RESEARCH ARTICLES

Willingness to Participate in Testing, Contact Tracing, and Taking the COVID-19 Vaccine among Community Members in a Southwestern State in Nigeria

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Abstract

Background: This study aimed to describe community members' willingness to participate in COVID-19 testing, contact tracing, and acceptance of the COVID-19 vaccine in a Southwestern state in Nigeria.

Methods: We conducted a descriptive cross-sectional study using an interviewer-administered questionnaire. Community members aged 15 years and above were studied using a multi-stage sampling technique. One question each was asked on respondents' willingness for COVID-19 testing, contact disclosure, and willingness to take the COVID-19 vaccine. Descriptive statistics and chi-square tests were conducted on willingness for COVID-19 testing, contact disclosure and taking the COVID-19 vaccine. Multivariate logistic analyses were performed on variables that were significant at the bivariate level. P-values <0 .05 were statistically significant.

Results: Among the 691 respondents, 244 (35.3%) were aged 21-29 years, 436 (73.2%) were willing to take the COVID-19 test, 458 (66.3%) were willing to disclose contacts' names if tested positive, and 434 (74.8%) were willing to take the COVID-19 vaccine. Persons who earned less than 30,000 naira (U.S.$78.95) monthly had two times the odds to be willing to take the COVID-19 test (OR=2.031, (95%CI=1.117-3.694), p = **0.02**). Persons who had completed 10-12 years of education had three times the odds to be willing to disclose contacts if tested positive for COVID-19 (OR=2.628, (95%CI=1.301-5.308), p=**0.007**). Persons whose financial status worsened, i.e., those whose income had reduced during the COVID-19 pandemic, had three times the odds to be willing to take the COVID-19 vaccine (OR=2.686, (95%CI=1.363-6.448), p=**0.006**).

Conclusion: Interventions to improve willingness for COVID-19 testing and taking the COVID-19 vaccine should be targeted towards those wealthy individuals.

Keywords: COVID-19, COVID-19 testing, disclosure of COVID-19 contacts.

Introduction

The emergence of the novel Coronavirus disease (COVID-19) in Wuhan city, China, in December, 2019 ushered changes in the state of events globally [1]. These necessitated a transition from the traditional physical gatherings and hand hygiene to social distancing and regular hand hygiene [1,2]. As of 11 May, 2021, 160,398,044 COVID-19 cases and 2,840,296 COVID-19 deaths have been recorded globally. Of the global total, the African continent accounts for 3.3% (4,690,491) of cases and 4% (125,406) of deaths [3]. In Nigeria, 165,515 cases (< 1% of the global COVID-19 cases) and 2,065 deaths (< 1% of the global COVID-19 deaths) have been recorded as of 11 May, 2021 [3]. Similar to the global experience, the Nigerian government implemented COVID-19 mitigation measures including physical distancing, use of face masks/shields, and hand hygiene [4]. These measures have been included in the requirements for school resumption across Nigeria amid the COVID-19 outbreak. In addition, public health campaigns, testing, and contact tracing activities are

being utilized for the prompt detection of COVID-19 cases to promote case management [5].

Testing is a crucial effort taken towards the submergence of COVID-19 [5]. The evolving community-wide transmission of COVID-19 in Nigeria therefore mandates enhanced testing capacities in communities. Testing activities have commenced across Nigerian communities, however, these have been met by myriads of misconceptions and falsehood [6]. Anecdotal evidence from Nigeria reported that COVID-19 tests could pose harm to individuals [7]. It is also believed that COVID-19 test samples (such as blood or oropharyngeal swabs) would be used by the Nigerian government for ulterior purposes [7]. In other instances, the existence of COVID-19 has been entirely denied. As a result, many community members in Nigeria deny the authenticity of the COVID-19 tests, a feat which is perceived as unnecessary in the present day [6]. The Nigerian government has taken many laudable steps to debunk the fallacies gaining ground nationwide. These steps have included the dissemination of evidence-based information on the available channels of information, such as social media and traditional media [6]. These public health campaigns have yielded considerable results in demystifying the COVID-19 testing activity and enhancing the uptake of COVID-19 tests among many [5]. However, many individuals remain unconvinced about the genuineness of COVID-19 tests, and as such are increasingly reluctant to get tested for COVID-19 [8].

In the COVID-19 context, contact tracing has been identified as a potent strategy for keeping the community-wide transmission of COVID-19 at bay [9]. When contacts of COVID-19 cases are identified, they are immediately commenced on isolation, either at their homes or at the treatment centre [10]. The practicality of home-based isolation depends on the results obtained from the assessment of intended housing area designated professionals. However, despite the supportive atmosphere associated with home stay, unsupervised management of COVID-19 cases may enhance further spread of COVID-19 to many individuals [11,12]. For contact tracing to be effective, disclosure of the identity (names, contact details, and addresses) of contacts need to be revealed by a COVID-19 case [10]. This would help to prevent placing other individuals at risk for COVID-19. Despite the inherent benefits therein, contact tracing has been met by different perceptions among many, top of which anecdotal evidence reveals is a bridge of individual's privacy and confidentiality [8].

Historically, vaccines have demonstrated huge capacities for the prevention and treatment of infectious diseases, such as Yellow fever, polio, and measles [13]. The routine immunization program in Nigeria has yielded optimal results towards the reduction of childhood mortality, and improved chances of child survival [14]. The development of the Ebolavirus disease vaccine has been described as an active tool for preventing of future outbreaks of Ebolavirus. In the context of the COVID-19 outbreak, research on the COVID-19 vaccine is ongoing [15]. Previous experiences with the introduction of vaccines have been met with numerous perceptions among community members. In the COVID-19 context, the perception of community members is key to determining their willingness to take the COVID-19 vaccine [7]. COVAX was launched as a global strategy to ensure an equitable access to the COVID-19 vaccine globally, and strategies are being implemented to ensure its roll-out by the first quarter of 2021 [16,17]. The COVAX vaccine is currently being administered in Nigeria and other countries. The willingness to accept the COVID-19 vaccine in the United states have been reported among only two-thirds of individuals [16]. Hesitation for the acceptance of the COVID-19 vaccine has been associated with safety concerns, while positive perception regarding the COVID-19 vaccine is key to its successful delivery [7]. The distribution of the COVAX COVID-19 vaccine has commenced in Nigeria, although it is only available to health workers at the moment [18]. Understanding the willingness for participation in testing, contact tracing, and uptake of the COVID-19 vaccine is required at the moment. Knowledge obtained in this regard is needed to inform public health decisions and strategize for enhanced community participation in the COVID-19 testing, contact disclosure, and vaccine acceptance. Therefore, this study aimed to describe community members' willingness to participate in COVID-19 testing, contact tracing, and acceptance of the COVID-19 vaccine in a Southwestern state in Nigeria.

Materials and Methods
Study design and study setting

We conducted a descriptive cross-sectional study among residents of communities in Akure, Ondo State. Ondo state is located in Southwest Nigeria, with Akure as its capital city. Ondo state is bounded by Kwara and Kogi states to the north, Edo state to the East, Osun and Ogun states to the west, and by the Atlantic Ocean to the South [19]. Ondo state has 18 local government areas (LGAs). The official language in Ondo state is English language, while Yoruba language is the major informal language used for communication in communities across Ondo state. As of the 1 April, 2021, Ondo state recorded 3,197 COVID-19 cases (2% of Nigeria's total COVID-19 cases), and 63 deaths [20].

Study population

One member of each household in selected communities was eligible for participating in this study. All consenting community members in selected areas in Akure were included in the study, while individuals below 15 years were excluded from the study due to the need to obtain consent from their parents, most of whom might be unavailable at the time of data collection. Verbal consent was obtained from each study participant prior to the commencement of data collection.

Sample size determination

The sample size was calculated using the Leslie Kish formula for sample size determination for proportion as follows:

$$n = Z\alpha^2 p(1-p)/d^2 \text{ where:}$$

n= Minimum desired sample size
Z= the standard normal deviate, set as 1.96 which corresponds to 5% level of significance.
P= 50% was used
d= Degree of accuracy (precision) set at 5 % (0.05)
n= 1.962*0.5* (1-0.5)/0.052=384

On adjusting for a design effect of 2.0 due to the cluster sampling technique used in this study, a total sample size of 768 was obtained. However, we obtained a response rate of 691 (90%) following the administration of the questionnaire.

Sampling technique

A multistage sampling technique was used to select the respondents in the community

Stage 1

From the list of all the political wards in Akure North (12) and South (11) LGAs, two wards were selected from each LGA using simple random sampling technique, i.e., four wards in both.

Stage 2

A list of all the settlements/streets was obtained for the 4 wards selected. A settlement was selected in each ward using simple random sampling technique.

Stage 3

A central location was used as a starting point in the selected settlement or street, which was chosen by spinning a bottle. All consenting residents that met the inclusion criteria in the four selected settlements/areas/neighbourhood/streets were included in the study and interviewed until a quarter of the sample size was reached. Each settlement was regarded as a cluster.

Data collection methods and instruments

Data was collected using a structured interviewer-administered questionnaire. The questionnaire was divided into 5 sections:

Section A: Socio-demographic characteristics
The sociodemographic characteristics included respondents' age, sex, occupation, highest level of education, occupation, presence of illness, living with people in a COVID-19 risk group, financial situation (i.e., improvement or reduction in income) over the past three months (i.e., between July and September, 2020), average monthly income, and wealth quintile.

Section B: Willingness to take the COVID-19 test

Section C: Willingness to share contacts' names when infected with COVID-19

Section D: Willingness to take the COVID-19 vaccine

Section E: Information required before accepting the COVID-19 vaccine.

Open-ended questions were asked on the willingness of community members to participate in COVID-19 testing activities, and contact tracing when infected with COVID-19. In addition, close-ended questions (questions with a list of possible answers already provided) were asked regarding the willingness of community members to accept the COVID-19 vaccine. All the responses provided by the respondents were appropriately ticked. Validation of the questionnaire was done by an infectious disease epidemiologist. The questionnaire was pre-tested among community members in a LGA that had not been selected for the study. Modification of few ambiguous questions was done. Back-translation of the questionnaire was done by individuals with excellent understanding of Yoruba and English languages. The questionnaire was mostly administered to respondents in English language because most of the respondents had obtained basic formal education.

Independent variables included: Sociodemographic characteristics such as respondents' age, sex, occupation, highest level of education, occupation, presence of illness, living with people in a COVID-19 risk group, financial situation over the past three months, average monthly income, and wealth quintile.

Outcome/dependent variables were: Willingness to take the COVID-19 vaccine, willingness to share contacts' names when infected with COVID-19, willingness to take the COVID-19 vaccine, and information required before accepting the COVID-19 vaccine.

Data were collected by trained research assistants (RAs) who had a minimum qualification of secondary education. Training of the RAs was conducted on the 29 and 30 September, 2020 both in Yoruba and English language to ensure complete understanding of the questionnaire. A practical session was conducted among the RAs on the 30 September to ensure mastery of the questions. Data collection was done between 1 October and 9 October, 2020. Field supervision was conducted daily by an appointed supervisor, the most qualified out of the RAs.

Data Management
Quantitative

The data were inputted and analysed using SPSS version 22 [21]. Chi-square tests were used for the assessment of significant associations between proportions. Age was summarized using mean and standard deviation, while frequencies and percentages were used for categorical variables.

We computed the socio-economic status (SES) indices using the Principal Components Analysis on SPSS.

Information on the ownership of house items such as a stove, electric fan, refrigerator, air conditioner, radio, television, and generator, piped water in the household, bicycle, motor vehicle, upholstered chairs, sewing machine and washing machine were input into the software to determine socio-economic status. For the SES, wealth quintiles were used for the calculation of wealth distribution cut points. The wealth quintiles were Q1= first, Q2=second, Q3=third, Q4= fourth, Q5=fifth, while "Q1" denoted "lowest wealth index" and "Q5", "the highest wealth quintile".

A single question was used to ascertain whether the respondent would like to have a COVID-19 test done and their willingness to disclose who they have had contact with. The five-point Likert scale was used to grade these responses, ranging from "1" that implied "Strongly Agree", "2" implied "Agree", "3" implied "Not decided", "4" implied "Disagree", to "5" implied "Strongly Disagree". Reverse coding was done where required. Thereafter, options "1" and "2" were merged as "Yes", and responses "3, 4 and 5" were merged as "No". Bivariate chi-square tests were conducted on respondents' willingness regarding contact tracing, contacts' disclosure, and acceptance of the COVID-19 vaccine. Multivariate logistic analyses were performed on variables that were significant at the bivariate level. Three logistic models were separately built to assess the determinants of willingness to take the COVID-19 test, willingness to disclose contacts, and willingness to take the COVID-19 vaccine. P-values <0 .05 were accepted as significant.

Ethical Consideration

Ethical approval to carry out the study was obtained from the Health Research Ethics Committee of the Federal Medical Centre, Owo, Ondo State (FMC/OW/380/Vol. XCVI/75). Participants were informed of their right to decline or withdraw from the study at any time without any adverse consequences.

Written informed consent was required from participants, as they were required to sign or thumbprint the consent form. However, when either signing or thumbprinting was not possible, verbal informed consent was obtained from the respondents. Study participants were informed of their voluntariness to participate in the study, with no consequence attached to withdrawal prior to the completion of the data collection.

The participants were assured of the use of the information obtained for research purposes only, and results obtained from each respondent was kept confidential on a password-protected computer. Anonymity was ensured in the data collection instrument, and research assistants were trained to keep information confidential. Participants were not exposed to any harm as a result of participating in the study.

Results

Among the 691 respondents, 244 (35.3%) were aged 21-29 years, and 247 (35.7%) had completed secondary education. Also, 341 (49.3%) lived with children below 18 years. In addition, 205 (66.3%) earned an average monthly income below 30,000 naira (U.S.$78.95). Other sociodemographic characteristics are as shown in Table 1.

Among the respondents, 436 (73.2%) were willing to take the COVID-19 test. Of this total, 347 (76.4%) were willing to take the COVID-19 test to receive appropriate care. Also, 291 (64.2%) were willing to take the COVID-19 test because they believed the test helps stop COVID-19. In addition, 137 (30.4%) were willing to take the COVID-19 test because friends and family expect they get tested. Other reasons for willingness to take the COVID-19 test among the respondents are as shown in Figure 1.

Among the respondents, 458 (66.3%) were willing to disclose contacts' names if tested positive. Of this total, 387 (64.1%) were willing to disclose contacts' names due to the belief that contact tracing helps stop COVID-19 transmission. On the other hand, 221 (48%) were willing to participate in contact disclosure because this was their responsibility as citizens (Figure 2).

Among them, 18 (52.9%) persons with 0-9 years of education were willing to get tested for COVID-19, compared to 155 (71.8%) of those who had 10-12 years of education and 263 (76%) with more than 12 years of education. The association between the highest level of formal education and willingness to get tested for COVID-19 was significant (x^2=8.726, p=**0.013**) (Table 2).

Among the respondents, 246 (69.9%) males were willing to disclose contacts if tested positive for COVID-19 compared to 212 (52.5%) females. The association between sex and willingness to disclose contacts if tested positive for COVID-19 was significant (x^2=4.174, p=**0.041**). Also, 17 (45.9%) of persons who have had 0-9 years of education were willing to disclose contacts when tested positive for COVID-19. There was a significant association between the level of education and willingness to disclose contacts if tested positive for COVID-19 (x^2=7.578, p=**0.023**) (Table 3).

Among the respondents, 434 (74.8%) were willing to take the COVID-19 vaccine when available. Of this total, 123 (17.8%) were willing to take the COVID-19 vaccine to be healed/treated from COVID-19, while 63 (9.1%) were willing to take the COVID-19 vaccine to prevent onward transmission of COVID-19. Also, 17 (2.5%) respondents were willing to take the COVID-19 vaccine to prevent death (Figure 3).

Among them, 93 (78.8%) below 20 years were willing to take the COVID-19 vaccine compared to older persons. There was a significant association between the age of community members and willingness to take the COVID-19 vaccine (x^2=9.015, p=**0.029**). Also, 7 (46.7%) of persons with illness were willing to take the COVID-19 vaccine compared to healthy persons. There was a significant association between the presence of illness and willingness to take the COVID-19 vaccine (x^2=7.261, p=**0.026**) (Table 4).

Table 5 shows the specifications on the COVID-19 vaccine to be required by the community members in Ondo state before willingness to take the COVID-19

vaccine could be obtained. Among them, 329 (67.4%) would require information on the use of the vaccine for a long time with no serious health effect, while 317 (68.3%) would require information on whether the vaccine is being used in other countries.

Table 6 shows the determinants of willingness for COVID-19 testing, disclosure of contacts, and taking the COVID-19 vaccine among the respondents. Persons who earned less than 30,000 naira (U.S.$78.95) monthly were two times the odds to be willing to take the COVID-19 test compared to others. There was a significant association between average monthly income of community members and willingness for COVID-19 testing, contact tracing, and vaccine acceptance (OR=2.031, (95%CI=1.117-3.694), p=**0.020**)

Table 1. Socio-demographic characteristics of community members in Ondo state
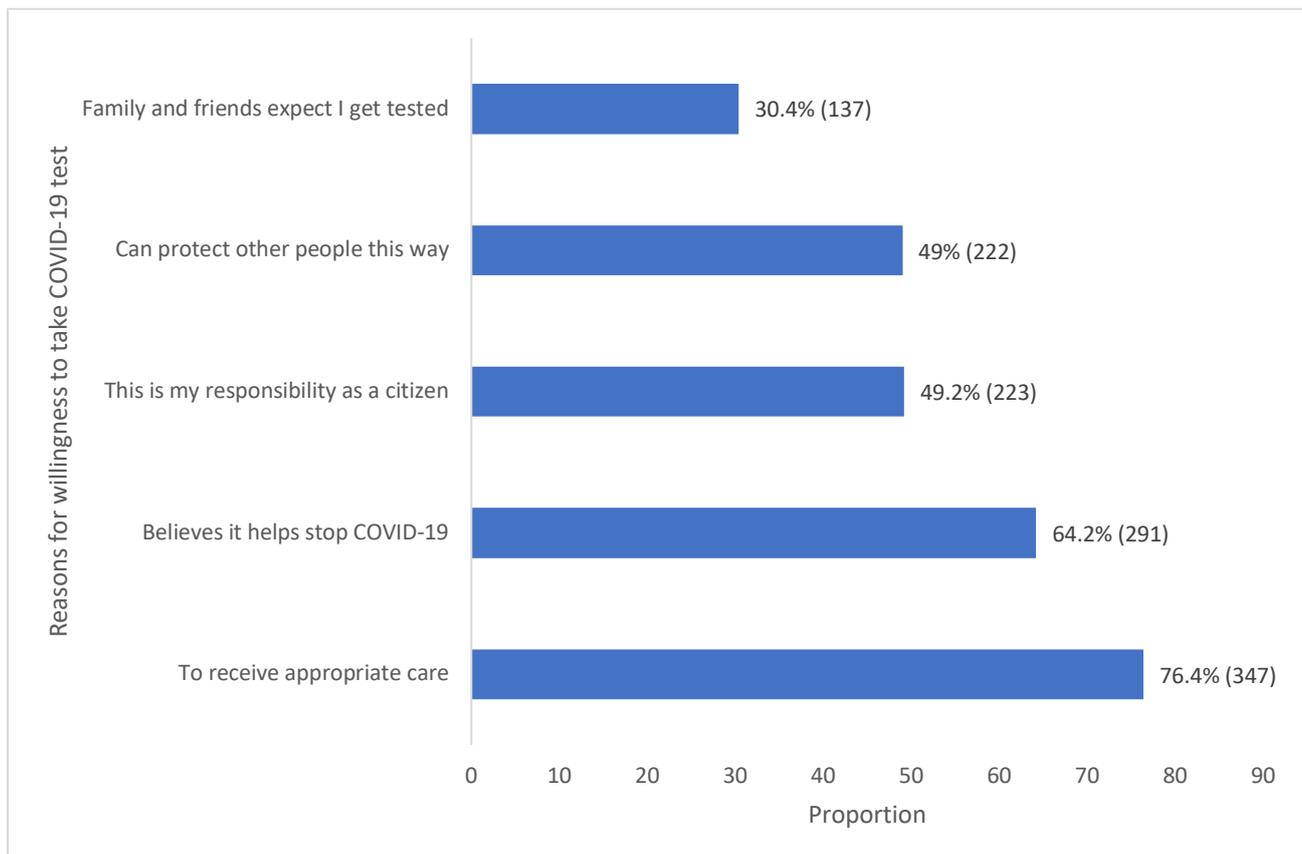
Socio-demographic Characteristics	Frequency	%
Age group (Years)		
<20	147	21.3
21-29	244	35.3
30-39	160	23.2
≥40	140	20.3
Sex		
Male	352	50.9
Female	339	49.1
Highest level of Education		
0-9 years (completed Basic 9)	37	5.4
10-12 years (completed secondary education)	247	35.7
More than 12 years (post-secondary)	407	58.9
Occupation		
Health professional	112	16.2
Non-health professional	579	83.8
Presence of illness*		
Yes	20	2.9
No	649	93.9
Don't Know	22	3.2
Live alone		
Yes	154	22.3
No	537	77.7
Live with children below 18 years		
Yes	341	49.3
No	350	50.7
Live with people in a COVID-19 risk group**		
Yes	56	8.1
No	635	91.9

| Financial situation over the past three months		
Improved	116	16.8
Remains the same	151	21.9
Worse	349	50.5
Don't know	75	10.9
Average monthly income (N=309)		
<30,000 naira (U.S.$78.95)	205	66.3
≥30,000 naira (U.S.$78.95)	104	33.7
Wealth quintiles		
First	138	20.0
Second	138	20.0
Third	138	20.0
Fourth	138	20.0
Fifth	139	20.1

*: Illness: diabetes, high blood pressure, asthma
**: COVID-19 risk group: People over 65 years and/or with chronic diseases

Figure 1. Reasons for willingness to take COVID-19 test among community members in Ondo state (Multiple responses allowed)

Figure 2. Reasons for willingness for contacts' disclosure when tested positive for COVID-19 in Ondo state (Multiple responses allowed)
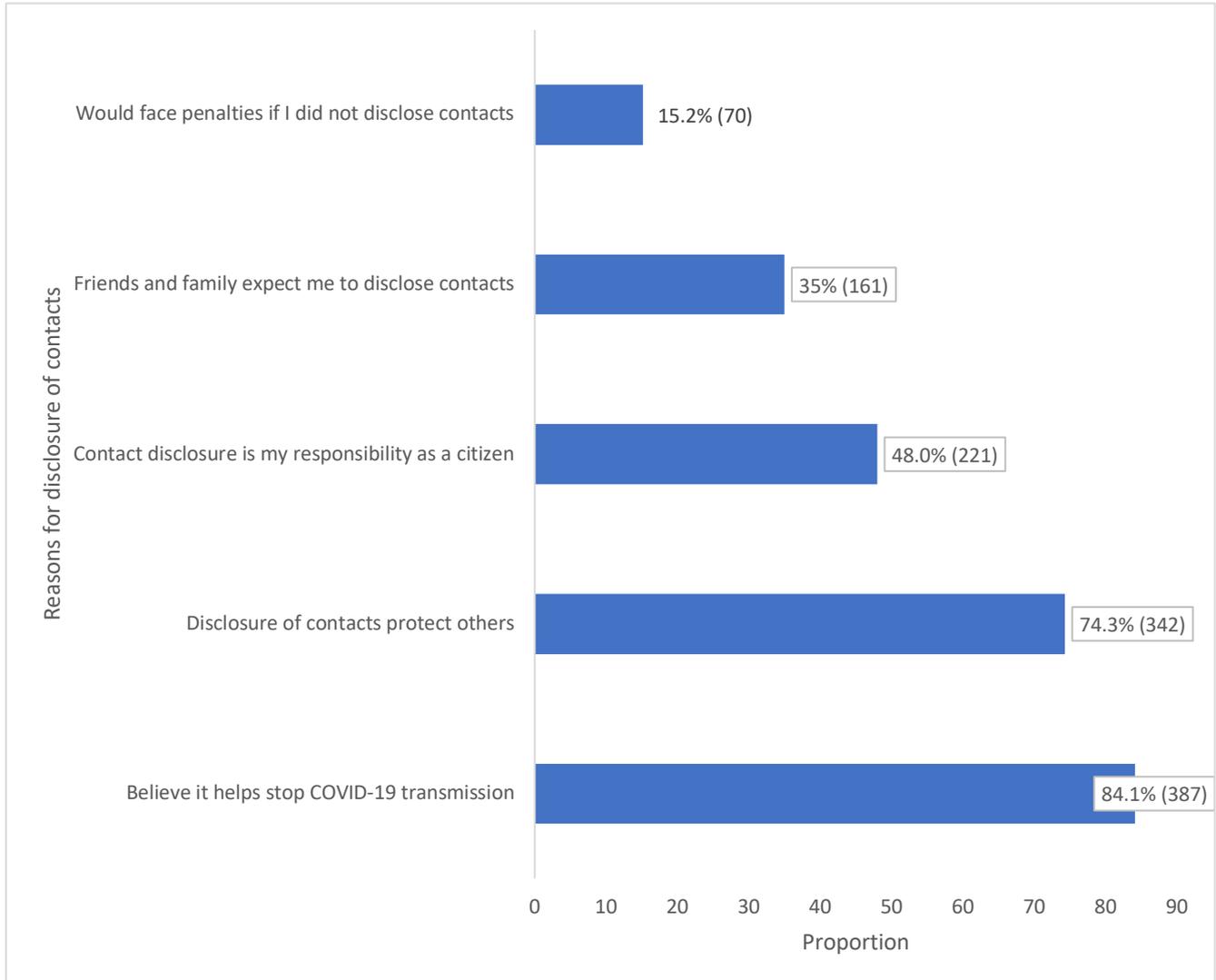
Table 2. Association between sociodemographic characteristics and willingness to get tested for COVID-19

Socio-demographic Characteristics	Willing to get tested for COVID-19		χ^2	p-value
	Yes n (%)	No n (%)		
Age group (Years)				
<20	92 (72.4)	35 (27.6)	1.087	0.780
21-29	147 (71.0)	60 (29.0)		
30-39	198 (75.5)	35 (24.5)		
≥40	89 (74.8)	30 (25.2)		
Sex				

Male	225 (72.3)	86 (27.7)	0.216	0.642
Female	211(74.0)	74 (26.0)		
Highest level of formal Education				
0-9 years (completed Basic 9)	18 (52.9)	16 (47.1)	8.726	**0.013**
10-12 years (completed secondary education)	155 (71.8)	61 (28.2)		
More than 12 years (post-secondary)	263 (76.0)	83 (24.0)		
Occupation				
Health professional	362 (71.7)	143 (28.3)	3.645	0.056
Non-health professional	74 (81.3)	17 (18.7)		
Presence of illness*				
Yes	8 (47.100)	9 (52.9)	6.321	**0.042**
No	413 (83.8)	147 (26.2)		
Don't Know	15 (78.9)	4 (21.1)		
Live alone				
Yes	99 (73.3)	36 (26.7)	0.003	0.957
No	337 (73.1)	124 (26.9)		
Live with children below 18 years				
Yes	219 (73.0)	81 (27.0)	0.007	0.932
No	217 (73.3)	79 (26.7)		
Live with people in a COVID-19 risk group**				
Yes	38 (79.2)	10 (20.8)	0.961	0.327
No	398 (72.6)	150 (27.4)		
Financial situation over the past three months				
Improved	70 (69.3)	31 (30.7)	4.044	0.257
Unchanged	100 (80.0)	25 (20.0)		
Worse	220 (71.9)	86 (28.1)		
Don't know	46 (71.9)	18 (28.1)		
Average monthly income (N=309)				
<30,000 naira (U.S.$78.95)	118 (66.7)	59 (33.3)	5.147	**0.023**
≥30,000 naira (U.S.$78.95)	78 (79.6)	20 (20.4)		
Wealth quintile				
First	91 (71.1)	37 (28.9)	8.526	0.074
Second	92 (73.6)	33 (26.4)		
Third	76 (64.4)	42 (35.6)		
Fourth	86 (77.5)	25 (22.5)		
Fifth	91 (79.8)	23 (20.2)		

Table 3. Association between sociodemographic characteristics and willingness to disclose contacts when tested positive for COVID-19

Socio-demographic Characteristics	Willingness to disclose contacts when tested positive for COVID-19		χ^2	p-value
	Yes **n (%)**	**No** **n (%)**		
Age group (Years)				
<20	99 (67.3)	48 (32.7)	0.657	0.883
21-29	159 (65.2)	85 (34.8)		
30-39	104 (65.0)	56 (35.0)		
≥40	96 (68.6)	44 (31.4)		
Sex				
Male	246 (69.9)	106 (30.1)	4.174	**0.041**
Female	212 (62.5)	127 (37.5)		
Highest level of Education				
0-9 years (Completed Basic 9)	17 (45.9)	20 (54.1)	7.578	**0.023**
10-12 years (completed secondary education)	170 (68.8)	77 (31.2)		
More than 12 years (post-secondary)	271 (66.6)	136 (33.4)		
Occupation				
Health professional	75 (67.0)	37 (33.0)	0.028	0.867
Non-health professional	383 (55.1)	196 (33.9)		
Presence of illness*				
Yes	9 (45.0)	11 (55.0)	4.190	0.123
No	434 (66.9)	7 (31.1)		
Don't Know	15 (68.2)	7 (31.8)		
Live alone				
Yes	98 (93.6)	56 (36.4)	0.620	0.431
No	360 (67.0)	177 (33.0)		
Live with children below 18 years				
Yes	233 (68.3)	108 (31.7)	1.263	0.261
No	225 (64.3)	125 (35.7)		
Live with people in a COVID-19 risk group**				
Yes	36 (64.3)	20 (35.7)	0.109	0.742
No	422 (66.5)	213 (33.5)		

Financial situation over the past three months				
Improved	72 (62.1)	44 (37.9)	2.126	0.547
Unchanged	106 (70.2)	45 (29.8)		
Worse	229 (65.6)	120 (34.4)		
Don't know	51 (68.0)	24 (32.0)		
Average monthly income (N=309)				
<30,000 naira (U.S.$78.95)	135 (65.9)	70 (34.1)	0.356	0.551
≥30,000 naira (U.S.$78.95)	72 (69.2)	32 (30.8)		
Wealth quintiles				
First	93 (67.4)	45 (32.6)	1.957	0.744
Second	91 (65.9)	47 (34.1)		
Third	95 (68.8)	43 (31.2)		
Fourth	85 (61.6)	53 (38.4)		
Fifth	94 (67.6)	45 (32.4)		

Figure 3. Reasons for willingness to take the COVID-19 vaccine among community members in Ondo state (Multiple responses allowed)
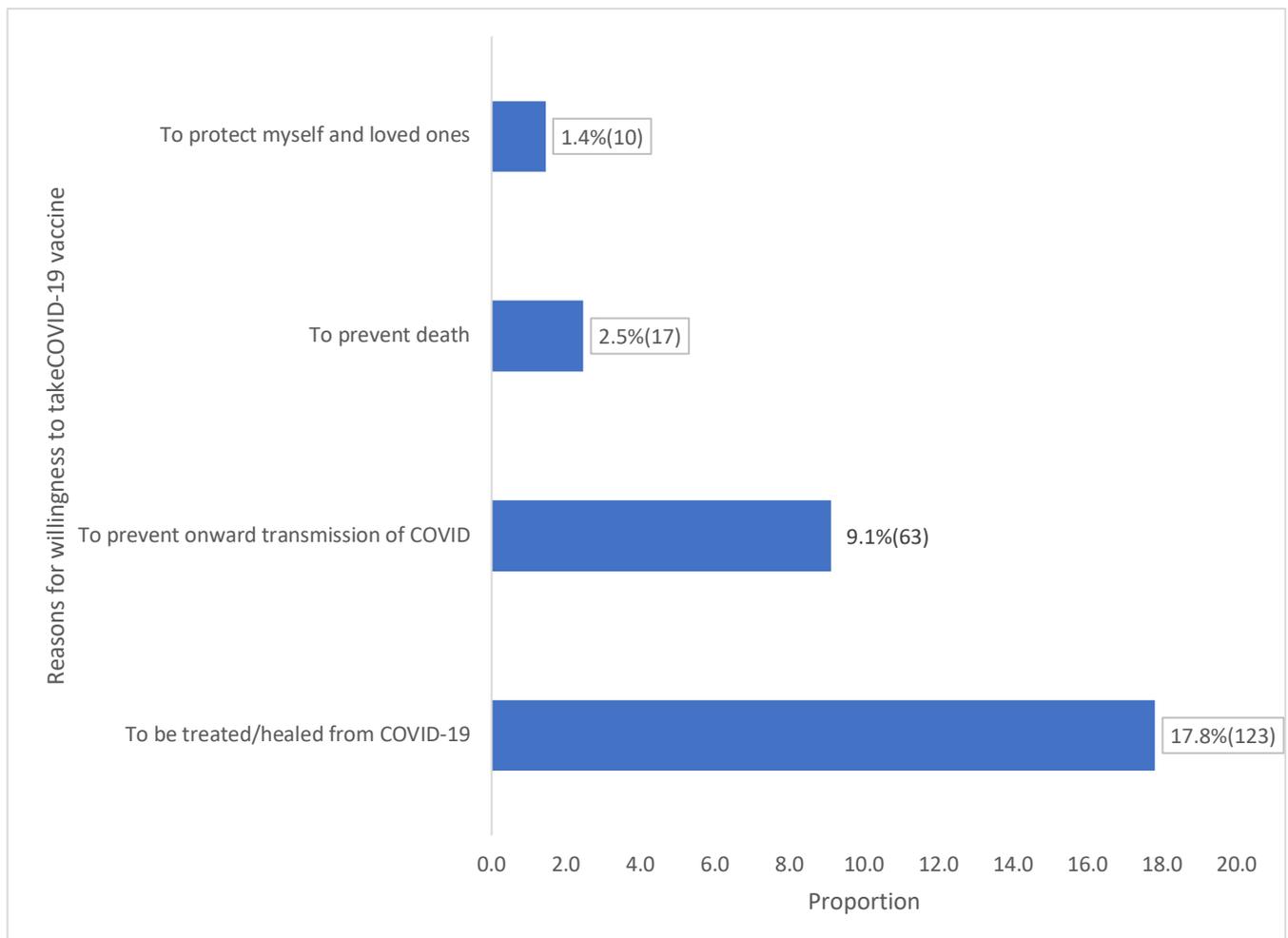
Table 4. Association between sociodemographic characteristics and willingness to take the COVID-19 vaccine

Socio-demographic Characteristics	Willing to take COVID-19 vaccine		χ²	p-value
	Yes **n (%)**	**No** **n (%)**		
Age group (Years)				
<20	93 (78.8)	25 (21.2)	9.015	**0.029**
21-29	152 (74.9)	51 (25.1)		
30-39	111 (79.9)	28 (20.1)		
≥40	78 (65.0)	42 (35.0)		
Sex				
Male	223 (74.1)	78 (25.9)	0.183	0.669
Female	211 (75.6)	68 (24.4)		
Highest level of Education				
0-9 years (Completed Basic 9)	17 (53.1)	15 (46.9)	8.471	**0.014**
10-12 years (completed secondary education)	160 (76.2)	50 (23.8)		
More than 12 years (post-secondary)	257 (76.0)	81 (24.0)		
Occupation				
Health professional	368 (75.1)	122 (24.9)	0.126	0.722
Non-health professional	66 (73.3)	24 (26.7)		
Presence of illness*				
Yes	7 (46.7)	8 (53.3)	7.261	**0.026**
No	411 (75.3)	135 (24.7)		
Don't Know	16 (84.2)	3 (15.8)		
Live alone				
Yes	101 (77.1)	30 (22.9)	4.264	0.496
No	333 (74.2)	116 (25.8)		
Live with children below 18 years				
Yes	208 (71.6)	85 (29.0)	4.630	**0.031**
No	226 (78.7)	61 (21.3)		
Live with people in a COVID-19 risk group**				
Yes	38 (82.6)	8 (17.4)	1.606	0.205
No	396 (79.6)	138 (25.8)		
Financial situation over the past three months				
Improved	55 (59.1)	38 (40.9)	16.532	**0.001**

Unchanged	101 (81.5)	23 (18.5)		
Worse	226 (75.6)	73 (24.4)		
Don't know	52 (81.2)	12 (18.8)		
Average monthly income (N=309)				
<30,000 naira (U.S.$78.95)	138 (80.2)	34 (19.8)	0.908	0.341
≥30,000 naira (U.S.$78.95)	73 (75.3)	24 (24.7)		
Wealth quintiles				
First	95 (77.2)	28 (22.8)	6.274	0.180
Second	82 (69.5)	36 (30.5)		
Third	82 (73.2)	30 (26.8)		
Fourth	85 (72.0)	33 (28.0)		
Fifth	90 (82.6)	19 (17.4)		

Table 5. COVID-19 vaccine specifications required before willingness to take the COVID-19 among community members in Ondo state

COVID-19 vaccine specifications	**n**	**%**
Recommendation from the Ministry of Health (N=541)	383	70.8
Whether it has been used for a long time with no serious side effect (N=488)	329	67.4
Whether the vaccine is being used in other countries (N=464)	317	68.3
Recommendation from the family doctor (N=505)	312	61.8
Whether payment would be needed to receive the COVID-19 vaccine (N=504)	309	61.3
Easy of accessing COVID-19 vaccine (N=455)	284	62.4
The risk of getting infected with COVID-19 after vaccination (N=478)	278	58.2
Whether a high uptake of COVID-19 vaccine would lift bans on gatherings (N=420)	269	64.0
Proximity of vaccination center to residential areas (N=480)	239	49.8
Country in which the vaccine was produced (N=460)	217	47.2

Table 6. Determinants of willingness for COVID-19 testing, disclosure of contacts, and taking the COVID-19 vaccine among community members in Ondo state

Willingness to take the COVID-19 test	B	Odds Ratio	95% CI for OR		p-value
			Lower	Upper	
Highest level of Education					
0-9 years (Completed Basic 9)		1			
10-12 years (Completed secondary education)	0.352	1.422	0.455	4.444	0.545
More than 12 years (Post-secondary)	0.241	1.272	0.418	3.869	0.672
Presence of illness					
No		1			
Don't know	-2.173	0.114	0.011	1.176	0.068
Yes	0.864	2.372	0.274	20.500	0.432
Average monthly income					
<30,000 naira (U.S.$78.95)	0.709	2.031	1.117	3.694	**0.020**
≥30,000 naira (U.S.$78.95)		1			
Willingness to disclose contacts after testing positive for COVID-19					
Sex					
Male		**1**			
Female	0.336	1.399	1.017	1.924	**0.039**
Highest level of education					
0-9 years (Completed Basic 9)		**1**			
10-12 years (completed secondary education)	0.966	2.628	1.301	5.308	**0.007**
More than 12 years (post-secondary)	0.857	2.356	1.192	4.655	**0.014**
Willingness to take the COVID-19 vaccine					
Age group (years)					
<20		1			
21-29	-0.393	0.675	0.380	1.200	0.181
30-39	0.180	1.197	0.622	2.301	0.590
≥40	-0.661	0.516	0.272	0.982	**0.044**
Highest level of education					
0-9 years (JSS3)		1			
10-12 years (completed secondary education)	0.708	2.029	0.886	4.647	0.094
More than 12 years (post-secondary)	0.788	2.198	0.966	5.001	0.060
Presence of illness					
Yes		1			

No	0.538	1.713	0.475	6.182	0.411
Don't Know	-1.219	0.296	0.093	0.938	**0.039**
Live with children below 18 years					
Yes		1			
No	0.434	1.544	0.980	2.434	0.061
Financial situation over the past three months					
Improved		1			
Unchanged	1.358	3.888	2.050	7.376	**<0.001**
Worse	0.988	2.686	1.576	4.576	**<0.001**
Don't know	1.087	2.965	1.363	6.448	**0.006**

Discussion

We found that nearly three-quarters of community members in Ondo state, Nigeria, were willing to take the COVID-19 test. The large proportion of willingness obtained in this study is greater than that of an international research conducted among caregivers of children in emergency department (43%) [22]. The results from the present study could be traced to the regular health campaigns conducted on the need for COVID-19 tests by the Ministry of Health and the Nigeria Centre for Disease Control [4]. Findings from this study revealed that a large proportion of persons who earned less than 30,000 naira (U.S.$78.95) monthly were more willing to take the COVID-19 test. A likely explanation for this finding could be the availability of COVID-19 tests in public health facilities at no cost. The ease of accessing the COVID-19 testing centres in Nigeria also makes testing services easily acceptable to the masses [23]. It should however be noted that the one-third who are unwilling to take the COVID-19 test could prompt unwillingness among other individuals. The promotion of willingness for COVID-19 tests should be promoted nationwide, excluding no one.

The frequently cited reasons for respondents' willingness to take the COVID-19 tests were to receive appropriate care if confirmed positive, and the belief that testing helps stop COVID-19. These arrays of evidence allude to the fact that it is known among many that COVID-19 management cannot be sourced by oneself [24]. Rather, it requires the consultation of infectious disease experts currently working on the management of COVID-19 positives [25]. The premonition that testing is the key indicator for one's COVID-19 status confirms the effectiveness of public health campaigns conducted by the Nigeria Centre for Disease Control [26]. The results obtained from this study also highlight that many Nigerians would not compromise the health of other individuals by hesitating to take the COVID-19 tests. It is therefore required that this display of patriotism is appreciated by the national government and encouraged. For this cause, it is essential that modalities are implemented to further make COVID-19 testing services readily available and accessible.

Among the community members, nearly two-thirds were willing to disclose contacts' names if tested positive. This could be due to the knowledge that contacts and confirmed COVID-19 cases have an equal likelihood to transmit COVID-19 on to healthy persons. In this study, we found that nearly two-thirds of males are more likely to disclose contacts if tested positive for COVID-19. This finding may be due to the lower level of allegiance placed on relationships by males compared to females [27]. As such, the non-disclosure of contacts among females if tested positive for COVID-19 highlight that women display lower confidence in disclosing their contacts. As a result, many females are likely to handle contacts' information with secrecy. Currently, there is paucity of literature on gender differences in disclosing contacts when tested positive for COVID-19. However, a research conducted in the United States of America reported that women have had lower confidence in coping with the COVID-19 pandemic compared to men [28]. Our findings therefore may be due to the need to avoid stigmatization among many females. The female gender has been described a population group among whom stigmatization is more likely if contacts' information gets divulged [29]. Intensifying information on the effectiveness of contact disclosure in breaking the chain of COVID-19 transmission is therefore required especially among females. To achieve this, the engagement of community leaders, opinion group leaders, religious leaders, males, and women leaders themselves should be prioritized [30,31]. We also identified a higher likelihood for contact disclosure among persons with higher educational levels if tested positive for COVID-19. This finding implies that education is key to promoting the willingness for contact disclosure in Nigeria among COVID-19 cases. Our findings therefore imply that awareness programs on contact disclosure should be focused on persons with lower levels of education.

Among the community members, nearly three-quarter were willing to take the COVID-19 vaccine when available. The proportion obtained in our study is higher than the 61% obtained from a nationwide net operating

income poll conducted among Nigerians in December, 2020, in a similar context [32]. The variance recorded in these studies could be explained by the difference in time and data collection sites. This study found that nearly two-thirds of persons aged 40 years or more are more willing to take the COVID-19 vaccine. This finding implies that the need for the COVID-19 vaccine is well understood by older persons [33,34]. Evidence has however shown that persons within younger age groups are also vulnerable to COVID-19. Therefore, it is required that the acceptance of the COVID-19 vaccine is promoted and encouraged among younger persons. From this study, persons who felt unsure of their health status were more likely to accept the COVID-19 vaccine compared to others. This shows that ignorance of one's health condition could significantly improve COVID-19 vaccine uptake. In the Nigerian context, many individuals are not aware of their health conditions. This ignorance is primarily due to the low income earned by households which may be barely sufficient to cover subsistence living. It is therefore needful that recommendations on COVID-19 vaccine acceptance is encouraged for all persons, regardless of the knowledge of one's health status.

From this study, a large proportion of persons whose financial situation had remained unchanged or worsened, i.e., those whose income had reduced during the COVID-19 pandemic in the past three months, were more willing to take the COVID-19 vaccine. This finding implies that richer individuals are less willing to take the COVID-19 vaccine. A likely explanation for this finding is that richer persons have better access to quality healthcare even when costs are attached. In the race towards a healthy nation amid the COVID-19 pandemic, ensuring a high proportion of acceptance of the COVID-19 vaccine among the entire population is required [35]. Information on the benefits of the COVID-19 vaccine should be regularly disseminated across modern media platforms. Information on the risk factors for severe COVID-19 status such as underlying illness should be included in the COVID-19 vaccine information package. Previous research conducted on the malarial vaccine has documented that the knowledge of malarial risk factors is a factor that influences the acceptance of the malarial vaccine [36,37]. It is therefore required that these specifications are made available regarding the COVID-19 vaccine. These pieces of information could be provided through health workers, social and traditional media, as well as from peer groups.

Strengths and Limitations

The results obtained from this study could have been limited in scope because it was conducted in only one out of the 36 states in Nigeria. Also, the wide variation of the socio-economic profile and health-seeking behaviour across the country's geopolitical zone and states could limit the generalizability of the study. Despite these limitations, this research is relevant because it presents novel insight into the willingness for COVID-19 testing, disclosure of contacts, and uptake of the COVID-19 vaccine among community member in Nigeria.

Conclusion

To break the transmission chain of COVID-19, non-pharmaceutical measures such as social distancing, cough etiquette, and improved hand hygiene have been recommended. More importantly, testing, contact tracing, and acceptance of the COVID-19 vaccine that is currently being implemented are needful at this time. Interventions to improve willingness for COVID-19 testing and taking the COVID-19 vaccine should be targeted towards wealthy individuals. These could include taking COVID-19 tests to places, e.g., evening clubs, where many of the rich congregate. To enhance willingness for contacts' disclosure, individuals with low levels of education should be targeted. Community sensitization activities on the importance of contacts' tracing should be organized. Such sensitization activities could be held in markets, motor garages, and less-developed communities. Similarly, active community engagement of community and religious leaders' opinions would improve the practice of contact disclosure.

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