BENIN JOURNAL OF POSTGRADUATE MEDICINE

Volume 14, Issue 1, October - December 2023

BJPM

An Official Publication of Association of Resident Doctors,
University of Benin Teaching Hospital (ARD-UBTH), Benin City, Nigeria.

BENIN JOURNAL OF POSTGRADUATE MEDICINE

Original Article

Assessment Of COVID-19 Vaccine Uptake Among Residents Of Urban And Semi-urban Communities In Benin City, Nigeria

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ABSTRACT

Background: Nigeria has had poor COVID-19 vaccine uptake as a result of vaccine hesitancy, vaccine mistrust and government mismanagement of the initial COVID-19 outbreak management. It was therefore, important to assess the knowledge, attitudes towards, level of uptake and determinants of COVID-19 vaccine uptake among residents of New Benin Community and Ovbiogie Communities in Benin City in order to guide future vaccine campaigns.

Methods: The study was carried out among 1,310 respondents in New Benin and Ovbiogie communities in Benin City using a descriptive cross-sectional design and multi stage sampling technique. An adapted interviewer-administered questionnaire was used to for data collection. Sample size was calculated using a p of 0.79 and 0.70 and data analysis was carried out using IBM SPSS version 25.0 software and $p < 0.05$ was considered significant.

Results: This study revealed a high proportion of respondents 509 (77.4%) in Ovbiogie community had good knowledge of COVID-19 vaccine while majority of respondents 603 (92.5%) had good knowledge of COVID-19 vaccines in New Benin community. Two-thirds of respondents 396 (66.0%) in New Benin had positive attitude towards COVID-19 vaccines while about half 333 (52.3%) had positive towards COVID-19 vaccines in Ovbiogie community. About one-fifth 123 (18.7%) of respondents in Ovbiogie community had ever taken the vaccines, while less than one tenth 48 (7.4%) had ever received the vaccines in New Benin community of which. Level of education, skill level, social class, knowledge of and attitude towards COVID-19 vaccines were significantly associated with uptake of COVID-19 vaccine in both communities.

Conclusion: Knowledge of COVID-19 and COVID-19 vaccines was good in both communities however the uptake of the vaccine was higher in Ovbiogie than in New Benin community. Over half of the respondents who had not taken the vaccine was as a result of inadequate information about the vaccine.

Keywords: COVID-19 vaccine, Uptake, Urban, Knowledge, Attitude, Benin City

INTRODUCTION

Coronavirus disease (COVID-19) is a mild to severe respiratory illness caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which appeared to have been initially detected in Wuhan city, Hubei province, China.[1,2] As at 9th November 2023, there have been 266,675 confirmed cases and 3,155 deaths in Nigeria.[3] Transmission of the virus is from person to person via respiratory droplets infecting people of all ages especially persons ≥ 60 years, those with underlying health conditions such as hypertension, diabetes, sickle cell disease, chronic kidney disease and obesity.[4-6]

To mitigate the transmission and effects, non-pharmacological interventions were initially implemented until the approval of the Pfizer-BioNTech COVID-19 Vaccine in August 2021 as well as Moderna, Oxford/AstraZeneca, Johnson & Johnson, Sinopharm, Sinovac, COVAXIN, Covovax (Novavax) and CanSino Biologics Ad5-nCov-S (Convidecia) COVID-19 vaccines subsequently.[7-9] These vaccines had been proven to provide substantially higher protection against COVID-19 infection compared with immunity from a previous COVID-19 infection.[10-12] COVID-19 vaccines are safe, effective and reduce the risk of severe illness and death from COVID-19 infection however as at April 2023, only 115,983,921 doses had been administered in Nigeria with a coverage rate of 30%[13] as a result of poor knowledge and attitude towards the vaccine as well as high vaccine hesitancy due to misinformation, disinformation and conspiracy theories about COVID-19 and COVID-19 vaccines.[14] Also, the accelerated development, approval and roll out of COVID-19 vaccine further drove pre-existing distrust and suspicion.[15] Misinformation, negative experiences from the healthcare system and general distrust for the government fueled vaccine hesitancy as the COVID-19 vaccine was introduced in Nigeria.[15,16] The low uptake of the vaccine in Africa and Nigeria thus posed a significant challenge to achieving herd immunity and controlling the spread of COVID-19, particularly with the emergence of new variants.

Addressing this problem requires understanding and addressing the underlying concerns and misinformation, improving vaccine education and accessibility and building trust in the healthcare system and government.[17] However, only few studies have assessed the uptake of actual COVID-19 vaccination among the general adult population in Benin City. Most of the studies were done when the vaccination was still relatively less available and accessible. It was therefore, important to assess the knowledge, attitudes towards and level of uptake of COVID-19 vaccine among residents of New Benin and Ovbiogie Communities in Benin City, Edo State, Nigeria. Also relevant is the identification of the determinants of uptake in order to effectively mobilize response measures and highlight plans for future response to the disease. Results will also aid in understanding effective vaccine promotion measures for other vaccine preventable diseases and even curb future outbreaks.

METHODOLOGY

Study design and area

A comparative cross-sectional study design was used for this study and the study area comprised of New Benin (urban) and Ovbiogie (semi-urban) communities, Benin City, Edo State. Edo State is an inland State in the South-south geopolitical zone of Southern Nigeria. She shares boundaries with Delta State on the South, Ondo State on the West, Kogi State on the North-East and the River

Niger along the Eastern border. The predominant indigenous ethnic groups are the Benin, Esan, Afemai and Owan, however the state has a significant population of residents from other ethnic groups across the country.[18] Edo state has a land area of 19,794 square kilometers and lies geographically between latitudes 5°44'N to 7°37'N and longitudes 5°44'E to 6°43'E.[19] The population of Edo State as at 2006 Census was 3,233,366[20] and has a projected population of 4,747,052 as at 2022 at a growth rate of 2.4%[21]

Benin is the capital city of Edo State and the inhabitants of Benin City are small to medium scale business operators, civil servants, farmers, artisans, transport operators, students and bankers. The predominant religion is Christianity; others are Islam and Traditional African worship. Majority of the inhabitants are Benin-speaking and others are non-indigenes. The city hosts many public and private institutions including government parastatals, educational institutions, industries, banks, markets, hotels and restaurants etc. The major health facilities in Benin City include both secondary and tertiary health facilities which are government and privately owned. They include University of Benin Teaching Hospital (UBTH), Federal Neuropsychiatric Hospital, Central Hospital Benin, Stella Obasanjo Hospital (Government owned) as well as St Philomena and Faith Mediplex which are Faith Based Healthcare Facilities.

New Benin community is in Oredo LGA while Ovbiogie is in Ovia North-East LGA, Edo State. The New Benin community coordinates are longitude 5.55˚E and latitude 6.23˚N with an elevation of 81 meters above sea level and has a tropical climate. New Benin is bounded on the north by Upper Lawani Road, on the South by Akugbe Street, on the East by New Lagos Road and on the West by Omoruyi Street. Ovbiogie community lies on longitude 5.5814˚E and latitude 6.4859˚N and is bounded on the West by Oluku, northward by Okhun community, southward by Otufure/Iyowa community and eastward by Iwu/Ekiadolor community.

Study duration

The study was carried out from July 2021 to July, 2023

Study population

The study population comprised of adults aged ≥18 years in New Benin and Ovbiogie communities and excluded persons who were too ill to participate. The minimum sample size required for the study, which was calculated using the formula for comparing proportions ($n= n_1+ n_2= 4 (Z_{1-\alpha/2}+ Z_{1-\beta})^2 (P) (1 – P)/d^2$.[22] For the purpose of this study, p_1 and p_2 was taken as 79% and 70% which represents the proportion of who have taken at least one dose of COVID-19 vaccine in a study carried out to access vaccine uptake in urban and rural populations in the United States.[23] After adjusting for nonresponse at a rate of 10%, minimum sample size calculated was 1,200. Adolescents who met the inclusion criteria were recruited for the study. A multi stage sampling method consisting of three stages was used in selecting the respondents.

Data collection tools and methods

Data was collected with the aid of structured interviewer administered questionnaire developed by reviewing previously published papers.[24,25] Survey questionnaire was divided into four (4) sections based on the socio demographic data and objectives of the study. The tool was standardized following peer review in the Department of Public Health & Community Medicine. Trained research assistants were used to collect data. The questionnaire was used to seek information on the

socio-demographic characteristics of the respondents, knowledge of COVID-19 and COVID-19 vaccine, attitude towards COVID-19 vaccine and uptake of COVID-19 vaccine.

Data analysis

The questionnaire was retrieved, sorted and screened for completeness after which the data were coded and entered into the IBM SPSS version 25.0 spreadsheet for analysis.

Age of respondents were categorized into intervals of 10 years (≤24; 25 – 34, 35 – 44, 45 – 54, 55 – 64, ≥ 65 years). The occupation of respondents was coded into skill levels according to modified ILO classification.[26] The modified ILO skill level were categorized into Skill levels 0 – 4 (**Skill level 0:** Housewives, students, unemployed, retired**; Skill level 1:** Office cleaners, gardeners, laborers, kitchen assistants; **Skill level 2:** Bus drivers, secretary, butchers, tailors, sale assistants, police officers, hairdressers, mechanics, electricians; **Skill level 3:** Shop managers, medical radiographers, legal secretaries, medical lab technicians; **Skill level 4:** Medical practitioners, civil engineers, secondary school teachers, Musicians and marketing managers). Level of education was also categorized as no formal education, primary, secondary and tertiary levels of education. Average household income was categorized using the Nigerian minimum wage of ₦30,000 as; < ₦30,000; ₦30,000 - ₦150,000 and >₦150,000. The socio-economic status of respondents was computed using the modification of Oyedeji; Olusanya et al. and Ibadin & Akpede's classification for social class.[27-29] Points were assigned to the different categories of respondents' highest level of education, skill level and monthly income to yield a composite score as explained in Figure 1.LOW SOCIOECONOMIC STATUSHousehold size ≤6 was regarded as a small family size and >6 was regarded as a large family size.[30]

Knowledge of COVID-19 and vaccine was assessed using 27 questions with correct question assigned a score of 1 for each correctly answered question and a score of 0 for incorrect and unanswered questions. Individual total score were represented in percentages. Respondents who scored <50% of the total score were taken to have poor knowledge, scores of ≥50% were taken as good knowledge.[31] The Likert scale response was used to assess respondent's attitude towards COVID-19 vaccination. Where 1= `disagree`, 2= `undecided`, 3= `agree` and was assessed using 13 questions with a maximum score of 39. Each individual total score was represented in percentages and were classified as; ≤ 40% (negative attitude); 41-59% (indifferent attitude) and ≥ 60% (positive attitude).

Univariate analysis was carried out to describe the data. Continuous data like age was summarized using the mean (standard deviation) and median (interquartile range). Categorical data such as ethnicity, class and level of education of parents were presented as frequencies and percentages in a table or represented using other appropriate graphical methods. Bivariate analysis was carried out to determine the association between socio-demographic variables and various outcomes using Chi-square and Fisher's exact test and p-value of < 0.050 was considered statistically significant. The data was presented with frequency distribution tables, prose and charts.

Ethical consideration

Approval for the study was sought from and granted by the Head of Department, Department of Community Health, School of Medicine, University of Benin, Benin-City.

Permission was obtained from the Heads of New Benin and Ovbiogie community and from the heads of each household before administration of

questionnaire.

Verbal consent and assent was taken from respondents and they were educated on the purpose of the study before they were interviewed.

Limitation of the study

The study may be subject to information bias and intentional withholding of facts by respondents based on perception of the concept of COVID-19 and COVID-19 vaccine.

RESULTS

A total of 1,310 responses (New Benin – 652 and Ovbiogie – 658) were collected during this study, giving a response rate of 100%. The highest age group in both New Benin (230, 35.3%) and Ovbiogie (190, 28.9%) communities was 25 – 34 years. The mean age for the New Benin and Ovbiogie communities was 35.5 ± 13.0 and 34.2 ± 13.6 years respectively. Both communities had more female than male respondents: New Benin (373, 57.2%) and Ovbiogie (364, 55.3%). Majority of the respondents in both New Benin (621, 95.2%) and Ovbiogie (615, 93.5%) communities were Christian. The major ethnic group in both communities was Benin: New Benin (253, 38.8%) and Ovbiogie (288, 43.8%). There was a difference in the distribution of respondents according to ethnic group in both communities which was statistically significant ($p < 0.001$).

Majority of the respondents in both communities were married: New Benin (376, 57.7%) and Ovbiogie (361, 54.9%). Of those married, there were more monogamous marriage type than polygamous in both communities: New Benin (367, 97.6%) and Ovbiogie (333, 92.2%). Majority of respondents in both communities had household sizes between 1 – 6: New Benin (582, 89.3%) and Ovbiogie (565, 85.9%). The median household size for both communities was 4 persons. Both communities had more respondents whose highest level of education was secondary: New Benin (349,48.5%) and Ovbiogie (371, 51.5%). Majority of respondents in the Ovbiogie community (538, 81.8%) and most of those in the New Benin community (417, 64.0%) had monthly household income that fell between 30,000 - 150,000). The median income for the New Benin and Ovbiogie communities were 50,000 naira and 60,000 naira respectively. There was a statistically significant difference in distribution of respondents in both communities based on their household monthly income ($p < 0.001$). Majority of respondents in both communities were in the middle socio-economic status: New Benin (532, 81.6%) and Ovbiogie (561, 85.3%). There was a statistically significant difference in distribution of respondents in both communities based on their socio-economic status ($p = 0.002$).

All respondents in both New Benin (652, 100%) and Ovbiogie (658, 100%) communities had heard of COVID-19. The commonest sources of information about COVID-19 in both communities were television and radio: New Benin (television - 601, 92.2%; radio - 412, 63.2%) and Ovbiogie (television - 529, 80.4%; radio - 390, 59.3%). Most of the respondents knew that COVID-19 was caused by a virus. However, a higher proportion in the New Benin community (494, 75.1%) were better informed compared to (446, 68.4%) in the New Benin community. Majority of respondents in Ovbiogie (379, 57.6%), and less than half of those in the New Benin 310 (47.5%) thought transmission was airborne. About half of respondents in the New Benin 336 (51.5%) and almost half of those in the New Benin community 372 (56.5%) thought transmission was through inhalation of respiratory droplets.

Majority of the respondents, (640, 97.3%) in Ovbiogie community and (600, 92.0%) in the New

Benin community had heard about the COVID-19 vaccine. The commonest side effects of the COVID-19 vaccine recognized by the respondents were Fever and Headaches in both communities. Most of the respondents (477, 74.5%) in Ovbiogie and (464, 77.3%) in New Benin community and knew that the COVID-19 vaccine was available in Nigeria.

Only 148 (31.0%) of the respondents in the New Benin community knew that the Oxford AstraZeneca, Moderna (162, 34.0%), Pfizer (106, 22.1%), and Johnson and Johnson (62, 13.0%) vaccines were the COVID-19 vaccine available in Nigeria. Two hundred and thirty-one (38.5%) in the New Benin community were undecided if it was safe to take the vaccine. However, in Ovbiogie community, 309 (48.3%) of the respondents agreed it was safe to take the vaccine. The relationship between attitude towards safety of the vaccine and location of study was statistically significant ($p < 0.001$). In both communities, a higher number of respondents (300, 50.0%- New Benin, 329, 51.4%-Ovbiogie) agreed that the COVID-19 vaccine can prevent COVID-19 infection. Two hundred and eighty-four (47.3%) respondents in the New Benin community were undecided if the COVID-19 vaccine increases the occurrence of COVID-19 while 274 (42.8%) in the Ovbiogie community disagreed.

Two hundred and eight (34.7%) in New Benin and 248 (38.8%) in Ovbiogie were undecided if they would recommend COVID-19 vaccine to their family and friends. The difference was statistically significant ($p = 0.002$). Two hundred and forty (40.0%) of the respondents in the New Benin community as against 287 (44.8%) in the Ovbiogie were undecided if the unknown safety profile discouraged them from taking the COVID-19 vaccine ($p = 0.138$). In both communities, a higher number of respondents were undecided if COVID-19 vaccines are generally safe: New Benin (268, 44.6%) and Ovbiogie (275, 43.0%). The difference was statistically significant. Two hundred and twelve (35.3%) of respondents in the New Benin community disagreed that they would use the vaccine if it is free while 236 (36.9%) in the Ovbiogie were undecided. The difference was statistically significant ($p = 0.008$). Two hundred and seven (34.5%) in the New Benin community disagreed that if we were all required by the government to take the vaccine, they would take it. In the Ovbiogie community, 251 (39.2%) of the respondents were undecided. The difference was statistically significant ($p = 0.005$). Two hundred and forty-six (41.0.%) of the respondents in the New Benin community agreed that vaccination decreases their chances of getting COVID-19 or its complications while 296 (46.3%) in Ovbiogie community were undecided and the difference was statistically significant ($p < 0.001$). Two hundred and seventy-three (45.4%) and 297 (44.4%) of the respondents in the New Benin and Ovbiogie communities respectively were undecided on if the vaccine will likely work for everyone. One hundred and ninety-seven (32.8%) of the respondents in the New Benin community will take the vaccine if their family or friends suggested they should, while 230 (35.9%) of the Ovbiogie community respondents will not take the vaccine even if suggested by their family and friends. The difference was statistically significant ($p < 0.001$).

TABLE 1: OVERALL KNOWLEDGE AND ATTITUDE TOWARDS COVID-19 VACCINE

Variable	Knowledge of COVID-19 vaccine		χ2	p-value	Attitude towards COVID-19 vaccine			χ2	p-value
	Good Freq (%)	Poor Freq (%)			Positive Freq (%)	Indifferent Freq (%)	Negative Freq (%)		
Location of study									
New Benin (urban)	603 (92.5)	49 (7.5)	58.425*	**<0.001**	396 (66.0)	182 (30.3)	22 (3.7)	27.885	**<0.001**
Ovbiogie (semi-urban)	509 (77.4)	149 (22.6)			333 (52.0)	257 (40.2)	50 (7.8)		

*** = Chi-square, + = Fisher's exact**

TABLE 2: UPTAKE OF COVID-19 VACCINE

Variable	Location of study		Test statistic	p-value
	New Benin Freq (%)	Ovbiogie Freq (%)		
Taken COVID-19 vaccine	**n = 652**	**n = 658**		
Yes	48 (28.1)	123 (71.9)	37.048*	**< 0.001**
No	604 (53.0)	535 (47.0)		
Completed vaccination	**n = 48**	**n = 123**		
Yes	31 (64.6)	78 (63.4)	0.020*	> 0.999
No	17 (35.4)	45 (36.6)		
Place of vaccination	**n = 48**	**n = 123**		
Hospital	46 (95.8)	91 (74.6)		
Workplace	2 (4.2)	16 (13.1)		
Home	0 (0.0)	5 (4.1)		
School	0 (0.0)	5 (4.1)		
Church	0 (0.0)	4 (0.6)		
Mosque	0 (0.0)	1 (0.2)		
Have a vaccine card	**n = 48**	**n = 123**		
Yes	47 (97.9)	105 (85.4)		
No	1 (2.1)	18 (14.6)		
Card seen	**n = 48**	**n = 123**		
Yes	24 (50.0)	49 (39.8)		
No	24 (50.0)	74 (60.2)		

TABLE 3: ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS AND KNOWLEDGE OF COVID-19 VACCINE

Variable	New Benin			Ovbiogie		
	Attitude towards COVID-19 Vaccine			Attitude towards COVID-19 Vaccine		
	Positive Freq (%)	Indifferent Freq (%)	Negative Freq (%)	Positive Freq (%)	Indifferent Freq (%)	Negative Freq (%)
Age group(yrs)	**n = 396**	**n = 182**	**n = 22**	**n = 333**	**n = 257**	**n = 50**
18 – 24	99 (78.0)	25 (19.7)	3 (2.4)	92 (51.4)	74 (41.3)	13 (7.3)
25 – 34	142 (61.7)	78 (33.9)	10 (4.3)	109 (58.9)	60 (32.4)	16 (8.6)
35 – 44	101 (66.4)	44 (28.9)	7 (4.6)	74 (48.1)	65 (42.2)	15 (9.7)
45 – 54	47 (59.5)	27 (34.2)	5 (6.3)	36 (58.1)	23 (37.1)	3 (4.8)
55 – 64	31 (73.8)	10 (23.8)	1 (2.4)	16 (50.0)	13 (40.6)	3 (9.4)
≥ 65	16 (72.7)	6 (27.3)	0 (0.0)	6 (21.4)	22 (78.6)	0 (0.0)
	$\chi^2 = 14.417$; p = 0.151			$\chi^2 = 25.033$; p = **0.005**		
Sex	**n = 396**	**n = 182**	**n = 22**	**n = 333**	**n = 257**	**n = 50**
Male	200 (71.7)	67 (24.0)	12 (4.3)	164 (57.1)	104 (36.2)	19 (6.6)
Female	236 (63.3)	123 (33.0)	14 (3.8)	169 (47.9)	153 (43.3)	31 (8.8)
	$\chi^2 = 6.208$; p = **0.045**			$\chi^2 = 5.550$; p = 0.061		
Highest LOE						
NFE	7 (41.2)	9 (52.9)	1 (5.9)	5 (41.7)	7 (58.3)	0 (0.0)
Primary	69 (60.5)	41 (36.0)	4 (3.5)	39 (39.8)	48 (49.0)	11 (11.2)
Secondary	208 (65.8)	99 (31.3)	9 (2.8)	191 (53.1)	141 (39.2)	28 (7.8)
Tertiary	112 (73.2)	33 (21.6)	8 (5.2)	98 (57.6)	61 (35.9)	11 (6.5)
	$\chi^2 = 13.174$; p = **0.043**			$\chi^2 = 10.709$; p = 0.092		
Skill level						
Skill level 0	88 (83.0)	14 (13.2)	4 (3.8)	54 (57.4)	39 (41.5)	1 (1.1)
Skill level 1	31 (64.6)	13 (27.1)	4 (8.3)	6 (28.6)	11 (52.4)	4 (19.0)
Skill level 2		242 (59.8)			150 (37.0)	
Skill level 3	26 (81.3)	5 (15.6)	1 (3.1)	0 (0.0)	3 (100.0)	0 (0.0)
Skill level 4	9 (100.0)	0 (0.0)	0 (0.0)	36 (62.1)	21 (36.2)	1 (1.7)
	Fisher's exact = 35.874; p < **0.001**			Fisher's exact = 23.607; p = **0.001**		
Household size	**n = 396**	**n = 182**	**n = 22**	**n = 333**	**n = 257**	**n = 50**
1-6	346 (64.9)	166 (31.1)	21 (3.9)	298 (54.1)	210 (38.1)	43 (7.8)
>6	50 (74.6)	16 (23.9)	1 (1.5)	35 (39.3)	47 (52.8)	7 (7.9)
	$\chi^2 = 2.858$; p = 0.277			$\chi^2 = 7.329$; p = **0.024**		
Income (naira)						
<30000	90 (52.3)	71 (41.3)	11 (6.4)	31 (53.4)	23 (39.7)	4 (6.9)
30000-150000	270 (70.7)	103 (27.0)	9 (2.4)	273 (52.5)	210 (40.4)	377 (7.1)
>150000	36 (78.3)	8 (17.4)	2 (4.3)	29 (46.8)	24 (38.7)	9 (14.5)
	$\chi^2 = 23.293$; p < **0.001**			Fisher's exact = 4.034; p = 0.398		

* = Chi-square, $^+$ = Fisher's exact, LOE: Level of Education

TABLE 4: ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS AND ATTITUDE TOWARDS COVID-19 VACCINE

Variable	New Benin			Ovbiogie		
	Attitude towards COVID-19 Vaccine			Attitude towards COVID-19 Vaccine		
	Positive Freq (%)	Indifferent Freq (%)	Negative Freq (%)	Positive Freq (%)	Indifferent Freq (%)	Negative Freq (%)
Age group(yrs)	**n = 396**	**n = 182**	**n = 22**	**n = 333**	**n = 257**	**n = 50**
18 – 24	99 (78.0)	25 (19.7)	3 (2.4)	92 (51.4)	74 (41.3)	13 (7.3)
25 – 34	142 (61.7)	78 (33.9)	10 (4.3)	109 (58.9)	60 (32.4)	16 (8.6)
35 – 44	101 (66.4)	44 (28.9)	7 (4.6)	74 (48.1)	65 (42.2)	15 (9.7)
45 – 54	47 (59.5)	27 (34.2)	5 (6.3)	36 (58.1)	23 (37.1)	3 (4.8)
55 – 64	31 (73.8)	10 (23.8)	1 (2.4)	16 (50.0)	13 (40.6)	3 (9.4)
≥ 65	16 (72.7)	6 (27.3)	0 (0.0)	6 (21.4)	22 (78.6)	0 (0.0)
	$\chi^2 = 14.417$; p = 0.151			$\chi^2 = 25.033$; p = **0.005**		
Sex	**n = 396**	**n = 182**	**n = 22**	**n = 333**	**n = 257**	**n = 50**
Male	200 (71.7)	67 (24.0)	12 (4.3)	164 (57.1)	104 (36.2)	19 (6.6)
Female	236 (63.3)	123 (33.0)	14 (3.8)	169 (47.9)	153 (43.3)	31 (8.8)
	$\chi^2 = 6.208$; p = **0.045**			$\chi^2 = 5.550$; p = 0.061		
Highest LOE						
NFE	7 (41.2)	9 (52.9)	1 (5.9)	5 (41.7)	7 (58.3)	0 (0.0)
Primary	69 (60.5)	41 (36.0)	4 (3.5)	39 (39.8)	48 (49.0)	11 (11.2)
Secondary	208 (65.8)	99 (31.3)	9 (2.8)	191 (53.1)	141 (39.2)	28 (7.8)
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	$\chi^2 = 13.174$; p = **0.043**			$\chi^2 = 10.709$; p = 0.092		
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Skill level 2		242 (59.8)			150 (37.0)	
Skill level 3	26 (81.3)	5 (15.6)	1 (3.1)	0 (0.0)	3 (100.0)	0 (0.0)
Skill level 4	9 (100.0)	0 (0.0)	0 (0.0)	36 (62.1)	21 (36.2)	1 (1.7)
	Fisher's exact = 35.874; p < **0.001**			Fisher's exact = 23.607; p = **0.001**		
Household size	**n = 396**	**n = 182**	**n = 22**	**n = 333**	**n = 257**	**n = 50**
1-6	346 (64.9)	166 (31.1)	21 (3.9)	298 (54.1)	210 (38.1)	43 (7.8)
>6	50 (74.6)	16 (23.9)	1 (1.5)	35 (39.3)	47 (52.8)	7 (7.9)
	$\chi^2 = 2.858$; p = 0.277			$\chi^2 = 7.329$; p = **0.024**		
Income (naira)						
<30000	90 (52.3)	71 (41.3)	11 (6.4)	31 (53.4)	23 (39.7)	4 (6.9)
30000-150000	270 (70.7)	103 (27.0)	9 (2.4)	273 (52.5)	210 (40.4)	377 (7.1)
>150000	36 (78.3)	8 (17.4)	2 (4.3)	29 (46.8)	24 (38.7)	9 (14.5)
	$\chi^2 = 23.293$; p < **0.001**			Fisher's exact = 4.034; p = 0.398		

* = Chi-square, $^+$ = Fisher's exact, LOE: Level of Education

TABLE 5: ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS AND UPTAKE OF COVID-19 VACCINE

Variable	New Benin				Ovbiogie			
	Uptake of COVID-19 Vaccine		Test statistic	p-value	Uptake of COVID-19 Vaccine		Test statistic	p-value
	Yes Freq (%)	No Freq (%)			Yes Freq (%)	No Freq (%)		
Age group (yrs)	**n = 48**	**n = 604**			**n = 123**	**n = 535**		
18 – 24	13 (10.2)	114 (89.8)	7.577*	0.176	16 (8.7)	168 (92.6)	21.112*	**0.001**
25 – 34	13 (5.7)	217 (94.3)			39 (20.5)	151 (79.5)		
35 – 44	8 (5.3)	144 (94.7)			35 (22.2)	123 (77.8)		
45 – 54	6 (7.6)	73 (92.4)			20 (31.3)	44 (68.8)		
55 – 64	4 (9.5)	38 (90.5)			8 (24.2)	25 (75.8)		
≥ 65	4 (18.2)	18 (81.8)			5 (17.2)	24 (82.8)		
Skill level								
Skill level 0	15 (13.3)	98 (86.7)	17.405^{+}	**0.001**	19 (19.6)	78 (80.4)	30.704^{+}	0.177
Skill level 1	1 (1.8)	55 (98.2)			3 (14.3)	18 (85.7)		
Skill level 2	25 (5.7)	417 (94.3)			73 (15.2)	406 (84.8)		
Skill level 3	4 (12.5)	28 (87.5)			0 (0.0)	3 (100.0)		0.120
Skill level 4	3 (33.3)	6 (66.7)			28 (48.3)	30 (51.7)		
Social class								
Low	6 (26.1)	17 (73.9)	15.839*	**0.001**	26 (43.3)	34 (56.7)	26.562*	< **0.001**
Middle	40 (7.5)	492 (92.5)			90 (16.0)	471 (84.0)		
High	2 (2.1)	95 (97.9)			7 (18.9)	30 (81.1)		
Marital status	**n = 48**	**n = 604**			**n = 123**	**n = 535**		
Ever married	30 (7.1)	394 (92.9)	0.146*	0.754	87 (22.4)	301 (77.6)	8.654*	**0.004**
Never married	18 (7.9)	210 (92.1)			36 (13.3)	234 (86.7)		
Marriage type	**n = 28**	**n = 348**			**n = 82**	**n = 279**		
Monogamous	28 (7.6)	339 (92.4)	0.742*	0.634	81 (24.3)	252 (75.7)	6.336*	**0.016**
Polygamous	0 (0.0)	9 (100.0)			1 (3.6)	27 (96.4)		
Household size	**n = 48**	**n = 604**			**n = 123**	**n = 535**		
1-6	45 (7.7)	537 (92.3)	1.088*	0.347	113 (20.0)	452 (80.0)	4.493*	**0.043**
>6	3 (4.3)	67 (95.7)			10 (10.8)	83 (89.2)		
Highest level of education	**n = 48**	**n = 604**			**n = 123**	**n = 535**		
No formal education	0 (0.0)	20 (100.0)	38.356*	**< 0.001**	0 (0.0)	15 (100.0)	43.190	**< 0.001**
Primary	2 (1.6)	122 (98.4)			8 (7.8)	94 (92.2)		
Secondary	17 (4.9)	332 (95.1)			56 (15.1)	315 (84.9)		
Tertiary	29 (18.2)	130 (81.8)			59 (34.7)	111 (65.3)		

* = Chi-square, $^{+}$ = Fisher's exact

TABLE 6: ASSOCIATION BETWEEN KNOWLEDGE OF COVID-19 AND UPTAKE OF COVID-19 VACCINE

Variable	New Benin				Ovbiogie			
	Uptake of COVID-19 Vaccine		Fisher's exact	p-value	Uptake of COVID-19 Vaccine		χ^2	p-value
	Yes n = 48 Freq (%)	No n = 604 Freq (%)			Yes n =123 Freq (%)	No n = 535 Freq (%)		
Knowledge of COVID-19								
Good	47 (7.8)	556 (92.2)	2.200+	0.165	117 (23.0)	392 (77.0)	27.260*	**< 0.001**
Poor	1 (2.0)	48 (98.0)			6 (4.0)	143 (96.0)		

TABLE 7: ASSOCIATION BETWEEN ATTITUDE TOWARDS COVID-19 AND UPTAKE OF COVID-19 VACCINE

Variable	New Benin				Ovbiogie			
	Uptake of COVID-19 Vaccine		χ^2	p-value	Uptake of COVID-19 Vaccine		χ^2	p-value
	Yes n = 48 Freq (%)	No n = 604 Freq (%)			Yes n =123 Freq (%)	No n = 535 Freq (%)		
Attitude towards COVID-19 vaccine								
Positive	47 (11.9)	349 (88.1)	23.693	**< 0.001**	112 (33.6)	221 (66.4)	93.009*	**< 0.001**
Indifferent	1 (0.5)	181 (99.5)			10 (3.9)	247 (96.1)		
Negative	0 (0.0)	22 (100.0)			1 (2.0)	49 (98.0)		

DISCUSSION

All respondents were aware of COVID-19 and majority were aware of COVID-19 vaccine. The main sources of information were Television, Radio and social media respectively in both New Benin and Ovbiogie communities. These findings may be due to higher level of education, increased social economic status and high level of public enlightenment campaign about the COVID-19. Similar findings were obtained in a comparative study done in Ogun state which assessed vaccine acceptability and its determinants among urban and rural community. They also demonstrated that almost all the respondents are aware of COVID-19 disease with Television and radio being the major sources of information in the study.[32]

Awareness of COVID-19 symptoms is critical to identify and diagnose the disease early, which is crucial in managing its spread. Early diagnosis and treatment can help prevent severe illness and death resulting from COVID-19, reduce the burden on healthcare systems, and ultimately save lives. Good awareness of COVID-19 can help individuals distinguish between facts and misinformation, and make informed decisions regarding their health and safety. This awareness is also essential for public health planning and decision-making among all stakeholders.

Majority of the respondents were aware that vaccine is available in Nigeria. More than one-quarter of the respondents reported AstraZeneca as the vaccine available in New Benin community and less than half reported Moderna as the main vaccine available in Ovbiogie community. Furthermore, majority of the respondents believe that the vaccine can offer protection from the COVID-19 disease. In all, majority of respondents

in this study showed good knowledge of COVID-19 and COVID-19 vaccine in both communities. This finding corroborates findings from another community-based study done in Ethiopia which assessed COVID-19 vaccine knowledge, attitude, acceptance, and determinants of COVID-19 vaccine acceptance among adult population in Ethiopia where majority of the respondents were aware of the COVID-19 vaccine and almost all the respondents believe that the vaccine offered protection against the disease.[33] This finding was also supported by another community-based done in Ondo State to assess public beliefs and willingness to accept COVID-19 vaccines among adults in South-Western Nigeria where they also reported that over two-thirds of study participants believed in the effectiveness of the vaccine.[34]

Good knowledge about the vaccine can help increase vaccine uptake in the community, as understanding the benefits of getting vaccinated they are more likely to get vaccinated themselves, and also encourage their family and friends to do the same. This can also lead to better informed decision making about vaccine uptake. This can also lead to increased support for vaccination efforts and other public health measures to control the spread of COVID-19.[33]

More than half of the respondents in Ovbiogie and a quarter of respondents in New Benin community felt the vaccine was safe for use and does not increase disease occurrence. Having a good knowledge about the safety of the vaccine will increase the motivation of the populace, hence drive vaccine uptake with wider vaccine coverage.

Most respondents with positive attitude towards the vaccine in Ovbiogie community were older adults compared to New Benin, where positive attitude was seen in younger adults. Older adults were more likely to have positive attitude because most of them may have experienced similar outbreaks such as with small pox and thus the need for vaccination and have positive attitudes to the COVID-19 vaccine. Such attitudes, if found among household heads are likely to influence and motivate other family members to take the vaccine with increased level of household and community protection. This finding was similar to that of a cross-sectional study done in Kano, Nigeria which revealed that most older respondents in urban area had positive attitude when compared to the young adults.[35] Young people make up a very large and important category of the population, therefore having a positive attitude among young people will drive uptake of the vaccine.

The New Benin community had more males and females who showed positive attitude towards the COVID-19 vaccine in comparison with the Ovbiogie community. This was similar to report from a study in Bangladesh which showed that both men and women had positive attitude in the urban area while those in the suburbs had poor attitude.[36] Women are the gatekeepers to the home, having a positive attitude will translate to an increase in family uptake and consequently the community at large.[37]

Most of the respondents who had skilled level 2 and above and attained some level of education beyond primary level had a more positive attitude towards the vaccine and were open to taking the vaccine. Increase in attitude could be likely due to their level of exposure and access to information which enables them to have a better attitude, make good choices and consequently increase uptake in the long run. This is similar to a study done in Saudi Arabia which showed that higher levels of educational qualification were associated with better attitude towards the vaccine, among those living in both suburban and urban communities.[38]

Overall, these findings suggest that public health campaigns and interventions should be tailored to the specific social and economic factors that may be influencing vaccine attitudes and ultimately

helping to increase vaccine uptake and control the spread of COVID-19.

Level of education was found to increase attitude and uptake and as such, public health education campaigns should focus on providing accurate information about the vaccine to increase knowledge and awareness among the general population, especially those with lower levels of education and skills. This will address any concerns or misconceptions through targeted messaging and community engagement.

Majority of respondents in both New Benin and Ovbiogie communities had poor level of uptake of the vaccine. Level of uptake was found to be higher in Ovbiogie compared to New Benin community. Difference in uptake levels could be linked to the fact that a lot of misinformation about the vaccine has been spread since the outset of the pandemic.[38] Poor uptake initially was likely due to insufficient information about the vaccine and the fear of untoward side effect. Similar findings were also observed in a study conducted among 1,500 counties across the USA which showed that there was low uptake of the COVID-19 vaccine in both suburban and urban communities.[39] COVID-19 vaccine surveillance report across England also revealed that urban communities had higher vaccine uptake compared to suburban communities which was in contrast with our study.[40,41] Similarly a study done to examine rural, suburban and urban differences in vaccine uptake across Kenya found that peri-urban communities had lower vaccine uptake rates compared to urban communities.[42] Low level of education, low income, and lack of trust in healthcare providers were found to be significantly associated with low level of vaccine uptake in both rural and urban areas. Poor uptake levels will consequently prolong the time to achieve herd immunity among the population and allow for the formation of new strains.[43]

Most of the respondents with low uptake of the vaccine cited the fear of adverse side effect and not having enough information about the vaccine were some of the reasons for not taking the vaccine. Similarly, a study done in Kenya revealed that the unknown profile of the vaccine and fear of side effects were the reasons for low uptake.[44] Fear of the side effects will deter most respondents from taking the vaccine. Hence, adequate information about the vaccine in local parlance should be disseminated to prevent the spread of false information and causing panic among the population.[45]

A significant proportion of respondents with low uptake were young adults in both New Benin and Ovbiogie communities. Reasons for such low uptake could also be linked to poor health seeking behavior in this group, which makes them ignore the need for vaccination and the vast access to information online which exposes them to false information, conspiracy theories and consequently reduces the ability to convince them to take the vaccine. However, this is in contrast to a study done in USA which cited that adults ≥50 years, were least likely to be vaccinated with at least one dose of the COVID-19 vaccine.[39] This will likely reduce the uptake of vaccine, herd immunity and coverage.[43]

Most women had poor uptake in both suburban and urban communities. Poor uptake was likely due to the fact that women are more skeptical about new innovations while males who are more dominant in the society and are open to new changes and willing to be experimental. This is in contrast to a Kenyan study which showed women had higher uptake because of the notion that COVID-19 affects women more than men.[42] Most women who were never married showed poor uptake of the vaccine in both communities. Lack of information and support from partner may have been the reason for lack of interest in taking the

vaccine among unmarried respondents. This however contrast to a cross-sectional study in Bagladesh which showed both married and unmarried women to have had good uptake.[36] Unmarried women make up a significant portion of the community and hence affects vaccine coverage and herd immunity.

Most respondents with smaller household sizes, skill levels below 2, low income had poor uptake in both New Benin and Ovbiogie communities. Most respondents who had low income were menial workers who are probably busy looking for jobs and did not have time to go get the vaccine. This was similar to findings from a cross-sectional study in Bangladesh which showed that there was a significantly low level of uptake among individuals in the suburbs compared to urban area.[46] This implies a more different approach or adaptive strategies to access such individuals and can this result in delayed uptake and attainment of herd immunity.[45]

Despite the low educational level of most respondents in Ovbiogie community, which may predispose them towards outright vaccine rejection; they were found to have good knowledge about the vaccine and had good uptake when compared to their urban counterparts in New Benin community. This was in contrast with a cross-sectional study done in England which showed that low levels of education were associated with low COVID-19 vaccine uptake.[40] This may likely be as a result of the time lag between the two studies which was sufficient enough for the proper dissemination and addressing issues about the disease and the vaccine. This means that there are other possible non-formal but effective ways of information sharing which can be explored for future vaccine roll-out campaigns.

CONCLUSION

The knowledge of the COVID-19 and COVID-19 vaccine was high in both New Benin and Obviogie communities. The attitude towards the COVID-19 vaccine was also high in both communities.

The uptake of the vaccine was higher in Obviogie community than the New Benin community with a higher proportion of respondents in both communities citing inadequate information about the vaccines as the primary reason for not taking the vaccine at the time.

Level of education, skill level, socioeconomic status and attitude towards COVID-19 vaccines positively affected the uptake of the vaccine in both communities while knowledge was significantly associated with uptake in Ovbiogie community.

RECOMMENDATIONS

There is a need for collaboration with trusted sources such as public health organizations, faith-based organizations, civil society groups, healthcare providers, community leaders to disseminate information on COVID-19 and vaccine

Practice incentive vaccination such as providing free transportation to and fro vaccine centers and other rewards. Individuals will need to encourage their friends, family and colleagues about the benefits of getting vaccinated by getting vaccinated as well as share their experience and encourage others to do same.

ACKNOWLEDGMENTS

The authors wish to acknowledge the Head of Department, Department of Community Health,

School of Medicine, University of Benin, Benin-City, the Heads (Odionwere) of New Benin and Ovbiogie communities and all respondents who participated in the study.

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INSTITUTION WHERE RESEARCH WORK WAS DONE:

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SOURCE OF FUNDING: Nil

We the authors certify that this work has not been published anywhere else and that all authors contributed significantly to this work.

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APPENDIX

LEVEL OF EDUCATION								
SKILL LEVEL			NFE & PRIMARY	SECONDARY	TERTIARY			MONTHLY INCOME (₦)
			1	2	3			
	0 & 1	1	3	4	5	1	< 30,000	
	2 & 3	2	5	6	7	2	30,000 - 69,999	
	4	3	7	8	9	3	≥ 70,000	

Key: **NFE:** No Formal Education

LOW SOCIOECONOMIC STATUS
MIDDLE SOCIOECONOMIC STATUS
HIGH SOCIOECONOMIC STATUS

Figure 1: Composite scoring for socio-economic status of respondents

Score:

< 30,000:	1
30,000 – 69,999:	2
≥ 70,000:	3

NFE & Primary Education:	1
Secondary Education:	2
Tertiary Education:	3

Skill Level 0 & 1:	1
Skill Level 2 & 3:	2
Skill Level 4:	3