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People's willingness to use COVID-19 self-testing in Nigeria: a cross-sectional survey

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ABSTRACT

Objectives Nigeria has been badly affected by the COVID-19 pandemic, and the poor testing coverage in the country may make controlling the spread of COVID-19 challenging. The aim of this study was to assess the general public's acceptability of SARS-CoV-2 self-testing as an approach which could help to address this gap.

Setting A household-based survey was conducted in five urban and five rural local government areas in the states of Akwa Ibom, Anambra, Benue, Kaduna and Lagos, in mid-2021.

Participants 2126 respondents (969 were female) participated. A five-pronged, probabilistic sampling approach was used to recruit individuals older than 17 years and available to participate when randomly approached in their households by the surveyors. A 35-item questionnaire was used to collect data on their values towards SARS-CoV-2 self-testing. Primary outcomes were: likelihood to use a self-test; willingness to pay for a self-test; and likely actions following a reactive self-test result.

Results Of the total 2126 respondents, 14 (0.66%) were aware of COVID-19 self-testing, 1738 (81.80%) agreed with the idea of people being able to self-test for COVID-19, 1786 (84.05%) were likely/very likely to use self-tests if available, 1931 (90.87%) would report a positive result and 1875 (88.28%) would isolate if they self-tested positive. Factors significantly associated with the use of a self-test were having a college education or higher (adjusted Odds Ratio (AOR): 1.55; 95% CI: 1.03 to 2.33), full-time employment (AOR: 1.67; 95% CI: 1.06 to 2.63), feeling at moderate/high risk of COVID-19 (AOR: 2.43; 95% CI: 1.70 to 3.47) and presence of individuals at risk of COVID-19 within the household (AOR: 1.38; 95% CI: 1.06 to 1.78).

Conclusion A majority of Nigerians agree with the concept of COVID-19 self-testing and would act to protect public health on self-testing positive. Self-test implementation research is necessary to frame how acceptability impacts uptake of preventive behaviours following a positive and a negative self-test result.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The sample is characterised by a balanced diversity in terms of age, gender, education status and location of residence.
⇒ This is a multicountry survey, and findings from this study have contributed to the World Health Organization issuing guidance on SARS-CoV-2 self-testing.
⇒ Social desirability might have influenced how survey respondents indicated how they would react if they received a positive self-test result.
⇒ The randomisation of respondents at home might have been skewed towards the selection of those individuals who are often to be found at home.
⇒ The selection of study states and study urban sites might have led to an under-representation of illiterate or unemployed individuals in the study sample.

INTRODUCTION

The World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) a pandemic on 11 March 2020. Nigeria reported its first case of COVID-19 on 28 February 2020[1 2] and has kept its numbers of COVID-19 cases low, with 266 192 cases and 3155 deaths by November 2022.[3] Efforts to strengthen the health system following the 2014–2016 Ebola crisis and several other health emergencies have enabled Nigeria to respond effectively to curtail the spread of the COVID-19 pandemic,[2 4] for example, by sequencing the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) genome and promoting COVID-19 vaccination.[4–6]

An important public health response to the pandemic is to ensure the availability of testing for SARS-CoV-2 infection at a community-level.[7] Nigerian health authorities prioritised an increase in PCR testing and public access to rapid antigen-detection testing devices for SARS-CoV-2 for those with suspected COVID-19 and their close contacts.[8] However, this limited Nigeria's capacity to screen for COVID-19 cases outside of healthcare establishments. Limited access

to facility-provided COVID-19 tests limited prompt detection of cases and increased the risk of community spread of COVID-19.[3] Poor access to COVID-19 testing may be one reason for the low COVID-19 rates reported in Nigeria.[9] Affordable, safe and easily available health technology to facilitate community members' access to testing and subsequent adoption of infection control measures would be of immense value for pandemic control.

COVID-19 self-tests have optimal performance and end-user acceptability.[10–12] Self-tests have been used to increase case detection of SARS-CoV-2 in Greece, the USA and India.[13–15] Studies have reported acceptability of self-testing as a complementary case detection approach among university students and staff in the United Kingdom[16] and the United Arab Emirates,[17] and among the general public in Greece and Cyprus.[18]

Self-tests may be a game changer in Nigeria. However, in-depth observational studies that assess attitudes and behaviours around testing among populations in lower socio-economic income groups and among those vulnerable to suffer the impact of COVID-19 disease, are necessary.[19] Thus, before the deployment of self-testing in Nigeria, it is important to assess the acceptability of COVID-19 self-testing among the general population. To achieve this, we conducted a household-based survey to determine the acceptability of COVID-19 self-tests, by assessing people's values in relation to COVID-19 self-tests and the actions they would take on receiving a positive COVID-19 self-test result.

METHODS

Design

This was a household survey conducted between July and August 2021. This study was conducted alongside an online survey of healthcare workers and a qualitative inquiry,[20] whose findings will be reported in a separate manuscript.

Sites

Study participants were recruited from one state in five of the six geopolitical zones in Nigeria, specifically Anambra State (South-East), Akwa Ibom (South-South), Benue (North-Central), Kaduna (North-West) and Lagos (South-West). The North-East geopolitical zone was excluded due to security concerns. In each state, an urban and a rural local government area (LGA) were selected as survey sites (10 sites in total). The urban LGAs were each state's capital. Rural LGAs were selected using the following criteria: (1) consideration of COVID-19 pandemic restrictions in place; (2) feasibility of obtaining local authorities' permission to conduct the surveys; and (3) security and safety concerns.

Population

The study population was the general population. The inclusion criteria were being aged>17 years, being present in their homes at the time the surveyors visited and willingness to provide written informed consent. There were no exclusion criteria.

Sample size

Separate sample size calculations were performed for each site. It was estimated that at least 196 or more respondents would be needed in each of the 10 sites to have a confidence level of 95% that the real value (of likelihood to use self-testing) would be within±7% of the measured value.

Data collection instrument validation

A 35-item questionnaire was developed in English for the study.[16] The questionnaire included items to collect information on respondents' demographics, experiences with COVID-19 and conventional COVID-19 testing, values and acceptability of COVID-19 self-tests, and possible actions to be taken after using a COVID-19 self-test.

The initial questionnaire was printed out and prepiloted with five Nigerian individuals in Ile-Ife, Osun State, where the survey implementing organisation is based. The piloted questionnaire was then revised, and its digital version was prepared using KoBoToolbox. This second version of the questionnaire was further revised for content validation by seven Nigerian study staff (five study state coordinators, one social scientist and one project manager) in a first round, and by an international epidemiologist and a social scientist in a second round. Based on the feedback received from the reviews, a third version of the questionnaire was pilot-tested by 40 surveyors (8 per each survey state). In this third pilot stage, each surveyor administered the questionnaire, in its digital form, to two individuals from their communities. A final version of the questionnaire was developed based on the revision made from the third pilot stage feedback. Cronbach's alpha was conducted to determine the tool's reliability, with values ranging from 0.73 to 0.78 for various sections of the questionnaire.

Sampling and recruitment

A five-pronged, probabilistic sampling approach to identifying and recruiting survey respondents was used. First, the boundaries of the 10 selected LGAs were delimited using Google MyMaps. In preparing the LGAs maps, any areas where recruitment of respondents would be impossible (e.g., airports near the state capitals, marshes or forests, or military areas) were left out of the maps' boundaries. The 10 resulting maps were each divided into 40 areas of similar geographical size.

Second, a random list generator (RANDOM.ORG) was used to select 14 areas on each map. Third, in each of the 14 areas, 21 households were randomly selected. Fourth, the 14 selected areas were randomly assigned, using RANDOM.ORG, to an LGA-specific, 7-day survey schedule. All schedules comprised a Monday to Sunday morning and an afternoon shift.

All maps were exported in a format compatible with the compass app ViewRanger. In each LGA, in each survey

Table 1 Respondents' socio-demographic characteristics (N=2126)

Variable	Rural		Urban		Subtotal (Rural and urban)		
	Female N=520 n (%)	Male N=550 n (%)	Female N=449 n (%)	Male N=607 n (%)	Female N=969 n (%)	Male N=1157 n (%)	Total N=2126 n (%)
Mean age (SD), years	36.337 (10.643)	38.825 (14.45)	36.337 (10.643)	37.433 (11.849)	36.601 (11.71)	38.097 (13.167)	37.414 (12.542)
Age group (years)							
18–35	267 (51.35)	257 (46.73)	233 (51.89)	300 (49.42)	500 (51.60)	557 (48.14)	1057 (49.72)
36–55	205 (39.42)	214 (38.91)	186 (41.43)	251 (41.35)	391 (40.35)	465 (40.19)	856 (40.26)
≥56	48 (9.23)	79 (14.36)	30 (6.68)	56 (9.23)	78 (8.05)	135 (11.67)	213 (10.02)
Self-reported ethnicity *							
Anang	3 (0.58)	1 (0.18)	11 (2.46)	17 (2.80)	14 (1.44)	18 (1.56)	32 (1.51)
Fulani	20 (3.85)	23 (4.18)	5 (1.12)	10 (1.65)	25 (2.58)	33 (2.85)	58 (2.73)
Hausa	61 (11.73)	119 (21.64)	20 (4.46)	98 (16.14)	81 (8.36)	217 (18.76)	298 (14.02)
Ibibio	90 (17.31)	118 (21.45)	73 (16.29)	88 (14.50)	163 (16.82)	206 (17.80)	369 (17.36)
Idoma	8 (1.54)	3 (0.55)	15 (3.35)	15 (2.47)	23 (2.37)	18 (1.56)	41 (1.93)
Igbo	134 (25.77)	112 (20.36)	127 (28.35)	132 (21.75)	261 (26.93)	244 (21.09)	505 (23.75)
Tiv	86 (16.54)	95 (17.27)	73 (16.29)	86 (14.17)	159 (16.41)	181 (15.64)	340 (15.99)
Yoruba	86 (16.54)	52 (9.45)	75 (16.74)	85 (14.00)	161 (16.62)	137 (11.84)	298 (14.02)
Education							
None	50 (9.62)	31 (5.64)	9 (2.00)	11 (1.82)	59 (6.09)	42 (3.63)	101 (4.75)
Quranic education	12 (2.31)	33 (6.00)	6 (1.34)	6 (1.34)	18 (1.86)	42 (3.63)	60 (2.82)
Primary	109 (20.96)	112 (20.36)	37 (8.24)	61 (10.07)	146 (15.07)	173 (14.97)	319 (15.01)
Secondary	238 (45.77)	227 (41.27)	176 (39.20)	222 (36.63)	414 (42.72)	449 (38.84)	863 (40.61)
College/vocational	40 (7.69)	45 (8.18)	85 (18.93)	90 (14.85)	125 (12.90)	135 (11.68)	260 (12.24)
University	66 (12.70)	99 (18.00)	143 (32.08)	208 (34.33)	196 (20.22)	307 (26.55)	503 (23.67)
Other	5 (0.96)	3 (0.55)	6 (1.34)	5 (0.83)	11 (1.14)	8 (0.70)	19 (0.90)
Employment status							
Unemployed	105 (20.19)	81 (14.73)	80 (17.82)	55 (9.06)	185 (19.09)	136 (11.75)	321 (15.10)
Student	45 (8.65)	68 (12.36)	31 (6.90)	49 (8.07)	76 (7.84)	117 (10.11)	193 (9.08)
Employed, part-time	11 (2.12)	20 (3.64)	23 (5.12)	36 (5.93)	34 (3.51)	56 (4.84)	90 (4.23)
Employed, full time	34 (6.54)	51 (9.27)	96 (21.38)	156 (25.70)	130 (13.42)	206 (17.89)	337 (15.85)
Self-employed, part-time	79 (15.19)	68 (12.36)	43 (9.58)	61 (10.05)	122 (12.59)	129 (11.15)	251 (11.81)
Self-employed, full time	234 (45.00)	239 (43.45)	165 (36.75)	224 (36.90)	399 (41.18)	463 (40.02)	862 (40.55)
Retired, on a pension	12 (2.31)	23 (4.18)	11 (2.45)	26 (4.28)	23 (2.37)	49 (4.24)	72 (3.39)

*Of the 60 ethnicities self-reported by the respondents, only those ethnolinguistic groups representing >1% of the sample are included in this table.

shift, a pair of surveyors used the ViewRanger app to identify selected households. As a fifth step in this sampling approach, on arriving at each preselected household, the surveyors randomly selected one respondent per household; where there was more than one eligible participant, one participant was selected by a ballot. Where there was no eligible participant or where household members declined to participate, the next household was approached.

Informed consent and data collection

In each household, the purpose of the survey was explained to the head of the household. If the surveyor was invited to stay, an eligible participant was identified, irrespective of whether they were visiting or lived there. If an individual agreed to participate, written informed consent was requested. Consenting individuals received a second signed copy of the information sheet and the consent form. As part of the consent process, individuals were asked if they would like to receive the study findings via email. For those who did not want to share their email address, an explanation on how to request the study findings from the principal investigator was provided. An individual's refusal to participate was respected, but, for quality control purposes, anyone who refused was asked to consent that the surveyors noted down their age, sex and reason for refusal.

Once consent was provided, the surveyors proceeded to administer the survey questionnaire using the mobile app

Table 2 Perceived access to and utilisation of COVID-19 testing by study respondents (N=2126)

Variable	Rural		Urban		Subtotal (Rural and urban)		
	Female N=520 n (%)	Male N=550 n (%)	Female N=449 n (%)	Male N=607 n (%)	Female N=969 n (%)	Male N=1157 n (%)	Total N=2126 n (%)
Feeling at risk							
No risk	147 (28.27)	151 (27.45)	117 (26.06)	122 (20.13)	264 (27.24)	273 (23.62)	537 (25.27)
Low risk	201 (38.65)	177 (32.18)	117 (26.06)	147 (24.26)	318 (32.82)	324 (28.03)	642 (30.21)
Mild risk	76 (14.62)	83 (15.09)	50 (11.14)	89 (14.69)	126 (13.00)	172 (14.88)	298 (14.02)
Moderate risk	39 (7.50)	76 (13.82)	74 (16.48)	94 (15.51)	113 (11.66)	170 (14.71)	283 (13.32)
High risk	57 (10.96)	63 (11.45)	91 (20.27)	154 (25.41)	148 (15.27)	217 (18.77)	365 (17.18)
Household members							
Children only	84 (16.18)	95 (17.27)	120 (26.73)	114 (18.78)	204 (21.07)	209 (18.06)	413 (19.44)
Children and elders	25 (4.82)	20 (3.64)	25 (5.57)	28 (4.61)	50 (5.17)	48 (4.15)	98 (4.61)
Children and elders and CD	6 (1.16)	8 (1.45)	3 (0.67)	6 (0.99)	9 (0.93)	14 (1.21)	23 (1.08)
Elders only	73 (14.07)	94 (17.09)	62 (13.81)	81 (13.34)	135 (13.95)	175 (15.13)	310 (14.59)
Elders and CD	18 (3.47)	26 (4.73)	7 (1.56)	8 (1.32)	25 (2.58)	34 (2.94)	59 (2.78)
CD only	31 (5.97)	40 (7.27)	15 (3.34)	20 (3.29)	46 (4.75)	60 (5.19)	106 (4.99)
Children and CD	7 (1.35)	3 (0.55)	0 (0.00)	0 (0.00)	7 (0.72)	3 (0.26)	10 (0.47)
Has had COVID-19							
Yes, confirmed by test	6 (1.15)	15 (2.73)	4 (0.89)	5 (0.83)	10 (1.03)	20 (1.73)	30 (1.41)
Yes, confirmed by a healthcare worker	31 (5.96)	46 (8.36)	2 (0.45)	3 (0.50)	33 (3.41)	49 (4.24)	82 (3.86)
Ever felt they could not access testing when needed							
Never	413 (79.42)	428 (77.82)	368 (82.14)	480 (79.08)	781 (80.68)	908 (78.48)	1690 (79.48)
At least once	103 (19.81)	122 (22.18)	74 (16v52)	118 (19.43)	177 (18.28)	240 (20.74)	417 (19.63)
Has tested for COVID-19							
Never	480 (92.31)	474 (86.18)	420 (93.54)	564 (92.92)	900 (92.98)	1038 (89.71)	1938 (91.16)
At least once	39 (7.50)	76 (13.82)	27 (6.02)	40 (6.59)	66 (6.82)	116 (10.03)	182 (8.56)
For those tested… (N)	n=39	n=75	n=27	n=40	n=66	n=115	n=181
Months ago (mean, SD)	4.0 (3.422)	4.4 (3.394)	5.4 (4.332)	7.3 (15.608)	4.7 (3.912)	5.7 (10.662)	5.3 (8.867)
–							
Very convenient	2 (5.13)	9 (12.00)	9 (33.33)	12 (30.00)	11 (16.67)	21 (18.26)	32 (17.68)
Convenient	28 (71.79)	48 (64.00)	11 (40.74)	14 (35.00)	39 (59.09)	62 (53.91)	101 (55.80)
Neutral	5 (12.82)	6 (8.00)	0 (0.00)	4 (10.00)	5 (7.58)	10 (8.70)	15 (8.29)
Inconvenient	2 (5.13)	9 (12.00)	6 (22.22)	9 (22.50)	8 (12.12)	18 (15.65)	26 (14.36)
Very inconvenient	2 (5.13)	3 (4.00)	1 (3.70)	1 (2.50)	3 (4.55)	4 (3.48)	7 (3.87)
Mean (SD)	3.66 (.86)	3.68 (.97)	3.77 (1.25)	3.67 (1.20)	3.71 (1.03)	3.68 (1.05)	3.69 (1.04)
–							
Result in less than 1 hour	15 (38.46)	29 (38.16)	7 (25.93)	3 (7.50)	22 (33.33)	32 (27.59)	54 (29.67)
Result the same day	9 (23.08)	13 (17.11)	6 (22.22)	8 (20.00)	15 (22.73)	21 (18.10)	36 (19.78)
Result the following day	5 (12.82)	5 (6.58)	4 (14.81)	10 (25.00)	9 (13.64)	15 (12.93)	24 (13.19)
Result 2 days later	3 (7.69)	6 (7.89)	1 (3.70)	2 (5.00)	4 (6.06)	8 (6.90)	12 (6.59)
Result 3–7 days later	3 (7.69)	8 (10.53)	2 (7.41)	8 (20.00)	5 (7.58)	16 (13.79)	21 (11.54)
Result more than 1 week later	2 (5.13)	9 (11.84)	5 (18.52)	4 (10.00)	7 (10.61)	13 (11.21)	20 (10.99)

Continued

Table 2 Continued

Variable	Rural		Urban		Subtotal (Rural and urban)		
	Female N=520 n (%)	Male N=550 n (%)	Female N=449 n (%)	Male N=607 n (%)	Female N=969 n (%)	Male N=1157 n (%)	Total N=2126 n (%)
Never received the result	2 (5.13)	4 (5.26)	1 (3.70)	4 (10.00)	3 (4.55)	8 (6.90)	11 (6.04)
–							
Paid for the test (N)	4 (0.77)	14 (2.55)	2 (0.45)	3 (0.49)	6 (0.62)	17 (1.47)	174 (1.08)
Amount paid (mean US$, SD)	15.72 (18.82)	8.4 (8.48)	27.96 (43.33)	5.6 (5.54)	13.28 (15.53)	24.014 (40.1)	21.21 (35.31)

CD, People with chronic diseases.;

KoBoCollect, in a private location chosen by the respondent. As COVID-19 self-testing was not available for the general public in Nigeria at the time of the conduct of the survey, the surveyors showed all respondents the image of a COVID-19 self-test device that requires collection of specimens from both nostrils and which is similar to the SARS-CoV-2 antigen-detection tests that is used by healthcare professionals in Nigerian primary healthcare clinics.

Primary outcomes of interest for analysis

Dependent variables were willingness to use a self-test, willingness to pay for a self-test and actions taken on receiving a positive self-test result. Willingness to use a self-test was explored using a 5-point Likert scale (from very unlikely to very likely to use a self-test). Willingness to pay was explored by asking respondents how much they would be willing to pay for a self-test device if they needed it and it was not provided for free. This was a numerical question, and respondents were asked to not answer '0 naira' unless they were absolutely unwilling to pay for a self-test device. Actions taken on receiving a positive self-test result were explored by asking respondents if they would wear a face mask, self-isolate, report the result and warn their close contacts after receiving a positive self-test result. These were dichotomous questions (yes/no).

Independent variables were: sociodemographic information (age, sex, education level, occupation), risk perception, living with a person perceived at increased risk of COVID-19 (children, elders, individuals with a chronic disease), prior experience with facility-provided COVID-19 testing and awareness of self-testing devices.

Data analysis

Statistical analyses were performed using STATA V.14 software. Descriptive, bivariate and regression analyses were conducted. Bivariate analyses were performed to identify significant associations between the dependent and independent variables. Those independent variables significantly associated with the dependent variables at a p value<0.05 were entered into three multivariate regression models developed. A logistic regression model was used to identify the independent variables associated with willingness to use a self-test and willingness to pay for a COVID-19 self-test. An ordinary least squares (OLS) regression was used to identify independent variables associated with actions taken on receiving a positive COVID-19 self-test result. For the OLS, an index was constructed by combining affirmative responses for the expected actions. Each potential action taken on receiving a positive test result was represented as a performance measure. Each performance measure was normalised to a mean of 0 and Standard Deviation (SD) of 1. A standardised index was constructed by determining the total of the normalised performance measures.

Patient and public involvement

The states and sites were selected through consultation with six community stakeholders in Nigeria. The decision not to conduct the survey in North-Eastern Nigeria was reached through the consultation with the community stakeholders.

RESULTS

Participants' characteristics

There were 2126 respondents, comprising 969 (45.57%) females and 1070 (50.32%) rural dwellers (table 1). The mean age of female and male respondents was 36.6 (SD 11.71) and 38.1 (SD 13.17) years, respectively. With the exception of four Ghanaians and one Cameroonian, all respondents were Nigerian born. Of >60 ethnolinguistic groups in Nigeria, the Hausa (14.02%), Ibibio (17.36%), Igbo (23.75%), Tiv (15.99%) and Yoruba (14.02%) were the most represented groups in the sample. In terms of education, 319 (15.01%), 863 (40.61%) and 447 (21.04%) respondents had completed primary, secondary and college or higher education, respectively (table 1). Rates of completion of college or higher education ranged from 12.12% for females in rural areas to 30.03% for males in urban areas. While 105 (20.19%) of female respondents in rural areas were unemployed, just 55 (9.06%) of male respondents in urban areas were unemployed.

As shown in table 2, 1073 (50.49%) respondents perceived that they were not living with someone at

Table 3 Acceptability of self-testing for COVID-19 disease among study respondents (N=2126)

Variable	Rural		Urban		Subtotal (Rural and urban)		
	Female N=520 n (%)	Male N=550 n (%)	Female N=449 n (%)	Male N=607 n (%)	Female N=969 n (%)	Male N=1157 n (%)	Total N=2126 n (%)
Agree with the concept of COVID-19 self-testing							
Yes	397 (76.49)	442 (80.36)	379 (84.41)	520 (85.70)	776 (80.17)	962 (83.16)	1738 (81.80)
No	72 (13.87)	73 (13.27)	54 (12.03)	59 (9.72)	126 (13.02)	132 (11.41)	258 (12.14)
Awareness of self-tests for							
COVID-19	0 (0.00)	2 (0.38)	6 (1.33)	6 (1.10)	6 (0.60)	8 (0.66)	14 (0.66)
HIV	126 (24.22)	139 (25.26)	159 (35.37)	335 (55.20)	285 (29.41)	437 (37.76)	722 (33.96)
Malaria	174 (33.42)	205 (37.29)	157 (34.92)	277 (45.70)	331 (34.18)	452 (39.08)	783 (36.83)
Syphilis	2 (0.41)	5 (0.91)	6 (1.33)	5 (0.90)	8 (0.85)	10 (0.83)	18 (0.85)
Ulcer (*Helicobacter pylori*)	12 (2.30)	20 (3.63)	3 (0.71)	7 (1.10)	15 (1.53)	26 (2.23)	41 (1.93)
Pregnancy	349 (67.09)	186 (33.81)	308 (68.60)	319 (52.60)	657 (67.77)	470 (40.65)	1127 (53.01)
Likelihood to use a self-test							
Very unlikely	27 (5.19)	48 (8.73)	19 (4.23)	27 (4.46)	46 (4.75)	75 (6.49)	121 (5.69)
Unlikely	40 (7.69)	25 (4.55)	14 (3.12)	19 (3.14)	54 (5.57)	44 (3.81)	98 (4.61)
Neutral	38 (7.31)	31 (5.64)	24 (5.35)	27 (4.46)	62 (6.40)	58 (5.02)	120 (5.65)
Likely	179 (34.42)	198 (36.00)	194 (43.21)	263 (43.40)	373 (38.49)	461 (39.88)	834 (39.25)
Very likely	236 (45.38)	248 (45.09)	198 (44.10)	270 (44.55)	434 (44.79)	518 (44.81)	952 (44.80)
–							
Likelihood (mean, SD)	4.07 (1.13)	4.04 (1.21)	4.19 (.98)	4.2 (.98)	4.13 (1.07)	4.12 (1.10)	4.12 (1.08)
Reasons to use a self-test							
To know the test result quickly	282 (63.37)	282 (60.65)	246 (60.89)	316 (56.23)	528 (62.19)	598 (58.23)	1126 (60.02)
To request treatment before becoming severely ill	193 (43.37)	203 (43.66)	184 (45.54)	242 (43.06)	377 (44.41)	445 (43.33)	822 (43.82)
To test in private and keep the result confidential	148 (33.26)	169 (36.34)	137 (33.91)	178 (31.67)	285 (33.57)	347 (33.79)	632 (33.69)
To be calm about the disease	77 (17.30)	89 (19.14)	149 (36.88)	219 (38.97)	226 (26.62)	308 (29.99)	534 (28.46)
To save time travelling to/ waiting at a testing site	116 (26.07)	116 (24.95)	55 (13.61)	89 (15.84)	171 (20.14)	205 (29.96)	376 (20.04)
Willing to test weekly							
Yes	400 (76.92)	455 (82.73)	349 (77.73)	480 (79.08)	749 (77.30)	935 (80.81)	1684 (79.21)
No	64 (12.31)	64 (11.64)	59 (13.14)	81 (13.34)	123 (12.69)	145 (12.53)	268 (12.61)
For the respondents willing to pay for a self-test	N=343	N=356	N=296	N=423	N=639	N=779	N=1418
Maximum acceptable payment in US$ (median, IQR)	0.72 (1.92)	1.2 (1.98)	1.2 (1.92)	1.2 (1.92)	1.2 (1.92)	1.2 (1.92)	1.2 (1.92)

increased risk of severe COVID-19; 65 (17.18) respondents perceived themselves to be at high risk of COVID-19 infection. Of the 112 (5.27%) respondents who reported suspecting that they had previously had COVID-19, 30 (1.41%) had a confirmatory test. Also, 1690 (79.48%) respondents stated that they had never felt that they could not access a COVID-19 test when they needed it.

Most respondents (n=1938, 91.16%) had never received a COVID-19 test (table 2). In the rural sites, both female and male respondents were more likely to have been tested at least once than in urban sites (7.50% vs 6.02% for females; 13.82% vs 6.59% for males). Of the 182 (8.56% of the total) respondents who had ever tested for COVID-19, 174 (86.78%) had to pay for the test, 101 (55.80%) and 32 (17.68%) respondents rated the experience as convenient and very convenient, respectively, and 90 (49.45%) respondents received their test result the same day.

Willingness to use a SARS-CoV-2 self-test

Table 3 shows that although only 50 (2.35%) respondents knew about self-tests for COVID-19, 1738 (81.80%)

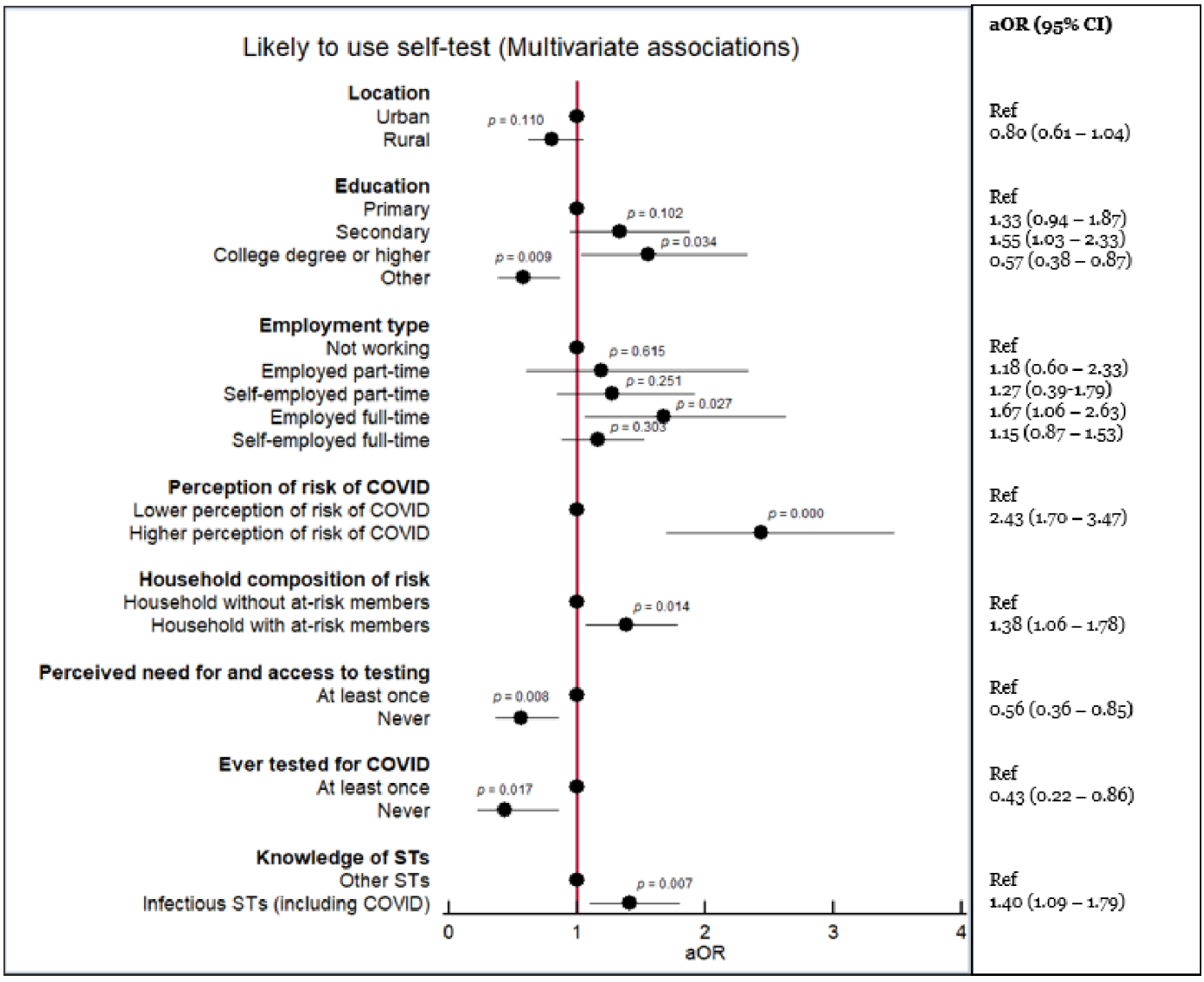

Figure 1 Multivariate logistic regression analysis to assess factors associated with the willingness of adults in Nigeria to use a COVID-19 self-test (N=2126.) ST, Self-testing; aOR, Adjusted Odds Ratio; 95%CI, 95% Confidence Interval; Ref., Reference.

respondents agreed with the concept of allowing people to self-test for COVID-19 and 1786 (83.05%) respondents stated that they would be very likely/likely to use self-tests if available. The lowest proportion of individuals who would use a self-test kit were males in rural areas (8.73%). Reasons for being willing to use a self-test in the future were being able to know the test result quickly (60.02%), request treatment before becoming severely ill (43.82%), test in private and keep the result confidential (33.69%), be calm about the disease (28.46%) and save time travelling to/waiting at a testing site (28.62%) (table 3).

Figure 1 shows that respondents who had completed college education or higher (adjusted OR (AOR): 1.55; 95% CI: 1.03 to 2.33; p<0.034); were in full-time employment (AOR: 1.67; 95% CI 1.06 to 2.63; p<0.027); felt at high or moderate risk of COVID-19 (AOR: 2.43; 95% CI: 1.70 to 3.47; p<0.001); shared a household with individuals perceived to be at increased risk of COVID-19 (AOR: 1.38; 95% CI: 1.06 to 1.78; p<0.014); and had previous knowledge of self-tests for infectious diseases (AOR: 1.40; 95% CI: 1.09 to 1.79; p<0.007) had significantly higher odds of being willing to use a COVID-19 self-test. On the other hand, people who had never tested for COVID-19 (AOR: 0.43; 95% CI: 0.22 to 0.86; p<0.017) and who had never felt that they could not access a COVID-19 test when they needed it (AOR: 0.56; 95% CI: 0.36 to 0.85; p<0.008) had lower odds of being willing to use a self-test.

Willingness to pay for a COVID-19 self-test

If COVID-19 self-test kits were provided free of charge, 1684 (79.21%) respondents would be willing to test on a weekly basis, if recommended by health authorities. If not provided free of charge, 1418 (66.76%) respondents would be willing to pay for a self-test should they need it. The mean maximum amount that female and male respondents would be willing to pay was US$1.84 (SD 3.029) and US$2.513 (SD 4.29), respectively.

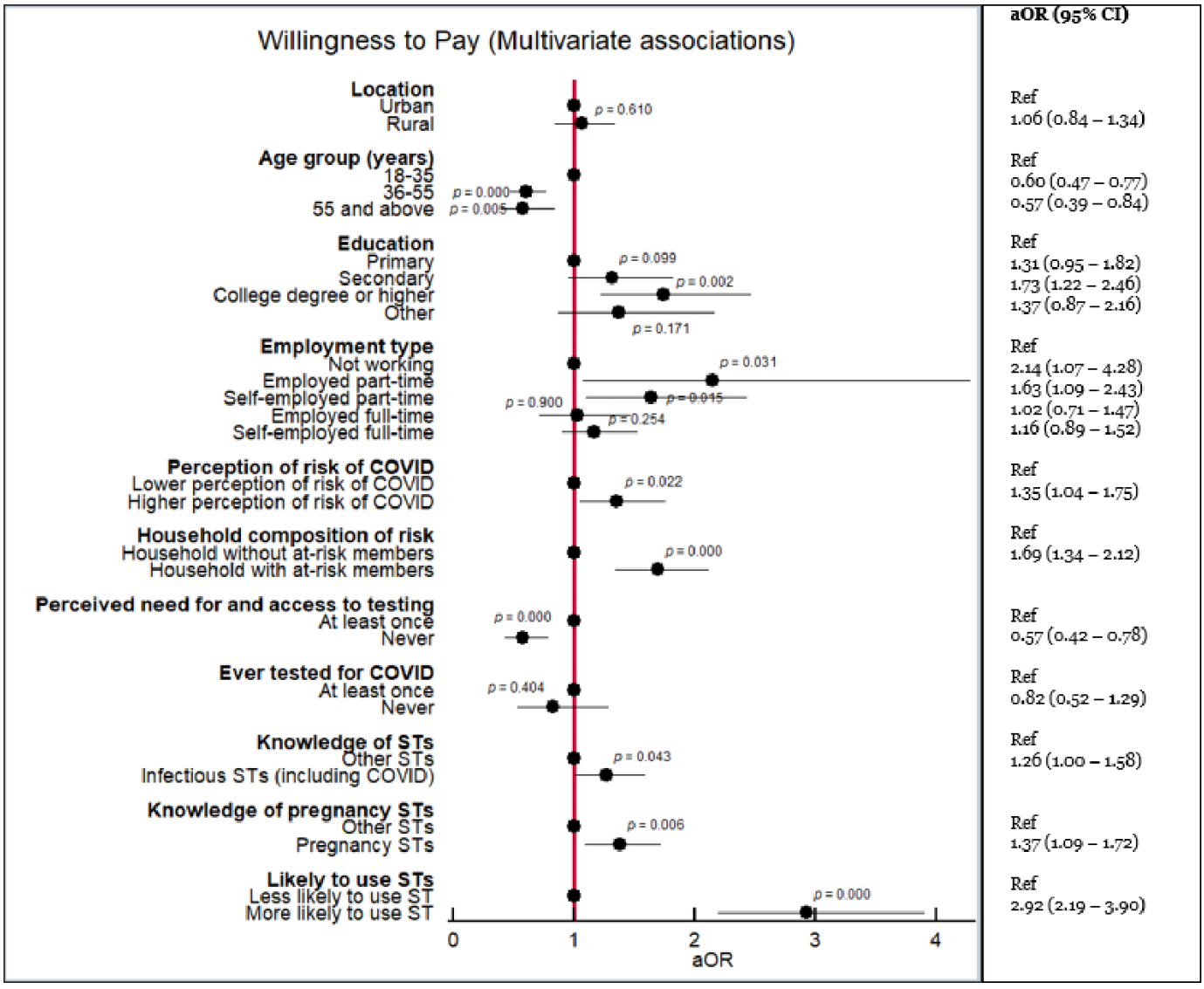

Figure 2 Multivariate logistic regression analysis to assess factors associated with the willingness of adults in Nigeria to pay for a COVID-19 self-test (N=2126). ST, Self-testing; aOR, Adjusted Odds Ratio; 95%CI, 95% Confidence Interval; Ref., Reference.

Figure 2 shows that respondents between the ages of 36–55 years (AOR: 0.60; 95% CI: 0.47 to 0.77; p<0.001) and ≥56 years (AOR: 0.57; 95% CI: 0.39 to 0.84; p<0.005) had significantly lower odds of being willing to pay for a COVID-19 self-test compared with respondents aged ≤35 years. Respondents who never felt they could not access a COVID-19 test when they needed it (AOR: 0.57; 95% CI: 0.42 to 0.78; p<0.001) also had significantly lower odds of being willing to pay for a self-test. Respondents who had a college degree or higher education (AOR: 1.73; 95% CI: 1.22 to 2.46; p<0.002); who were employed part-time (AOR: 2.14; 95% CI: 1.07 to 4.28; p<0.031) or self-employed part-time (AOR: 1.63; 95% CI: 1.09 to 2.43; p<0.015); who felt they were at moderate to high risk of contracting COVID-19 (AOR: 1.35; 95% CI: 1.04 to 1.75; p<0.022); who were cohabiting with people at increased risk of COVID-19 disease (AOR: 1.69; 95% CI: 1.34 to 2.12; p<0.001); or who knew about pregnancy self-testing (AOR: 1.37; 95% CI: 1.09 to 1.72; p<0.006) had significantly higher odds of being willing to pay for a COVID-19 self-test.

Actions taken on receiving a positive COVID-19 self-test result

Table 4 shows that if respondents used a self-test device and the result was positive, the majority would communicate the result to a clinic (90.87%), go to a health facility to request in-person post-test counselling (90.63%), self-isolate (88.28%) and identify and warn their contacts (87.68%). If they had symptoms compatible with COVID-19 and knew that they had been in close contact with an individual who had the disease, but their self-test result was negative, half of the sample would self-isolate (51.79%) and only a minority would stop wearing masks (23.25%) or stop social distancing (30.31%).

Figure 3 shows that adherence with recommended COVID-19 hygiene and prevention actions following a

Table 4 Actions that respondents would take following a SARS-CoV-2 self-test (N=2126)

Variable	Rural		Urban		Subtotal (Rural and urban)		Total
	Female N=520 n (%)	Male N=550 n (%)	Female N=449 n (%)	Male N=607 n (%)	Female N=969 n (%)	Male N=1157 n (%)	N=2162) n (%)
Practices on receipt of a negative self-test for a person with symptoms and exposed to a COVID-19 case							
Stop self-isolation	305 (58.65)	325 (59.09)	195 (43.43)	276 (45.47)	500 (51.60)	601 (51.94)	1101 (51.79)
Stop wearing a face mask	147 (28.32)	156 (28.36)	73 (16.26)	118 (19.44)	220 (22.73)	274 (23.68)	494 (23.25)
Stop social distancing	181 (34.81)	191 (34.79)	100 (22.27)	172 (28.34)	281 (29.00)	363 (31.40)	644 (30.31)
Practices on receipt of a positive self-test result							
Communicate the result to a clinic, hospital and/or COVID-19 hotline	455 (87.50)	489 (88.91)	423 (94.21)	564 (93.07)	878 (90.61)	1053 (91.09)	1931 (90.87)
Go in-person to a clinic or hospital to get post-testing counselling from a healthcare worker	476 (91.54)	496 (90.18)	408 (91.07)	545 (89.93)	884 (91.32)	1041 (90.05)	1925 (90.63)
Self-isolate	469 (90.19)	484 (88.00)	391 (87.28)	531 (87.62)	860 (88.84)	1015 (87.80)	1875 (88.28)
Identify and warn close contacts	459 (88.27)	470 (85.45)	391 (87.08)	544 (89.62)	850 (87.72)	1014 (87.64)	1864 (87.68)
Inform their employer (n=respondents employed)	N=355* 270 (76.06)	N=378* 258 (68.25)	N=327* 241 (73.30)	N=477* 379 (79.45)	N=682* 511 (74.93)	N=855* 637 (74.50)	N=1537* 1148 (74.69)

*The denominators in this variable include only those respondents who reported being self-employed or employed by others, either full time or part-time.

positive self-test result was significantly and negatively associated with having no formal education compared with those who had completed primary education (coefficient: −0.41; 95% CI: −0.62 to −0.20; p<0.001). Similarly, people who never felt that they could not access a COVID-19 test when they needed it (coefficient: −0.15; 95% CI −0.23 to −0.07; p<0.001) would have lower odds of complying with recommended actions following a positive COVID-19 self-test result.

DISCUSSION

Self-testing can help to ensure that those who have a SARS-CoV-2 infection access clinic-based care. Our survey provides information regarding the Nigerian public's values around COVID-19 self-testing, its acceptability and likely actions to be taken following a self-test result; this can help inform policies and programmes on COVID-19 self-testing once regulatory approval for the delivery of self-testing is granted by the Nigerian government.

Our survey showed a high acceptability towards COVID-19 self-testing, and a high degree of willingness to comply with hygiene and infection-control measures on receiving a positive self-test result. Agreement with the use of COVID-19 self-tests was higher in our survey than in surveys conducted with the same methodological approach in Indonesia and Brazil.[21 22] This could in part be due to differences in access to conventional COVID-19 testing between the countries. In Nigeria, 79.48% of respondents reported having never had difficulty accessing a COVID-19 test, compared with 94.76% in Indonesia and 74.35% in Brazil.[21 22] Acceptability of self-testing in Nigeria was also higher than in an online survey conducted in Greece and Cyprus, where 79.0% of respondents from the general public reported willingness to self-test.[17] Nevertheless, the high likelihood of using self-testing observed in our survey should be treated with caution, as the enthusiasm for this case detection approach may be a reflection of discontent with restrictive government policies on testing. It remains to be seen whether COVID-19 self-tests, once regulated and available on the market, are as widely adopted as the present study seem to suggest, or as other study conducted in the United Kingdom—where self-testing is regulated—have reported.[23]

High acceptability of self-testing in Nigeria suggests that facilitating its easy access to the general public may help increase the country's COVID-19 testing rates. Since the first case of COVID-19 was detected, Nigeria has tested just 5 593 537 members of its more than 200 million population.[24] This low testing rate is a cause for concern because of the high prevalence of other diseases, which might worsen the prognosis for people infected with SARS-CoV-2:[25] In Nigeria, more than 1.7 million individuals are living with HIV[26], 460 000 have tuberculosis[27] and 29% of the annual deaths are from non-communicable diseases.[28] In this context, self-testing is a complementary approach to provider-initiated COVID-19 testing that could facilitate prompt diagnosis and management of COVID-19 and, as a result, prevent further morbidity in people affected by other diseases.

The huge negative impact of the COVID-19 pandemic on the economic growth of Nigeria highlights the need

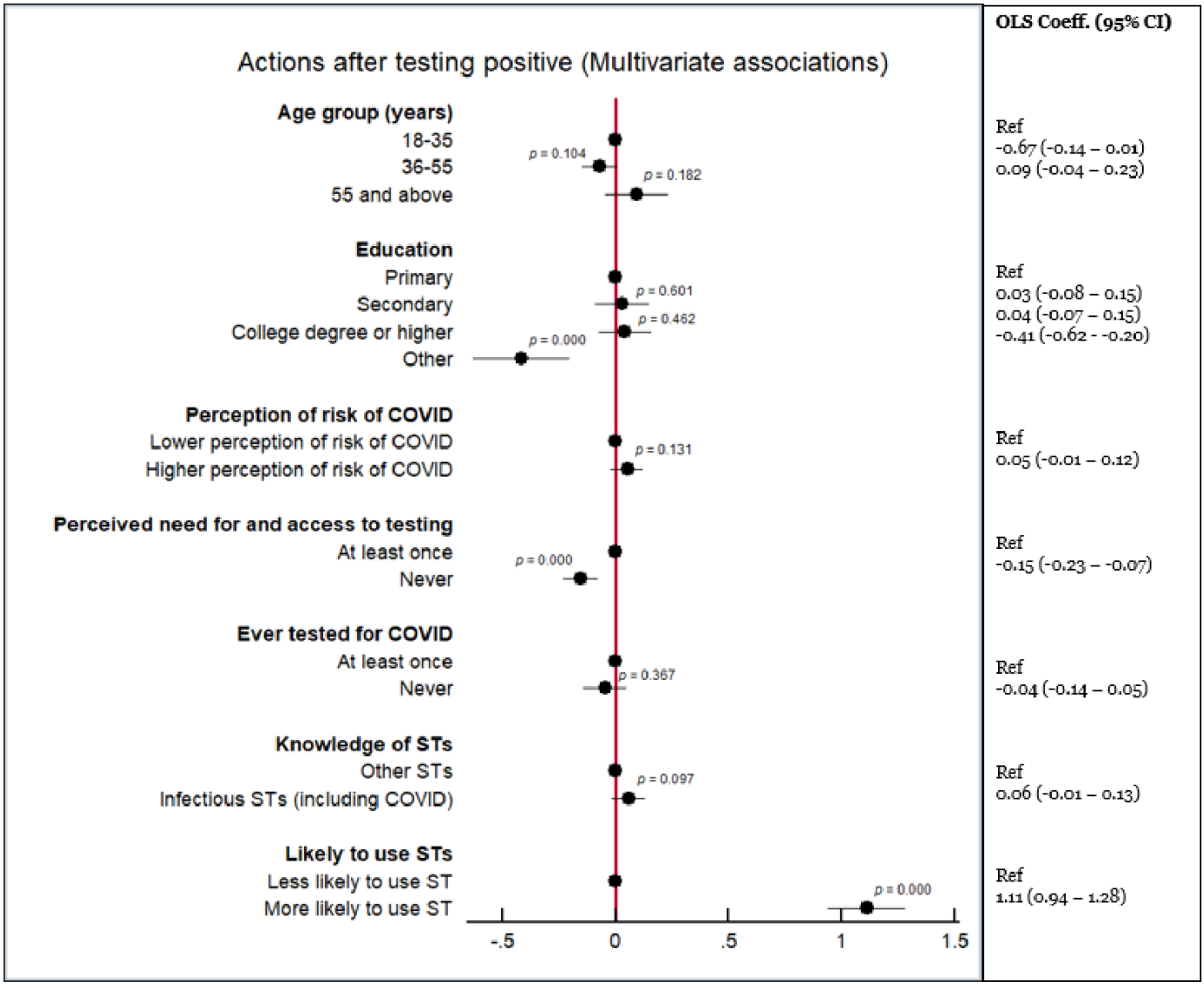

Figure 3 Ordinary least squares (OLS) analysis to assess factors associated with the compliance of adults in Nigeria with recommended hygiene and preventive measures post-COVID-19 self-testing (N=2126). ST, Self-testing; OLS, Ordinary Least Square; Coeff., Coefficient; 95%CI, 95% Confidence Interval; Ref, Reference.

for prompt decisions about mechanisms to ramp up COVID-19 testing.[29] Market stratification for targeted interventions may be needed when promoting the use of self-test kits. In our survey, more than two-thirds of respondents were willing to pay for a self-test. Our multivariate analyses indicated that older respondents and those at higher risk of severe COVID-19 disease were less willing to pay for a self-test. A household-based survey conducted in Kenya also identified that 63.1% of respondents were willing to pay for a self-test if it was not provided for free, and respondents 36 years and older were less likely to be willing to pay for a self-test.[30]

Incorrect perceptions about the need for COVID-19 testing also reduced interest in using and or in paying for a self-test, although Aduh *et al*[31] suggested possible ways to address challenges that may ensue from poor perceptions of COVID-19 risk. Our study indicates that when risk is perceived, people are willing to self-test and are also more likely to comply with expected actions following a positive COVID-19 self-test result. However, unlike in the UK where participants of a mixed-method study expressed willingness to maintain the use of COVID-19 preventive measures after a negative result,[23] half of the respondents in our study would not self-isolate after a negative result even if they had symptoms compatible with COVID-19 and they had been in contact with a COVID-19 case. As in other countries, provision of information on the possibility of false negative results will be needed when self-testing is introduced in Nigeria. Programmes designed to ramp up COVID-19 self-testing could include campaigns that address risk perception, understanding on the limitations of using self-diagnostics for infectious diseases, as well as cost concerns that might prevent those at risk of severe COVID-19 infection from taking advantage of a tool that can facilitate prompt access to care and help prevent the spread of the SARS-CoV-2.

It is estimated that 39.1% of Nigerians were living below the international poverty line of US$1.90 per person per day in 2018/2019[32] Thus the average maximum cost of a self-test (US$1.84, SD 3.029) proposed by our survey respondents may be beyond the reach of many Nigerians. Strategic policy and programme decisions must be taken now, ahead of any introduction of COVID-19 self-test kits into the Nigerian market, including the possibility of subsidies, as was the case with HIV self-test kits.

LIMITATIONS

Our large, nationally representative sample suggests these findings are generalisable to the wider population in Nigeria; however, our survey had some limitations. First, there is a possibility that social desirability bias might have influenced how the respondents indicated the likelihood of using or paying for a self-test, or how they would react if they received a positive result. There was also a risk that their preconceived ideas and assumptions on self-tests might have also influenced their responses. To mitigate these risks, images of how a nasal self-test should be conducted were showed to the respondents prior to the administration of the survey. In future, acceptability studies framed alongside self-test implementation research may help to further ground the responses in reality.

The risk of selection bias was mitigated by the application of a five-pronged probabilistic sampling approach. However, at the outset, the decisions we took regarding the selection of study states and study urban sites might have influenced an under-representation of low literate or unemployed individuals in the sample. Additionally, the decision to recruit respondents in their homes rather than in the streets could have skewed the sample towards an over-representation of individuals who are most often found at home. We tried to reduce this risk by ensuring that all sites' survey schedules covered all days of the week, and facilitating the logistics (including security personnel) necessary for the surveyors to recruit respondents from dawn until dusk in each site.

CONCLUSION

In conclusion, a majority of the Nigerian public appreciates that self-tests represent an approach that could help them test for SARS-CoV-2 infection. If a self-test result is positive, most would self-isolate and communicate the result to local health authorities. Those who self-test negative may stop isolating, even if they had symptoms and were a close contact of a COVID-19 case. Information on the possibility of false negative results, alongside information on how to handle and dispose self-tests safely, will be indispensable. Further sensitisation on the potential of self-tests and on procedures to follow if experiencing COVID-19 symptoms, alongside the provision of financial and social safety nets for the most vulnerable, is necessary if self-tests are to assist individuals in becoming actors for change.

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Contributors SS, EIR and GZM-P developed the initial research project. MF adapted the research protocol and led the implementation of the study in Nigeria. MF, GZM-P and SS wrote the manuscript. GZM-P, DB and AB performed the data analyses. VU, OA, RA, MI, PAO and OM coordinated the state surveys. All authors have reviewed and approved the final version of the manuscript. SS is responsible, as the guarantor, for the overall content of the article.

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REFERENCES

1 Adepoju P. Nigeria responds to COVID-19; first case detected in sub-Saharan Africa. *Nat Med* 2020;26:444–8.
2 Adesanya OA. Government preparedness and response towards COVID-19 outbreak in nigeria: a retrospective analysis of the last 6 months. *J Glob Health* 2020;10
3 Johns Hopkins Coronavirus Resource Centre. Nigeria: COVID-19 overview. 2022. Available: https://coronavirus.jhu.edu/region/nigeria [Accessed 20 Jan 2022].
4 Ahanhanzo C, Johnson EAK, Eboreime EA, *et al*. COVID-19 in west africa: regional resource mobilisation and allocation in the first year of the pandemic. *BMJ Glob Health* 2021;6:e004762.

5 Shaibu JO, Onwuamah CK, James AB, *et al*. Full length genomic sanger sequencing and phylogenetic analysis of severe acute respiratory syndrome coronavirus 2 (SARS-cov-2) in nigeria. *PLoS One* 2021;16
6 Happi C, Okwuraiwe A, Onwuamah C, *et al*. First african SARS-cov-2 genome sequence from nigerian COVID-19 case. 2020;
7 World Health Organization, FIND the global alliance for diagnostics. SARS-cov-2 antigen-detecting rapid diagnostic tests: an implementation guide. 2020. Available: https://www.who.int/publications/i/item/9789240017740 [Accessed 20 Jan 2022].
8 Garba B, Zakaria Z, Salihu MD, *et al*. Breaking the cycle of the COVID-19 transmission: a challenge for nigeria. *J Glob Health* 2020;10
9 Dan-Nwafor C, Ochu CL, Elimian K, *et al*. Nigeria's public health response to the COVID-19 pandemic: january to may 2020. *J Glob Health* 2020;10
10 European Centre for Disease Prevention and Control. Considerations on the use of self-tests for COVID-19 in the EU/EEA. 2021. Available: https://www.ecdc.europa.eu/en/publications-data/considerations-use-self-tests-covid-19-eueea
11 Hoehl S, Schenk B, Rudych O, *et al*. High-frequency self-testing by schoolteachers for sars-cov-2 using a rapid antigen test–results of the safe school hesse study. *Dtsch Arztebl Int* 2021;118:252–3.
12 Lindner AK, Nikolai O, Rohardt C, *et al*. Diagnostic accuracy and feasibility of patient self-testing with a SARS-cov-2 antigen-detecting rapid test. *J Clin Virol* 2021;141:104874.
13 Indian Council of Medical Research. COVID-19 home testing using rapid antigen tests (rats). 2021. Available: https://www.icmr.gov.in/pdf/covid/kits/COVID_Home_Test_Kit_06012022.pdf [Accessed 1 Jan 2022].
14 U.S. Food and Drug Administration. Coronavirus (COVID-19) update: FDA authorizes first COVID-19 test for self-testing at home. 2020. Available: https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-authorizes-first-covid-19-test-self-testing-home [Accessed 31 Jan 2022].
15 Self-testing.gov.gr. οδηγίες προς τους πολίτες. 2021. Available: https://self-testing.gov.gr/ [Accessed 22 Jun 2021].
16 Wanat M, Logan M, Hirst JA, *et al*. Perceptions on undertaking regular asymptomatic self-testing for COVID-19 using lateral flow tests: a qualitative study of university students and staff. *BMJ Open* 2021;11
17 Goggolidou P, Hodges-Mameletzis I, Purewal S, *et al*. Self-testing as an invaluable tool in fighting the COVID-19 pandemic. *J Prim Care Community Health* 2021;12
18 Jairoun AA, Al Hemyari SS, Abdulla NM, *et al*. Acceptability and willingness of UAE residents to use OTC vending machines to deliver self-testing kits for COVID-19 and the implications. *J Multidiscip Healthc* 2022;15:1759–70.
19 Bevan I, Stage Baxter M, Stagg HR, *et al*. Knowledge, attitudes, and behavior related to COVID-19 testing: a rapid scoping review. *Diagnostics (Basel)* 2021;11
20 Shilton S, Ivanova Reipold E, Roca Álvarez A, *et al*. Assessing values and preferences toward SARS-cov-2 self-testing among the general population and their representatives, health care personnel, and decision-makers: protocol for a multicountry mixed methods study. *JMIR Res Protoc* 2021;10
21 Thomas C, Shilton S, Thomas C, *et al*. Values and preferences of the general population in indonesia in relation to COVID-19 self-testing: A cross-sectional survey. *Public and Global Health* [Preprint].
22 Martínez-Pérez GZ, Shilton S, Saruê M, *et al*. Self-testing for SARS-cov-2 in São paulo, brazil: results of a population-based values and attitudes survey. *BMC Infect Dis* 2022;22:720.
23 Mathers J, Poyner C, Thompson D, *et al*. Exploration of the uptake of asymptomatic COVID-19 lateral flow testing in birmingham, UK: survey and qualitative research. *BMJ Open* 2022;12
24 Nigeria Centre for Disease Control. COVID-19 Nigeria. 2022. Available: https://covid19.ncdc.gov.ng/ [Accessed 20 Jan 2022].
25 Anjorin AA, Abioye AI, Asowata OE, *et al*. Comorbidities and the COVID-19 pandemic dynamics in Africa. *Trop Med Int Health* 2021;26:2–13.
26 UNAIDS. Country: Nigeria. 2021. Available: https://www.unaids.org/en/regionscountries/countries/nigeria [Accessed 20 Jan 2022].
27 Federal Ministry of Health Nigeria. National tuberculosis catastrophic cost survey: report of the national survey to determine the proportion of TB patients and their households experiencing catastrophic cost due to TB; 2017.
28 World Health Organization. Nigeria fulfils commitment, launches plan for the prevention and control of non-communicable diseases. 2019. Available: https://www.afro.who.int/news/nigeria-fulfils-commitment-launches-plan-prevention-and-control-non-communicable-diseases#:~:text=In%20Nigeria%2C%20research%20by%20WHO,NMSAP%20between%202019%2D2025.%E2%80%9D [Accessed 20 Jan 2022].
29 Irwin A, Lain J, Vishwanath T. Using data to combat the ongoing crisis, and the next, in nigeria. 2021. Available: https://blogs.worldbank.org/opendata/using-data-combat-ongoing-crisis-and-next-nigeria [Accessed 24 Jan 2022].
30 Manguro G, Shilton S, Omenda S, *et al*. Are kenyans likely to use COVID-19 self-testing kits? results from a cross-sectional survey. *Int J Public Health* 2022;67
31 Aduh U, Folayan MO, Afe A, *et al*. Risk perception, public health interventions, and covid-19 pandemic control in sub-Saharan Africa. *J Public Health Afr* 2020;
32 World Bank. Poverty & equity brief - nigeria. 2021. Available: https://databank.worldbank.org/data/download/poverty/987B9C90-CB9F-4D93-AE8C-750588BF00QA/AM2020/Global_POVEQ_NGA.pdf [Accessed 17 Feb 2022].