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Uptake of COVID-19 vaccines and associated factors among adults in Uganda: a cross-sectional survey

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1 **Uptake of COVID-19 vaccines and associated factors among adults in**

2 **Uganda: a cross-sectional survey**

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1

22 **Abstract**

23 **Objective** The Coronavirus Disease (COVID-19) pandemic remains one of the most significant

24 public health challenges ever faced globally. Vaccines are key to ending the pandemic as well as

25 minimize its consequences. This study assessed the uptake of COVID-19 vaccines and

26 associated factors among adults in Uganda.

27 **Design, setting and participants** We conducted a cross-sectional mobile phone survey among

28 1173 adults across the four regions of Uganda.

29 **Main outcome variable** Participants reported their uptake of COVID-19 vaccines.

30 **Results** Overall, 49.7% had received COVID-19 vaccines with 19.2% having obtained a full

31 dose and 30.5% an incomplete dose. Among the unvaccinated, 91.0% indicated intention to

32 vaccinate. Major reasons for vaccine uptake were protection of self from COVID-19 (86.8%)

33 and a high perceived risk of getting the virus (19.6%). On the other hand, non-uptake was related

34 to vaccine unavailability (42.4%), lack of time (24.1%), and perceived safety (12.5%) and

35 effectiveness concerns (6.9%). The factors associated with receiving the COVID-19 vaccines

36 were older age ($\geq$ 65 years) (APR = 1.32 (95% CI: 1.08 – 1.61), secondary (APR = 1.36 (95%

37 CI: 1.12 – 1.65), or tertiary education (APR = 1.62 (95% CI: 1.31 – 2.00), and health workers as

38 a source of information on COVID-19 (APR = 1.26 (95% CI: 1.10 – 1.45). Also, those who

39 reported a medium-income (APR = 1.24 (1.02 – 1.52) and those resident in Northern (APR =

40 1.55, 95%CI 1.18 – 2.02) and Central regions (APR = 1.48, 95%CI 1.16 – 1.89) had a higher

41 uptake of COVID-19 vaccines.

42 **Conclusions** Uptake of COVID-19 vaccines was moderate in this sample and was associated

43 with older age, secondary and tertiary education, medium-income, region of residence, and

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44 health workers as a source of COVID-19 information. Efforts are needed to increase access to

45 vaccines and should utilize health workers as champions to enhance uptake.

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47 **Wordcount: 3250**

48

49 **Keywords:** associated factors, COVID-19, intention, uptake, Uganda, vaccines, willingness

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51 **STRENGTHS AND LIMITATIONS OF THIS STUDY**

52 • This study had a high response rate with over 94% of the participants consenting to

53 participate in the phone survey.

54 • Results from the backchecking with the same individuals showed high consistency with the

55 survey results.

56 • Being a mobile phone survey, the study participants were not representative of the population

57 as only those with a mobile phone could participate.

58 • Reporting of vaccination status could have been subject to social desirability bias, which we

59 minimized by reminding participants that the study was only for research purposes.

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67   **INTRODUCTION**

68   The Coronavirus disease of 2019 (COVID-19) has resulted in significant morbidity and mortality

69   globally and negatively disrupted multiple socio-economic sectors. As of 31st March 2022, over

70   488 million confirmed cases and 6.1 million deaths had been registered globally [1]. In Africa,

71   more than 11 million confirmed COVID-19 cases and 251,953 deaths were reported since the

72   onset of the epidemic. Within the same period, Uganda recorded 163,905 cumulative COVID-19

73   cases and 3,596 confirmed deaths [1]. In response and under the advice of the World Health

74   Organization, many countries at the beginning of the pandemic implemented non-pharmaceutical

75   interventions (NPIs) that restricted movement such as lockdowns and curfews. Several

76   governments both globally and in Africa also closed schools, places of worship, recreation

77   centres, and public places. Governments also promoted regular hand and respiratory hygiene,

78   wearing of facemasks, ensuring physical and social distancing, and working from home [2]. These

79   public health and social measures significantly impacted the delivery of routine health care

80   services, caused job losses, disrupted education and formal and informal trade, and increased

81   gender-based violence and mental health disorders [3-5].

82   Vaccines as key pharmaceutical interventions to contain COVID-19 were adopted almost one

83   year into the pandemic globally. Uganda recorded its first confirmed case of COVID-19 on 21st

84   March 2020 and received its first batch of COVID-19 vaccines one-year later in March 2021. At

85   the start, vaccination targeted high-risk groups including health workers, teachers, security

86   personnel, persons older than 50 years, and those with co-morbidities. Starting August 2021

87   when the country received more doses of vaccines, vaccination was opened up to all Ugandans

88   aged 18 years and above. Vaccines were largely available through designated health facilities,

89   outreaches and mobile vaccination service points. The Ministry of Health (MoH) ran media

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90 campaigns to mobilise communities for COVID-19 vaccination working hand in hand with local

91 government structures. High vaccination coverage was critical for containment of the pandemic,

92 re-opening of the economy and reversal of the negative socio-economic impacts of the NPIs.

93 However, the opening up of eligibility for vaccination was marred with negative information and

94 fears of vaccine hesitancy. In order to develop critical strategies to achieve high vaccination

95 coverage, there is need for an in-depth understanding of factors influencing the uptake of

96 COVID-19 vaccination. This study, therefore, sought to gather and analyse data to determine the

97 uptake of COVID-19 vaccines and associated factors among adults in Uganda.

98 **METHODS**

99 **Study setting**

100 This study was conducted in Uganda located in Eastern Africa. The country has 136 districts

101 distributed in four administrative regions (Northern, Eastern, Central, and Western) which were

102 all involved in the study. As of 2020, Uganda had an estimated population of approximately 41.8

103 million people [6]. Having registered its first confirmed case of COVID-19 in March 2020, the

104 country had by November 2021 experienced two waves of the disease. The first wave of the

105 pandemic occurred from August 2020 to February 2021 of various non-Delta variants while the

106 second wave happened from May to October 2021 fueled by the Delta variant [1 7].

107 **Study design and population**

108 This was a cross-sectional mobile phone survey conducted in November 2021 among a

109 nationally constituted sample of adults. The study enrolled persons aged ≥18 years sampled from

110 the country's four administrative regions: Central, Eastern, Northern and Western. We excluded

111 persons who said they were ill and unable to participate in the interview.

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Sample size estimation

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113 To enable tracking changes in adherence to NPIs following the introduction of vaccines, we used

114 a previous sample of study respondents from an earlier survey [8] whose data were collected in

115 March 2021 [8]. The sample size for the previous survey was determined using the Leslie Kish

116 formula for cross-sectional studies [9] considering the following assumptions: Two-sided Z

117 statistic corresponding to a 95% confidence interval (1.96), NPI adherence level of 50% since no

118 other study had been conducted to show the composite level of adherence, a precision of 5% and

119 a design effect of 2.5 [8]. Considering a non-response rate of 10%, the total sample size estimate

120 was 1056 people.

Sampling strategy

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122 We used the sample from an earlier survey [8], which was constituted following quota sampling.

123 Quotas were set on age, gender and location proportionate to national COVID-19 case

124 distribution statistics as of February 2021 [10]. With quotas in place, a simple randomly selected

125 (SRS) sample was obtained among the eligible population using a database of phone contacts of

126 previous survey respondents provided by a registered research firm. In cases of replacement of

127 previous participants due to unavailability or refusal to participate, a similar case distribution was

128 followed during sampling of new contacts.

Data collection

129

130 Data were collected using a structured survey questionnaire, with mostly closed-ended questions,

131 informed by a review of published literature [8 11 12]. The questionnaire was pretested among 20

132 people from the four regions of Uganda and relevant adjustments were made. The questionnaire

133 was translated into nine major local languages spoken in Uganda, namely: *Ateso, Luganda,*

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134 *Lugbara, Lugisu, Luo, Lusoga, Ngakarimojong, Runyankole-Rukiga* and *Runyoro-Rutooro.* A

135 separate group of translators validated the questionnaire translations and any discrepancies were

136 addressed. The final survey instrument in each language was programmed in SurveyCTO

137 software, incorporating appropriate routing, conditional logic, and other controls and uploaded

138 on hand-held mobile tablets. Bench testing of the survey questionnaire was conducted, and

139 adjustments made before actual data collection. Trained research assistants with a minimum of a

140 Diploma in a health-related field, fluent in the survey languages and with experience in mobile

141 surveys conducted the interviews. Research assistants made phone calls from a designated place

142 in Kampala to the respondents from whom they sought verbal informed consent after explaining

143 to them what the study entailed and entered data into the tablets. Respondents who preferred to

144 defer the phone interviews due to busy schedules or other reasons received follow-up phone calls

145 based on agreed-upon appointment times. Daily checks of the survey data were conducted to

146 monitor quality and intervene early and appropriately, as well as ensure adherence to established

147 quotas. A team of supervisors oversaw the work of the research assistants ensuring that questions

148 were asked appropriately, and respondents were interviewed in the language they were most

149 comfortable with. At the end of the interview period, we conducted back checking of 10% of

150 respondents to ascertain the quality of collected data.

151 **Data management and analysis strategy**

152 During data collection, each research assistant examined, edited, and cleaned their data daily

153 before uploading it to the server. Data were encrypted and anonymized on the server and later

154 downloaded and exported to Stata 15.0 for further cleaning. Data analysis was conducted in

155 Rstudio Version 1.4.1106 (RStudio, PBC). Descriptive statistics have been provided in the form

156 of means (standard deviation) for continuous variables while categorical variables have been

7

157   expressed as frequencies and percentages. Socioeconomic status was generated as an additive

158   index from 6 variables on household ownership of television, computer, sofa set, refrigerator,

159   and cassette/CD/DVD player, and access to electricity. The socio-economic status index was

160   then divided into tertiles. The dependent variable was self-reported uptake of COVID-19

161   vaccines, which constituted those who reported receiving at least one dose of any World Health

162   Organization (WHO) approved COVID-19 vaccines. We also determined the intention to uptake

163   COVID-19 vaccines by asking unvaccinated respondents if they intended to receive the vaccine.

164   The independent variables included socio-demographic characteristics (age, gender, employment

165   status, education and occupation, place of residence (urban vs. rural, region) and source of

166   information on COVID-19. To determine the factors associated with vaccination uptake, we ran

167   multivariable modified Poisson regressions with robust error variance and presented prevalence

168   ratios and corresponding 95% confidence intervals. Only variables with a p-value ≤ 0.2 at

169   bivariate levels were included in the final model.

170   **Patient and public involvement**

171   No patients or members of the public were involved in the study design, setting the research

172   questions, interpretation or writing up of results, or reporting of the research.

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178 **RESULTS**

179 **Sociodemographic characteristics of participants**

180 Of the 1,249 respondents reached, a total of 1,173 (94%) participants completed the survey. The

181 mean age of respondents was 39.7 years (SD ±14.2) and majority 717 (61.1%) were males. Half

182 606 (51.7%) of the study participants were from the Central region, 548 (46.8%) had an urban

183 residence and 548 (46.7%) belonged to the lowest socioeconomic tertile. Nearly four in ten

184 (39%) respondents had only primary or no formal education (Table 1).

185 *Table 1: Sociodemographic characteristics of participants*

Characteristic	Number of participants (N = 1,173)	Percentage (%)[1]
Sex		
Male	717	61.1
Female	456	38.9
Age group (years), Mean age (SD)	39.7 (±14.2)	
18 – 35	553	47.1
36 – 55	439	37.4
56 - 64	92	7.8
65+	89	7.6
Region of residence		
North	182	15.5
East	211	18
Central	606	51.7
West	174	14.8
Residence		
Urban	548	46.8
Rural	417	35.6
Semi-urban	207	17.7
Not stated	1	
Earnings per month ($)		
< 14	256	25.6
14 – 29	226	22.6
30 – 57	196	19.6
58 – 143	229	22.9
> 143	93	9.3

9

Characteristic	Number of participants (N = 1,173)	Percentage (%)[1]
Not stated	173	
Education level		
None or Incomplete Primary	265	23.2
Primary (completed)	180	15.7
Secondary	431	37.7
Tertiary	268	23.4
Not stated	27	
Socio-economic index		
Low	548	46.7
Middle	435	37.1
Higher	190	16.2
Religion		
Catholic	384	33.3
Anglican	372	32.3
Born Again (Pentecostal)	147	12.8
Muslim	226	19.6
Other religions	24	2.1
Not stated	20	
Current Occupation		
Unemployed	193	17.1
Employed	182	16.1
Self employed	355	31.4
Casual laborer	67	5.9
Farmer	334	29.5
Not stated	42	
Current household size, Mean (SD)	5.6 (3.5)	
5 or fewer	653	55.7
6 – 10	430	36.7
More than 10	90	7.7

186 [1] *Percentages calculated do not include respondents who did not record responses (e.g. "Not stated" in the tables)*

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188

189 **Uptake of COVID-19 vaccines and intention to vaccinate**

190 Among all respondents, 225 (19.2%) reported receiving a full dose of the vaccine and 357

191 (30.5%) an incomplete dose. Slightly above sixty per cent of the respondents 367 (63.2%)

192 reportedly experienced side effects following vaccination mostly fever 147 (40.1%), fatigue 115

10

(31.3%) and headache 101 (27.5%). Among those who had not received a vaccine, 537 (91.8%)

reported intention to vaccinate (

Table 2).

Table 2: Vaccination uptake and intention to vaccinate among participants

Variable	Count	Percentage (%)[1]
Vaccination uptake	**(n = 582)**	
Full dose (two shots)	225	19.2
Incomplete dose	357	30.5
No vaccination	590	50.3
Experienced any side effects after first dose		
No	214	36.8
Yes	367	63.2
Side effects reported	**(n = 367)**	
Fever	147	40.1
Fatigue	115	31.3
Headache	101	27.5
Muscle soreness /pain	95	25.9
Injection site reaction	88	24.0
Others[2]	38	10.4
Vaccination intention (among unvaccinated)	**n = 590**	
Intend to vaccinate	537	91.0
Did not intend to vaccinate	48	8.1
Did not know	5	0.8

[1] *Percentages calculated do not include respondents who did not record responses e.g. "Not stated" in the tables*
[2] *Allergic reaction, cough, body pain, dizziness, arrhythmias, body weakness, paralysis for a few days, erectile dysfunction for a few days*

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203 **Reasons for vaccine uptake/ non-uptake and intention/un intention to vaccinate**

204 The reasons for COVID-19 vaccine uptake and intention to vaccinate were similar with both

205 categories of respondents mostly reporting the need to obtain protection from COVID-19 and

206 having a high perceived risk of getting the virus. Over 40% of respondents who had not been

207 vaccinated attributed it to vaccine unavailability 250 (42.4%) and below a quarter of respondents

208 to not having time 142 (24.1%). The reasons for lack of intention to vaccinate were mainly

209 related to safety 24 (50.0%) and effectiveness concerns 17 (35.4%) which were similarly

210 reported for non-uptake of vaccines (

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227   Table 3).

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244   **Table 3: Reasons for (non) uptake of COVID-19 vaccines and intention to vaccinate**
245   **(multiple response)**

Reasons	Uptake of vaccines n = 582 (%)	Intention to vaccinate n = 537 (%)
To protect self from COVID-19	505 (86.8%)	458 (85.3%)
High perceived risk of getting COVID-19	114 (19.6)	90 (16.8%)
Prioritized due to health (comorbidities)	95 (16.3)	34 (6.3%)
Recommendation from health workers	81 (13.9)	38 (7.1)
Prioritized due to occupation	74 (12.7)	-
Travel purposes	44 (7.6)	45 (8.4%)

13

Job requirement	-	82 (15.3%)
Others	21 (3.6)[1]	20 (3.8)[2]
Reasons	**Non uptake of vaccines n = 590 (%)**	**No intention to vaccinate n = 48 (%)**
Vaccines are unavailable	250 (42.4)	1 (2.1)
Don't have time	142 (24.1)	2 (4.2)
Safety concerns	74 (12.5)	24 (50.0)
Doubt vaccine effectiveness	41 (6.9)	17 (35.4)
Not among eligible group	30 (5.1)	4 (8.3)
Transport costs	24 (4.1)	Not reported
Don't know where to access the vaccines from	20 (3.4)	Not reported
Do not fear COVID-19/ trust immunity	10 (1.7)	1 (2.1)
Others	82 (14.0)[3]	7 (14.6)[4]

246 [1] *Requirement for school attendance, being exemplary, following MOH guidelines, boosting*
247 *immunity, to access services, among the eligible group.*
248 [2] *Access to health services, government mandate, pressure from peers, to be exemplary,*
249 *requirement for school attendance.*
250 [3] *Pregnant, breastfeeding, waiting for another vaccine type, lack identification documents, long*
251 *queues, currently sick, recently recovered from COVID-19.*
252 [4] *Religious beliefs, do not believe COVID-19, HIV positive and fear side effects, underlying*
253 *Hepatitis B infection, Body already weak, Lack of identification documents.*
254

255 **Willingness to vaccinate for different vaccine types**

256 All respondents were asked if they would receive the different types of COVID-19 vaccines if

257 offered at that point and were free of charge. Only 316 (26.9%) reported that they would take

258 any vaccine regardless of the type and 488 (41.6%) indicated a willingness to take at least one

259 type of the vaccine. The most preferred COVID-19 vaccines types were Johnson and Johnson

260 436 (37.4%) and AstraZeneca 405 (34.7%) (Figure 1).

261

262 ***Figure 1 Willingness for COVID-19 vaccination for different vaccine types***

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264 **Factors associated with uptake of COVID-19 vaccines**

265 At the multivariable analysis level, participants aged ≥65 years had a 32% higher likelihood to

266 have been vaccinated compared to those aged 18-35 years (Adjusted PR = 1.32, 95% CI 1.08 –

267 1.61, p = 0.008). Participants from the Northern (adjusted PR = 1.55, 95% CI 1.18 – 2.02, p =

268 0.002) and Central regions (adjusted PR = 1.48, 95% CI 1.16 – 1.89, p = 0.002) respectively had

269 a 55% and 48% higher likelihood to have received the vaccine compared to those from the

270 Western region. Participants with secondary (adjusted PR = 1.36, 95% CI 1.12 – 1.65, p = 0.002)

271 or tertiary education (Adjusted PR = 1.62, 95% CI 1.31 – 2.00, p < 0.001) were more likely to

272 have received the COVID-19 vaccine compared to those with incomplete primary/no formal

273 education. Respondents whose monthly income was between $30 and $57 (APR = 1.24 (1.02 –

274 1.52), p = 0.029) had a higher uptake of COVID-19 vaccines than those who earned < $14.

275 Having health workers as a source of information on COVID-19 was associated with higher

276 uptake of COVID-19 vaccines in Uganda (adjusted PR = 1.26, 95%CI 1.10 – 1.45, p = 0.001)

277 (Table 4).

278 **Table 4: Factors associated with COVID-19 vaccine uptake among adults**

Variables / Characteristics	Self-reported uptake of COVID-19 vaccine		Unadjusted PR (95% CI)[1]	p-value	Adjusted PR (95% CI)[2]	p-value
	No (%)	Yes (%)				
Age in years						
18 – 35	296 (53.5)	257 (46.5)	1		1	
36 – 55	213 (48.6)	225 (51.4)	1.11 (0.97 – 1.26)	0.124	1.09 (0.95 – 1.25)	0.244
56 – 64	44 (47.8)	48 (52.2)	1.12 (0.91 – 1.39)	0.292	1.17 (0.92 – 1.48)	0.193
65+	37 (41.6)	52 (58.4)	1.26 (1.03 -1.53)	**0.023**	1.32 (1.08 – 1.61)	**0.008**
Region of residence						

15

Variables / Characteristics	Self-reported uptake of COVID-19 vaccine		Unadjusted PR (95% CI)[1]	p-value	Adjusted PR (95% CI)[2]	p-value
	No (%)	Yes (%)				
Western	115 (66.5)	58 (33.5)	1		1	
Northern	74 (40.7)	108 (59.3)	1.77 (1.39 – 2.25)	**<0.001**	1.55 (1.18 - 2.02)	**0.002**
Eastern	112 (53.1)	99 (46.9)	1.40 (1.09 – 1.80)	**0.010**	1.29 (0.99 - 1.69)	0.064
Central	289 (47.7)	317 (52.3)	1.56 (1.25– 1.95)	**0.001**	1.48 (1.16 - 1.89)	**0.002**
Residence						
Urban	270 (49.4)	277 (50.6)			1	
Rural	206 (49.4)	211 (50.6)	0.99 (0.88 – 1.13)	0.990	1.11 (0.97 – 1.28)	0.137
Semi-urban	114 (55.1)	93 (44.9)	0.89 (0.75 – 1.05)	0.173	0.92 (0.75 – 1.11)	0.373
Gender						
Male	351 (49.0)	366 (51.0)	1		1	
Female	239 (52.5)	216 (47.5)	0.93 (0,82 – 1.05)	0.237	1.00 (0.87 – 1.14)	0.973
Wealth index						
Low	290 (53.0)	257 (47.0)	1		1	
Middle	217 (49.9)	218 (50.1)	1.07 (0.94 – 1.21)	0.328	1.06 (0.91 – 1.24)	0.442
High	83 (43.7)	107 (56.3)	1.20 (1.03 – 1.40)	**0.021**	1.03 (0.83 – 1.28)	0.758
Current Occupation						
Unemployed	91 (47.2)	102 (52.8)	1		1	
Employed	76 (41.8)	106 (58.2)	1.10 (0.92 – 1.32)	0.294	1.03 (0.84 – 1.27)	0.763
Self employed	196 (55.2)	159 (44.8)	0.85 (0.71 – 1.01)	0.066	0.84 (0.68 – 1.02)	0.078
Casual laborer	45 (67.2)	22 (32.8)	0.62 (0.43 – 0.90)	**0.011**	0.73 (0.48 – 1.11)	0.146
Farmer	164 (49.1)	170 (50.9)	0.96 (0.81 – 1.14)	0.664	0.99 (0.82 – 1.19)	0.931
Education level						
No formal education / incomplete primary	161 (60.8)	104 (39.2)	1		1	

16

Variables / Characteristics	Self-reported uptake of COVID-19 vaccine		Unadjusted PR (95% CI)[1]	p-value	Adjusted PR (95% CI)[2]	p-value
	No (%)	Yes (%)				
Complete primary	109 (60.6)	71 (39.4)	1.01 (9.79 - 1.27)	0.966	1.00 (0.78 – 1.28)	0.998
Secondary education	207 (48.0)	224 (52.0)	1.32 (1.11 – 1.58)	**0.002**	1.36 (1.12 – 1.65)	**0.002**
Tertiary	98 (36.6)	170 (63.4)	1.62 (1.36 – 1.93)	**< 0.001**	1.62 (1.31 – 2.00)	**< 0.001**
Household size (mean)	5.41	5.99	1.02 (1.01 – 1.03)	**< 0.001**	1.02 (1.00 – 1.03)	0.071
Monthly income ($)						
< 14	144 (56.2)	112 (43.8)	1		1	
14 – 29	117 (51.8)	109 (48.2)	1.10 (0.91 – 1.34)	0.324	1.08 (0.89 – 1.32)	0.423
30 – 57	86 (43.9)	110 (56.1)	1.28 (1.07 – 1.55)	**0.009**	1.24 (1.02 – 1.52)	**0.029**
58 – 143	114 (49.8)	115 (50.2)	1.15 (0.95 – 1.39)	0.154	0.98 (0.79 – 1.22)	0.876
> 143	36 (38.7)	57 (61.3)	1.40 (1.13 – 1.73)	**0.002**	1.16 (0.91 – 1.49)	0.219
Health workers as source of information on COVID-19[3]						
No	245 (57.9)	178 (42.1)	1		1	
Yes	345 (46.1)	404 (53.9)	1.28 (1.13 – 1.45)	**< 0.001**	1.26 (1.10 – 1.45)	**0.001**

279 [1] *Bivariate analysis*

280 [2] *Multivariable analysis*

281 [3]*Other sources of information included family members, friends/peers, Radio, Television, community*

282 *members and social media among others which were dichotomized and included in the analysis but were*

283 *not significant*

284

285 **DISCUSSION**

286 This study examined the uptake of COVID-19 vaccines and associated factors among adults

287 aged 18 years and above in Uganda. Among the study participants, about one in five (19.2%)

288 reported receiving a full dose of the COVID-19 vaccine while 30.5% had received an incomplete

289 dose. Over 90% of those who were unvaccinated reported the intention to be vaccinated. The

290 major reasons for vaccine uptake and intention to vaccinate were protection of self from COVID-

17

291 19 and a high perceived risk of getting the virus while reasons for vaccine non-uptake were

292 vaccine unavailability, the lack of time to go get vaccinated, and safety and effectiveness

293 concerns. The factors that were associated with receiving the COVID-19 vaccine were older age

294 (65 years and above), having secondary education and above, having a moderate income, and

295 reporting health workers as a source of information on COVID-19. Being a resident of Northern

296 and Central Uganda was also associated with a high likelihood of receiving the vaccine.

297 Uptake of COVID-19 vaccines in this sample of respondents was higher for both full and

298 incomplete doses than the vaccinated proportion of the population as of November 2021 when

299 this study was conducted. Ministry of Health data of 8th November 2021 indicated that 55.8%

300 and 16.8% of the priority groups and 12.2% and 3.7% of the adult population had received their

301 first and second doses of the vaccine respectively [13]. The higher-than-baseline vaccination

302 coverage could be attributed to the use of mobile phones for the survey and thus the relatively

303 urbanized study sample whose access to vaccines was higher than those in rural areas. Moreover,

304 a high proportion of participants were from the Central region, which was most impacted by

305 COVID-19, and their experiences could have influenced vaccine uptake. In addition, intention to

306 vaccinate was very high at over 90%; higher than the combined "definite intention" of 57.8%

307 and "probable intention" of 26.2% from the March survey round [8]. In a November 2021 survey

308 among 23,000 respondents from 19 African Union members states including Uganda, (78%) of

309 respondents had either been vaccinated or were likely to get vaccinated [14]. The second COVID-

310 19 wave fueled by the Delta variant that was experienced in Uganda from June to September

311 2021 and led to at least 2,800 deaths compared to the less than 300 recorded at the end of the

312 first wave [1] [15] could also have contributed to the high uptake of the vaccine and intention-to-

313 vaccinate. In addition, there was concern about potential vaccine mandates including anticipation

18

314 that the unvaccinated would be denied health and social services which could also have increased

315 the intention to vaccinate.

316 The major reasons for vaccine uptake and intention to vaccinate were protection of self from

317 COVID-19 and a high perceived risk of getting the virus, similar to previous research [11]. This is

318 also an indication of the respondents' appreciation of the role of vaccines in preventing morbidity

319 and saving lives. Those unvaccinated attributed it to vaccine unavailability and the lack of time.

320 The survey in 19 African countries concluded that low vaccine uptake was mostly due to

321 unpredictable supply of vaccines and logistical hurdles than reluctance or refusal to get

322 vaccinated [14]. To bridge the willingness-intention-uptake gap in Uganda, the Ministry of Health

323 should increase access and availability of COVID-19 vaccines. Evidence shows that strategies

324 that take vaccines closer to the communities are likely to mitigate time and transport-related

325 barriers and increase vaccine uptake [16 17]. This could be achieved by increasing the number of

326 health facilities offering the vaccines, conducting more vaccination outreaches, or setting up

327 mobile vaccine points. The World Health Organization guidance has also emphasized the

328 importance of location and time in COVID-19 vaccine uptake [18]. On the other hand, the study

329 reported that safety and effectiveness concerns hindered vaccine uptake and intention to

330 vaccinate similar to previous research [8 11 19-22]. Of note as well was the observed high prevalence

331 (63%) of self-reported vaccine side effects which could go a long way in reinforcing safety

332 concerns among the population. Vaccine adverse events should be monitored closely, and

333 appropriate information, education and communication material developed including information

334 on expected side effects to counter their potential effect on the uptake of vaccination by the

335 unvaccinated. Accurate, consistent and transparent communication and dialogue about

336 uncertainty, risks and anticipated benefits can go a long way in building confidence and trust in

19

337 the COVID-19 vaccines and create motivation for vaccination [18] [22]. This could also bridge

338 observed gaps in vaccine preference to prevent this from being a barrier to vaccination. The

339 Johnson and Johnson vaccine being a single shot had a higher preference among respondents due

340 to the perceived inconvenience and unpredictability of obtaining a second vaccine dose.

341 It was not surprising that those aged 65 years and above had a higher vaccination uptake as these

342 were part of the prioritized group for COVID-19 vaccination in the country. Education status

343 also predicted vaccination status similar to previous research on COVID-19 vaccine acceptability

344 [23-26]. However, further efforts are required to ensure the dissemination of accurate and simple

345 COVID-19 vaccination messages to those of lower education levels including translating

346 information in the local languages so that this group is not left behind. A moderate income was

347 associated with higher vaccine uptake; however, this relationship was not sustained with

348 increasing income levels. The regional differences observed in the uptake of COVID-19 vaccines

349 may have been due to differences in vaccine access and availability, especially for Central region

350 which was most hit by the pandemic and was prioritized early during vaccine rollout. From

351 previous research, income levels and locations have been reported as predictors of COVID-19

352 vaccine acceptability [26] [27].

353 One major finding from our work was that respondents whose source of information on COVID-

354 19 was health workers had a higher likelihood for COVID-19 vaccination. This positions health

355 workers as a key resource in increasing vaccination uptake, and thus they should be furnished

356 with sufficient and accurate information and supported with effective communication tools to

357 influence their clients at facility and community level. Previous studies report that health worker

358 advice on vaccination was most trusted [11] [21]. Health workers can lead health education and

359 awareness programs on COVID-19 and use their platforms at health facility and community

20

360 level to influence the masses to uptake COVID-19 vaccines. However, vaccine uptake among

361 health workers themselves was low at the time even when they were prioritized for vaccination

362 from the start of the campaigns in Uganda and elsewhere. In a March 2021 survey in Uganda,

363 just after the launch of the COVID-19 vaccination exercise, a vaccine acceptability rate of 37.3%

364 and hesitancy of 30.7% were reported among medical students [12]. In a June to August 2021

365 online survey, acceptance or willingness to uptake the COVID-19 vaccine stood at over 97% and

366 65.3% of eye healthcare workers had received a COVID-19 vaccine shot influenced by high

367 perceived susceptibility and benefits [28]. An in-depth study among health workers reported the

368 lack of trust in the vaccine, fear of side effects, not feeling at risk, lack of sufficient information

369 about vaccines, health systems challenges and religious beliefs as barriers to COVID-19

370 vaccination [29]. When health workers are vaccinated, they are more likely to recommend the same

371 to their clients [30]. Therefore, appropriate interventions should be instituted to effectively deal

372 with vaccine hesitancy among health workers and have them as champions for COVID-19

373 vaccination.

374 **Study limitations and strengths**

375 Being a mobile phone survey, the study participants were not representative of the population

376 and only those with a mobile phone could participate, contributing to selection bias. However

377 mobile phone coverage in Uganda has increased over the years; according to the Uganda

378 National Household Survey 2020, 74.0% of Ugandans own mobile phones [31]. There was also

379 potential for social desirability bias, especially regarding reporting vaccination status which we

380 minimized by reminding participants that the study was only for research purposes. Also, as a

381 cross-sectional survey, the direction of associations observed is not clear. On the other hand, our

382 study had a high response rate with over 94% of the participants consenting to participate.

21

383 Results from the backchecking with the same individuals also showed high consistency with the

384 survey results. Our study provides insights into COVID-19 vaccination uptake and intention to

385 vaccinate which can facilitate the development of context-relevant strategies to increase

386 vaccinations.

387

388 **CONCLUSIONS**

389 Half of the study respondents were vaccinated against COVID-19, which was associated with

390 older age, higher education level, moderate income, region of residence and reporting health

391 workers as the source of COVID-19 information. Among the unvaccinated, over 90% expressed

392 intention to vaccinate. Efforts are needed to increase access to vaccines and utilize health

393 workers as a key resource in sharing information and champions to influence the masses which

394 should positively impact uptake of COVID-19 vaccines.

395

399

400 **Author Contributions**

401 RN, NC, SNK, AN, WS, LLT and RKW conceptualized and designed the study. RN, NC, SNK,

402 AN, IW, SKiz supported the data collection. RN, NC, SNK, AN, STW, IW, SKiz, SKiw, WS,

403 LLT and RKW contributed to analysis and interpretation of findings. RN, NC, STW wrote the

404 first draft of the manuscript. SNK, AN, IW, SKiz, SKiw, WS, LLT and RKW critically reviewed

405 the draft manuscript. All authors read and approved the final manuscript.

406

412

Competing interests

414 None declared.

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417

Patient and public involvement

419 Patients and/or the public were not involved in the design, or conduct, or reporting, or

420 dissemination plans of this research.

421

Consent for publication

423 Not applicable

424

Ethics approval and consent to participate

23

426 Ethical approval to conduct the survey was sought from the Makerere University School of

427 Public Health Higher Degrees Research and Ethics Committee (protocol SPH-2021-150) and the

428 study was registered by the Uganda National Council of Science and Technology (HS1742ES).

429 Verbal consent was provided before participation in the survey. Personally identifiable

430 information including name of respondent, their phone number and the household head name

431 were encrypted with passwords on the SurveyCTO server and drives and was only accessible to

432 the investigator(s). All phones and tablets used for data collection were password-protected to

433 protect respondent data.

434

435 **Data availability statement**

436 The data are available from the corresponding author on reasonable request.

437

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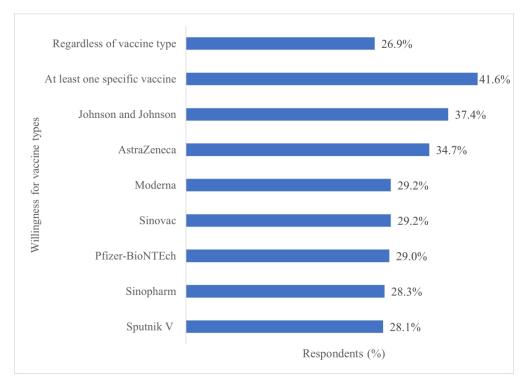
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For peer review only

28

Willingness for COVID-19 vaccination for different vaccine types

408x294mm (130 x 130 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6,20
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	7,8
		(*c*) Explain how missing data were addressed	7,8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	Not necessary
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9

		(b) Indicate number of participants with missing data for each variable of interest	9-16
Outcome data	15*	Report numbers of outcome events or summary measures	9-16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-16
		(*b*) Report category boundaries when continuous variables were categorized	9-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevant
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	None
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	20,21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	20,21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Uptake of COVID-19 vaccines and associated factors among adults in Uganda: a cross-sectional survey

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1 **Uptake of COVID-19 vaccines and associated factors among adults in**

2 **Uganda: a cross-sectional survey**

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1

Abstract

Objective The Coronavirus Disease (COVID-19) pandemic remains one of the most significant public health challenges ever faced globally. Vaccines are key to ending the pandemic as well as minimize its consequences. This study determined the uptake of COVID-19 vaccines and associated factors among adults in Uganda.

Design, setting and participants We conducted a cross-sectional mobile phone survey among adults in Uganda.

Main outcome variable Participants reported their uptake of COVID-19 vaccines.

Results Of the participants contacted, 94% (1173) completed the survey. Overall, 49.7% had received COVID-19 vaccines with 19.2% having obtained a full dose and 30.5% an incomplete dose. Among the unvaccinated, 91.0% indicated intention to vaccinate. Major reasons for vaccine uptake were protection of self from COVID-19 (86.8%) and a high perceived risk of getting the virus (19.6%). On the other hand, non-uptake was related to vaccine unavailability (42.4%), lack of time (24.1%), and perceived safety (12.5%) and effectiveness concerns (6.9%). The factors associated with receiving COVID-19 vaccines were older age ($\geq$ 65 years) (APR = 1.32 (95% CI: 1.08 − 1.61), secondary (APR = 1.36 (95% CI: 1.12 − 1.65), or tertiary education (APR = 1.62 (95% CI: 1.31 − 2.00), and health workers as a source of information on COVID-19 (APR = 1.26 (95% CI: 1.10 − 1.45). Also, reporting a medium-income (APR = 1.24 (1.02 − 1.52) and residence in Northern (APR = 1.55, 95% CI 1.18 − 2.02) and Central regions (APR = 1.48, 95% CI 1.16 − 1.89) were associated with vaccine uptake.

Conclusions Uptake of COVID-19 vaccines was moderate in this sample and was associated with older age, secondary and tertiary education, medium-income, region of residence, and

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44 health workers as a source of COVID-19 information. Efforts are needed to increase access to

45 vaccines and should utilize health workers as champions to enhance uptake.

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47 **Wordcount: 3300**

48

49 **Keywords:** associated factors, COVID-19, intention, uptake, Uganda, vaccines, willingness

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51 **STRENGTHS AND LIMITATIONS OF THIS STUDY**

52 • This study had a high response rate with over 94% of the participants consenting to

53 participate in the phone survey.

54 • Results from the backchecking with the same individuals showed high consistency with the

55 survey results.

56 • Being a mobile phone survey, the study participants were not representative of the population

57 as only those with a mobile phone could participate.

58 • Reporting of vaccination status could have been subject to social desirability bias, which we

59 minimized by reminding participants that the study was only for research purposes.

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INTRODUCTION

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68 The Coronavirus disease of 2019 (COVID-19) has resulted in significant morbidity and mortality

69 globally and negatively disrupted multiple socio-economic sectors. As of 31st March 2022, over

70 488 million confirmed cases and 6.1 million deaths had been registered globally [1]. In Africa,

71 more than 11 million confirmed COVID-19 cases and 251,953 deaths were reported since the

72 onset of the epidemic. Within the same period, Uganda recorded 163,905 cumulative COVID-19

73 cases and 3,596 confirmed deaths [1]. In response and under the advice of the World Health

74 Organization, many countries at the beginning of the pandemic implemented non-pharmaceutical

75 interventions (NPIs) that restricted movement such as lockdowns and curfews. Several

76 governments both globally and in Africa also closed schools, places of worship, recreation

77 centres, and public places. Governments also promoted regular hand and respiratory hygiene,

78 wearing of facemasks, ensuring physical and social distancing, and working from home [2].

79 These public health and social measures significantly impacted the delivery of routine health

80 care services, caused job losses, disrupted education and formal and informal trade, and

81 increased gender-based violence and mental health disorders [3-5].

82 Vaccines as key pharmaceutical interventions to contain COVID-19 were adopted almost one

83 year into the pandemic globally. Uganda recorded its first confirmed case of COVID-19 on 21st

84 March 2020 and received its first batch of COVID-19 vaccines one-year later in March 2021. At

85 the start, vaccination targeted high-risk groups including health workers, teachers, security

86 personnel, persons older than 50 years, and those with co-morbidities. Starting August 2021

87 when the country received more doses of vaccines, vaccination was opened up to all Ugandans

88 aged 18 years and above. Vaccines were largely available through designated health facilities,

89 outreaches and mobile vaccination service points. The Ministry of Health (MoH) ran media

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90 campaigns to mobilise communities for COVID-19 vaccination working hand in hand with local

91 government structures. High vaccination coverage was critical for containment of the pandemic,

92 re-opening of the economy and reversal of the negative socio-economic impacts of the NPIs.

93 However, the opening up of eligibility for vaccination was marred with negative information and

94 fears of vaccine hesitancy. In order to develop critical strategies to achieve high vaccination

95 coverage, there is need for an in-depth understanding of factors influencing the uptake of

96 COVID-19 vaccination. This study, therefore, sought to gather and analyse data to determine the

97 uptake of COVID-19 vaccines and associated factors among adults in Uganda.

98 **METHODS**

99 **Study setting**

100 This study was conducted in Uganda located in Eastern Africa. The country has 136 districts

101 distributed in four administrative regions (Northern, Eastern, Central, and Western) which were

102 all involved in the study. As of 2020, Uganda had an estimated population of approximately 41.8

103 million people [6]. Having registered its first confirmed case of COVID-19 in March 2020, the

104 country had by November 2021 experienced two waves of the disease. The first wave of the

105 pandemic occurred from August 2020 to February 2021 of various non-Delta variants while the

106 second wave happened from May to October 2021 fueled by the Delta variant [1, 7].

107 **Study design and population**

108 This was a cross-sectional mobile phone survey conducted in November 2021 among a

109 nationally constituted sample of adults. The study enrolled persons aged ≥18 years sampled from

110 the country's four administrative regions: Central, Eastern, Northern and Western. We excluded

111 persons who said they were ill and unable to participate in the interview.

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Sample size estimation

113 To enable tracking changes in adherence to NPIs following the introduction of vaccines, we used

114 a previous sample of study respondents from an earlier survey [8] whose data were collected in

115 March 2021 [8]. The sample size for the previous survey was determined using the Leslie Kish

116 formula for cross-sectional studies [9] considering the following assumptions: Two-sided Z

117 statistic corresponding to a 95% confidence interval (1.96), NPI adherence level of 50% since no

118 other study had been conducted to show the composite level of adherence, a precision of 5% and

119 a design effect of 2.5 [8]. Considering a non-response rate of 10%, the total sample size estimate

120 was 1056 people.

Sampling strategy

122 We used the sample from an earlier survey [8], which was constituted following quota sampling.

123 Quotas were set on age, sex, and location proportionate to national COVID-19 case distribution

124 statistics as of February 2021 [10]. The distribution of cases at the time was as follows: age: 18–

125 35 years (51%), 36–55 years (37%), 56–65 years (8%), 65+ years (4%); sex: male (60%) and

126 female (40%); and region: Central (55%) and 15% for each of Eastern, Western, and Northern

127 regions. With quotas in place, a simple randomly selected (SRS) sample was obtained among the

128 eligible population using a database of phone contacts provided by a registered research firm. In

129 cases of replacement of previous participants due to unavailability or refusal to participate, a

130 similar case distribution was followed during sampling of new contacts.

Data collection

132 Data were collected using a structured survey questionnaire (supplementary file 01), with mostly

133 closed-ended questions, informed by a review of published literature [8, 11, 12]. The

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134 questionnaire was pretested among 20 people from the four regions of Uganda and relevant

135 adjustments were made. The questionnaire was translated into nine major local languages spoken

136 in Uganda, namely: *Ateso, Luganda, Lugbara, Lugisu, Luo, Lusoga, Ngakarimojong,*

137 *Runyankole-Rukiga* and *Runyoro-Rutooro.* An independent group of translators validated the

138 questionnaire translations and any discrepancies were addressed. The final survey instrument in

139 each language was programmed in SurveyCTO software, incorporating appropriate routing,

140 conditional logic, and other controls and uploaded on hand-held mobile tablets. Bench testing of

141 the survey questionnaire was conducted, and adjustments made before actual data collection.

142 Trained research assistants with a minimum of a Diploma in a health-related field, fluent in the

143 survey languages and with experience in mobile surveys conducted the interviews. Research

144 assistants made phone calls from a designated place in Kampala to the respondents from whom

145 they sought verbal informed consent after explaining to them what the study entailed and entered

146 data into the tablets. The average interview time was 26 minutes. Respondents who preferred to

147 defer the phone interviews due to busy schedules or other reasons received follow-up phone calls

148 based on agreed-upon appointment times. Daily checks of the survey data were conducted to

149 monitor quality and intervene early and appropriately, as well as ensure adherence to established

150 quotas. A team of supervisors oversaw the work of the research assistants ensuring that questions

151 were asked appropriately, and respondents were interviewed in the language they were most

152 comfortable with. At the end of the interview period, we conducted back checking of 10% of

153 respondents to ascertain the quality of collected data.

154 **Data management and analysis strategy**

155 During data collection, each research assistant examined, edited, and cleaned their data daily

156 before uploading it to the server. Data were encrypted and anonymized on the server and later

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157 downloaded and exported to Stata 15.0 for further cleaning. Data analysis was conducted in

158 Rstudio Version 1.4.1106 (RStudio, PBC). Descriptive statistics have been provided in the form

159 of means (standard deviation) for continuous variables while categorical variables have been

160 expressed as frequencies and percentages. Socioeconomic status was generated as an additive

161 index from 6 variables on household ownership of television, computer, sofa set, refrigerator,

162 and cassette/CD/DVD player, and access to electricity. The socio-economic status index was

163 then divided into tertiles. The dependent variable was self-reported uptake of COVID-19

164 vaccines, which constituted those who reported receiving at least one dose of any World Health

165 Organization (WHO) approved COVID-19 vaccines. We also determined the intention to uptake

166 COVID-19 vaccines by asking unvaccinated respondents if they intended to receive the vaccine.

167 The independent variables included socio-demographic characteristics (age, gender, employment

168 status, education and occupation, place of residence (urban vs. rural, region) and source of

169 information on COVID-19. To determine the factors associated with vaccination uptake, we ran

170 multivariable modified Poisson regressions with robust error variance and presented prevalence

171 ratios and corresponding 95% confidence intervals. Only variables with a p-value $\leq$ 0.2 at

172 bivariate levels were included in the final model.

173 **Patient and public involvement**

174 No patients or members of the public were involved in the study design, setting the research

175 questions, interpretation or writing up of results, or reporting of the research.

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179   **RESULTS**

180   **Sociodemographic characteristics of participants**

181   Of the 1,249 respondents reached, a total of 1,173 (94%) participants completed the survey. The

182   mean age of respondents was 39.7 years (SD ±14.2) and majority 717 (61.1%) were males. Half

183   606 (51.7%) of the study participants were from the Central region, 548 (46.8%) had an urban

184   residence and 548 (46.7%) belonged to the lowest socioeconomic tertile. Nearly four in ten

185   (39%) respondents had only primary or no formal education (Table 1).

186   *Table 1: Sociodemographic characteristics of participants*

Characteristic	Number of participants (N = 1,173)	Percentage (%)[1]
Sex		
Male	717	61.1
Female	456	38.9
Age group (years), Mean age (SD)	39.7 (±14.2)	
18 – 35	553	47.1
36 – 55	439	37.4
56 - 64	92	7.8
65+	89	7.6
Region of residence		
North	182	15.5
East	211	18
Central	606	51.7
West	174	14.8
Residence		
Urban	548	46.8
Rural	417	35.6
Semi-urban	207	17.7
Not stated	1	
Earnings per month ($)		
< 14	256	25.6
14 – 29	226	22.6
30 – 57	196	19.6
58 – 143	229	22.9
> 143	93	9.3

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Characteristic	Number of participants (N = 1,173)	Percentage (%)[1]
Not stated	173	
Education level		
None or Incomplete Primary	265	23.2
Primary (completed)	180	15.7
Secondary	431	37.7
Tertiary	268	23.4
Not stated	27	
Socio-economic index		
Low	548	46.7
Middle	435	37.1
Higher	190	16.2
Religion		
Catholic	384	33.3
Anglican	372	32.3
Born Again (Pentecostal)	147	12.8
Muslim	226	19.6
Other religions	24	2.1
Not stated	20	
Current Occupation		
Unemployed	193	17.1
Employed	182	16.1
Self employed	355	31.4
Casual laborer	67	5.9
Farmer	334	29.5
Not stated	42	
Current household size, Mean (SD)	5.6 (3.5)	
5 or fewer	653	55.7
6 – 10	430	36.7
More than 10	90	7.7

187 [1] *Percentages calculated do not include respondents who did not record responses (e.g. "Not stated" in the tables)*

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189

190 **Uptake of COVID-19 vaccines and intention to vaccinate**

191 Among all respondents, 225 (19.2%) reported receiving a full dose of the vaccine and 357

192 (30.5%) an incomplete dose. Slightly above sixty per cent of the respondents 367 (63.2%)

193 reportedly experienced side effects following vaccination mostly fever 147 (40.1%), fatigue 115

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194   (31.3%) and headache 101 (27.5%). Among those who had not received a vaccine, 537 (91.8%)

195   reported intention to vaccinate (

196   Table 2).

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198   **Table 2: Vaccination uptake and intention to vaccinate among participants**

Variable	Count	Percentage (%)[1]
Vaccination uptake	**(n = 582)**	
Full dose (two shots)	225	19.2
Incomplete dose	357	30.5
No vaccination	590	50.3
Experienced any side effects after first dose		
No	214	36.8
Yes	367	63.2
Side effects reported	**(n = 367)**	
Fever	147	40.1
Fatigue	115	31.3
Headache	101	27.5
Muscle soreness /pain	95	25.9
Injection site reaction	88	24.0
Others[2]	38	10.4
Vaccination intention (among unvaccinated)	**n = 590**	
Intend to vaccinate	537	91.0
Did not intend to vaccinate	48	8.1
Did not know	5	0.8

199   [1] *Percentages calculated do not include respondents who did not record responses e.g. "Not stated" in the tables*

200   [2] *Allergic reaction, cough, body pain, dizziness, arrhythmias, body weakness, paralysis for a few days,*

201   *erectile dysfunction for a few days*

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204 **Reasons for vaccine uptake/ non-uptake and intention/un intention to vaccinate**

205 The reasons for COVID-19 vaccine uptake and intention to vaccinate were similar with both

206 categories of respondents mostly reporting the need to obtain protection from COVID-19 and

207 having a high perceived risk of getting the virus. Over 40% of respondents who had not been

208 vaccinated attributed it to vaccine unavailability 250 (42.4%) and below a quarter of respondents

209 to not having time 142 (24.1%). The reasons for lack of intention to vaccinate were mainly

210 related to safety 24 (50.0%) and effectiveness concerns 17 (35.4%) which were similarly

211 reported for non-uptake of vaccines (

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245   **Table 3: Reasons for (non) uptake of COVID-19 vaccines and intention to vaccinate**
246   **(multiple response)**

Reasons	Uptake of vaccines n = 582 (%)	Intention to vaccinate n = 537 (%)
To protect self from COVID-19	505 (86.8%)	458 (85.3%)
High perceived risk of getting COVID-19	114 (19.6)	90 (16.8%)
Prioritized due to health (comorbidities)	95 (16.3)	34 (6.3%)
Recommendation from health workers	81 (13.9)	38 (7.1)
Prioritized due to occupation	74 (12.7)	-
Travel purposes	44 (7.6)	45 (8.4%)

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Job requirement	-	82 (15.3%)
Others	21 (3.6)[1]	20 (3.8)[2]
Reasons	**Non uptake of vaccines n = 590 (%)**	**No intention to vaccinate n = 48 (%)**
Vaccines are unavailable	250 (42.4)	1 (2.1)
Don't have time	142 (24.1)	2 (4.2)
Safety concerns	74 (12.5)	24 (50.0)
Doubt vaccine effectiveness	41 (6.9)	17 (35.4)
Not among eligible group	30 (5.1)	4 (8.3)
Transport costs	24 (4.1)	Not reported
Don't know where to access the vaccines from	20 (3.4)	Not reported
Do not fear COVID-19/ trust immunity	10 (1.7)	1 (2.1)
Others	82 (14.0)[3]	7 (14.6)[4]

247   [1] *Requirement for school attendance, being exemplary, following MOH guidelines, boosting*
248   *immunity, to access services, among the eligible group.*
249   [2] *Access to health services, government mandate, pressure from peers, to be exemplary,*
250   *requirement for school attendance.*
251   [3] *Pregnant, breastfeeding, waiting for another vaccine type, lack identification documents, long*
252   *queues, currently sick, recently recovered from COVID-19.*
253   [4] *Religious beliefs, do not believe COVID-19, HIV positive and fear side effects, underlying*
254   *Hepatitis B infection, Body already weak, Lack of identification documents.*
255

256   **Willingness to vaccinate for different vaccine types**

257   All respondents were asked if they would receive the different types of COVID-19 vaccines if

258   offered at that point and were free of charge. Only 316 (26.9%) reported that they would take

259   any vaccine regardless of the type and 488 (41.6%) indicated a willingness to take at least one

260   type of the vaccine. The most preferred COVID-19 vaccine types were Johnson and Johnson 436

261   (37.4%) and AstraZeneca 405 (34.7%) (Figure 1).

262   *Figure 1 Willingness for COVID-19 vaccination for different vaccine types*

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263

Factors associated with uptake of COVID-19 vaccines

265   At the multivariable analysis level, participants aged ≥65 years had a 32% higher likelihood to

266   have been vaccinated compared to those aged 18-35 years (Adjusted PR = 1.32, 95% CI 1.08 –

267   1.61, p = 0.008). Participants from the Northern (adjusted PR = 1.55, 95% CI 1.18 – 2.02, p =

268   0.002) and Central regions (adjusted PR = 1.48, 95% CI 1.16 – 1.89, p = 0.002) respectively had

269   a 55% and 48% higher likelihood to have received the vaccine compared to those from the

270   Western region. Participants with secondary (adjusted PR = 1.36, 95% CI 1.12 – 1.65, p = 0.002)

271   or tertiary education (Adjusted PR = 1.62, 95% CI 1.31 – 2.00, p < 0.001) were more likely to

272   have received the COVID-19 vaccine compared to those with incomplete primary/no formal

273   education. Respondents whose monthly income was between $30 and $57 (APR = 1.24 (1.02 –

274   1.52), p = 0.029) had a higher uptake of COVID-19 vaccines than those who earned < $14.

275   Having health workers as a source of information on COVID-19 was associated with higher

276   uptake of COVID-19 vaccines in Uganda (adjusted PR = 1.26, 95%CI 1.10 – 1.45, p = 0.001)

277   (Table 4).

278   **Table 4: Factors associated with COVID-19 vaccine uptake among adults**

Variables / Characteristics	Self-reported uptake of COVID-19 vaccine		Unadjusted PR (95% CI)[1]	p-value	Adjusted PR (95% CI)[2]	p-value
	No (%)	Yes (%)				
Age in years						
18 – 35	296 (53.5)	257 (46.5)	1		1	
36 – 55	213 (48.6)	225 (51.4)	1.11 (0.97 – 1.26)	0.124	1.09 (0.95 – 1.25)	0.244
56 – 64	44 (47.8)	48 (52.2)	1.12 (0.91 – 1.39)	0.292	1.17 (0.92 – 1.48)	0.193
65+	37 (41.6)	52 (58.4)	1.26 (1.03 -1.53)	**0.023**	1.32 (1.08 – 1.61)	**0.008**

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Variables / Characteristics	Self-reported uptake of COVID-19 vaccine		Unadjusted PR (95% CI)[1]	p-value	Adjusted PR (95% CI)[2]	p-value
	No (%)	Yes (%)				
Region of residence						
Western	115 (66.5)	58 (33.5)	1		1	
Northern	74 (40.7)	108 (59.3)	1.77 (1.39 – 2.25)	**<0.001**	1.55 (1.18 - 2.02)	**0.002**
Eastern	112 (53.1)	99 (46.9)	1.40 (1.09 – 1.80)	**0.010**	1.29 (0.99 - 1.69)	0.064
Central	289 (47.7)	317 (52.3)	1.56 (1.25– 1.95)	**0.001**	1.48 (1.16 - 1.89)	**0.002**
Residence						
Urban	270 (49.4)	277 (50.6)			1	
Rural	206 (49.4)	211 (50.6)	0.99 (0.88 – 1.13)	0.990	1.11 (0.97 – 1.28)	0.137
Semi-urban	114 (55.1)	93 (44.9)	0.89 (0.75 – 1.05)	0.173	0.92 (0.75 – 1.11)	0.373
Gender						
Male	351 (49.0)	366 (51.0)	1		1	
Female	239 (52.5)	216 (47.5)	0.93 (0,82 – 1.05)	0.237	1.00 (0.87 – 1.14)	0.973
Wealth index						
Low	290 (53.0)	257 (47.0)	1		1	
Middle	217 (49.9)	218 (50.1)	1.07 (0.94 – 1.21)	0.328	1.06 (0.91 – 1.24)	0.442
High	83 (43.7)	107 (56.3)	1.20 (1.03 – 1.40)	**0.021**	1.03 (0.83 – 1.28)	0.758
Current Occupation						
Unemployed	91 (47.2)	102 (52.8)	1		1	
Employed	76 (41.8)	106 (58.2)	1.10 (0.92 – 1.32)	0.294	1.03 (0.84 – 1.27)	0.763
Self employed	196 (55.2)	159 (44.8)	0.85 (0.71 – 1.01)	0.066	0.84 (0.68 – 1.02)	0.078
Casual laborer	45 (67.2)	22 (32.8)	0.62 (0.43 – 0.90)	**0.011**	0.73 (0.48 – 1.11)	0.146
Farmer	164 (49.1)	170 (50.9)	0.96 (0.81 – 1.14)	0.664	0.99 (0.82 – 1.19)	0.931
Education level						
No formal education /	161 (60.8)	104 (39.2)	1		1	

Variables / Characteristics	Self-reported uptake of COVID-19 vaccine		Unadjusted PR (95% CI)[1]	p-value	Adjusted PR (95% CI)[2]	p-value
	No (%)	Yes (%)				
incomplete primary						
Complete primary	109 (60.6)	71 (39.4)	1.01 (9.79 - 1.27)	0.966	1.00 (0.78 – 1.28)	0.998
Secondary education	207 (48.0)	224 (52.0)	1.32 (1.11 – 1.58)	**0.002**	1.36 (1.12 – 1.65)	**0.002**
Tertiary	98 (36.6)	170 (63.4)	1.62 (1.36 – 1.93)	**< 0.001**	1.62 (1.31 – 2.00)	**< 0.001**
Household size (mean)	5.41	5.99	1.02 (1.01 – 1.03)	**< 0.001**	1.02 (1.00 – 1.03)	0.071
Monthly income ($)						
< 14	144 (56.2)	112 (43.8)	1		1	
14 – 29	117 (51.8)	109 (48.2)	1.10 (0.91 – 1.34)	0.324	1.08 (0.89 – 1.32)	0.423
30 – 57	86 (43.9)	110 (56.1)	1.28 (1.07 – 1.55)	**0.009**	1.24 (1.02 – 1.52)	**0.029**
58 – 143	114 (49.8)	115 (50.2)	1.15 (0.95 – 1.39)	0.154	0.98 (0.79 – 1.22)	0.876
> 143	36 (38.7)	57 (61.3)	1.40 (1.13 – 1.73)	**0.002**	1.16 (0.91 – 1.49)	0.219
Health workers as source of information on COVID-19[3]						
No	245 (57.9)	178 (42.1)	1		1	
Yes	345 (46.1)	404 (53.9)	1.28 (1.13 – 1.45)	**< 0.001**	1.26 (1.10 – 1.45)	**0.001**

279   *[1] Bivariate analysis*

280   *[2] Multivariable analysis*

281   *[3] Other sources of information included family members, friends/peers, Radio, Television, community*

282   *members and social media among others which were dichotomized and included in the analysis but were*

283   *not significant*

284

285   **DISCUSSION**

286   This study examined the uptake of COVID-19 vaccines and associated factors among adults

287   aged 18 years and above in Uganda. Among the study participants, about one in five (19.2%)

288   reported receiving a full dose of the COVID-19 vaccine while 30.5% had received an incomplete

289   dose. Over 90% of those who were unvaccinated reported the intention to be vaccinated. The

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290 major reasons for vaccine uptake and intention to vaccinate were protection of self from COVID-

291 19 and a high perceived risk of getting the virus while reasons for vaccine non-uptake were

292 vaccine unavailability, the lack of time to go get vaccinated, and safety and effectiveness

293 concerns. The factors that were associated with receiving the COVID-19 vaccine were older age

294 (65 years and above), having secondary education and above, having a moderate income, and

295 reporting health workers as a source of information on COVID-19. Being a resident of Northern

296 and Central Uganda was also associated with a high likelihood of receiving the vaccine.

297 Uptake of COVID-19 vaccines in this sample of respondents was higher for both full and

298 incomplete doses than the vaccinated proportion of the population as of November 2021 when

299 this study was conducted. Ministry of Health data of 8th November 2021 indicated that 55.8%

300 and 16.8% of the priority groups and 12.2% and 3.7% of the adult population had received their

301 first and second doses of the vaccine respectively [13]. The higher-than-baseline vaccination

302 coverage could be attributed to the use of mobile phones for the survey and thus the relatively

303 urbanized study sample whose access to vaccines was higher than those in rural areas. Moreover,

304 a high proportion of participants were from the Central region, which was most impacted by

305 COVID-19, and their experiences could have influenced vaccine uptake. In addition, intention to

306 vaccinate was very high at over 90%; higher than the combined "definite intention" of 57.8%

307 and "probable intention" of 26.2% from the March survey round [8]. In a November 2021 survey

308 among 23,000 respondents from 19 African Union members states including Uganda, (78%) of

309 respondents had either been vaccinated or were likely to get vaccinated [14]. The second

310 COVID-19 wave fueled by the Delta variant that was experienced in Uganda from June to

311 September 2021 and led to at least 2,800 deaths compared to the less than 300 recorded at the

312 end of the first wave [1, 15] could also have contributed to the high uptake of the vaccine and

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313 intention-to-vaccinate. In addition, there was concern about potential vaccine mandates including

314 anticipation that the unvaccinated would be denied health and social services which could also

315 have increased the intention to vaccinate.

316 The major reasons for vaccine uptake and intention to vaccinate were protection of self from

317 COVID-19 and a high perceived risk of getting the virus, similar to previous research [11]. This

318 is also an indication of the respondents' appreciation of the role of vaccines in preventing

319 morbidity and saving lives. Those unvaccinated attributed it to vaccine unavailability and the

320 lack of time. The survey in 19 African countries concluded that low vaccine uptake was mostly

321 due to unpredictable supply of vaccines and logistical hurdles than reluctance or refusal to get

322 vaccinated [14]. Earlier surveys in Uganda conducted in 2020 had also shown a high acceptance

323 of COVID-19 vaccines of over 85% [11, 16]. To bridge the willingness-intention-uptake gap in

324 Uganda, the Ministry of Health should increase access and availability of COVID-19 vaccines.

325 Evidence shows that strategies that take vaccines closer to the communities are likely to mitigate

326 time and transport-related barriers and increase vaccine uptake [17, 18]. This could be achieved

327 by increasing the number of health facilities offering the vaccines, conducting more vaccination

328 outreaches, or setting up mobile vaccine points. The World Health Organization guidance has

329 also emphasized the importance of location and time in COVID-19 vaccine uptake [19]. On the

330 other hand, the study reported that safety and effectiveness concerns hindered vaccine uptake and

331 intention to vaccinate similar to previous research [8, 11, 20-23]. Of note as well was the

332 observed high prevalence (63%) of self-reported vaccine side effects which could go a long way

333 in reinforcing safety concerns among the population. Vaccine adverse events should be

334 monitored closely, and appropriate information, education and communication material

335 developed including information on expected side effects to counter their potential effect on the

19

336 uptake of vaccination by the unvaccinated. Accurate, consistent and transparent communication

337 and dialogue about uncertainty, risks and anticipated benefits can go a long way in building

338 confidence and trust in the COVID-19 vaccines and create motivation for vaccination [19, 23].

339 This could also bridge observed gaps in vaccine preference to prevent this from being a barrier to

340 vaccination. The Johnson and Johnson vaccine being a single shot had a higher preference

341 among respondents due to the perceived inconvenience and unpredictability of obtaining a

342 second vaccine dose.

343 It was not surprising that those aged 65 years and above had a higher vaccination uptake as these

344 were part of the prioritized group for COVID-19 vaccination in the country. Education status

345 also predicted vaccination status similar to previous research on COVID-19 vaccine acceptability

346 [24-27]. However, further efforts are required to ensure the dissemination of accurate and simple

347 COVID-19 vaccination messages to those of lower education levels including translating

348 information in the local languages so that this group is not left behind. A moderate income was

349 associated with higher vaccine uptake; however, this relationship was not sustained with

350 increasing income levels. The regional differences observed in the uptake of COVID-19 vaccines

351 may have been due to differences in vaccine access and availability, especially for Central region

352 which was most hit by the pandemic and was prioritized early during vaccine rollout. From

353 previous research, income levels and locations have been reported as predictors of COVID-19

354 vaccine acceptability [27, 28].

355 One major finding from our work was that respondents whose source of information on COVID-

356 19 was health workers had a higher likelihood for COVID-19 vaccination. This positions health

357 workers as a key resource in increasing vaccination uptake, and thus they should be furnished

358 with sufficient and accurate information and supported with effective communication tools to

20

359 influence their clients at facility and community level. Previous studies report that health worker

360 advice on vaccination was most trusted [11, 22]. Health workers can lead health education and

361 awareness programs on COVID-19 and use their platforms at health facility and community

362 level to influence the masses to uptake COVID-19 vaccines. However, vaccine uptake among

363 health workers themselves was low at the time even when they were prioritized for vaccination

364 from the start of the campaigns in Uganda and elsewhere. In a March 2021 survey in Uganda,

365 just after the launch of the COVID-19 vaccination exercise, a vaccine acceptability rate of 37.3%

366 and hesitancy of 30.7% were reported among medical students [12]. In a June to August 2021

367 online survey, acceptance or willingness to uptake the COVID-19 vaccine stood at over 97% and

368 65.3% of eye healthcare workers had received a COVID-19 vaccine shot influenced by high

369 perceived susceptibility and benefits [29]. An in-depth study among health workers reported the

370 lack of trust in the vaccine, fear of side effects, not feeling at risk, lack of sufficient information

371 about vaccines, health systems challenges and religious beliefs as barriers to COVID-19

372 vaccination [30]. When health workers are vaccinated, they are more likely to recommend the

373 same to their clients [31]. Therefore, appropriate interventions should be instituted to effectively

374 deal with vaccine hesitancy among health workers and have them as champions for COVID-19

375 vaccination.

376

377

378 **Study limitations and strengths**

379 Being a mobile phone survey, the study participants were not representative of the population

380 and only those with a mobile phone could participate, contributing to selection bias. However

21

381   mobile phone coverage in Uganda has increased over the years; according to the Uganda

382   National Household Survey 2020, 74.0% of Ugandans own mobile phones [32]. There was also

383   potential for social desirability bias, especially regarding reporting vaccination status which we

384   minimized by reminding participants that the study was only for research purposes. Also, as a

385   cross-sectional survey, the direction of associations observed is not clear. On the other hand, our

386   study had a high response rate with over 94% of the participants consenting to participate. The

387   high response rate could be attributed to following up previous survey participants, flexibility in

388   conducting interviews at convenient times, as well as the time compensation (phone credit of 1.5

389   US dollars) provided. Results from the backchecking with the same individuals also showed high

390   consistency with the survey results. Our study provides insights into COVID-19 vaccination

391   uptake and intention to vaccinate which can facilitate the development of context-relevant

392   strategies to increase vaccinations.

393

394   **CONCLUSIONS**

395   Half of the study respondents were vaccinated against COVID-19, which was associated with

396   older age, higher education level, moderate income, region of residence and reporting health

397   workers as the source of COVID-19 information. Among the unvaccinated, over 90% expressed

398   intention to vaccinate. Efforts are needed to increase access to vaccines and utilize health

399   workers as a key resource in sharing information and champions to influence the masses which

400   should positively impact uptake of COVID-19 vaccines.

401

402   **Acknowledgements**

22

405

Author Contributions

407   RN, NC, SNK, AN, WS, LLT and RKW conceptualized and designed the study. RN, NC, SNK,

408   AN, IW, SKiz supported the data collection. RN, NC, SNK, AN, STW, IW, SKiz, SKiw, WS,

409   LLT and RKW contributed to analysis and interpretation of findings. RN, NC, STW wrote the

410   first draft of the manuscript. SNK, AN, IW, SKiz, SKiw, WS, LLT and RKW critically reviewed

411   the draft manuscript. All authors read and approved the final manuscript.

412

418

Competing interests

420   None declared.

Consent for publication

422   Not applicable

423

Ethics approval and consent to participate

424

425 Ethical approval to conduct the survey was sought from the Makerere University School of

426 Public Health Higher Degrees Research and Ethics Committee (protocol SPH-2021-150) and the

427 study was registered by the Uganda National Council of Science and Technology (HS1742ES).

428 Verbal consent was provided before participation in the survey. Personally identifiable

429 information including name of respondent, their phone number and the household head name

430 were encrypted with passwords on the SurveyCTO server and drives and was only accessible to

431 the investigator(s). All phones and tablets used for data collection were password-protected to

432 protect respondent data.

Data availability statement

433

434 The data are available from the corresponding author on reasonable request.

435

Supplementary files

436

437 Supplementary file 01: Study questionnaire

438

439

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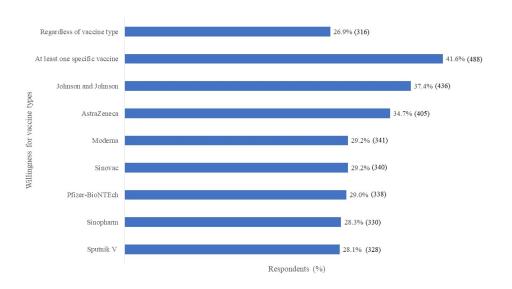
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27

Willingness for COVID-19 vaccination for different vaccine types

338x190mm (96 x 96 DPI)

Uptake of COVID-19 vaccines and associated factors among adults in Uganda: a cross-sectional survey

Question	Answer	
MAKERERE SCHOOL OF PUBLIC HEALTH AND MIT GOV/LAB MOBILE SURVEY QUESTIONNAIRE		
Phone number used for interview		
Did the call go through?	1	Yes
	0	No
	-97	DO NOT READ: Refused
Was this the respondent previously interviewed?	1	Yes
	0	No
	-97	DO NOT READ: Refused
[Insert Consent Text]		
Do you voluntarily agree to participate in this survey?	1	Yes
	0	No
	-97	DO NOT READ: Refused
Explain:		
A7. What is your name?		
A8. What is your age?		
A9. What region do you live in?	1	North
	2	East
	3	Central
	4	West
	-97	DO NOT READ: Refused
A10. What district do you live in?	[Insert filtered list of districts]	
A11. Do you live in an urban, rural, or semi-urban area?	1	Urban
	2	Rural
	3	Semi-urban
	-99	DO NOT READ: Don't know
	-97	DO NOT READ: Refused
A12. Gender of respondent	1	Female
	0	Male
Next, I am going to ask some questions on your awareness and intention to take the COVID-19 vaccine.		
E1. As an adult, have you received a vaccine other than the COVID-19 vaccines? (Hepatitis B, Yellow fever, tetanus)	1	Yes
	0	No
	-97	DO NOT READ: Refused
E2. Have you ever been asked to get a vaccine and declined?	1	Yes
	0	No
	-97	DO NOT READ: Refused

Question	Answer	
E3. What COVID-19 vaccines have you heard of? *Do not read options aloud. Select all that apply.*	1	AstraZeneca
	2	Pfizer-BioNTEch
	3	Moderna
	4	Johnson and Johnson
	5	Sinopharm
	6	Sinovac
	7	Sputnik V
	-96	Other (Specify)
	8	Has heard of COVID-19 vaccine but does not know any names
	0	None, has not heard of any COVID-19 vaccine
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
Other, specify:		
E4. Have you received the COVID-19 vaccine? *Read all options aloud*	1	Yes, full dose
	2	Yes, incomplete dose
	0	No
	-97	DO NOT READ: Refused
E5. Which vaccine did you receive? *Do not read options aloud. Select all that apply.*	1	AstraZeneca
	2	Pfizer-BioNTEch
	3	Moderna
	4	Johnson and Johnson
	5	Sinopharm
	6	Sinovac
	7	Sputnik V
	-96	Other (Specify)
	8	Has heard of COVID-19 vaccine but does not know any names
	0	None, has not heard of any COVID-19 vaccine
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
Other, specify:		

Question	Answer	
E6. Why did you receive the COVID-19 vaccine? *Do not read options aloud. Select all that apply.*	1	To protect self / others from COVID-19
	2	High perceived risk of getting COVID-19
	3	Travel purposes
	4	Recommendation from health workers
	5	Prioritized due to occupation
	6	Prioritized due to health
	-96	Other (Specify)
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
Other, specify:		
E7. Did you experience any side effects within 7 days following the first dose?	1	Yes
	0	No
	-97	DO NOT READ: Refused
E8. Which side effects did you experience following the first dose? *Do not read options aloud. Select all that apply.*	1	Fever
	2	Fatigue
	3	Headache
	4	Muscle soreness/pain (myalgia)
	5	Allergic reaction
	6	Injection site reaction
	-96	Other (Specify)
	-97	DO NOT READ: Refused
Other, specify:		
E9. Did you experience any side effects within 7 days following the second dose?	1	Yes
	0	No
	-97	DO NOT READ: Refused
E10. Which side effects did you experience following the second dose? *Do not read options aloud. Select all that apply.*	1	Fever
	2	Fatigue
	3	Headache
	4	Muscle soreness/pain (myalgia)
	5	Allergic reaction
	6	Injection site reaction
	-96	Other (Specify)
	-97	DO NOT READ: Refused
Other, specify:		

Question	Answer	
E11. Why haven't you ever received the COVID-19 vaccine? *Do not read options aloud. Select all that apply.*	1	Safety concerns / fear of adverse events
	2	Doubt vaccine effectiveness
	3	Do not fear COVID-19 / trust immunity
	4	Don't know where to access vaccine from
	5	Religious beliefs
	6	COVID-19 is a hoax / politics
	7	Not among eligible group
	8	Not having time
	9	Transport costs
	10	Cost of vaccine
	11	Vaccines are unavailable
	-96	Other (Specify)
	-99	DO NOT READ: Don't know
	-97	DO NOT READ: Refused
Other, specify:		
E12. Do you intend to receive the COVID-19 vaccine if it is available?	1	Yes
	0	No
	-97	DO NOT READ: Refused
E13. Why do you intend to receive the COVID-19 vaccine? *Do not read options aloud. Select all that apply.*	1	To protect self / others from COVID-19
	2	High perceived risk of getting COVID-19
	3	Travel purposes
	4	Recommendation from health workers
	5	Prioritized due to occupation
	6	Prioritized due to health
	-96	Other (Specify)
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
Other, specify:		
E14. Why don't you intend to receive the COVID-19 vaccine? *Do not read options aloud. Select all that apply.*	1	Safety concerns / fear of adverse events
	2	Doubt vaccine effectiveness

Question	Answer	
	3	Do not fear COVID-19 / trust immunity
	4	Don't know where to access vaccine from
	5	Religious beliefs
	6	COVID-19 is a hoax / politics
	7	Not among eligible group
	8	Not having time
	9	Transport costs
	10	Cost of vaccine
	11	Vaccines are unavailable
	-96	Other (Specify)
	-99	DO NOT READ: Don't know
	-97	DO NOT READ: Refused
Other, specify:		
E15. Has anyone in your household received their COVID-19 vaccine?	1	Yes, specify
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
E16. In your household, who has received their COVID-19 vaccine? *Do not read options aloud. Select all that apply.*	1	Parents
	2	Children
	3	Grandparents
	4	Grandchildren
	5	Siblings
	6	Cousins
	7	Aunts and Uncles
	8	Spouse
	-96	Other (Specify)
	-97	DO NOT READ: Refused
Other, specify:		
E17. Do you know anyone personally in your community who has received their COVID-19 vaccine?	1	Yes, specify
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused

Question	Answer	
E18. Among those you know personally in your community, who has received their COVID-19 vaccine? *Do not read options aloud. Select all that apply.*	1	Traditional leaders
	2	Religious leaders
	3	Colleagues
	4	Personal friends
	5	Neighbors
	-96	Other (Specify)
	-97	DO NOT READ: Refused
Other, specify:		
Next, I am going to ask some questions about COVIDEX.		
E19. Have you ever heard of COVIDEX before?	1	Yes
	0	No
	-97	DO NOT READ: Refused
E20. Has anyone in your household ever bought or used COVIDEX?	1	Yes
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
E21. Personally, how much trust do you have in COVIDEX? *Read all options aloud*	1	Trust it a great deal
	2	Tend to trust it
	3	Tend to distrust it
	4	Distrust it greatly
	-99	DO NOT READ: Not sure or don't know
	-97	DO NOT READ: Refused
Next, I am going to ask some more questions on COVID-19 vaccines.		
(Randomize order of F2)		
F2. If you were offered the COVID-19 **AstraZeneca** vaccine right now free of cost, would you take the vaccine? *Read all options aloud*	1	Yes
	0	No
	-95	Have not heard of
	-97	DO NOT READ: Refused
F2. If you were offered the COVID-19 **Pfizer-BioNTEch** vaccine right now free of cost, would you take the vaccine? *Read all options aloud*	1	Yes
	0	No
	-95	Have not heard of
	-97	DO NOT READ: Refused
F2. If you were offered the COVID-19 **Moderna** vaccine right now free of cost, would you take the vaccine? *Read all options aloud*	1	Yes
	0	No
	-95	Have not heard of
	-97	DO NOT READ: Refused
F2. If you were offered the COVID-19 **Johnson and Johnson** vaccine right now free of cost, would you take the vaccine? *Read all options aloud*	1	Yes
	0	No
	-95	Have not heard of
	-97	DO NOT READ: Refused

Question	Answer	
F2. If you were offered the COVID-19 **Sinopharm** vaccine right now free of cost, would you take the vaccine? *Read all options aloud*	1	Yes
	0	No
	-95	Have not heard of
	-97	DO NOT READ: Refused
F2. If you were offered the COVID-19 **Sinovac** vaccine right now free of cost, would you take the vaccine? *Read all options aloud*	1	Yes
	0	No
	-95	Have not heard of
	-97	DO NOT READ: Refused
F2. If you were offered the COVID-19 **Sputnik V** vaccine right now free of cost, would you take the vaccine? *Read all options aloud*	1	Yes
	0	No
	-95	Have not heard of
	-97	DO NOT READ: Refused
F3. Why would you choose these vaccines?	1	More effective
	2	Less adverse events
	3	Used in Western countries
	4	Trust in source
	-96	Other (Specify)
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
Other, specify		
F4. If you needed information on vaccines, who in your community would you talk to for advice?		
F5. What are your sources of information on COVID-19? *Do not read options aloud. Select all that apply.*	1	Family members
	2	Friends/peers
	3	Health worker
	4	Phone (messages and calls)
	5	Radio
	6	Television
	7	Church/Mosque
	8	Community member/village health team member
	9	Local leader
	10	Social media (Facebook, WhatsApp, Twitter)
	11	Internet
	-96	Other (Specify)
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused

Question	Answer	
Other, specify		
F6. Which three sources of information do you trust the most? _Do not read options aloud. Select all that apply._	1	Family members
	2	Friends/peers
	3	Health worker
	4	Phone (messages and calls)
	5	Radio
	6	Television
	7	Church/Mosque
	8	Community member/village health team member
	9	Local leader
	10	Social media (Facebook, WhatsApp, Twitter)
	11	Internet
	-96	Other (Specify)
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
Other, specify		
F7. Have you ever been tested at a health facility or laboratory and found to have COVID-19?	1	Yes
	0	No
	-97	DO NOT READ: Refused
F8. Was this COVID infection before or after you received the full dose of the vaccine?	1	Before
	2	After
	3	Both
	-97	DO NOT READ: Refused
B1. What is your highest level of education?	1	No school
	2	Some primary
	3	Complete primary
	4	Secondary - ordinary
	5	Secondary - advanced
	6	Tertiary
	-96	Other (Specify)
	-97	DO NOT READ: Refused
Other, specify		
B2. What is your religion?	1	Catholic
	2	Anglican
	3	Born Again/Pentecostal
	4	Muslim
	-96	Other (Specify)
	-97	DO NOT READ: Refused

Question	Answer	
Other, specify		
B3. On average, how much money do you earn per month? *In Ugandan Shillings*	1	under 50,000
	2	50,001 - 100,000
	3	100,001 - 200,000
	4	200,001 - 500,000
	5	500-001 - 1,000,000
	6	1,000,001 and above
	-97	DO NOT READ: Refused
B4. Does your household have **a television**?	1	Yes
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
B4. Does your household have **electricity**?	1	Yes
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
B4. Does your household have **a computer**?	1	Yes
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
B4. Does your household have a **sofa set**?	1	Yes
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
B4. Does your household have a **refrigerator**?	1	Yes
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused
B5. Does anyone in your household own a **cassette/CD/DVD player**?	1	Yes
	0	No
	-99	DO NOT READ: Don't Know
	-97	DO NOT READ: Refused

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B6A. What is your current occupation? *Read all options aloud*	1	Unemployed/retiree/housewife
	2	Employed
	3	Self-employed
	4	Casual laborer
	5	Farmer
	- 96	Other (Specify)
	- 97	DO NOT READ: Refused

Other, specify:

B7A. How many people stay in your home, currently?

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	6,20
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	7,8
		(*c*) Explain how missing data were addressed	7,8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	Not necessary
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9

		(b) Indicate number of participants with missing data for each variable of interest	9-16
Outcome data	15*	Report numbers of outcome events or summary measures	9-16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-16
		(*b*) Report category boundaries when continuous variables were categorized	9-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevant
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	None
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	20,21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	20,21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.