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ORIGINAL ARTICLE

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Acceptability, Hesitancy and Willingness to Pay for COVID-19 Vaccine among Lagos Residents

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Keywords

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vaccine acceptability;

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willingness to pay

ABSTRACT

Background: Coronavirus disease (COVID-19) is an infectious disease that has plagued the world beginning from 2019 when it was first discovered, laudable efforts have been made by science to produce vaccines to mitigate the effects of this disease. This study sought to assess the knowledge of COVID-19 and vaccine acceptability, hesitancy, willingness to pay and associated factors among Lagos residents.

Methods: The study design was cross-sectional and descriptive with a mixed methods approach. Respondents (2924) residing in Lagos were selected for the study using multi-stage sampling technique. Data collection was done using an interviewer-administered questionnaire for quantitative data and a focus group discussion guide for qualitative data. Quantitative data analysis was done using the Statistical Package for the Social Sciences Version 23, while qualitative data was analysed thematically.

Results: The study revealed that most respondents (81%) were aware that COVID-19 vaccines are available in Nigeria. Two-thirds (67%) of the respondents were willing to receive the vaccine (acceptance) and 48.2% were vaccine hesitant. Willingness to pay for the vaccine was quite low (18%) and this was also reflected in the focus group discussions. Educational status, income, occupation and knowledge were significant predictors of COVID-19 vaccine acceptance.

Conclusion: The findings show higher than average rates of vaccine hesitancy although most respondents had good knowledge of COVID-19. Efforts by government agencies to improve community access to education, better occupations and incomes are recommended to improve vaccine acceptance.

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) is a communicable respiratory disease caused by a new strain of coronavirus that has caused illnesses in humans. The first human cases of COVID-19, the disease caused by the novel coronavirus causing COVID-19, subsequently named SARS-CoV-2 were first reported by officials in Wuhan City, China, in December 2019.[1] It was declared a global pandemic by the World Health Organization (WHO) on March

11, 2020 due to its rapid spread across countries with devastating impacts on the health and economic sectors of these countries.[2] The COVID-19 pandemic led to a dramatic loss of human life worldwide. Global reports as of February 28, 2023, put COVID-19 confirmed cases as 758,390,564 with 6,859, 093 fatalities.[3] Nigeria was not spared with 266,593 confirmed cases and 3,155 deaths.[4]

Vaccination is a key intervention and plays a major role in the fight to achieve disease eradication and elimination, control of mortality, morbidity and complications, mitigation of disease severity, prevention of infection and even protection of unvaccinated populations through herd immunity.[5] Despite the huge efforts made to achieve a successful roll out of COVID-19 vaccines, major hindrances can be related to acceptability, hesitancy and willingness to pay (WTP) for vaccines. The first vaccine listed for emergency use by the WHO was the COVID-19 messenger Ribonucleic Acid (mRNA) vaccine by Pfizer/BioNTech on the 31st of December 2020,[6] although the first vaccination outside of a clinical trial was carried out on the 8th of December 2020 after development of the vaccine in the same year.[7] Nigeria received the first shipment of COVID-19 vaccines on the 2nd of March 2021[8] and vaccination subsequently commenced.

In 2015, the WHO Strategic Advisory Group of Experts defined vaccine hesitancy as a delay in acceptance or refusal of vaccination services,[9] which can vary in form and intensity based on where it occurs and what vaccine is involved, as has been confirmed in multiple studies.[10,11] In most countries, vaccine hesitancy is a growing public health challenge. WTP is an approach to estimate the maximum amount that an individual is willing to allocate to programs, services and health technologies.[12] The side effects that may come along with the vaccine administration is one of the major reasons why people may not be willing to accept or pay for the vaccine although some people may readily accept the vaccine if requested by their employer.[13] A global survey of potential acceptance of a COVID-19 vaccine revealed that 71.5% of the participants reported that they would be very or somewhat likely to take the vaccine, while 61.4% reported that they would accept their employer's recommendation to do so.[13] The differences in acceptance rates ranged from almost 90% (in China) to less than 55% (in Russia).[13] A cross-sectional study carried out on vaccine hesitancy among university students in Italy during the COVID-19 pandemic showed that 86.1% students reported that they would choose to have a vaccination for COVID-19; conversely, 13.9% students reported that they would not or are not sure to get vaccinated (low intention to vaccinate). This meant that one student out of 10 showed a low intention to vaccinate (vaccine hesitancy).[14] A global survey on COVID-19 vaccine hesitancy which included two of Africa's most populous and visible nations, Nigeria and South Africa showed that 71.5% of the participants said they would take a "proven safe and effective vaccine" while 14% would refuse it outrightly. An additional 14% said they would hesitate to take the vaccine.[15]

Understandably, vaccine safety gets more public attention than vaccine effectiveness, the hesitancy to take vaccines, acceptability and WTP for vaccines are issues that the medical field and the government of any country have to contend with when vaccines are newly introduced. A lot of conspiracy theories about the safety, efficacy, allocation equity of COVID-19 vaccine emerged in Nigeria,[16] and belief in these conspiracy theories was a threat to the adoption of COVID-19 preventive behaviours as well as an obstacle to achieving adequate coverage and immunity. Therefore, stakeholders in the health sector needed to identify and respond adequately to these theories to ensure a successful implementation of the COVID-19 vaccine program viz a viz vaccine acceptability, hesitancy and WTP for the vaccine.

This study was conducted to assess the knowledge of COVID-19, its prevention, public acceptance, hesitancy, WTP for the COVID-19 vaccine and to identify factors associated with vaccine hesitancy among Lagos state residents.

METHODS

Lagos State is the economic capital of Nigeria and is located in the South-western geopolitical zone of Nigeria with Ikeja as her capital. Lagos has a land mass of 3,577 km^2, and an estimated population of 15.4 million in 2022 with about 65.3% of these being adults.[17,18] Lagos State has 20 Local Government Areas (LGA) and 37 Local Council Development Areas (LCDA). Sixteen of the LCDAs are classified as urban and four are rural.

The study population was drawn from the adult residents of Lagos state who were adults aged 18 years and above, and who had been resident in Lagos for at least 6 months prior to data collection. The study design was descriptive, cross sectional using mixed methods.

The required sample size for quantitative data collection was determined using Cochran's formula based on the following assumptions: standard normal deviate, z (2.576) corresponding to a 99% confidence interval, a prevalence, p of 14% (0.14) vaccine hesitancy,[15] (1-p) of 0.86, a level of precision of 0.025 and an anticipated response rate of 90%. The minimum sample size calculated was 1,426, which was increased to 3000 respondents to improve the validity of, and generalizability of the study.

For quantitative data collection, a multistage sampling technique was used made up of the following stages:

Stage 1: A total of 4 LGAs were selected from the 20 LGAs of Lagos State (1 rural and 3 urban) via simple random sampling method by balloting, and these were Apapa, Eti-osa, Kosofe and Epe (rural).

Stage 2: In each of these LGAs, 8 wards were selected by simple random sampling from the lists of wards per LGA which were obtained from the Ministry of Local Government and Community Affairs/ Medical officer of Health of the LGAs which had a total of 48 wards.

Table 1: Vaccine hesitancy based on VHS among respondents

Vaccine Hesitancy Scale (VHS) tool item (n=2924)	Strongly disagree Freq (%)	Disagree Freq (%)	Neutral Freq (%)	Agree Freq (%)	Strongly agree Freq (%)	No response Freq (%)
L1- Vaccines are important for good health	67(2.3)	102(3.5)	602(20.5)	1229(42.0)	697(23.8)	227(7.8)
L2- COVID-19 vaccines are effective	99(3.4)	173(5.9)	933(31.9)	1040(35.6)	437(14.9)	242(8.3)
L3- Getting vaccinated against COVID-19 is important for good health of others	94(3.2)	163(5.6)	726(24.8)	1160(39.7)	544(18.6)	237(8.1)
L4- I feel COVID-19 vaccines are beneficial	66(2.3)	157(5.4)	790(27.0)	1140(39.0)	513(17.5)	258(8.8)
L5- New vaccines such as COVID-19 carry more risks than older vaccines	144(4.9)	295(10.1)	1083(37.0)	795(27.2)	339(11.6)	268(9.2)
L6- The information we receive about COVID-19 vaccines are reliable and true	118(4.0)	206(7.0)	824(28.2)	1113(38.1)	395(13.5)	268(9.2)
L7- Getting vaccinated against COVID-19 is a good way of protecting myself against the disease	96(3.3)	171(5.8)	726(24.8)	1086(37.1)	567(19.4)	278(9.5)
L8- Generally, I do what my Dr/healthcare provider recommends about vaccines	101(3.5)	160(5.5)	740(25.3)	1081(37.0)	566(19.4)	276(9.4)
L9- I am concerned about serious adverse effects of the COVID-19 vaccine	98(3.4)	229(7.9)	846(28.9)	915(31.3)	544(18.6)	292(10.0)
Vaccine Hesitancy (Summary from VHS assessment)	**Frequency (n= 2715)**			**Percentage**		
Low vaccine hesitancy	1407			51.8		
High vaccine hesitancy	1308			48.2		

Stage 3: Each selected ward had a sampling frame which was the list of streets in the ward. Ten streets were selected by simple random sampling from each of these, making a total of 40 streets.

Stage 4: On each street, using a sampling frame of the total number of houses on each street, 10 houses were consecutively selected to ensure uniformity across all streets following the LGA numbering system.

Stage 5: In each selected house, 1 household was selected. The selection was done via a ballot where more than 1 existed in the house.

Stage 6: In selected households, one eligible respondent was selected. Where a household

had more than one eligible respondent, the selection was done via a ballot.

A target of at least 750 respondents were selected at each LGA to make a total of 3000, however after removal of incomplete data and exclusion of those who did not give consent, Apapa had 696, Eti-osa 745, Kosofe 754 and Epe 729 respondents, making a total of 2924 respondents (greater than minimum sample size of 1426 but 97.5% of final sample size).

For qualitative data collection, respondents for the focus group discussions (FGD) were selected by purposive sampling based on availability. (8 participants per group). Two FGDs were conducted per LGA (1 female and 1 male).

This study defined vaccine acceptability as the willingness to receive the vaccine when offered as assessed by a single question, while vaccine hesitancy was the degree of reluctance to get vaccinated assessed via a vaccine hesitancy scale.

The survey instruments used were an interviewer-administered questionnaire and an FGD guide. The questionnaire was developed based on the Vaccine Hesitancy Scale (VHS) section of the WHO (SAGE) working group's diagnostic tool,[19] the objectives of the study and the available information about COVID-19. The VHS is a ten-item scale which has a first component (consisting of seven items) representing 'lack of confidence' and the second component (consisting of two items) representing ''risks", the 10th item was found to be unreliable and was not used. The 'lack of confidence' component has a Cronbach's alpha of 0.92 and inter-item correlations ranged between 0.52 and 0.79. The 'risks' component has a Cronbach's alpha of 0.64 and the inter-item correlation was 0.47. The scale's structure, internal consistency, construct and criterion validity were adequate to identify vaccine hesitant individuals.[20]

Section A of the questionnaire elicited socio-demographic details, section B assessed the knowledge of COVID-19 and its prevention, section C focused on COVID-19 vaccine hesitancy based on the VHS, section D assessed vaccine acceptability and WTP for the vaccine, while section E elicited information on how to improve acceptability of the vaccine in the community.

An FGD Guide was developed in line with the study objectives and was used in the conduct of the FGD. The guide elicited information about the COVID-19 vaccine, its acceptability, hesitancy and WTP for it when available.

Data collection was carried out from the 2nd of August to the 15th of September 2021 by 13 Research Assistants (RAs) (3 per urban LGA, 4 in Epe LGA). Quantitative data was collected with the use of the questionnaires in the KoBoCollect v2021 application via face-to-face interviews with respondents in their houses. RAs were trained over 2 days prior to data collection to ensure good understanding of the research objectives, questions to be asked, use of the application and how to protect themselves from infection with COVID-19 during data collection. The RAs were aged

above 18 years of age and had successfully completed secondary education possessing a minimum of GCE Ordinary level certificates or its equivalent. The RAs made use of face masks and hand sanitizers and administered the questionnaires under the supervision of selected members of the research team who took on the role of Supervisors.

FGDs for qualitative data collection were conducted by the RAs supervised by the Researchers. Eight participants per LGA were purposively selected and invited by the RAs for the FGDs, they were reminded via text messages and calls on the discussion day. The selected participants were within the same age range (20-45 years) for each FGD. The FGDs were held in a round table setting, and each participant was encouraged to freely express their opinions, and referred to by the participant numbers assigned to them. Each session was anchored by the researchers and trained research assistants taking on the roles of a moderator, recorder and note taker who also noted the non-verbal cues and group dynamics. All sessions had audio recordings done after obtaining written informed consent from the participants. The audio recordings were transcribed soon after the discussions. Each session lasted between 45 -90 minutes.

Data management for quantitative data involved the download of the data in excel format from the KoBoCollect toolbox application, and this was exported to the Statistical Package for the Social Sciences Version 23 for analysis. Outcome variables included awareness of COVID-19, knowledge of COVID-19, acceptability, hesitancy and WTP for COVID-19 vaccines. Associations between various respondents' characteristics and the outcome variables were sought for using the Chi-Square test. Multivariate analysis was done using logistic regression for factors found to be significant ($p< 0.05$) on bivariate analysis to identify predictors of vaccine acceptability, hesitancy and WTP for COVID-19 vaccines. The VHS was measured and graded based on a five-point Likert-type rating scale ranging from 1 mark for 'strongly disagree' to 5 marks for 'strongly agree'. Items L5 and L9 were directly scored while all other items on the 9- item scale were reverse scored to indicate higher scores for vaccine hesitancy. The VHS using the 9 items gave a Cronbach's alpha score of 0.908 indicating satisfactory reliability. The mean VHS score of 23.7 was used as the cut- off point and all scores equal to and above this were graded as high vaccine hesitancy, while those below were graded as having low vaccine hesitancy. Knowledge of COVID-19 was determined by awarding a score of one to a correct answer and a score of zero to wrong answers. The maximum knowledge score was 25 (for 25 questions) and the minimum was 0. All awarded scores were summed up to make the total score for the knowledge section and these were converted to percentages. A knowledge grade was assigned to each respondent based on their total percentage score as follows; 0-50% (Poor knowledge); 51-100% (Good knowledge).[21] Acceptability was assessed by a singular response of "yes", "no" or "I don't know" to whether the respondent will take the vaccine if

available. A "yes" was taken as acceptability while other responses were graded as non-acceptability. WTP for the vaccine was assessed by a singular response of "yes" or "no" to whether the respondent is willing to pay for the vaccine. A "yes" was graded as WTP for the vaccine.

Qualitative data from the FGDs were analysed thematically. The recordings were transcribed by 2 RAs. Audio recordings were played back randomly to ensure no information was lost during transcription by the lead qualitative investigator. Researchers on the coding team (who were not involved in conducting the FGDs or in transcription) read through the transcripts to obtain a general idea of the themes and develop an initial list of them. Open, axial and selective coding were done. Two of the researchers independently coded the transcripts. These codes were compared and where there were discrepancies, the codes were discussed and final code(s) to be assigned were agreed upon. The investigator and coders read through the transcripts again to ensure that all segments of the transcripts were coded. During the process of coding, the research staff who conducted the FGDs provided clarification of phrases/ statements where necessary. The process of reading through the transcripts and coding continued until saturation was attained. Data was organized based on the themes that arose from the groups using constant comparison analysis and ideas were interpreted in context. Quotes that captured the identified themes were presented.

The entire study duration was for a period of about 12 months. The participants were informed of the objectives of the study and its potential benefits for the health system and the state in the control of the COVID-19 pandemic. There was a minimal risk of harm to participants as they had the questionnaires administered to them while adhering to all COVID-19 prevention protocols. Informed consent was obtained from each participant prior to enrolment in the study. Ethical clearance was obtained from the Lagos State University Teaching Hospital (LASUTH) health research and ethics committee Reference Number: LREC/06/10/1614 prior to conduct of study. Permission was also obtained from the Lagos State Primary Health Care Board.

RESULTS

Socio-demographic and socioeconomic details

About a third of respondents (36%) were aged 30-39 years, married (69%), had at least a secondary school education (55%) and belonged to the Yoruba ethnic group (65%). About half were females (51%) and were Christians (49%). Slightly more than half of the respondents (55%) were self-employed with 42% of the respondents being engaged in semi-skilled occupations such as hairdressing. A third (33%) earned below $1.9 per day (0-₦23,655), while the larger proportion (59.4%) earned between ₦24,656 -₦100,000 per month. A minority (7.1%) earned over ₦100,000 per month. The minimum income was zero while maximum was ₦1,200,000

Table 2: COVID-19 Vaccine acceptance and willingness to pay (WTP)

Vaccine acceptance and willingness to pay	Frequency (n= 2924)	Percentage
Aware COVID-19 vaccine is available in Nigeria	2369	81.0
Taking the vaccine would reduce concerns about infection	1649	56.4
Acceptance		
Respondents willing to take the vaccine **(Acceptance)**	1971	67.4
Immediately (n=1971)	971	49.3
Later after seeing effect on others **(n=1971)**	822	41.7
Reasons for unwillingness to take the vaccine (n=953)		
Unbelief of existence of COVID-19	225	23.6
COVID-19 is not a problem here	115	12.1
I protect myself	91	9.5
I do not trust the vaccine	483	50.7
Others	39	4.1
Willingness to pay (WTP)		
Respondents willing to pay for the vaccine (WTP)	520	17.8
Respondents thought Govt should make vaccines free	2404	82.2
Cost respondents were WTP (₦) (n= 520)		
<1000	314	60.4
1000-5000	200	38.5
>5000	6	1.2
Mean ±SD	676.6±747.9	
Reasons for unwillingness to pay for the vaccine(n=2404)		
Unbelief of existence of COVID-19	191	7.9
COVID-19 is not a problem here	75	3.1
I do not need the vaccine	103	4.3
I do not trust the vaccine	177	7.4
Felt vaccines should be free and so should not pay	1826	76.0
Others	32	1.3

Knowledge of COVID-19

Almost all respondents (94%) had heard about COVID-19 with the media being the commonest source of their information (88%). Over three-quarters (76%) of respondents believed COVID-19 was real and about a third (36%) rated the government handling of the pandemic as "good". The most commonly identified symptoms of COVID-19 were cough (88%) and fever (86%) while diarrhoea (28%) was the least known symptom. Cough (89%), sneezing (88%) and touching surfaces (71%) were correctly identified by a majority of respondents as means of spread of the virus.

FGD results about whether COVID is real showed that some respondents believed it was real but some in Apapa LGA had not known anyone personally with the infection.

"*I don't know of anyone that's infected but with what we see on TV daily about the rate at which people are dying as a result of COVID*" (Male, P2)

There was also awareness about its apparent origin in China and the early association with travel. There were different views expressed on the existence of COVID-19, some respondents believe the disease is important and has a serious impact on the world while others do not believe it is real.

"It's an infectious disease that is spread through air droplets or when an infected person sneeze(s) or cough(s).."

"...It's a pandemic and deadly disease ravaging all over the world now..."

"...A virus that is brought by those who travelled out..."

"...It's a virus we have heard about and not seen...."

"...I don't believe it's real..."

Participants had heard different myths about the vaccine even though they did not believe them. The myths-centred around the vaccines having a negative effect on health by conferring supernatural abilities.

"... It will (the vaccine) change humans into zombies...."

"...I heard that if you take the vaccine, it will make metal stick to your body so if you put spoon against your body, it will not drop..."

A majority (76%) correctly identified that both healthy and ill people could contract COVID-19 and were also aware of COVID-19 preventive measures. Less than half of the respondents (44%) perceived they were at no risk at all of contracting COVID-19, while about half (53%) felt the disease could result in serious complications. The majority of the respondents (81%) had good knowledge of COVID-19.

COVID-19 preventive practices

Hand hygiene all the time to prevent COVID-19 was the most practiced means of prevention by respondents (43%), followed by cough hygiene (34%), use of hand sanitizers (32%) and social distancing (28%).

Two thirds of respondents agreed or strongly agreed that vaccines are important for good health (66%), COVID-19 vaccines are effective (51%), getting vaccinated against COVID-19 is important for good health of others (58%), COVID-19 vaccines are beneficial (57%), the information they receive about COVID-19 vaccines are reliable and true (52%), getting vaccinated against COVID-19 is a good way of protecting one's self against the disease (57%) and they did what the healthcare provider recommends about vaccines (56%). (Table 1) Over a third of respondents also agreed or strongly agreed that new vaccines such as COVID-19 carry more risks than older vaccines (39%) and were concerned about serious adverse effects of the COVID-19 vaccine (50%). Almost half of the respondents exhibited high vaccine hesitancy (48%). **(Table 1)**

The majority of respondents (81%) were aware of the availability of the COVID-19 vaccines in Nigeria. Two-thirds (67%) of respondents were willing to take the vaccine, about half of these (49%) would take the vaccine immediately if offered, while 42% preferred to wait until they had seen the effects on other people. Among those unwilling to take the vaccine, a lack of trust of the vaccine was the reason given by 51% for this stance. Less than a fifth (18%) of respondents were willing to pay for the vaccine and almost two-thirds of these (60%) were willing to pay less than ₦1000 for it. The mean amount that the respondents were willing to pay was ₦676.60 The commonest reason for respondents' unwillingness to pay for the vaccine was that they felt the vaccines should

be free and so they should not pay for them (76%).

During the FGDs, when respondents were asked about conspiracy theories associated with the vaccine, respondents in Epe mentioned the vaccine could change people to zombies and occurrence of blood clots, while those from Kosofe stated magnetism and death could result. A respondent from Epe put it this way:

"*Don't think they will accept it (the vaccines) because they haven't seen a patient but if palliative is attached, they might accept because they wouldn't leave their job to go and take*" (Female P8)

About what government should do concerning the vaccine participants felt:

"*Government should seek help from WHO to assist with the provision of vaccine"*

There was also the feeling that *"door to door awareness creation and service as done for polio vaccination should be employed for the COVID-19 vaccines*." (Epe, Male P2)

Another participant (Apapa, Male P3) opined that:

"*Locally made vaccines would be accepted as the international vaccine aren't trusted as a result of the rumours making the rounds*".

About acceptability of the vaccine- there was some expressed scepticism, but acceptability was commoner and would improve with education of the people and making the vaccine process stress-free were the participants opinions.

"*When giving the vaccine they should be educated more about the vaccine*" (Apapa, Female P2)

Many participants felt the vaccine would be received by the people, but they would not be willing to pay for it:

"*Will be happy to receive but I will observe the outcome before I take it*" (Epe, Female P4) and "*the community are not going to pay to receive vaccine*" (Epe, Male P6)

Factors affecting COVID-19 vaccine hesitancy, acceptance and WTP

A larger proportion of respondents who were single, had little (primary school education) or no schooling, belonged to the Hausa ethnic group or others and practiced Islam or traditional religion had high vaccine hesitancy ($p<0.05$). **(Table 3)**

A significantly larger proportion of the respondents who were self-employed, unemployed and in unskilled occupations had high vaccine hesitancy ($p<0.001$). **(Table 4)**

A significantly greater proportion of respondents who would not accept the COVID-19 vaccine, were not willing to pay for the vaccine, had poor knowledge of COVID-19, never practiced hand hygiene or social distancing had high vaccine hesitancy ($p<0.001$). **(Table 5)**

Respondents in paid employment had a statistically significant higher odds of high vaccine hesitancy ($p=0.002$). The less skilled a worker was, the less the willingness to accept, the less WTP and the poorer the knowledge of COVID-19, the higher the vaccine hesitancy. **(Table 6)**

The less respondents identify as part of the 3 major ethnic groups, the more likely they are to accept the vaccination. Respondents with

primary and secondary education are 2.4 and 1.5 times more likely to accept the COVID-19 vaccine. The less the respondents that were in paid employment, with skilled or semi-skilled occupations and having poor knowledge of COVID-19, the greater their acceptance of the vaccine. **(Table 7)**

Respondents having a primary or secondary education, being self- employed, and having a monthly income had a higher odd of being WTP for the vaccine. Respondents having skilled or semi-skilled occupations and having poor knowledge of COVID-19 had a lower odd of being WTP for the COVID-19 vaccine. **(Table 8)**

Table 3: Sociodemographic factors associated with vaccine hesitancy among respondents

Sociodemographic factors	Low vaccine hesitancy Freq (%)	High vaccine hesitancy Freq (%)	Total Freq (%)	Test of significance
Age of respondents (years)				
18-29	390(51.0)	375(49.0)	765(28.2)	X^2= 5.931
30-39	537(54.1)	456(45.9)	993(36.6)	Df= 2
40-49	312(51.3)	296(48.7)	608(22.4)	p=0.314
50-59	124(47.5)	137(52.5)	261(9.6)	
60-69	31(46.3)	36(53.7)	67(2.5)	
70 and above	13(61.9)	8(38.1)	21(0.8)	
Total	1407(51.8)	1308(48.2)	2715(100.0)	
Marital status				
Single	339(47.5)	375(52.5)	714(26.3)	X^2= 9.582
Married	1011(53.1)	894(46.9)	1905(70.2)	Df= 3
divorced/separated	36(63.2)	21(36.8)	57(2.1)	**p=0.022**
widow/widower	21(53.8)	18(46.2)	39(1.4)	
Total	1407(51.8)	1308(48.2)	2715(100.0)	
Gender				
Female	730(52.7)	654(47.3)	1384(51.0)	X^2= 0.962
Male	677(50.9)	654(49.1)	1331(49.0)	Df= 1
Total	1407(51.8)	1308(48.2)	2715(100.0)	p=0.337
Education				
No formal schooling	50(32.1)	106(67.9)	156(5.7)	X^2= 97.924
Primary	92(35.1)	170(64.9)	262(9.7)	Df= 3
Secondary	754(50.6)	737(49.4)	1491(54.9)	**p<0.0001**
Tertiary	511(63.4)	295(36.6)	806(29.7)	
Total	1407(51.8)	1308(48.2)	2715(100.0)	
Ethnic group				
Hausa	114(33.4)	227(66.6)	341(12.6)	X^2= 60.539
Igbo	262(57.8)	191(42.2)	453(16.7)	Df= 3
Yoruba	984(54.3)	828(45.7)	1812(66.7)	**p<0.0001**
Others	47(43.1)	62(56.9)	109(4.0)	
Total	1407(51.8)	1308(48.2)	2715(100.0)	
Religion				
Christian	782(58.7)	550(41.3)	1332(49.1)	Fishers
Islam	612(45.3)	740(54.7)	1352(49.8)	Exact=50.735
Traditional religion	10(38.5)	16(61.5)	26(1.0)	**p<0.0001**
Others	3(60.0)	2(40.0)	5(0.2)	
Total	1407(51.8)	1308(48.2)	2715(100.0)	

Table 4: Socioeconomic factors associated with vaccine hesitancy among respondents

Socioeconomic factors	Low vaccine hesitancy Freq (%)	High vaccine hesitancy Freq (%)	Total Freq (%)	Test of significance
Employment status				
Self employed	741(49.1)	767(50.9)	1508(55.5)	X^2= 19.399
Paid employment	501(58.0)	363(42.0)	864(31.8)	df= 2
Unemployed	165(48.1)	178(51.9)	343(12.0)	**p<0.0001**
Total	1407(51.8)	1308(48.2)	2715(100.0)	
Occupation				
Unskilled (Trader, cleaner, clerk etc.)	432(42.9)	574(57.1)	1006(37.1)	X^2= 88.183
Semi-skilled (Hairdresser, driver, technician etc.)	593(51.8)	551(48.2)	1144(42.1)	df= 2
Skilled (Nurse, accountant, teacher etc.)	382(67.6)	183(32.4)	565(20.8)	**p<0.0001**
Total	1407(51.8)	1308(48.2)	2715(100.0)	
Income/Month (₦)				
0-23,655 (0-$1.9 per day-extreme poverty)	467(33.2)	479(36.6)	946(34.8)	X^2= 4.047
>23,655-100,000	849(53.4)	740(46.6)	1589(58.5)	df= 2
>100,000	91(50.6)	89(49.4)	180(6.6)	p=0.132
Total	1407(51.8)	1308(48.2)	2715(100.0)	

DISCUSSION

The COVID-19 pandemic which started in 2019 quickly became one of the world's largest pandemics, affecting over 200 countries with over half a billion confirmed cases and more than 6 million deaths worldwide.[22] In the pandemic era, correct and adequate knowledge of the disease with the necessary adherence to precautionary measures[23] is key for its effective prevention and control of disease outbreaks to optimise the well-being of the public. The study findings are a reflection of the level of awareness about the pandemic and knowledge of prevention methods among Lagos state residents. In this study, the majority had good knowledge of COVID-19 which has probably aided prevention efforts. This is similar to what occurred during the Ebola epidemic when it was reported that the knowledge among people about ways to eliminate risks of contracting the Ebola Virus contributed to a reduction in the number of cases of infection in mid-2015.[24] There were many sources of information noted in available data. The findings in this study that identified the media as the major sources of information about COVID-19 are similar to a study conducted during the severe acute respiratory syndrome (SARS) epidemic in Hong Kong.[25] Furthermore, it was reported that the traditional media is an important source of information during an outbreak,[26] while among residents in the United States, the internet was cited as an important source of knowledge following an outbreak. The media therefore remains a reliable medium through which information is shared for consistent and intensified enlightenment of the public during an outbreak which includes relevant and targeted strategies to curb the epidemic to ensure compliance with WHO and government-

approved measures. This brings to fore the importance of increased visibility of credible and official sites such as the WHO and Nigeria Centre for Disease Control (NCDC) websites (which form a part of the media) to the public by government and policymakers. This is necessary to dispel fear and panic among residents, fuelled by false information and conspiracy theories being disseminated on social media.

Vaccinations remain one of the cost-effective public health interventions against infectious diseases. About two-thirds of respondents were willing to take the vaccine even as the majority agreed vaccines are important for good health. This finding compared favourably with global average vaccine acceptance rates which fluctuated between 86% to 54% in 2020.[27] This finding also corroborates the result of a similar study conducted in Saudi Arabia and the United Kingdom where about three-quarters were willing to take the COVID-19 vaccine. These studies, however, did not assess willingness to uptake vaccine if it requires charges.[28,29] WTP - a notion which was explored in the present study and revealed only 18% of respondents were willing to pay for the vaccine, although the vaccine is currently available free of charge.

The acceptance of the vaccine is consistent with several reports that COVID-19 vaccines were safe[30,31] which is contrary to the widely talked-about magnetic theory mentioned by one of the FGD participants. Hence, increased awareness creation on the benefits of vaccine use is pivotal including continuous campaigns and mass advocacy on COVID-19. The acceptance of the COVID-19 vaccine is crucial, as well as the availability and equitable distribution in resource-poor settings such as Nigeria which would help attain herd immunity in a short time.

Major hindrances to getting a COVID-19 vaccine include vaccine hesitancy, scepticism, and refusal. Findings from the present study indicate that majority of the participants expressed some hesitancy with respect to COVID-19 vaccines, due to perceived side effects, a fear expressed by half of the respondents and if not properly addressed, could increase vaccine hesitancy. A failure to address these concerns could delay or prevent the achievement of herd immunity in Lagos and Nigeria.

Vaccine hesitancy has been observed in the roll out of other vaccines in the past. Findings from this study however revealed that close to half of the respondents expressed some hesitancy to COVID-19 vaccines, which was much higher when compared to global averages of between 16-36%,[27] and with perceived serious adverse effects of the COVID-19 vaccine being cited by half of the respondents. The fear of potential side effects of COVID-19 vaccine is a significant factor that affects the willingness to uptake the vaccine among respondents. This is probably due to a lot of misconceptions about the disease and its vaccine.[32–35] Other studies have cited other reasons such as the accelerated development of the vaccine,[36] several negative campaigns targeted at discrediting the vaccines and queries about its safety.[37] Another study in Israel corroborated this finding as participants responded that they were worried about the side

effects of COVID-19 vaccines.[39] Though there is evidence that adverse effects may arise from vaccination, they are generally mild.[40] Hence, if this fear is not promptly addressed, it could lead to more hesitancy. This has public health implications for other vaccines which are very vital in the control of vaccine-preventable diseases. Given the emergent findings from the present study, the need for continuous enlightenment of the public about vaccine safety cannot be overemphasized. Targeted campaigns that highlight known risks versus benefits can also help improve awareness thereby contributing positively to increased acceptance. In this study, majority of the study participants indicated that COVID-19 vaccine should be administered at no cost, with less than a fifth of the study participants willing to pay a fee for COVID-19 vaccination. This is a similar finding to another study conducted in Nigeria, which reported only a quarter (26%) of the participants were willing to pay a fee for COVID-19 vaccination.[40] These findings contrast with those documented in another setting in Indonesia which reported majority (78.3%) of the participants expressed WTP for vaccination.[41] This could be due to the socio-economic status of the average individual in the study area as about a third of the respondents lived on less than 1.9 dollars per day (below the poverty line). Also, the long-term existence of free immunization programs especially among children, available to citizens free of charge as they are mostly donor-funded programs may be contributory. This study findings are however reflected in the global proportion of 26% stating their WTP for the vaccine.[27] About half (49%) of the study respondents who indicated an interest in paying for COVID-19 vaccination were not willing to pay above five hundred Nigerian Naira. In addition, a significant percentage of this proportion indicated non-readiness to pay above the Naira equivalent of $1.90 which is the daily threshold for absolute poverty.[42] Respondents would prefer the vaccine be administered at no cost.

Significant predictors of vaccine hesitancy in this study included being a skilled worker in paid employment, accepting to receive the vaccine, being WTP for the vaccine and knowledge of COVID-19. These bore slight similarities to predictors of vaccine acceptance and WTP for the vaccine which included educational status, being self-employed in skilled or semi-skilled occupations, monthly income and knowledge of COVID-19. Findings from a review of research conducted on vaccine hesitancy determinants reported age, income, educational attainment, health literacy, rurality, parental status, mistrust in authority, disgust sensitivity, and risk aversion, these predominant factors were completely at variance with the results from this study.[43] However, a scoping review of predictors of vaccine acceptance with majority of the studies reviewed having been conducted in the United kingdom and the United states reported factors such as educational status, occupation/employment status and information about COVID-19 among others as predictors of vaccine acceptance which corroborated the findings from this study.[43]

The limitations experienced in the course of this study included courtesy bias, and some hostility from individuals who were opposed to COVID-19 vaccination. These were overcome by carefully explaining the study objectives to respondents and encouraging their honest responses.

Table 5: Association between acceptance, WTP for COVID-19 vaccine, knowledge, preventive practices and vaccine hesitancy among respondents

Acceptance, WTP and COVID-19 knowledge and preventive practices	Low vaccine hesitancy Freq (%)	High vaccine hesitancy Freq (%)	Total Freq (%)	Test of significance
Willing to take the COVID-19 vaccine (Acceptance)				
Yes	1230(66.7)	614(33.3)	1844(67.9)	X^2= 509.723
No	177(20.3)	694(79.7)	871(32.1)	df= 1
Total	1407(51.8)	1308(48.2)	2715(100.0)	**p<0.0001**
Willing to pay (WTP) for COVID-19 vaccine				
Yes	344(70.3)	145(29.7)	489(18.0)	X^2= 81.975
No	1063(47.8)	1163(52.2)	2226(82.0)	df= 1
Total	1407(51.8)	1308(48.2)	2715(100.0)	**p<0.0001**
Knowledge of COVID-19				
Poor knowledge	70(15.5)	383(84.5)	453(16.7)	X^2= 288.082
Good knowledge	1337(59.1)	925(40.9)	2262(83.3)	df= 1
Total	1407(51.8)	1308(48.2)	2715(100.0)	**p<0.0001**
Practiced hand hygiene				
Always	791(63.0)	465(37.0)	1256(46.3)	X^2= 185.488
Sometimes	562(47.4)	624(52.6)	1186(43.7)	df= 3
Never	17(15.6)	92(84.4)	109(4.0)	**p<0.0001**
No response	37(22.6)	127(77.4)	164(6.0)	
Total	1407(51.8)	1308(48.2)	2715(100.0)	
Practiced social distancing				
Always	544(67.0)	268(33.0)	812(29.9)	X^2= 187.101
Sometimes	728(51.3)	691(48.7)	1419(52.3)	df= 3
Never	93(29.6)	221(70.4)	314(11.6)	**p<0.0001**
No response	42(24.7)	128(75.3)	170(6.3)	
Total	1407(51.8)	1308(48.2)	2715(100.0)	

CONCLUSION

Majority of the respondents had good knowledge of COVID-19 and its prevention. Acceptance of the vaccine, vaccine hesitancy and the WTP for vaccination in Lagos are comparable with global rates. About two-thirds accepted the vaccine, less than a fifth were WTP for it and about half of the respondents expressed some vaccine hesitancy. Educational status, income, occupation and knowledge were significant predictors of COVID-19 vaccine acceptance and all efforts to improve on these factors among the population should serve to improve vaccine acceptance.

Recommendations include continuous provision of scientific and correct information to the population via the media at grassroot level by the government agencies to ensure the community is well educated about COVID-19 and to encourage vaccine acceptance and increase vaccine uptake. Efforts to improve social status of the community by improving access to education, which will in turn lead to better income, occupations and knowledge are

recommended in the prevention of COVID-19 as well as other diseases.

Table 6: Predictors of vaccine hesitancy

Variable	Odds ratio		95% confidence interval		P value
Marital status			Lower limit	Upper limit	
Single	1.914		0.855	4.282	0.114
Married	1.458		0.660	3.221	0.351
divorced/separated	0.856		0.316	2.320	0.760
widow/widower		1.0			
Education					
No formal schooling	1.156		0.710	1.882	0.559
Primary	0.950		0.644	1.403	0.798
Secondary	0.803		0.627	1.029	0.084
Tertiary		1.0			
Ethnic group					
Hausa	0.747		0.474	1.178	0.210
Igbo	0.769		0.477	1.240	0.281
Yoruba	1.157		0.678	1.975	0.592
Others		1.0			
Religion					
Christian					
Islam	1.126		0.127	9.992	0.915
traditional religion	1.540		0.173	13.687	0.698
Others	1.641		0.151	17.794	0.684
Employment status					
Self employed	1.249		0.929	1.679	0.141
Paid employment	1.707		1.221	2.387	**0.002**
Unemployed		1.0			0.004
Occupation					
Skilled	0.618		0.443	0.861	**0.005**
Semi-skilled	0.941		0.763	1.160	0.569
Unskilled					
Willing to take the COVID-19 vaccine (Acceptance)					
Yes	0.192		0.154	0.240	**<0.001**
No		1.0			
WTP					
Yes	0.739		0.584	0.936	**0.012**
No		1.0			
Practiced hand hygiene					
Always	0.565		0.158	2.023	0.380
Sometimes	0.701		0.365	1.345	0.285
Never	0.899		0.471	1.716	0.748
No response		1.0			
Practiced social distancing					
Always	0.533		0.173	1.647	0.274
Sometimes	1.030		0.696	1.524	0.884
Never	1.182		0.823	1.699	0.365
No response		1.0			
Knowledge of COVID-19					
Poor knowledge	0.227		0.151	0.343	**<0.001**
Good knowledge		1.0			

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All authors attest they meet the ICMJE criteria for authorship.

Table 7: Predictors of vaccine acceptance

Variable	Odds ratio	95% confidence interval		P value
Ethnic group		Lower limit	Upper limit	
Hausa	0.481	0.307	0.752	**0.001**
Igbo	0.528	0.329	0.847	**0.008**
Yoruba	0.404	0.239	0.683	**0.001**
Others	1.0			
Education				
No formal schooling	1.513	0.949	2.413	0.082
Primary	2.363	1.619	3.448	**0.000**
Secondary	1.499	1.139	1.973	**0.004**
Tertiary	1.0			
Religion				
Christian	0.589	0.067	5.158	0.633
Islam	0.771	0.088	6.756	0.815
traditional religion	0.481	0.046	5.026	0.541
Others	1.0			
Employment status				
Self employed	0.906	0.683	1.203	0.496
Paid employment	0.513	0.365	0.722	**0.000**
Unemployed	1.0			
Occupation				
Skilled	0.443	0.303	0.648	**0.000**
Semi-skilled	0.726	0.591	0.890	**0.002**
Unskilled	1.0			
Income/Month (₦)				
0-23,655	1.162	0.766	1.764	0.480
>23,655-100,000	1.284	0.862	1.913	0.218
>100,000	1.0			
Knowledge of COVID-19				
Poor knowledge	0.112	0.089	0.142	**0.000**
Good knowledge	1.0			

Table 8: Predictors of WTP for COVID-19 vaccine

Variable	Odds ratio	95% confidence interval		P value
Ethnic group		Lower limit	Upper limit	
Hausa	0.860	0.514	1.440	0.566
Igbo	0.920	0.537	1.576	0.762
Yoruba	1.048	0.560	1.960	0.883
Others	1.0			
Education				
No formal schooling	0.485	0.284	0.830	**0.008**
Primary	1.035	0.661	1.620	0.882
Secondary	1.528	1.165	2.005	**0.002**
Tertiary	1.0			
Religion				
Christian	2.234	.340	14.681	0.403
Islam	3.168	.480	20.909	0.231
traditional religion	2.537	.281	22.885	0.407
Others	1.0			
Employment status				
Self employed	1.687	1.166	2.439	**0.005**
Paid employment	1.379	0.921	2.066	0.119
Unemployed	1.0			
Occupation				
Skilled	0.629	0.436	0.909	**0.014**
Semi-skilled	0.722	0.554	0.941	**0.016**
Unskilled	1.0			
Income/Month (₦)				
0-23,655 (0-$1.9 / day)	3.771	2.497	5.696	**0.000**
>23,655-100,000	1.542	1.098	2.166	**0.013**
>100,000	1.0			
Knowledge of COVID-19 Poor knowledge	0.145	0.088	0.240	**0.000**
Good knowledge	1.0			

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