The prospective COVID-19 vaccine: Willingness to pay and perception of community members in Ibadan, Nigeria (#53473)

First revision

Guidance from your Editor

Please submit by **29 Dec 2020** for the benefit of the authors .

Structure and Criteria
Please read the 'Structure and Criteria' page for general guidance.

Custom checks
Make sure you include the custom checks shown below, in your review.

Raw data check
Review the raw data.

Image check
Check that figures and images have not been inappropriately manipulated.

Privacy reminder: If uploading an annotated PDF, remove identifiable information to remain anonymous.

Files

Download and review all files from the materials page.

1 Tracked changes manuscript(s)
1 Rebuttal letter(s)
1 Figure file(s)
4 Table file(s)
1 Raw data file(s)
2 Other file(s)

Custom checks

Human participant/human tissue checks

- Have you checked the authors ethical approval statement?
- Does the study meet our article requirements?
- Has identifiable info been removed from all files?
- Were the experiments necessary and ethical?

Structure and Criteria

Structure your review

The review form is divided into 5 sections. Please consider these when composing your review:

1. **BASIC REPORTING**
2. **EXPERIMENTAL DESIGN**
3. **VALIDITY OF THE FINDINGS**
4. General comments
5. Confidential notes to the editor

You can also annotate this PDF and upload it as part of your review

When ready submit online.

Editorial Criteria

Use these criteria points to structure your review. The full detailed editorial criteria is on your guidance page.

BASIC REPORTING

- Clear, unambiguous, professional English language used throughout.
- Intro & background to show context. Literature well referenced & relevant.
- Structure conforms to PeerJ standards, discipline norm, or improved for clarity.
- Figures are relevant, high quality, well labelled & described.
- Raw data supplied (see PeerJ policy).

EXPERIMENTAL DESIGN

- Original primary research within Scope of the journal.
- Research question well defined, relevant & meaningful. It is stated how the research fills an identified knowledge gap.
- Rigorous investigation performed to a high technical & ethical standard.
- Methods described with sufficient detail & information to replicate.

VALIDITY OF THE FINDINGS

- Impact and novelty not assessed. Negative/inconclusive results accepted. *Meaningful* replication encouraged where rationale & benefit to literature is clearly stated.
- All underlying data have been provided; they are robust, statistically sound, & controlled.
- Speculation is welcome, but should be identified as such.
- Conclusions are well stated, linked to original research question & limited to supporting results.

Standout reviewing tips

The best reviewers use these techniques

Tip	*Example*
Support criticisms with evidence from the text or from other sources	*Smith et al (J of Methodology, 2005, V3, pp 123) have shown that the analysis you use in Lines 241-250 is not the most appropriate for this situation. Please explain why you used this method.*
Give specific suggestions on how to improve the manuscript	*Your introduction needs more detail. I suggest that you improve the description at lines 57- 86 to provide more justification for your study (specifically, you should expand upon the knowledge gap being filled).*
Comment on language and grammar issues	*The English language should be improved to ensure that an international audience can clearly understand your text. Some examples where the language could be improved include lines 23, 77, 121, 128 – the current phrasing makes comprehension difficult.*
Organize by importance of the issues, and number your points	*1. Your most important issue* *2. The next most important item* *3. …* *4. The least important points*
Please provide constructive criticism, and avoid personal opinions	*I thank you for providing the raw data, however your supplemental files need more descriptive metadata identifiers to be useful to future readers. Although your results are compelling, the data analysis should be improved in the following ways: AA, BB, CC*
Comment on strengths (as well as weaknesses) of the manuscript	*I commend the authors for their extensive data set, compiled over many years of detailed fieldwork. In addition, the manuscript is clearly written in professional, unambiguous language. If there is a weakness, it is in the statistical analysis (as I have noted above) which should be improved upon before Acceptance.*

The prospective COVID-19 vaccine: Willingness to pay and perception of community members in Ibadan, Nigeria

Olayinka Ilesanmi [Corresp., 1, 2], **Aanuoluwapo Afolabi** [Corresp., 1], **Obioma Uchendu** [1, 2]

[1] Department of Community Medicine, University of Ibadan, Ibadan, Oyo, Nigeria

[2] Department of Community Medicine, University College Hospital, Ibadan, Oyo, Nigeria

Corresponding Authors: Olayinka Ilesanmi, Aanuoluwapo Afolabi
Email address: ileolasteve@yahoo.co.uk, afoannade@gmail.com

BACKGROUND. The ongoing development of the COVID-19 vaccine necessitates the assessment of individual perception regarding the vaccine. This study aimed to assess the perception of community members and willingness to pay for the prospective COVID-19 vaccine in Ibadan, Nigeria.

METHODS. A descriptive cross-sectional study design was used. Data were collected using an interviewer-administered questionnaire in September, 2020. We studied community members aged 15 years and above using a multi-stage sampling technique. The perceptions of respondents about COVID-19 was assessed on 8 questions using the five-point Likert scale with a score point of "1" assigned for "Strongly Agree", "2" for Strongly Agree", "3" for "Not decided", "4" for "Disagree", and "5" for "Strongly disagree". During analysis, we reverse-coded the options by assigning a point of "1" for "Strongly disagree", "2" for "Disagree", "3" for "Not decided", "4" for "Agree", and "5" for "Strongly disagree". However, questions asked in the negative directions were not reverse-coded during analysis. Eight questions were used to assess the perception of community members regarding the prospective COVID-19 vaccine, and overall, the maximum point was 40. Points greater than or equal to 80% (≥32 points) implied positive perception. Descriptive statistics were done. Chi-square tests were used for the assessment of associations between sociodemographic characteristics and willingness to pay for the prospective COVID-19 vaccine. We conducted logistic regression tests on statistically significant variables at p-values <0.05.

RESULTS. The mean age of the 440 respondents studied was 37.22 ± 15.36 years, 193 (49%) were males, and 292 (67.3%) of the respondents had heard of the prospective COVID-19 vaccine. Among them, 232 (79.5%) respondents had positive perception regarding COVID-19 vaccine. Individuals in the fifth wealth quintile were ten times more likely to be willing to pay for the prospective COVID-19 vaccine compared to those in the first wealth quintile [Adjusted Odds Ratio=9.57, (95%CI=2.878-31.82) **p=<0.01**].

CONCLUSION. The prospective COVID-19 vaccine should be subsidized or made freely available to everyone.

The prospective COVID-19 vaccine: Willingness to pay and perception of community members in Ibadan, Nigeria.

Olayinka Ilesanmi[1,2], Aanuoluwapo Afolabi[1&], Obioma Uchendu[1,2]

Authors' Affiliations

[1]Department of Community Medicine, University of Ibadan, Oyo state, Nigeria

[2]Department of Community Medicine, University College Hospital, Oyo state, Nigeria

[&]corresponding author:

Aanuoluwapo Afolabi

Email: afoannade@gmail.com

+2348146764516

Abstract

BACKGROUND.

The ongoing development of the COVID-19 vaccine necessitates the assessment of individual perception regarding the vaccine. This study aimed to assess the perception of community members and willingness to pay for the prospective COVID-19 vaccine in Ibadan, Nigeria.

METHODS.

A descriptive cross-sectional study design was used. Data were collected using an interviewer-administered questionnaire in September, 2020. We studied community members aged 15 years and above using a multi-stage sampling technique. The perceptions of respondents about COVID-19 was assessed on 8 questions using the five-point Likert scale with a score point of "1" assigned for "Strongly Agree", "2" for Strongly Agree", "3" for "Not decided", "4" for "Disagree", and "5" for "Strongly disagree". During analysis, we reverse-coded the options by assigning a point of "1" for "Strongly disagree", "2" for "Disagree", "3" for "Not decided", "4" for "Agree", and "5" for "Strongly disagree". However, questions asked in the negative directions were not reverse-coded during analysis. Eight questions were used to assess the perception of community members regarding the prospective COVID-19 vaccine, and overall, the maximum point was 40. Points greater than or equal to 80% (≥32 points) implied positive perception. Descriptive statistics were done. Chi-square tests were used for the assessment of associations between sociodemographic characteristics and willingness to pay for the prospective COVID-19 vaccine. We conducted logistic regression tests on statistically significant variables at p-values <0.05.

RESULTS.

The mean age of the 440 respondents studied was 37.22 ± 15.36 years, 193 (49%) were males, and 292 (67.3%) of the respondents had heard of the prospective COVID-19 vaccine. Among them, 232 (79.5%) respondents had positive perception regarding COVID-19 vaccine. Individuals in the fifth wealth quintile were ten times more likely to be willing to pay for the prospective COVID-19 vaccine compared to those in the first wealth quintile [Adjusted Odds Ratio=9.57, (95%CI=2.878-31.82), **p=<0.01**].

CONCLUSION.

The prospective COVID-19 vaccine should be subsidized or made freely available to everyone.

INTRODUCTION

The 2019-Coronavirus disease (COVID-19) is a droplet infection characterized by rapid transmission, high mortality rate, and resulting complications among humans globally (Al-Hanawi et al., 2020). Due to these features, COVID-19 was declared a global pandemic by the World Health Organization (WHO), and thus necessitated the implementation of non-pharmaceutical control measures by all countries around the globe (WHO, 2020). These control measures have included the use of face masks, social distancing, school lockdowns, border closure, and hygiene protocols (Ilesanmi et al., 2020a&b; NCDC, 2020a). In spite of these containment and control efforts (Ilesanmi et al., 2020a&b; NCDC, 2020a), COVID-19 has remained a global threat with 63,821,835 cases and 1 482 541deaths recorded as of 2nd December, 2020 of which the African continent makes up 3.4% of cases and 3.5% mortality. The Nigerian COVID-19 experience has also been reported with 56604 cases and 1091 deaths (ECDC, 2020). The daily rise in COVID-19-related cases and fatalities thus indicate the inadequacy of the present COVID-19 mitigation measures. This therefore reveals the need for the development of vaccines for the aversion of further spread of COVID-19 locally and globally, a task for which individual perception needs to be considered.

Vaccines have demonstrated an excellent historical capacity for the elimination of many infectious illnesses such as tetanus, diphtheria, polio, rabies, pertussis, measles, and yellow fever (Chukuocha et al., 2020). The routine immunization program and the expanded program on immunization have enabled the number of persons covered for immunization (Chukwuocha et al., 2020). These programs have represented great feats in the prevention of common childhood illnesses and the maintenance of the well-being of children. In the context of malarial infection, the development of an efficacious malarial vaccine has been suggested as a vital strategy for reducing the burden of malaria especially in malarial-endemic countries such as Nigeria and Ghana (Ojakaa et al., 2011). The RTS,S malaria vaccine has been developed, and is being researched for appropriate technology to evaluate its efficacy (Ojakaa et al., 2011). The development of a safe and effective vaccine against the Ebolavirus disease (EVD) has been identified as an important tool for the prevention of future EVD outbreaks (Ojakaa et al., 2011; Huo et al., 2016). In lieu of this, experimental vaccines on EVD have commenced in five districts in Sierra Leone where majority of EVD cases have been recorded. Vaccine development

however introduces new interventions. These may however be met with some challenges (Huo et al., 2016).

Challenges have been experienced following the introduction of new health interventions in some settings. For instance, a polio vaccination program was rejected in a community in northern Nigeria due to wrong perception of religious leaders therein (Jegede, 2007). A similar experience was recorded in Ghana where community members rejected a mass deworming program scheduled by the government (Dodoo et al., 2007). In both instances, misunderstanding of the programs was responsible for their unsuccessful implementation (Febir et al, 2013). It is therefore evident that perception shapes one's knowledge of an infection and the acceptance of vaccination for its prevention. The Health Belief Model also posits that high levels of perceived susceptibility to an infection increases the likelihood for adopting and accepting of disease-preventive measures (Tarkang & Zotor, 2015). This array of evidence therefore indicates the need for evaluating the perception and practices of individuals prior to the introduction of a health intervention for each illness.

The uptake of vaccines and treatment options for illnesses have been described as an outplay of the cost evaluation in such regard among community members (Hajizadeh, 2018). Direct costs defined as the exact cost borne for the procurement of vaccines could be borne by a third party e.g. the government to improve the uptake of vaccines (Chukwuocha et al., 2018); however, the uptake of vaccines may remain yet unsatisfactory. Unsatisfactory levels of vaccine uptake could result from the indirect costs attached to receiving such vaccines. Indirect costs such as transportation expenses to the health facility, loss of productive hours during vaccination waiting time, and registration bills at health facilities could deter the acceptance of vaccination programs to reasonable levels (Hajizadeh, 2018). In the COVID-19 context, indirect costs could limit the prospective vaccine uptake despite the direct costs being borne by a sponsoring body. Although associated costs cannot be completely borne, the COVID-19 vaccine sponsoring body would need to ensure the decentralization of vaccine collection points to existing primary health centers available in community settings.

Given the novelty of COVID-19, its associated fatality, and ongoing efforts for the development of an effective COVID-19 vaccine, it therefore becomes needful to examine the knowledge, attitudes, and practices of community members in this regard. Findings from this study would be

helpful for the adequate planning for the introduction of effective COVID-19 vaccine. This formative study would thus be important in quickening prompt interventions which would be targeted at stimulating the right kind of support at community levels. This study therefore aimed to assess the willingness to pay and perception of community members in Oyo State, Nigeria regarding the COVID-19 vaccine.

MATERIALS AND METHODS

Study design and study setting

We conducted a descriptive cross-sectional study. Data was collected using an interviewer-administered questionnaire. Scheduled data collection took place between the 21st and 2?th of September, 2020. We conducted the study in Ibadan, Oyo State, Nigeria. Ibadan is the third most populated city, and the largest city by geographical area in Nigeria. Ibadan is located 128 kilometres inland northeast of Lagos and 530 kilometres southwest of Abuja, the Federal Capital Territory. As of 2nd December, 2020, Oyo State ranked fourth on the states affected by COVID-19 with 3,728 COVID-19 cases and 45 deaths recorded on the NCDC COVID-19 reports (NCDC, 2020b). The *lingua franca* in Nigeria is English Language, and the major informal language frequently used for communication in Ibadan is Yoruba.

Study population

All community members were enrolled as the study population in the selected communities in Ibadan. All individuals who consented were included in the study. Community members less than 15 years were excluded because parental consent which would be required may not be possible due to parental absence when data collection was ongoing. We obtained verbal consent from all study participants.

Sample size determination and sampling technique

We calculated the sample size using the formula for descriptive cross-sectional studies. The sample size was determined by the Leshlie Kish formula for sample determination for a single proportion as shown below:

$n = Z^2_\alpha * p\ (1 - p)/d^2$ where:

n = Minimum desired sample size

143 Z_α = the standard normal deviate, usually set as 1.96 which corresponds to a 5% level of
144 significance.

145 p = 50% was used

146 d = Degree of accuracy (precision) set at 5% (0.05)

147 We adjusted for a 10% non-response rate, and therefore generated a total sample size of 440
148 respondents.

149 We selected study respondents using a multi-stage sampling technique. In the stage 1, simple
150 random sampling was used to select 4 out of the 5 urban local government areas in Ibadan. The
151 choice of urban LGAs was preempted by the knowledge that many COVID-19 hotspots in
152 Ibadan are located in the urban LGAs. In the stage 2, we selected a political ward from each of
153 the selected LGAs. From each of the selected wards, we randomly chose a center location. The
154 direction of movement of the interviewers was determined by spinning a bottle. From areas
155 corresponding to the direction of the bottle tip, all consenting eligible adults who gave their
156 consents were included in the study until 110 persons were interviewed in each LGA. Therefore,
157 we sampled a total of 440 individuals across the communities in the selected wards.

158 **Data collection methods**

159 The questionnaire had six sections.

160 Section A, named "Sociodemographic characteristics" included respondents' information such as
161 age of respondents, sex, occupation, religion, highest level of education, ethnicity, marital status,
162 average monthly income, and wealth quintile. The second section named "Knowledge of
163 COVID-19" was used to elicit information on the knowledge of COVID-19 among community
164 members. The third section, "Knowledge of the prospective COVID-19 vaccine" provided
165 details on the knowledge of community members regarding the prospective COVID-19 vaccine.
166 The fourth section, named "Perceptions about the prospective COVID-19 vaccine" elicited
167 information on the perceptions of community members regarding the prospective COVID-19
168 vaccine. The fifth section, "Willingness to pay for the prospective COVID-19 vaccine" examined
169 the willingness of community members regarding payment for the prospective COVID-19
170 vaccine. The sixth section, "Information required before accepting the prospective COVID-19

vaccine" provided details on the information community members required before willingness to accept the COVID-19 vaccine could be gained.

Close-ended questions were asked on the knowledge of COVID-19 as well as the awareness of the prospective COVID-19 vaccine. Eight questions were asked on the perception about COVID-19 vaccine using a five-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree". The questions asked are as follows: "COVID-19 is a major public health problem requiring vaccine", "COVID-19 vaccine will prevent COVID-19", "COVID-19 vaccine should get administered to everyone", "COVID-19 vaccine is against our cultural belief", "COVID-19 vaccine will save productive hours lost to COVID-19 illness", "COVID-19 vaccine will save money spent on COVID-19 treatment", "I will take the COVID-19 vaccine when produced", and the "COVID-19 vaccine will not have adverse health effect". Close-ended questions were asked on the willingness to pay for the COVID-19 vaccine and the intent to comply with the prospective COVID-19 vaccine. The questions included "Are you willing to pay for the COVID-19 vaccine?", "If yes, specify reasons for your willingness", "If no, specify reasons for your unwillingness", and "What maximum amount are you willing to pay for the vaccine?". The interviewer correctly marked all points stated by the respondents.

We adapted the questionnaire from a tool used in a similar perception study on malarial vaccine in Southeast Nigeria (Chukuocha et al., 2018). Tool validation was done by an infectious disease epidemiologist. The questionnaire was pre-tested by the administration of 5 questionnaires in communities that were not selected for this study. We rephrased a few ambiguous questions. We back-translated the questionnaire using the competencies of experts who had an excellent grasp of the Yoruba language. We administered the questionnaire to most of the respondents in English language because a larger proportion of the study respondents had at least basic formal education. A postgraduate student was trained for data collection, and this helped to eliminate potential bias associated with administration of questionnaire by more individuals.

Independent variables included: Sociodemographic characteristics such as age, sex, level of education, occupation, and ethnic group.

Outcome/dependent variables were the knowledge of the prospective COVID-19 vaccine, perception regarding the prospective COVID-19 vaccine, willingness to pay for the vaccine, and information required before accepting the prospective COVID-19 vaccine.

Data management

The questionnaires were entered on the Statistical Program for Social Sciences (SPSS) after which data entry and cleaning was done. Data were analyzed with SPSS version 20 (IBM Corp, 2011). Age was summarized using mean and standard deviation, while frequencies and percentages were used for categorical variables. We assigned points of "1" and "0" to each correct and incorrect identified cause of COVID-19 respectively for 5 questions on the causes of COVID-19. Using the Bloom's cut-off, individuals with 3 or more cumulative points were categorized to have good knowledge of the cause of COVID-19, while people with lower points therefore had poor knowledge of COVID-19 cause.

We calculated the wealth index of respondents using the Principal Components Analysis (PCA) in SPSS (IBM Corp, 2011). The input to the PCA included responses on ownership of house and other key assets 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. Thereafter, we calculated distribution cut-off points using quintiles. The quintiles were Q1= first, Q2=second, Q3=third, Q4= fourth, Q5=fifth; with the poorest in the first wealth quintile and the richest in the fifth wealth quintile.

Individuals who have heard of the prospective COVID-19 vaccine were assigned a score of "1", while those who have not heard were assigned a score of "0". Among the respondents who have heard of the prospective vaccine, the sources of COVID-19 vaccine information were assessed. The perceptions of respondents about COVID-19 was assessed using the five-point Likert scale with options ranging from "Strongly Agree" to "Strongly disagree". We assigned a score of "1" to the "Strongly Agree "option, "2" to the "Agree" option; "3" to the "Not decided" option, "4" to the "Disagree" option, and "5" to the "Strongly disagree" option. At the point of data analysis, recoding of the five-point Likert scale was done for questions which had been asked in the positive direction. Therefore, we computed a score of "5" for the "Strongly Agree" option, "4" for "Agree", "3" for "Not decided", "2" for "Disagree", and "1" for the "Strongly disagree" option. Eight questions were asked on the perception of community members regarding the

prospective COVID-19 vaccine for which a total of "40" points were obtainable. Using the Bloom's cut-off point, scores greater than or equal to 80% (≥32 points) implied positive perception, while those corresponding to <80% (<32 points) implied negative perception regarding the prospective COVID-19 vaccine.

Chi-square tests were used for the assessment of associations between sociodemographic characteristics and willingness to pay for the prospective COVID-19 vaccine. Multivariate analysis of the determinants of willingness to pay for the prospective COVID-19 vaccine was conducted using the Logistic regression model. Since no data was collected at stages 1 and 2 of the sampling process, we built logistic regression without adjusting for clustering. P-values <0.05 were statistically significant.

Ethical approval and consent to participate

We obtained ethical approval for this study as part of COVID-19 Knowledge, attitude, practice and perception studies from the Oyo State Ministry of Health Ethical Review Committee with reference number AD/13/479/1779A. Informed consent and/or assent where required was obtained from the respondents. All respondents were assured of the confidentiality of information obtained from them. The respondents were duly informed of their right to withdraw from the study prior to its completion without any adverse implication. No known harm was inflicted on the respondents as a result of participation in this study.

255

256

257

258

259

260 **RESULTS**

261 The mean age of the 440 respondents was 37.22 ± 15.36 years. Overall, 202 (45.90%) were aged
262 between 21 and 40 years. Among the respondents, 193 (43.90%) were males, 293 (66.60%)
263 practiced Christianity, 371 (84.3%) were Yoruba, and 285 (64.80%) were married. Other
264 sociodemographic information is as shown in Table 1.

265 Among the respondents, 311 (70.70%) had good knowledge of the cause of COVID-19. The
266 causes of COVID-19 stated included contacts with saliva from a COVID-19-infected person and
267 participating in burial rites of a person who has died from COVID-19. Other causes mentioned
268 by respondents included contact with beddings, clothing, and personal utensils of a person who is
269 sick of COVID-19, and respiratory droplets of an infected person. Also, 292 (67.30%) of the
270 respondents had heard of the prospective COVID-19 vaccine. Among them, 205 (70.20%) had
271 gotten the prospective COVID-19 vaccine information from the radio, while 201 (68.80%) had
272 been informed on the prospective COVID-19 vaccine via the television. Also, 175 (59.90%)
273 respondents were informed of the COVID-19 vaccine through the social media. Other sources of
274 information on the prospective COVID-19 vaccine are as shown in Figure 1.

275 Table 2 shows the perceptions on the prospective COVID-19 vaccine among respondents.
276 Among the respondents, 281 (96.20%) strongly agreed that COVID-19 is a major public health
277 problem requiring vaccine, while 279 (95.50%) strongly agreed that the COVID19 vaccine
278 would prevent COVID-19. Also, 182 (62.30%) strongly disagreed that the COVID-19 vaccine is
279 against their cultural belief, and 180 (61.60%) strongly agreed to take the COVID-19 vaccine
280 when produced.

281 Overall, 232 (79.50%) respondents had positive perception regarding COVID-19 vaccine
282 compared to 60 (20.50%) with negative perception. Eighty-one (18.40%) of the respondents

were willing to pay for the prospective COVID-19 vaccine, among whom 45 (55.6%) were willing to pay at least 5000 naira ($13.16). All 81 (100.00%) respondents who were willing to pay for the COVID-19 vaccine attributed their willingness to the need to stay healthy. All 359 (100.00%) respondents who were unwilling to pay for the vaccine attributed their unwillingness to the unaffordability of vaccine costs by households. Also, 275 (62.50%) respondents require specific information on the prospective COVID-19 vaccine before accepting it (Table 3).

Fourteen (15.90%) respondents who belonged to the fourth wealth quintile were willing to pay for the prospective COVID-19 vaccine compared to 74 (84.10%) within same wealth quintile who were unwilling to pay. Forty-eight (54.50%) respondents in the fifth wealth quintile were willing to pay for the prospective COVID-19 vaccine compared to 40(45.50%) who were unwilling to pay (X^2= 99.32, **p=<0.01**). Individuals in the fourth wealth quintile were twice more likely to be willing to pay for the COVID-19 vaccine compared to those in the first wealth quintile [Adjusted Odds Ratio=2.22, 95%CI=0.66-7.44), p=0.20). Individuals in the fifth wealth quintile were ten times more likely to be willing to pay for the prospective COVID-19 vaccine compared to those in the first wealth quintile [Adjusted Odds Ratio=9.57, (95%CI=2.88-31.82), p=**<0.01]**. Other determinants of the willingness to pay for the COVID-19 vaccine are as shown in Table 4.

DISCUSSION

This study found that a large proportion of individuals (100%) were aware of the COVID-19 infection. Such a level of awareness is expected because COVID-19 occurrence is not a completely new event in Nigeria. Nigeria has been faced with the COVID-19 pandemic since the 27th of February, 2020, and implemented some mitigation measures regarding the containment of the COVID-19 infection. In this study, we found that many individuals (67.3%) are aware of the prospective COVID-19 vaccine. This finding could be possibly explained by the higher proportion of individuals with secondary education and above enrolled in this study. Some literatures have also reported the positive relationship between education and health awareness (Sani et al., 2016; Wang et al., 2018). Education may therefore be an important predictor of the awareness of prospective health interventions in communities with more educated persons. However, alternate channels of information could be employed in communicating intended health interventions across all educational levels in communities.

Regarding the source of information on the prospective COVID-19 vaccine, traditional media such as the radio and television provided more information to more individuals compared to other channels of information dissemination. Other studies have reported the dominance of traditional media in communicating COVID-19-related information (Olapegba et al., 2020; Ilesanmi & Afolabi, 2020a). The social media, a modern channel of information source, also accounted for nearly two-thirds of COVID-19 vaccine information. Findings from Egypt however reported that Facebook, a modern information site mainly provided information on COVID-19 to her citizens (Abdelhafiz et al., 2020). In addition, the internet, a social media platform, provided more Undergraduate students in Jordan with information on COVID-19 (Olaimat et al., 2020). This finding therefore highlights the need for harnessing these channels of information dissemination with high coverage to communicate rich information on the COVID-19 vaccine. Due to the aforementioned reasons, the Nigeria Center for Disease Control utilizes both the traditional and social media platforms for communicating COVID-19 information (Adepoju, 2020; Sote, 2020). In the COVID-19 vaccine context, it is required that collaboration be implemented across these platforms for the timely dissemination of information to members of the public. Health facilities should also be equipped with up-to-date information on the prospective COVID-19 vaccine for dissemination to individuals on hospital visits.

We found that many individuals acknowledged that COVID-19 is a public health problem requiring vaccine, and were confident that the COVID-19 vaccine will prevent COVID-19. The demonstration of such levels of assurance could be described as an outplay of the positive results gained from previous vaccination programs such as oral polio vaccination (OPV), measles, and yellow fever (Doherty et al., 2016). These vaccination programs led to a drastic reduction in the incidence of these illness, and helped to maintain healthy conditions in children (Febir et al., 2013; Chukwuocha et al., 2018). Many respondents strongly agreed that the COVID-19 vaccine will save productive hours and money lost to the COVID-19 illness. Loss of productive hours in the COVID-19 context has been reported to include the turn-out time for collection of COVID-19 test results, and time spent on isolation (Ilesanmi and Afolabi, 2020b&c). Despite of these potential benefits presented by the prospective COVID-19 vaccine, fewer persons however expressed their willingness to take the COVID-19 vaccine. Such unwillingness for vaccine acceptance stemmed from the skepticism associated with the affordability of the COVID-19 vaccine by households if costs were involved.

The minimum monthly wage of 30, 000 naira ($78.95) received by many Nigerians is an evidence that if COVID-19 vaccine costs exceeds 5,000 naira ($13.16), such procurement may not be affordable to the average Nigerian. Non-compliance to health interventions especially in low-resourced settings have been linked to the costs and affordability of such interventions. This has therefore limited the successes achieved on priority illnesses, such as malaria (Chukwuocha et al., 2018). Health interventions with no attached healthcare costs have achieved better results (Chukwuocha et al., 2018). Affordability by households should therefore be one of the factors given precedence during the planning and implementation of the prospective COVID-19 vaccine production. In addition, consideration should be given to all income groups in the population so that no population subgroup would be excluded from partaking of the prospective COVID-19 vaccine program.

Among the respondents who would require specific information on the prospective COVID-19 vaccine, information on payments was the most frequently stated required information. This posits that the costs attached could either reduce or increase the uptake of the COVD-19 vaccine when produced. Many individuals would also require information on the possible side effects before accepting the COVID-19 vaccine. Although it is known that many existing vaccines have minimal levels of side effects such as temporary diarrhea (CDC, 2020), the novelty of the prospective COVID-19 vaccine necessitates specific information on its side effects. If the possible side effects of the prospective COVID-19 vaccine are not too different from the side effects experienced with other illnesses for which vaccines are received, more individuals are likely to accept the prospective COVID-19 vaccine. Studies conducted on malarial vaccine have similarly documented side effects as an inevitable factor which influences the acceptance and compliance with the malarial vaccine (Menaca et al., 2014; Abdulkadir et al., 2015). The side effects of the prospective COVID-19 vaccine (if any) should be communicated alongside COVID-19 mitigation measures on the radio, tv, internet sites, and health facilities to ensure that no one is excluded regarding the COVID-19 vaccine information.

This study found that occupation is an important determinant to the willingness to pay for the COVID-19 vaccine. We similarly found that wealth index also determines the willingness to pay for the COVID-19 vaccine. This finding therefore implies that individuals in the higher wealth quintile are willing to pay for the prospective COVID-19 vaccine primarily because they could

afford it. Building on the foregoing, persons in the lower wealth quintile would be missed out on in the implementation of the prospective COVID-19 vaccine if only the higher wealth quintiles are considered regarding affordability of the COVID-19 vaccine. Previous studies conducted on malarial vaccine did not report any association between occupation or wealth index and willingness to pay for the vaccine (Menaca et al., 2014; Abdulkadir et al., 2015). In view of the present study, the COVID-19 pandemic has greatly affected the income of many individuals, and this could be an explanation for this finding. This finding further posits the need for the subsidization of the COVID-19 vaccine to improve the uptake of the vaccine when available.

Strengths of the Study

Up-to-date, majority of COVID-19 researches have been conducted on the knowledge, attitude, and practices of population groups on the COVID-19 illness itself. In line with recent developments on the containment and prevention of the COVID-19 infection, the present study has gone a step further in assessing the perception and willingness to pay for the prospective COVID-19 vaccine. To the best of our knowledge, this is the first of its kind. We also ruled out bias associated with multiple data collectors or the use of electronic data collection tools by using only one interviewer for data collection.

Limitations of the Study

Firstly, the study respondents were largely literate. The findings from this study therefore may not be generalizable in a less-literate setting. Also, the use of a small sample size limited the results obtained during further analysis, resulting in an extremely large confidence interval.

Conclusion

The perception of the prospective COVID-19 vaccine determines the willingness to take the COVID-19 vaccine. It also influences the compliance of an individual with the prospective COVID-19 vaccine. Individuals may be willing to take the COVID-19 vaccine, however the cost of purchasing it may not be affordable. It is therefore required that the prospective COVID-19 vaccine is fully subsidized or freely given in order to encourage its uptake among all individuals. In addition, information on the prospective COVID-19 vaccine and possible adverse effects

should be adequately communicated in clear terms through different channels of information such as tv and radio stations, social media, and health facilities. This will aid the implementation, acceptance, and compliance to the prospective COVID-19 vaccine, and will aid the sustainable journey towards the elimination of the COVID-19 pandemic. Further research should be conducted across COVID-19 affected countries to assess the preparedness of community members towards the eventual roll-out of the prospective COVID-19 vaccine.

ACKNOWLEDGEMENTS

The authors are grateful to all the community members who participated in this research.

References

Abdulkadir BI, Ajayi IO. 2015. Willingness to accept malaria vaccine among caregivers of under-5 children in Ibadan North Local Government Area, Nigeria. *MalariaWorld Journal* 6:2.

Adepoju P. 2020. Nigeria responds to COVID-19; first case detected in sub-Saharan Africa. *Nature Medicine* 26(4). doi: 10.1038/d41591-020-00004-2.

CDC. 2018. Vaccines and preventable diseases. *Available at https://www.cdc.gov/vaccines/vpd/rotavirus/public/index.html*. (Accessed 02 October, 2020).

Chukwuocha M, Okorie PC, Iwuoha GN, Ibe SN, Dozie IN. 2018. Awareness, perceptions and intent to comply with the prospective malaria vaccine in parts of South Eastern Nigeria. *BMC Malaria Journal* 17:187. doi: 10.1186/s12936-018-2335-0.

Dodoo A, Adjei S, Couper M, Hugman B, Edwards R: 2007. When rumors derail a mass deworming exercise. *Lancet* 370:465–466. doi: 10.1016/S0140-6736(07)61211-2.

ECDC. 2020. COVID-19 situation update worldwide, as of 19 September 2020. *Available at https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases*. (accessed 02 December 2020).

Doherty M, Buchy P, Standaert B, Giaquinto C, Prado-Cohrs D. 2020. Vaccine impact: benefits for human health. *Vaccine* 34(52):6707-6714. doi: 10.1016/j.vaccine.2016.10.025.

Febir LG, Asante KP, Dzorgbo D-B S, Senal KA, Letsa TS, Owusu-Agyei S. 2013. Community perceptions of a malaria vaccine in the Kintampo districts of Ghana. *Malaria Journal* 12:156. doi: 10.1186/1475-2875-11-394.

Hajizadeh M. 2018. Socioeconomic inequalities in child vaccination in low/middle-income countries: what accounts for the differences? *Journal of Epidemiology and Community Health* 72:719–725. doi:10.1136/jech-2017-210296.

Huo X, Shi G, Li X, Lai X, Deng L, Xu F, Chen M, Wei Q, Samba T, Liang X. 2016. Knowledge and attitudes about Ebola vaccine among the general population in Sierra Leone. *Vaccine* 34(15):1767-1772. doi:10.1016/j.vaccine.2016.02.046.

IBM Corp. 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.

Ilesanmi OS, Afolabi AA. 2020a. Perception and practices during the COVID-19 pandemic in an urban community in Nigeria: a cross-sectional study. *Peer Journal* 8:e10038. doi: 10.7717/peerj.10038.

Ilesanmi OS, Afolabi AA. 2020b. In search of the true prevalence of COVID-19 in Africa: Time to involve more stakeholders. *International Journal of Health and Life Sciences* In Press(In Press):e108105. doi: 10.5812/ijhls.108105.

Ilesanmi OS, Afolabi AA. 2020c. Time to move from vertical to horizontal approach in our COVID-19 response in Nigeria. *SciMedicine Journal* 3(Special):198-200.

Ilesanmi OS, Oguntoye AA, Afolabi AA. 2020a. The new norm in the management of COVID-19 positives: Home-based care. *Journal of Ideas in Health* 3(4):252-253.

Ilesanmi OS, Ariyo M, Afolabi AA. 2020b. Domestic violence amid the COVID-19 lockdown: a threat to individual safety. *Global Biosecurity* 2(1).

Jegede AS. 2007. What led to the Nigerian boycott of the polio vaccination campaign? *PLoS Medicine* 4:e73. doi: 10.1371/journal.pmed.0040073. doi: 10.28991/SciMedJ-2020-02-SI-3.

Menaca A, Tagbor H, Adjei R, Bart-Plange C, Collymore Y, Ba-Nguz A, Mertes K, Bingham A. 2014. Factors likely to affect community acceptance of a malaria vaccine in two districts of Ghana: a qualitative study. *PLoS ONE*. 2014;9:e109707. doi:10.1371/journal.pone.0109707.

NCDC. 2020. COVID-19 Nigeria. Nigeria Centre for Disease Control. *Available at https://covid19.ncdc.gov.ng*/. (accessed 01 December 2020).

NCDC. 2020. COVID-19 Nigeria. Nigeria Centre for Disease Control. Available at https://covid19.ncdc.gov.ng/. (accessed 02 December 2020).

Ojakaa DI, Ofware P, Machira YW, Yamo E, Collymore Y, Ba-Nguz A, Vansadia P, Bingham A. 2011. Community perceptions of malaria and vaccines in the South Coast and Busia regions of Kenya. *Malaria Journal* 10:147. doi: 10.1186/1475-2875-10-147.

478 Olaimat AN, Aolymat I, Shahbaz HM, Holley RA. 2020. Knowledge and Information Sources
479 About COVID-19 Among University Students in Jordan: A Cross-Sectional Study. *Frontiers in*
480 *Public Health* 8: 254. doi: 10.3389/fpubh.2020.00254. eCollection 2020.

481 Sani AM, Naab F, Aziato L. 2016. Influence of educational level on knowledge and practice of
482 breast self-examination among women in Sokoto, Nigeria. *Journal of Basic and Clinical*
483 *Reproductive Sciences* 5(2):100-106. doi: 10.4103/2278-960X.194482.

484 Sote L. 2020. So that Coronavirus won't consume us. The Punch Newspaper. *Available at*
485 *https://punchng.com/so-that-coronavirus-wont-consume-us/.* (accessed 20 June 2020).

486 Tarkang EE, Zotor FB. 2015. Application of the Health Belief Model (HBM) in HIV Prevention:
487 A Literature Review. *Central African Journal of Public Health* 1: 1-8.
488 doi: 10.11648/j.cajph.20150101.11

489 Wang M, Han X, Fang H, Xu C, Lin X, Xia S, Yu W, He J, Jiang S, Tao H. 2018. Impact of
490 Health education on knowledge and behaviors towards infectious diseases among students in
491 Gansu Province, China. BioMed Research International.2018;1-12. doi: 10.1155/2018/6397340.

492 WHO. 2020. Coronavirus disease 2019 (COVID-19) Situation Report –51 Geneva: World
493 Health Organization. *Available at https://covid19.who.int/.* (accessed 19 September 2020).

494

495

496

497

498

499

Figure 1

Sources of information on the prospective COVID-19 vaccine among community members in Ibadan, Nigeria

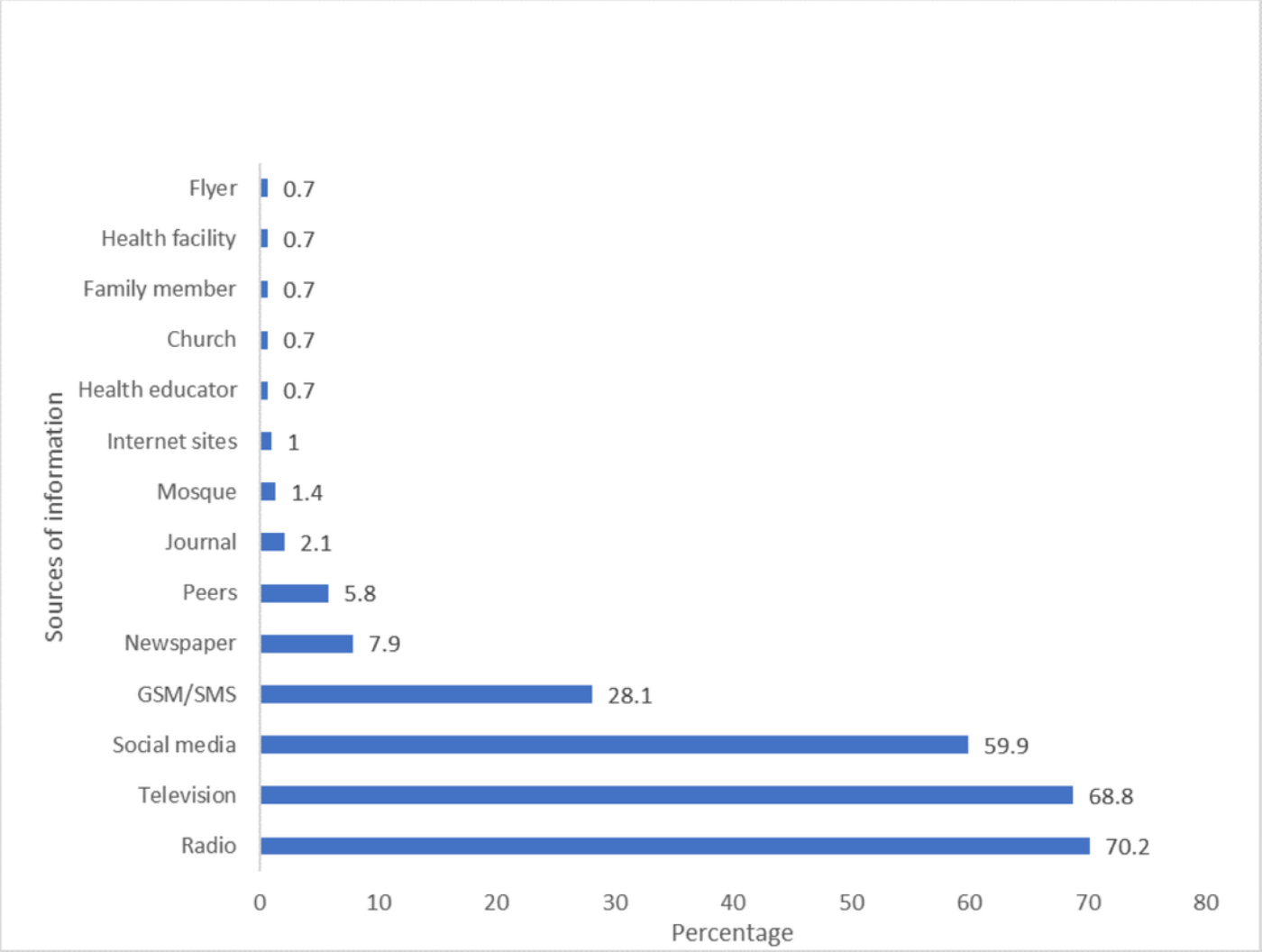

Table 1(on next page)

Socio-demographic characteristics of community members in Ibadan, Nigeria

Socio-demographic Characteristics	Frequency	%
Age group (Years)		
≤20	68	15.50
21-40	202	45.90
41-60	131	29.80
>60	39	8.90
Sex		
Male	193	43.90
Female	247	56.10
Religion		
Christianity	293	66.60
Islam	145	33.00
Traditional	2	0.50
Highest level of Education		
Primary and below	64	14.50
Secondary and above	376	85.50
Ethnicity		
Yoruba	371	84.30
Ibo	59	13.40
Hausa	10	2.30
Occupation		
Business/Trader	162	36.80
Artisan	101	23.00
Professional/Civil Servant/Teacher	68	15.50
Retiree/housewife/cleric/student	109	24.80
Marital Status		
Married	285	64.80
Single	132	30.00
Others*	23	5.20
Average monthly income		
<30,000 naira	149	33.90
≥30,000 naira	291	66.10
Wealth quintiles		
First	88	20.00
Second	88	20.00
Third	88	20.00
Fourth	88	20.00
Fifth	88	20.00

***: Widowed/divorced**

Table 2(on next page)

Perceptions on the prospective COVID-19 vaccine among community members in Ibadan, Nigeria

Perception	Frequency	%
COVID-19 is a major public health problem requiring vaccine		
Strongly Agreed	281	96.20
Agreed	2	0.70
Not decided	3	1.00
Disagree	-	-
Strongly disagreed	6	2.10
COVID-19 vaccine will prevent COVID-19		
Strongly Agreed	279	95.50
Agreed	3	1.00
Not decided	4	1.40
Disagree	-	-
Strongly disagreed	6	2.10
COVID-19 vaccine should get administered to everyone		
Strongly Agreed	209	71.60
Agreed	-	-
Not decided	11	3.80
Disagree	26	8.90
Strongly disagreed	46	15.80
COVID-19 vaccine is against our cultural belief		
Strongly Agreed	31	10.60
Agreed	35	12.00
Not decided	44	15.10
Disagree	-	-
Strongly disagreed	182	62.30
COVID-19 vaccine will save productive hours lost to COVID-19 illness		
Strongly Agreed	270	92.50
Agreed	4	1.40
Not decided	13	4.50
Disagree	-	-
Strongly disagreed	5	1.70
COVID-19 vaccine will save money spent on COVID-19 treatment		
Strongly Agreed	272	93.20
Agreed	3	1.00
Not decided	12	4.10
Disagree	-	-

Strongly disagreed	5	1.70
I will take the vaccine when produced		
Strongly Agreed	180	61.60
Agreed	4	1.40
Not decided	76	26.00
Disagree	9	3.10
Strongly disagreed	23	7.90
COVID-19 vaccine will not have adverse health effects		
Strongly Agreed	133	45.50
Agreed	3	1.00
Not decided	147	50.30
Disagree	2	0.70
Strongly disagreed	7	2.40

1

2

3

Table 3(on next page)

Willingness to pay for the COVID-19 vaccine and COVID-19 information required by community members in Ibadan, Nigeria

	Frequency	%
Willingness to pay for the COVID-19 vaccine		
Yes	81	18.40
No	359	81.60
Maximum amount intended for payment		
<5000 naira ($13.16)	36	44.40
≥5000 naira ($13.16)	45	55.60
Reasons for willingness*		
To stay healthy	81	100.00
To prevent loss of productive hours	23	28.40
To prevent further treatment expenses	23	28.40
To promote social acceptability of vaccines	9	11.10
Reasons for unwillingness**		
Costs not affordable by households	359	100.00
Fear of adverse effects	30	8.40
Fear of inaccessibility of vaccines	2	0.60
Contrary to religious beliefs	16	4.50
Contrary to culture	1	0.30
Require specific information on COVID-19 vaccine (N=440)		
Yes	275	62.50
No	165	37.50
Information required before accepting COVID-19 vaccine[##]**		
Whether payments would be required	248	90.20
Possible side effects of the vaccine	175	63.60
Number of doses needed	131	47.60
Whether the vaccine will prevent or cure COVID-19	90	32.70
Route of administration	58	21.10
Age range of individuals to be vaccinated	53	19.30
Manufacturer of the vaccine	24	8.70
Vaccine collection points	17	6.20
Duration of immunity provided	11	2.50
Whether vaccination would be accompanied by incentives	7	2.70
Vaccine's expiry date	2	0.50

1

2

Table 4(on next page)

Determinants of willingness to pay for COVID-19 vaccine among community members in Ibadan, Nigeria

Socio-demographic Characteristics	Willingness to pay		Adjusted Odds Ratio (95%CI)	p-value
	Yes Frequency (%)	No Frequency (%)		
Age group (Years)				
≤20	0 (0.00%)	60 (100.00)	0.0 (<0.01-<0.01)	1.00
20-39	27 (13.20)	177 (86.80)	0.82 (0.40- 1.71)	0.60
≥40	54 (30.70)	122 (69.30)	1	
	X^2 = 34.82	**p=<0.01**		
Sex				
Male	40 (20.70)	153 (79.30)		
Female	41 (16.60)	206 (83.40)		
	X^2 = 1.23	p=0.27		
Highest level of Education				
Primary and below	5 (7.80)	59 (92.20)	0.50 (0.16- 1.53)	0.23
Secondary and above	76 (20.20)	300 (79.80)	1	
	X^2 = 5.50	**p=0.02**		
Ethnicity				
Yoruba	66 (17.80)	305 (82.20)		
Ibo	15 (25.40)	44 (74.60)		
Hausa	0 (0)	10 (100.00)		
	X^2 = 4.28	p=0.12		
Occupation				
Business/Trader	32 (19.80)	130 (80.20)	0.61 (0.27- 1.39)	0.24
Artisan	22 (21.80)	79 (78.20)	0.50 (0.23- 1.07)	0.08
Professional/Civil Servant/Teacher	36 (38.20)	42 (61.80)	0.05 (0.01- 0.52)	**0.01**
Retiree/housewife/cleric/student	1 (0.90)	108 (99.10)	1	
	X^2=40.96	**p=<0.01**		
Marital Status				
Married	72 (25.30)	213 (74.70)	1.17 (0.19- 7.08)	0.87
Single	5 (3.80)	127 (96.20)	1.35 (0.43- 4.28)	0.61
Others*	4 (17.40)	19 (82.60)	1	
	X^2= 27.72	**p=<0.01**		
Average monthly income				
<30000	5 (3.40)	144 (96.60)	1.45 (0.45- 4.66)	0.53
≥30000	76 (26.10)	215 (73.90)	1	
	X^2= 33.99	**p=<0.01**		
Wealth quintiles				
First	5 (5.70)	83 (94.30)	1	
Second	6 (6.80)	82 (93.20)	1.21 (0.32- 4.60)	0.79
Third	8 (9.10)	80 (90.90)	1.14 (0.32- 4.12)	0.84
Fourth	14 (15.90)	74 (84.10)	2.22 (0.66- 7.44)	0.20
Fifth	48 (54.50)	40 (45.50)	9.57 (2.88- 31.82)	**<0.01**
	X^2= 99.32	**p=<0.01**		

1 ***: Divorced/Widowed, p<0.05**

2