveillance system should be in place to compile clinical and epidemiological data on trends in human infections. Finally, updated information from recognized international organizations like WHO should be regularly obtained, studied and utilized.

Keywords: *COVID-19, vaccination, pregnancy, acceptance, challenges, pandemic*

Cite This Article: Gloria Chijiogor Okeke, Ifesinachi Kevin Okeke, Aloysius Obinna Ikwuka, and Francis Chigozie Udeh, "COVID-19 Vaccination in Pregnancy: Acceptance and Challenges amongst Pregnant Women in Adena, North-Central Nigeria." *World Journal of Preventive Medicine*, vol. 11, no. 1 (2023): 1-9. doi: 10.12691/jpm-11-1-1.

1. Introduction

Knowledge, attitude and practice of healthcare workers towards waste management play a crucial role in the transmission of infections as a sterile, clean environment reduces the chances of transmission [1,2]. Viral infections have long been a significant challenge to human health, with some infections presenting mild symptoms and others posing a lethal threat if not managed properly. Viruses like human immunodeficiency virus (HIV), Marburg virus, Rabies virus, Hepatitis virus, Ebola virus, Zika virus, Herpes simplex virus, Lassa fever, Influenza, Coronavirus, etc. have been reported to cause deadly diseases [3]. However, some viruses also have beneficial properties, such as symbiotic relationships that help fight bacteria in the gastrointestinal tract, or their potential use in virotherapy to treat genetic diseases or to target and kill cancer cells. Certain viruses can also serve as vaccine or vaccine delivery agents [3].

A variant of coronavirus, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), like other viruses such as influenza virus (types A and B), parainfluenza virus, adenovirus, rhinoviruses, and respiratory syncytial virus is specific to affect the respiratory system. SARS-

CoV-2 causes coronavirus disease 2019 (COVID-19) and it was first identified in Wuhan, China in November 2019 [4]. Due to the rapid spread of the infection, COVID-19 was declared a pandemic on 11th March, 2020 by the World Health Organization (WHO) [5].

A total of 765,222,932 cases have been confirmed and over 6,921,614 deaths have been recorded as of 7th May, 2023 [6]. In Nigeria, 266,675 cases of COVID-19 infection have been reported, 3,567 active cases and a total of 3,155 deaths have been recorded as of 7th May, 2023 [39,50,53]. Kwara State in North-Central Nigeria ranked 13th out of the 36 states in Nigeria plus the Federal Capital Territory (FCT) and has a total of 4,691 reported cases of COVID-19 infection and 64 deaths as of 7th May, 2023 [7,8,9].

A good number of COVID-19 vaccines are in circulation worldwide. Examples include Pfizer BioNTech produced by BioNTech; Johnson & Johnson's (Janssen) by Janssen Biologies B.V.; AstraZeneca (Covishield) by AstraZeneca; Moderna by Moderna; Sputnik V (Gamaleya) by Gamaleya Research Institute of Epidemiology and Microbiology; BBV152 (Covaxin) by Indian Council of Medical Research (ICMR) and Bharat Biotech Ltd.; BBIBP-CorV (Sinopharm) by China National Pharmaceutical Group Corporation, Wuhan Institute of Biological Product, and Beijing Institute of Biological Products; CoronaVac by Sinovac Biotech Ltd [10,11]. Of these vaccines, the National Agency for Food and Drug Administration and Control (NAFDAC) in Nigeria approved the use of AstraZeneca (Covishield) in February 2021, Pfizer for emergency use in April 2021, and conditional emergency use of Janssen in May 2021 [11].

The administration of COVID-19 vaccines varies greatly across different regions. As of 30th April, 2023, 13,346,989,954 vaccine doses have been administered worldwide [6]. However, in Africa, vaccine distribution has been hindered by limited access, supply chain disruptions, and low vaccine acceptance rates [12]. As of February 2022, only 29% of the population had received the COVID-19 vaccine in Africa, with 12% fully vaccinated and 17% partially vaccinated. Seychelles has the highest vaccine acceptance rate at 77%, while Cameroon has the lowest at 3.2% [13]. Despite Nigeria's population of over 220 million, only 116,606,863 vaccine doses had been administered as of 3rd May, 2023 [39,50].

Complications of COVID-19 such as anemia during pregnancy [14,15] pose a risk to pregnant women and may result in adverse pregnancy outcomes such as pre-eclampsia, nausea and vomiting, depression, low birth weight, low APGAR score, preterm delivery, and death [16,17,18]. Results obtained from different studies indicate that high levels of blood pressure, glucose and lipid metabolic disorders, asymptomatic hyperuricemia, activation of systemic immune inflammation and fibrogenesis, contribute to kidney damage [19,20,21,22,23,24,25], which can lead to anemia taking into account that erythropoietin (an important factor in erythropoiesis) is synthesized by the kidneys.

Vaccination is considered a more promising prophylactic approach than treatment to mitigate the impact of COVID-19 on pregnancy outcomes [26]. Although there were limited trials involving pregnant women during the development of the COVID-19 vaccines [27], it is uncertain how pregnant women perceive the vaccine and the potential effects of COVID-19 on pregnancy [16]. Moreover, Dapagliflozin which is a sodium-glucose linked transporter 2 (SGLT-2) inhibitor increases the effectiveness of treatment and improve the clinical course of type 2 diabetes mellitus and hypertension in patients with such comorbidities [28,29,30,31,32,33].

Additionally, pregnant women are often focused solely on the health of their fetuses than theirs. Given that the well-being of the fetus is closely tied to the health of the mother, and vaccination is currently the most effective means of controlling COVID-19, it is of utmost importance to investigate the acceptance and challenges of acceptance of the COVID-19 vaccine amongst pregnant women in Adena, North-Central Nigeria.

2. Materials and Methods

2.1. Study Area

From September 2022 to January 2023, a descriptive study was conducted in Adena, one of the major towns in Kaiama Local Government Area (LGA) located in Kwara State, North-Central Nigeria. The 2006 census reported a population of 124,164 in Kaiama LGA, which is divided into ten political wards. Bokobaru is the predominant language spoken in the area, along with Fulani, Yoruba, and Hausa. The residents are mostly farmers cultivating cassava, guinea corn, soya beans, beans, and yam in commercial quantities.

2.2. Study Population and Sample Size Determination

The study population included only pregnant women residing in Adena town. With an estimated study population above 10,000, Kish Leslie's formula for cross-sectional studies was used to calculate the sample size [34].

$$n = \frac{Z^2 PQ}{d^2}$$

Where,

n = desired sample size when the total population is greater than 10,000.

Z = standard normal deviate usually set at 1.96 which corresponds to the 95% confidence interval.

P = proportion of the acceptance of COVID-19 vaccine during pregnancy, set at 18% (0.18) from the pilot study conducted among pregnant women in another state in Nigeria.

Q = complementary proportion equivalent to 1-P; that is, 1-0.18 which equals to 0.82

d = degree of accuracy desired (absolute precision), which is 5.0% (0.05).

Therefore:

$$n = \frac{(1.96)^2 (0.18)(0.82)}{(0.05)^2}$$

$$= \frac{3.8416 \times 0.18 \times 0.82}{0.0025} = \frac{0.5670201}{0.0025} = 227$$

For this study, a minimum of 227 participants was needed. To account for a potential non-response rate of 10%, the sample size was increased to 250. A simple random sampling technique was used to select 250 pregnant women as participants, and only those who voluntarily agreed to participate were included in the study. Additionally, the respondents' pregnancy status was confirmed through ultrasound scans and care was taken to ensure that they were at least 20 years old.

2.3. Study Procedure and Data Analysis

The research team and some trained assistants administered pre-tested questionnaires to eligible participants in order to collect data. The questionnaire had four sections: A, B, C, and D. Section A gathered socio-demographic information, Section B assessed the respondents' knowledge of COVID-19 vaccination among pregnant women, Section C focused on the participants' perceptions of COVID-19 vaccination during pregnancy, and Section D contained questions related to factors influencing COVID-19 vaccine acceptance. All sections of the questionnaire were structured as close-ended items. Data was analyzed using IBM, SPSS version 23.0 and Chi-square (X^2) was used to test null hypotheses. A 95% confidence interval was set and p-values ≤ 0.05 were considered to be statistically significant.

2.4. Ethical Consideration

Approval letters from the Director of the National Open University of Nigeria, Ilorin Study Centre was obtained as well as permission from the Kwara State Ministry of Health. Informed consent from each respondent was obtained and each respondent was assured that any information provided would be kept confidential.

3. Results

Out of the 250 participants, only 230 willingly took part in the study. Their data were extracted from the questionnaires, organized and analyzed. Table 1 shows the socio-demographic information of the women who participated. On average, they were 29.3±6.14 years old and their parity was 2.3±1.6 children. 94 (40.9%) of the women were Christians, and the rest were Muslims. 12 (5.2%) of the women had no formal education, while 18 (7.8%) had a Master's degree.

Table 2 presents the pregnant women's level of acceptance of COVID-19 vaccine. Out of the 230 participants, 134 (58.3%) had already been tested for COVID-19, while 96 (41.7%) had not been tested yet. Among the 134 tested women, 9.7% were positive, 87.3% were negative, and 3% were awaiting their results. 153 (66.5%) of the women believed that the vaccine is effective, while 77 (33.5%) did not believe it was effective. Additionally, 57.8% of the pregnant women stated that they would definitely take the vaccine if offered on the spot, 39.6% were unsure, and only 2.6% said that they would definitely not take the vaccine. The overall frequency of the responses to selected questions (1, 2, 10, 13, and 14) yielded an acceptance rate of 63.48%.

Table 1. Socio-demographic analysis of the pregnant women in Adena, North-Central Nigeria

Socio-demographic characteristics	Options	*n*	%
Age distribution	<21	6	2.6
	21-25	61	26.5
	26-30	63	27.4
	31-35	59	25.7
	≥36	43	17.8
	Total	**230**	**100**
	Mean age = 29.3±6.14		
Religious background	Christian	94	40.9
	Muslim	136	59.1
	Total	**230**	**100**
Parity	0	34	14.8
	1	41	17.8
	2	52	22.6
	3	49	21.3
	4	42	18.3
	5	1	0.4
	6	3	1.3
	7	8	3.5
	Total	**230**	**100**
	Mean parity = 2.3±1.6		
Educational level	No formal education	12	5.2
	Primary	31	13.5
	Secondary	29	12.6
	Diploma	24	10.4
	HND/OND/NCE	40	17.4
	BSc	76	33.0
	MSc	18	7.8
	Total	**230**	**100**

Table 2. Level of acceptance of COVID-19 vaccine among the respondents

S/No.	Questions	Responses	*n*	%
1	Do you think COVID-19 is in Nigeria?	Yes	174	75.7
		No	56	24.3
2	Have you had a COVID-19 test?	Yes	134	58.3
		No	96	41.7
3	If Yes, what was the result?	Positive	13	9.7
		Negative	117	87.3
		Awaiting Result	4	3.0
4	Do you know anyone who has or who had COVID-19 infection?	Yes	85	37.0
		No	145	63.0
5	Do you know anyone who died of COVID-19?	Yes	67	29.1
		No	163	70.9
6	Are you worried about getting COVID-19?	Yes	146	63.5
		No	84	36.5
7	Are you worried about your family or friends getting COVID-19?	Yes	155	67.4
		No	75	32.6
8	Have you ever been vaccinated for any type of illness in the past?	Yes	177	77.0
		No	53	23.0
9	Have your children ever received any vaccines for any type of illness?	Yes	156	67.8
		No	74	32.2
10	Do you think the COVID-19 vaccine works?	Yes	153	66.5
		No	77	33.5
11	Have you heard of any risks of the COVID-19 vaccine?	Yes	131	57.0
		No	99	43.0
12	Is the COVID-19 vaccine currently available anywhere in your region?	Yes	204	88.7
		No	26	11.3
13	If you were offered a COVID-19 vaccine today, would you take it?	Definitely Yes	133	57.8
		Not sure	91	39.6
		Definitely No	6	2.6
14	If you have children, would you accept a COVID-19 vaccine for them if it was available today?	Definitely Yes	136	59.1
		Not sure	69	30.0
		Definitely No	25	10.9

Table 3. Level of the challenges of accepting COVID-19 vaccine among the respondents

S/No.	Questions	Responses	*n*	%
1	I am scared of the side effects on my fetus	Yes	199	86.5
		No	31	13.5
2	Insufficient time for feedback on the side effects of the SARS-CoV-2 vaccine	Yes	179	77.8
		No	51	22.2
3	Insufficient time for feedback on the effectiveness of the SARS-CoV-2 vaccine	Yes	148	64.3
		No	82	35.7
4	Are you worried about COVID-19 vaccine?	Yes	142	61.7
		No	88	38.3
5	My educational level was associated with non-acceptance of COVID-19 vaccine	Yes	69	30.0
		No	161	70.0
6	Vaccine doses expire shortly after arrival (short shelf life)	Yes	81	35.2
		No	149	64.8

Table 3 highlights that 199 (86.5%) of the respondents agreed that they were scared of the side effects of the vaccine on their fetus, while 31 (13.5%) were not. 170 respondents said "Yes" that insufficient time for feedback on the side effects of the vaccine were their challenges, whereas 148 respondents said that the COVID-19 vaccine effectiveness was their challenge. 69 (39%) of the respondents believed that their educational level was associated with the non-acceptance of the COVID-19 vaccine. Lastly, Table 3 shows that 81 (35.3%) of the respondents agreed that the COVID-19 vaccine expires shortly after arrival, while 149 (64.8%) disagreed.

3.1. Tests of Hypotheses

This study focused on testing six (6) research hypotheses. These hypotheses tests aimed to determine whether there was a significant relationship between two independent variables, using a significance level of less than 0.05 ($p<0.05$).

Hypothesis One

H_0: There is no significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena based on their educational qualifications.

H_1: There is a significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena based on their educational qualifications.

Table 4 presents the results of Hypothesis One, where the null hypothesis (H_0) was rejected because the *p*-value was >0.05 (*p*=3.22221E-11), indicating that there is no significant difference in the acceptance of COVID-19 vaccine among pregnant women in Adena based on their educational qualifications.

Table 4. Association between educational qualifications and the acceptance of COVID-19 vaccine among pregnant women in Adena, North-Central Nigeria

	If you were offered a COVID-19 vaccine today, would you take it?							
	Actual values				Expected values			
Educational Qualification	Not sure	Definitely No	Definitely Yes	**Total**	Definitely Yes	Not sure	Definitely No	**Total**
No formal edu.	11	1	0	**12**	6.9	4.7	0.3	**12**
Primary	10	21	0	**31**	17.9	12.3	0.8	**31**
Secondary	0	26	3	**29**	16.8	11.5	0.8	**29**
Diploma	14	10	0	**24**	13.9	9.5	0.6	**24**
OND/HND	26	14	0	**40**	23.1	15.8	1.0	**40**
BSc	60	14	2	**76**	43.9	30.1	2.0	**76**
MSc	12	5	1	**18**	10.4	7.1	0.5	**18**
Total	**133**	**91**	**6**	**230**	**133**	**91**	**6**	**230**

p = 3.22221E-11; df = 12; Chi-square (χ^2) = 76.184

Hypothesis Two

H_0: There is no significant difference in the challenges of pregnant women in Adena in accepting the COVID-19 vaccine based on their educational qualifications.

H_1: There is a significant difference in the challenges of pregnant women in Adena in accepting the COVID-19 vaccine based on their educational qualifications.

Table 5 shows the Hypothesis Two test where H_0 was accepted because the Chi-square *p*-value was >0.05 (*p*=6.28578E-05). This means that there is no significant difference in the challenges of the respondents in accepting the COVID-19 vaccine based on their educational qualifications.

Table 5. Association between educational qualifications and the challenges of the respondents in accepting the COVID-19 vaccine

	I am scared of the side effects on my fetus					
	Actual values			Expected values		
Educational Qualification	Yes	No	**Total**	Yes	No	**Total**
No formal education	12	0	**12**	10.4	1.6	**12**
Primary	22	9	**31**	26.8	4.2	**31**
Secondary	27	2	**29**	25.1	3.9	**29**
Diploma	24	0	**24**	20.8	3.2	**24**
OND/HND	36	4	**40**	34.6	5.4	**40**
BSc	66	8	**76**	65.8	10.2	**76**
MSc	10	8	**18**	15.6	2.4	**18**
Total	**199**	**31**	**230**	**199**	**31**	**230**

p = 6.28578E-05; df = 6; Chi-square (χ^2) = 28.900.

Hypothesis Three

H_0: There is no significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena based on their age.

H_1: There is a significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena based on their age.

Table 6 illustrates the test of Hypothesis Three where H_0 was rejected because the *p*-value was <0.05 (*p*=0.001473). It can be deduced that there is a significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena based on their age.

Table 6. Association between age and the acceptance of the COVID-19 vaccine among the respondents

	If you were offered a COVID-19 vaccine today, would you take it?							
	Actual values				Expected values			
Age	Definitely Yes	Not sure	Definitely No	**Total**	Definitely Yes	Not sure	Definitely No	**Total**
<21 years	1	5	0	**6**	3.5	2.4	0.2	**6**
21-25 years	30	31	0	**61**	35.3	24.1	1.6	**61**
26-30 years	36	27	0	**63**	36.4	24.9	1.6	**63**
31-35 years	34	22	3	**59**	34.1	23.3	1.5	**59**
≥36 years	32	6	3	**41**	23.7	16.2	1.1	**41**
Total	133	91	6	**230**	**133**	**91**	**6**	**230**

p = 0.001473; df = 8; Chi-square (χ^2) = 25.262.

Hypothesis Four

H_0: There is no significant difference in the challenges of pregnant women in Adena in accepting the COVID-19 vaccine based on their age.

H_1: There is a significant difference in the challenges of pregnant women in Adena in accepting the COVID-19 vaccine on the basis of age.

Table 7 shows the test of Hypothesis Four where H_0 was rejected because the *p value* was <0.05 (p=0.00043), indicating that there is a significant difference in the challenges of the respondents in accepting the COVID-19 vaccine based on their age.

Table 7. Association between age and the challenges of the respondents in accepting COVID-19 vaccine

		I am scared of the side effects on my fetus					
		Actual values			Expected values		
		Yes	No	**Total**	Yes	No	**Total**
Age	<21 years	4	2	**6**	5.2	0.8	**6**
	21-25 years	52	9	**61**	52.8	8.2	**61**
	26-30 years	55	8	**63**	54.5	8.5	**63**
	31-35 years	59	0	**59**	51.0	8.0	**59**
	≥36 years	29	12	**41**	35.5	5.5	**41**
	Total	**159**	**23**	**230**	**159**	**23**	**230**

p = 0.00043; df = 4; Chi-square (χ^2) = 20.103

Hypothesis Five

H_0: There is no significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena based on religion.

H_1: There is a significant difference in the acceptance of the COVID-19 vaccine among pregnant women in Adena on the basis of religion.

Table 8 presents the results of Hypothesis Five, where the null hypothesis (H_0) was accepted because the p-value was >0.05 (p=0.23). This suggests that there is no significant difference in the acceptance of COVID-19 vaccine among pregnant women in Adena based on their religion.

Table 8. Association between religion and the acceptance of COVID-19 vaccine among the respondents

		If you were offered a COVID-19 vaccine today, would you take it?							
		Actual values				**Expected values**			
		Definitely Yes	Not sure	Definitely No	**Total**	Definitely Yes	Not sure	Definitely No	**Total**
Religion	Christian	48	43	3	**94**	54.4	37.2	2.5	**94**
	Muslim	85	48	3	**136**	78.6	53.8	3.5	**136**
	Total	**133**	**91**	**6**	**230**	**133**	**91**	**6**	**230**

p = 0.23; df = 2; Chi-square (χ^2) = 2.998

Hypothesis Six

H_0: There is no significant difference in the challenges of pregnant women in Adena in accepting the COVID-19 vaccine based on their religion.

H_1: There is a significant difference in the challenges of pregnant women in Adena in accepting the COVID-19 vaccine based on their religion.

Table 9 illustrates the test of Hypothesis Six where the H_0 was accepted and H_1 was rejected because p was >0.05 (p=0.1463), signifying that there is no significant difference in the challenges of pregnant women in Adena in accepting the COVID-19 vaccine based on their religion.

Table 9. Association between religion and the challenges of the respondents in accepting COVID-19 vaccine

		I am scared of the side effects on my fetus					
		Actual values			Expected values		
		Yes	No	**Total**	Yes	No	**Total**
Religion	Christian	85	9	94	81.3	12.7	**94**
	Muslim	114	22	136	117.7	18.3	**136**
	Total	**199**	**31**	**230**	**199**	**31**	**230**

p = 0.1463; df = 1; Chi-square (χ^2) = 2.077.

4. Discussion

Gaining knowledge about the acceptance rate of the COVID-19 vaccine and the challenges faced by pregnant women in accepting it, is crucial for implementing necessary interventions that will enhance the well-being of both mothers and fetuses. Numerous studies have documented the impact of COVID-19 on children and

pregnant women [35,36,37,38], as well as the effectiveness of COVID-19 vaccination [39,40,41,42], and various interventions during the pandemic [43].

Currently, there is no universally accepted antiviral treatment for COVID-19, although this does not imply that the infection cannot be effectively managed [44]. Given the variability and severity of the disease, the development of COVID-19 vaccines became essential. Among the different vaccines created, the UK was the first country to authorize the use of a specific type (Pfizer-BioNTech) [40,45,46]. Since pregnant women were not extensively included in the COVID-19 vaccine trials, it is important to update the existing literature regarding pregnant women's acceptance of COVID-19 vaccine and the challenges they face.

Previous research conducted by Al-Mustapha *et al*, 2022 reported a COVID-19 vaccine acceptance rate of 50.7% among 3,076 Nigerians of all genders [47]. In Africa, the average acceptance rate stands at 29%, with Seychelles having the highest rate at 77%, while other countries, including Cameroon, have very low acceptance rates below 10%, with Cameroon specifically at 3.2% [13]. This present study found that the acceptance rate of the COVID-19 vaccine among pregnant women was 57.8%, with 133 out of 230 respondents stating that they would definitely take the vaccine if offered immediately. A study conducted in France reported a much lower acceptance rate of 29.5% among pregnant women, primarily due to concerns about potential vaccine side effects on the fetus [40]. Ayhan *et al*, 2021 documented that 37% of pregnant women visiting Ankara City Hospital in Turkey would accept the vaccine only if it was recommended for pregnant women [39].

Another survey conducted by Skjefte *et al*, 2021, which consisted of 5,294 pregnant women and mothers of young children from sixteen countries, showed varying acceptance rates [42]. The highest acceptance rates among pregnant women were observed in Mexico and India (~85%), followed by Colombia (~73%), the United Kingdom and Chile (~48%), the United States of America (~41%), Australia (~39%), and Russia with the lowest acceptance rate (~29%) [42]. Chakraborty *et al*'s study, involving 8,708 participants from ten Asian countries, reported that the acceptance rate was highest in Malaysia (94.3%), followed by Indonesia (93.3%), China (88.6%), South Korea (79.8%), India (74.5%), Singapore (67.9%), Hong Kong (63.0%), Russia (54.9%), Saudi Arabia (50.52%), and Kuwait with the lowest acceptance rate (23.6%) for COVID-19 vaccines of Asian origin [10]. Finally, Marbán-Castro's study revealed that among pregnant women, 85% expressed willingness to take the vaccine if recommended by healthcare workers, 63% for self-protection, 54% to protect their baby, 12% if recommended by friends, 11% if other pregnant women received the vaccine, and 1% if the vaccine was provided for free [48]. From these findings, pregnant women only need reassurance of the safety of the vaccine for them and their fetus.

The primary challenge faced by pregnant women in receiving the COVID-19 vaccine in this study was fear of its potential side effects on their fetuses, with 86.5% expressing this fear. This finding aligns with previous research by Ayhan *et al*, 2021 and Skjefte *et al*, 2021, where ~50% and 65.9% respectively, of pregnant women refused the SARS-CoV-2 vaccine due to fear of its perceived harm to their fetus [39,42]. This apprehension may stem from limited data resulting from the low inclusion of pregnant women in vaccine trials. Nevertheless, the Advisory Committee on Immunization Practices has already recommended the use of COVID-19 vaccines for pregnant women, despite their underrepresentation in clinical trials [49,50].

In addition to concerns about side effects, inadequate feedback time for vaccinated pregnant women to report side effects (77.8%) and the vaccine's effectiveness (64.3%) were reported as significant challenges. Respondents expressed more confidence if vaccinated pregnant women were monitored for a specific period to confirm the vaccine's efficacy or to identify any complications. Another challenge highlighted by the women was the short shelf life of the vaccine, as some brands expire shortly after arrival. The Center for Disease Control and Prevention (CDC) provides varying expiry dates for different COVID-19 vaccines [51]. For example, the Pfizer-BioNTech vaccine can be stored for up to eighteen months in ultra-cold freezers (-90°C and -60°C) before expiration and up to ten weeks in refrigerated (2°C and 8°C) conditions [52]. The Moderna vaccine can be stored for up to six months in a freezer (-50°C and -15°C) and up to 30 days in refrigerated (2°C and 8°C) conditions [53]. Given the long storage duration of 6-18 months in an ultra-cold freezer, pregnant women need not worry about vaccine expiration as long as proper storage conditions are maintained. Additionally, 30% of the respondents identified their educational level as a challenge to accepting the SARS-CoV-2 vaccine, indicating a need for public education to address the knowledge gap among pregnant women for optimum results, as recommended in the studies of Musa *et al*, 2023 [1,2].

Concern about COVID-19 itself was found to be a significant factor affecting vaccine acceptance. In this present study, 38.3% of pregnant women in Adena reported no worry about COVID-19, which consequently hindered the vaccine acceptance rate. Skjefte *et al*, 2021 reported that 53% of Australian women showed no concern about COVID-19, the highest among the sixteen countries studied [42]. Other challenges mentioned by Skjefte *et al*, 2021 included vaccine approval for political reasons (44.9%) and insufficient safety and effectiveness data for pregnant women (48.8%) [42]. Less than 60% of pregnant women in Russia, Spain, the United States of America, Argentina, the United Kingdom, Australia, Chile, New Zealand, Italy, South Africa, and Peru expressed confidence in the vaccine's safety [42]. Moreover, approximately 78% of Russian pregnant women lacked confidence in the vaccine's effectiveness, making them the least likely to accept it. Given the low confidence levels in these countries, vaccine acceptance remains a challenge for health authorities.

Finally, this study demonstrated no significant association between COVID-19 vaccine acceptance among pregnant women and their educational qualification (p=3.22221E-11) and religion (p=0.23), but there was a significant association based on age (p=0.001473). Similarly, no significant association existed between the challenges faced by pregnant women in Adena regarding COVID-19

vaccination and their educational qualification (p=6.28578E-05) and religion (p=0.1463), but a significant difference was observed based on their age (p=0.00043). These findings indicate that pregnant women's acceptance and challenges with acceptance of COVID-19 vaccination vary significantly based on their age, while there is no notable difference based on their educational qualifications and religious beliefs.

5. Conclusion

This study revealed that the acceptance of COVID-19 vaccination amongst pregnant women in Adena, North-Central Nigeria, is slightly above average. The acceptance is influenced by the women's age, but not by their educational qualifications and religious backgrounds. The main challenges they face in accepting the vaccine were fear of potential side effects and a lack of sufficient information about the vaccine on pregnant women and their fetuses. Following the recommendations of the Ministry of Health, widespread vaccination would significantly contribute to reducing the spread of the virus among pregnant women. However, there is need for increased efforts in health education and mass sensitization in order to address the existing knowledge gaps. Prompt diagnosis and prevention of a reoccurrence of this pandemic should be the target of all relevant health authorities all over the world. It is worthy to note that on May 5th, 2023, the World Health Organization declared that the COVID-19 pandemic is no longer a global public health emergency.

Acknowledgments

Our special thanks go to all relevant government and institutional authorities who gave approval for this study to be carried out, and to all the pregnant women in Adena, North-Central Nigeria who consented voluntarily to participate in this study.

Conflict of Interest

The authors do not have any possible conflicts of interest.

References

[1] Musa S, Aliyu A, Ikwuka AO, Udeh FC. Knowledge and Attitude of Healthcare Workers towards Healthcare Waste Management at Yusuf Dantsoho Memorial Hospital (YDMH), Kaduna, Nigeria. *British Journal of Medical & Health Sciences*. 2023; 5(2): 1364-1374.

[2] Musa S, Aliyu A, Ikwuka AO, Udeh FC. Knowledge and Practice of Healthcare Waste Management among Healthcare Workers at Yusuf Dantsoho Memorial Hospital (YDMH), Kaduna, Nigeria. *European Journal of Clinical Medicine*. 2023; 4(2): 31-36.

[3] Mietzsch M, Agbandje-McKenna M. The Good That Viruses Do. *Annual Review of Virology*. 2017; 4: iii-v. Available online: http://www.annualreviews.org/errata/virology.

[4] Morens DM, Breman JG, Calisher CH, Doherty PC, Hahn BH, Keusch GT, *et al*. The origin of COVID-19 and why it matters. *The American Journal of Tropical Medicine and Hygiene*. 2020; 103(3): 955-959.

[5] World Health Organization. Director-General's opening remarks at the media briefing on COVID-19. 2020; Available online: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

[6] World Health Organization. WHO Coronavirus disease (COVID-19) dashboard with vaccination data. 2023; Available online: https://www.covid19.who.int/.

[7] National Center for Disease Control. COVID-19 Nigeria. 2023; Available online: https://covid19.ncdc.gov.ng/.

[8] World Health Organization. Coronavirus disease (COVID-19): Nigeria situation. 2023; Available online: https://covid19.who.int/region/afro/country/ng.

[9] Worldometer. COVID-19 Coronavirus pandemic. 2023; Available online: https://www.worldometers.info/coronavirus/#countries.

[10] Chakraborty C, Sharma AR, Bhattacharya M, Agoramoorthy G, Lee SS. Asian-Origin approved COVID-19 vaccines and current status of COVID-19 vaccination program in Asia: a critical analysis. *Vaccines*. 2021; 9,600.

[11] National Agency for Food and Drug Administration and Control. COVID-19 Vaccine update. 2023; Available online: https://www.nafdac.gov.ng/resources/covid-19-vaccine-update/.

[12] Jerving S. The long road ahead for COVID-19 vaccination in Africa. Lancet. 2021; 398(1303): 827-828.

[13] Center for Disease Control and Prevention. Symptoms of Coronavirus. 2021; Available online: https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html.

[14] Inya AU, Achara AP, Ikwuka AO, Udeh FC, Chi-kadibia U, Onazi O. Clinical Dynamics of Anemia in Pregnancy: A 16-week Cross-sectional Study of Pregnant Women Who Attended Antenatal Clinic of Federal Medical Center, Keffi, Nasarawa State, Nigeria. *American Journal of Clinical Medicine Research*. 2023; 11(1): 1-9.

[15] Inya AU, Achara AP, Ikwuka AO, Udeh FC, Chi-kadibia U, Onazi O. Patterns, Peculiarities and Associated Risk Factors of Anemia in Pregnancy: A Case Study of Pregnant Women Attending Antenatal Clinic in North-Central Nigeria. *European Journal of Preventive Medicine*. 2023; 11(2): 21-31.

[16] Bayrampour H, Salmon C, Vinturache A, Tough S. Effect of depressive and anxiety symptoms during pregnancy on the risk of obstetric interventions. *Journal of Obstetrics and Gynaecology Research*. 2015; 41(7): 1040-1048.

[17] Center for Disease Control and Prevention. Investigating the Impact of COVID-19 during Pregnancy. 2022; Available online: https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/special-populations/pregnancy-data-on-covid-19/what-cdc-is-doing.html.

[18] Di Mascio D, Khalil A, Saccone G, Rizzo G, Buca D, Liberati M, *et al*. Outcome of coronavirus spectrum infections (SARS, MERS, COVID-19) during pregnancy: a systematic review and meta-analysis. *American Journal of Obstetrics and Gynecology*. 2020; 2(2): 100-107.

[19] Ikwuka AO. Clinical effectiveness of GLP-1 RAs in patients with metabolic syndrome diseases. *Endocrine Practice*. 2019; 25(1): 104-105.

[20] Ikwuka AO. Dyslipidemia risk severity in patients with diabetes mellitus type 2 and essential hypertension. *Journal of the 21st International Medical Congress of Students and Young Scientists*. 2017; p. 59.

[21] Ikwuka AO. Features of kidney damage in patients with arterial hypertension and type 2 diabetes mellitus and optimization of treatment. *Specialized Academic Council IFNMU*. 2018; Available online: http://www.ifnmu.edu.ua/images/zagalna_informacia/spec_vcheni_radi/2017-2019/%D0%9420.601.01/Ikvuka/Avtoreferat.pdf.

[22] Ikwuka AO, Haman IO. Features of kidney damage in patients with diabetes mellitus type 2 and essential hypertension. *Journal of 86th Scientific and Practical Conference of Students and Young Scientists with International Participation "Innovations in medicine"*. 2017; p. 144.

[23] Ikwuka AO. Risk factors for the pathogenesis of diabetes mellitus type 2. *Materials of 84th Scientific and Practical Conference of Students and Young Scientists with International Participation "Innovations in medicine"*. 2015; p. 19.

[24] Ikwuka AO, Virstyuk NG, Luchko OR. Features of the functional state of kidneys in patients with diabetes mellitus type 2 and essential arterial hypertension. *Materials of scientific-practical*

conference with international participation "Babenkivski reading". 2017; p. 48.

[25] Virstyuk NG, Ikwuka AO, Haman IO, Adebomi MS. Diabetes mellitus type 2, arterial hypertension and dyslipidemia. *Materials of 2nd International Scientific and Practical Conference "Therapeutic readings: modern aspects of diagnosis and treatment of diseases of internal organs"*. 2016; p. 46-47.

[26] Liu Y, Chen H, Tang K, Guo Y. Withdrawn: clinical manifestations and outcome of SARS-CoV-2 infection during pregnancy. *Journal of Infection*. 2020; 10: S0163-4453(20)30109-2.

[27] Beigi RH, Krubiner C, Jamieson DJ, Lyerly AD, Hughes B, Riley L, *et al*. The need for inclusion of pregnant women in COVID-19 trials. *Vaccine*. 2021; 39: 868-870.

[28] Ikwuka AO. Clinical effectiveness of SGLT-2 inhibitors in patients with diabetes mellitus type 2 and essential hypertensive disease. *Endocrine Practice*. 2018; 24(1): 74.

[29] Ikwuka AO, Virstyuk N. Prognostic markers of nephropathy in patients with dual metabolic syndrome diseases (essential hypertensive disease and concomitant type 2 diabetes mellitus). *Endocrine Practice*. 2022; 28(5): S65-S66.

[30] Ikwuka AO, Virstyuk NG. Influence of SGLT2 inhibitor and A2RB (AT1) on fibrogenesis and heart failure in patients with essential hypertensive disease combined with diabetes mellitus type 2. *E-Poster No. 143 of the 44th & 45th Annual General and Scientific Meeting of the West African College of Physicians (WACP), 1-3 November, 2021*. 2021.

[31] Virstyuk NH, Ikwuka AO. Dapagliflozin influence on the clinical course of diabetes mellitus type 2 and essential hypertension in patients. *Recent Advances in Environmental Science from the Euro-Mediterranean and Surrounding Regions*. Springer International Publishing AG. 2018; p. 2007-2008.

[32] Virstyuk NH, Ikwuka AO, Losyuk LV, Kobrynska OYa, Markiv HD. Dapagliflozin utility in patients with diabetes mellitus type 2 and essential hypertensive disease. *Actual Problems of Modern Medicine*. 2017; 4(60) 1: 76-79.

[33] Virstyuk NH, Ikwuka AO, Luchko OR, Kocherzhat OI. Peculiarities of renal insufficiency in patients with diabetes mellitus type 2 and arterial hypertension. *Materials of scientific-practical conference with international participation "Achievements and prospects of experimental and clinical endocrinology" Twentieth Danilevsky readings*. 2021; p. 86-87.

[34] Bull BS, Lichtman MA, Beutler B, Kipps TJ, Seligsohn U, Kaushansky K, *et al*. "Morphology of the Erythron," In: WJ Williams (Ed), *Williams Haematology*, McGraw-Hill, USA. 2006; p. 369-385.

[35] Allotey J, Stallings E, Bonet M, *et al*. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *British Medical Journal*. 2020; 370: m3320.

[36] Dhochak N, Singhal T, Kabra SK, Lodha R. Pathophysiology of COVID-19: why children fare better than adults. *The Indian Journal of Pediatrics*. 2020; 87(7): 537-546.

[37] Wastnedge EAN, Reynolds RM, van Boeckel SR, Stock SJ, Denison FC, Maybin JA, *et al*. Pregnancy and COVID-19. *Physiological Reviews*. 2020; 101: 303-318.

[38] Wei SQ, Bilodeau-Bertrand M, Liu S, Auger N. The impact of COVID-19 on pregnancy outcomes: a systematic review and meta-analysis. *Canadian Medical Association Journal*. 2021; 193(16): E540-E548.

[39] Ayhan SG, Oluklu D, Atalay A, Beser DM, Tanacan A, Tekin OM, *et al*. COVID-19 vaccine acceptance in pregnant women. *International Journal of Gynecology and Obstetrics*. 2021; 154: 291-296.

[40] Egloff C, Couffignal C, Cordier AG, Deruelle P, Sibiude J, Anselem O, *et al*. Pregnant women's perceptions of the COVID-19 vaccine: A French survey. *PLoS ONE*. 2022; 17(2): e0263512.

[41] Janik K, Nietupska K, Iwanowicz-Palus G, Cybulski M. Fear of COVID-19 and vaccine hesitancy among pregnant women in Poland: A cross-sectional study. *Vaccines*. 2022; 10(10): 1700.

[42] Skjefte M, Ngirbabul M, Akeju O, Escudero D, Hernandez-Diaz S, Wyszynski DF, *et al*. COVID-19 vaccine acceptance among pregnant women and mothers of young children: results of a survey in 16 countries. *European Journal of Epidemiology*. 2021; 36: 197-211.

[43] Pradhan D, Biswaroy P, Naik PK, Ghosh G, Rath G. A review of current intervention for COVID-19 prevention. *Archives of Medical Research*. 2020; 51: 363-374.

[44] World Health Organization. Clinical management of COVID-19. *Living Guideline*. 2023; Geneva. WHO/2019- nCoV/clinical/2023. 1 Available online: https://apps.who.int/iris/handle/10665/365580.

[45] Jhirwal M, Singh P, Sharma C, Kathuria P, Shekhar S, Meena SP. Awareness and understanding of COVID-19 among pregnant women in Northern India. *Journal of Education and Health Promotion*. 2022; 11: 191.

[46] Ledford H, Cyranoski D, Van Noorden R. The UK has approved a COVID vaccine - here's what scientists now want to know. *Nature*. 2020; 588(7837): 205-206.

[47] Al-Mustapha AI, Okechukwu O, Olayinka A, Muhammed OR, Oyewo M, Owoicho SA, *et al*. A national survey of COVID-19 vaccine acceptance in Nigeria. *Vaccine*. 2022; 40(33): 4726-4731.

[48] Marbán-Castro E, Nedic I, Ferrari M, Crespo-Mirasol E, Ferrer L, Noya B, *et al*. Perceptions of COVID-19 maternal vaccination among pregnant women and healthcare workers and factors that influence vaccine acceptance: a cross-sectional study in Barcelona, Spain. *Vaccines*. 2022; 10: 1930.

[49] LaCourse S, John-Stewart G, Adams Waldorf KM. Importance of inclusion of pregnant and breastfeeding women in COVID-19 therapeutic trials. *Clinical Infectious Diseases*. 2020; 71(15): 879-881.

[50] Oliver SE, Gargano JW, Marin M, Wallace M, Curran KG, Chamberland M, *et al*. The Advisory Committee on Immunization Practices' Interim Recommendation for use of Pfizer-BioNTech COVID-19 vaccine—United States, 2020. *Morb Mortal Wkly Rep*. 2020; 69(50): 1922.

[51] Center for Disease Control and Prevention. Pfizer-BioNTech COVID-19 vaccine: storage and handling summary. 2023; Available online: www.cdc.gov/vaccines/covid-19/info-by-product/pfizer/downloads/storage-summary.pdf.

[52] Center for Disease Control and Prevention. Pfizer-BioNTech COVID-19 vaccine expriation date extension and beyond-use date. 2023; Available online: www.cdc.gov/vaccines/covid-19/info-by-product/pfizer/downloads/Pfizer-ExpirationExtBUD-508.pdf.

[53] Center for Disease Control and Prevention. Moderna COVID-19 vaccine: storage and handling summary. 2023; Available online: www.cdc.gov/vaccines/covid-19/info-by-product/Moderna/downloads/storage-summary.pdf.

© The Author(s) 2023. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).