BMC Public Health

RESEARCH

Open Access

COVID-19 vaccination, perceptions about the vaccine and willingness to take the vaccine among unvaccinated individuals at two Ugandan border points of entry

Joseph K. B. Matovu[1,2*], Rebecca Nuwematsiko[1], Christine Aanyu[1], Lilian Tabwenda[1], Tom Okade[1], David Musoke[1] and Esther Buregyeya[1]

Abstract

Background A recent systematic review shows high COVID-19 vaccine effectiveness in fully-vaccinated people in Africa. However, vaccine uptake has varied across populations. We assessed the uptake, perceptions of and willingness to take the COVID-19 vaccine among unvaccinated individuals at two Ugandan border points of entry.

Methods This was a cross-sectional quantitative study conducted at Malaba and Mutukula points of entry into Uganda between February and March 2023. We targeted people living in, working at, or transiting through the two points of entry, including truck drivers, point-of-entry customs officers and female sex workers, market vendors, among others. Data were collected on socio-demographic characteristics, vaccine uptake, perceptions and willingness to take the vaccine among unvaccinated individuals. We computed descriptive statistics and determined the factors associated with uptake of and willingness to take the vaccine using a modified Poisson regression model. Data analysis was conducted using STATA statistical package (version 14.0).

Results Of the 854 respondents, 50% ($n=427$) were from Mutukula. Overall, 80.3% ($n=686$) of the respondents reported that they had received at least one vaccine dose; no booster doses were reported. Respondents perceived that the vaccine was efficacious against COVID-19. COVID-19 vaccine uptake was associated with age-group 35–44 years [adjusted Prevalence Ratio [aPR] (95%CI) = 1.13 (1.01, 1.27)] or 45 + years [aPR (95%CI) = 1.19 (1.07, 1.33)]; being a truck driver [aPR (95%CI) = 1.16 (1.04, 1.29)] or health worker [aPR (95%CI) = 1.18 (1.05, 1.32)]; and the belief that the COVID-19 vaccine is protective against COVID-19 [aPR (95%CI) = 1.32 (1.10, 1.58)]. Nearly 60% of unvaccinated respondents ($n=99$) were willing to take the COVID-19 vaccine. Willingness to take the vaccine was associated with the belief that one can contract the coronavirus if not vaccinated [aPR (95%CI) = 3.67 (1.90, 7.10)] or the community was at risk of COVID-19 [aPR (95%CI) = 1.86 (1.33, 2.62)].

*Correspondence:
Joseph K. B. Matovu
jmatovu@musph.ac.ug

Full list of author information is available at the end of the article

Conclusion COVID-19 vaccine uptake was high in this setting while nearly six out of every ten unvaccinated individuals were willing to take the vaccine. Our findings lend credence for ongoing vaccination efforts at points of entry to contain the importation of new COVID-19 variants into the country.

Keywords COVID-19 vaccine, Uptake, Willingness to take the vaccine, Uganda

Background

The coronavirus disease (COVID-19), caused by the severe acute respiratory syndrome coronavirus type 2 (SARS-COV-2), remains a significant global public health problem and is currently the leading cause of death from a single infectious agent, after tuberculosis [1]. Since the first COVID-19 case was recorded in December 2019, the disease has spread across borders, leading to unprecedented consequences not only on health systems but also on the economic, social and psychological well-being of individuals worldwide [2–6]. As of August 18th, 2024, 776 million COVID-19 cases and 7.1 million deaths had been reported globally [7]. The WHO African Region had cumulatively recorded 9,582,654 cases and 175,528 deaths as of August 18th, 2024 [7]. The number of COVID-19 cases and deaths in Uganda also increased over the years since March 2020 to 172,155 cases and 3,632 deaths as of August 18th, 2024 [7].

During the pandemic, border points of entry were identified as possible routes for spread of COVID-19 across countries, due to the frequent cross border movements and interaction with travelers from different areas, some with high infections [8, 9]. Owing to the high risk of COVID-19 importation or exportation at border points, the Government of Uganda employed stringent measures to prevent the potential spread of the disease. These measures included nationwide lockdown, mandatory quarantine, limited movements at all points of entry, mass screening of individuals at the country's borders, quarantine of cases and their contacts, school closures, and travel restrictions among others [10, 11]. In addition, public health measures such as social distancing, frequent hand washing with soap and water, encouraging cough etiquette and vaccination were adopted to avert the spread of COVID-19 [10, 11]. There is no doubt that vaccination is one of the effective approaches to slow down the spread of COVID-19 [12–14]. A recent systematic review found high COVID-19 vaccine effectiveness (VE) in fully vaccinated people in Africa, particularly among those who received the commonly used *Johnson and Johnson* and *Oxford–AstraZeneca* vaccines [15]. For instance, a full dose of *Johnson and Johnson* vaccine had a VE of 94.2% against infection caused by the Alpha (B.1.1.7) variant and 38.1–72.0% VE against hospitalization by B.1.351 variant. On the other hand, the *Oxford–AstraZeneca* vaccine had a VE of 89.4% against hospitalization by the Omicron variant [15]. These findings underscore the need to promote public awareness about the importance of ongoing COVID-19 vaccination to reach unvaccinated individuals.

By December 31st, 2023, 67% of the world's population had been vaccinated with a complete primary series of a COVID-19 vaccine [7], suggesting that 33% of the world's population remain at risk of contracting the SARS-COV-2, the virus that causes COVID-19. Uganda introduced the COVID-19 vaccine on 10th March 2021 as a move to control the pandemic but also to pave way for easing restrictions [7, 16]. Due to limited vaccine doses, at-risk populations such as health workers, security personnel, border communities, among others, were initially prioritized for vaccination [17] and were later followed by the general population as more doses became available. By June 2023, a total of 26.4 million COVID-19 vaccine doses had been administered in Uganda, including 19.2 million as the first dose, 6.7 million as the second dose, and 494,000 as a booster dose [18]. However, despite the availability of millions of COVID-19 vaccines doses at the National Medical Stores in Uganda, uptake of the COVID-19 vaccine still remains low with only 29% of Ugandans being fully vaccinated while only 2% have received at least one booster dose [7]. Recently, Uganda reported that over five million doses of COVID-19 vaccines, worth UGX 28.16 billion (US$ 7,687,257; November 2024), had expired in the stores due to the low demand for the vaccines [19].

Although there are no new COVID-19 variants reported in Uganda at the moment [20], it is important that prevention measures remain in place especially at the border points of entry due to their vulnerability to the importation of new COVID-19 variants and other infectious diseases. For individuals in such settings, cross-border movement represents a daily necessity for work, trade, family visits, healthcare services, religious activities, entertainment, among other reasons [8]. This therefore places them at risk of not only acquiring COVID-19 and other infectious diseases, but also transmitting them to the general population [21–23]. However, even though border points of entry were initially prioritized for COVID-19 vaccination [24], there is limited data on uptake and willingness to take the vaccine among individuals living/working at or transiting through these border points of entry. This study therefore assessed the uptake of COVID-19 vaccine and willingness to take COVID-19 vaccine among unvaccinated individuals at two land border points of entry into Uganda to inform

interventions to improve COVID-19 vaccine uptake at these and similar points of entry.

Methods

Study setting

Uganda, a landlocked country in East Africa, has fifty-three (53) gazetted points of entry (4 airports, 16 inland ports, and 33 land points of entry) where travellers can obtain immigration services. This study was conducted at two of the busiest land points of entry into Uganda, namely: Malaba in Tororo district (eastern Uganda, bordering Kenya) and Mutukula in Kyotera district (south-western Uganda, bordering Tanzania). In early 2020, the two sites stood out as the primary points of entry through which SARS-COV-2 was imported into Uganda mainly through cross-border travellers [25]. Given that these points of entry serve as the main entry points into Uganda from Kenya (Malaba) and Tanzania (Mutukula), they continue to pose a great risk in facilitating the importation of new variants of COVID-19 or other infectious disease agents. Our study was conducted to generate data necessary to inform the design of interventions intended to improve uptake of COVID-19 prevention measures at the two points of entry (with plans to extend similar interventions to other points of entry in the future), including vaccination, given that they continue to remain key points of entry for imported infectious disease agents, including new COVID-19 variants or other infectious diseases.

Study design and population

This was a cross-sectional study conducted at Malaba and Mutukula land border points of entry into Uganda between February and March 2023. The study was conducted among individuals that were considered to be at risk of contracting COVID-19, including people living in, working at or transiting through the above-mentioned points of entry. These people were considered to be at risk of contracting COVID-19 because they were either always mobile (crossing country borders for trade or occupational reasons) or engaged with lots of people due to the nature of their work. Such mobility or frequent contacts with other people was assumed to increase the risk of contracting COVID-19. These people included local business traders, market vendors, truck drivers, female sex workers, health workers, point-of-entry customs officers, cargo loaders and off-loaders, truck mechanics, foreign exchange workers, *boda-boda* [motorcycle taxi] operators, bar waiters and waitresses, hawkers, saloon attendants, security guards, hotel managers and housewives. All respondents had to be Ugandans aged 18 years or older and not critically ill or mentally-challenged at the time of the study.

Sample size and sampling procedures

We estimated the sample size for this study using the Cochran (1977) formulae [26]. Assuming 80% power, proportion of 50%, 95% confidence level and a non-response rate of 10%, a sample size of 427 respondents was computed for each study site, for an overall total of 854 respondents at the two study sites. While we did not aim to test any hypothesis, we found it pertinent to estimate a sample size that would improve the precision and external validity of our study findings. In order to avoid enrolling respondents from one particular category of people (e.g., business traders), we generated rough estimates (quotas) of the number of respondents to be recruited from each category. By 'category of respondents', we refer to categories of people were enrolled in this study as listed under '*Study design and population*' above – i.e., business traders, market vendors, truck drivers, and female sex workers, among others. Given that we did not have adequate sampling frames for each category of respondents, the quotas per category were determined arbitrarily and study enrolment was based on first-come, first served basis, after eligibility screening. Enrolment took place at a designated place in the community where individuals were invited to come for screening and eventual study participation. We worked with the local leaders, customs office, and community health volunteers to mobilize people to come to the study enrolment site. Each respondent was screened for study eligibility (i.e., age 18 years or older; working or living at a border point of entry, or transiting through the border point of entry) and those that were eligible were recruited. As part of the recruitment process, we kept track of those enrolled per category of respondents to ensure that we had interviews with all categories of people. This process was continued until the required sample size at each study site was attained. The number of respondents interviewed in each category of respondents was based on the availability of eligible respondents and varied between categories.

Data collection procedures and methods

Research Assistants, who were University graduates, were trained on the study procedures by the team of investigators. The training covered the study questionnaire, field procedures and interview techniques. Data were collected on socio-demographic characteristics, perceptions about the COVID-19 vaccine, uptake of the COVID-19 vaccine and willingness to take the vaccine among those that were not vaccinated at the time. The questionnaire was uploaded on the *Kobocollect* app and installed on research assistants' phones to ensure real-time data collection, entry and quality checks. After the training, the questionnaire was piloted at one of the communities in Wakiso district in central Uganda to detect any inconsistencies in the flow of questions, skip instructions, and

clarity of questions. The questionnaire was translated into the local language (*Luganda*) and back translated into English to ensure that meanings were maintained and also the local implicit terms were not missed. The respondents were identified with the help of the area local council I chairpersons and the leaders of the different high-risk groups who introduced the team of data collectors to the different high-risk groups (sex workers, health workers, truck drivers, point of entry officers, local business traders/market vendors). After sampling of the respective respondents in the different categories at the two points of entry, consent was sought and the interviews were conducted in both English and Luganda, the prominent languages used in these points of entry.

Measurement of variables

The primary outcome was uptake of COVID-19 vaccine. The term 'COVID-19 vaccine' was used in the generic sense to refer to any type of COVID-19 vaccine. Uptake of the COVID-19 vaccine was determined as the proportion of interviewed respondents who self-reported that they had received at least one dose of COVID-19 vaccination, regardless of the type of vaccine received. To assess COVID-19 vaccine uptake, respondents were asked if they had received any dose of COVID-19 vaccination with 1=Yes and 0=No. Respondents who responded in the affirmative were further asked about the type of vaccine that they received, which we recorded in the questionnaire based on their individual self-reports. On the other hand, willingness to use the vaccine was determined as a proportion of unvaccinated respondents who agreed to take the vaccine if availed to them free of charge. Responses were coded as 1=Yes or 0=No.

Data analysis

The filled-in questionnaire was checked for completeness by the field supervisor. Data were then exported to Stata 14 (StataCorp, College Station, TX) for cleaning and analysis. Analysis consisted of graphical displays and computation of descriptive statistics including frequency distributions, percentages and mean scores. Given that the prevalence of COVID-19 vaccination uptake (a binary outcome) was above 10%, we found it prudent to use a modified Poisson regression model rather than logistic regression in order to generate precise, unbiased estimates. At the bivariate analysis level, we computed the dependent variable with each potential independent variable to obtain crude prevalence ratios (cPR). A conservative level of significance, set at $p<0.20$, was used to select potential independent variables for inclusion into the multivariable modified Poisson regression model. These variables included: age-group, marital status, sex, category of respondents, average income per month, religion, highest level of education, the belief that COVID-19 vaccine is effective, the belief that one is at a risk of contracting COVID-19, and border point of entry. Correlation and multi-collinearity were checked by conducting a correlation coefficient matrix and the variance inflation factor (VIF) test. For all potential independent variables with a correlation coefficient of >=0.40, multi-collinearity was suspected and further investigated using VIF. The VIF results for all the potential independent variables were less than 9.0, thus, all variables were considered for multivariable model building. A parsimonious modified Poisson regression model was constructed using backward elimination method to generate adjusted prevalence ratios (aPR) and their 95% confidence intervals (95% CI) associated with the uptake of COVID-19 vaccines. Probability values of <0.05 were considered to be significant. Data were analyzed using STATA (version 14) software.

Ethical consideration

Ethical approval was obtained from Makerere University School of Public Health Research and Ethics Committee *(Protocol#: 833)* and Uganda National Council for Science and Technology *(Protocol#: HS848ES)*. Written informed consent was obtained from all respondents in the surveys and data anonymity was ensured. All respondents were informed about the content and the purpose of the survey, the expected time for participating, and that all information collected from them would be kept confidential. Data were stored on a password-protected computer after identifiers had been removed. Because data collection took place when the lockdown measures had been lifted, we administered the questionnaires face-to-face with the respondents but ensured adequate protection of the study team and the respondents from any ongoing risk of contracting COVID-19 through the use of face masks and appropriate hand hygiene measures.

Results

Population characteristics

Table 1 shows the characteristics of the study population. Overall, 854 respondents participated in the study −50% (n=427) from Mutukula and 50% (n=427) from Malaba. Nearly half of the respondents (46%, n=391) were aged 35 years or older while 58.8% (n=502) were males. Twenty-two per cent (n=191) of the respondents were Point of Entry Customs staff, 14.9% (n=127) were local business traders; 14.7% (n=126) were market vendors, while 14.3% (n=122) were truck drivers. Of the remaining categories, 10.9% (n=93) were female sex workers, 6.2% (n=53) were health workers, while 16.6% (n=142) belonged to 'other categories', including cargo loaders and off-loaders, truck mechanics, foreign exchange workers, *boda-boda* (motorcycle taxi) operators, bar waiters and waitresses, hawkers, salon attendants, security guards, tailors, hotel managers and housewives. The majority of

Table 1 Characteristics of the study population

Characteristic	Malaba	Mutukula	Total
	(*n* = 427, %)	(*n* = 427, %)	(*N* = 854, %)
Age-group (years)			
18–24	38 (8.9)	128 (30.0)	166 (19.4)
25–34	143 (33.5)	154 (36.1)	297 (34.8)
35–44	129 (30.2)	89 (20.8)	218 (25.5)
45+	117 (27.4)	56 (27.6)	173 (20.3)
Sex			
Male	229 (53.6)	273 (63.9)	502 (58.8)
Female	198 (46.4)	154 (36.1)	352 (41.2)
Category of respondent			
Point of entry customs officer	74 (17.3)	117 (27.4)	191 (22.4)
Local business traders	75 (17.6)	52 (12.2)	127 (14.9)
Market vendor	87 (20.4)	39 (9.1)	126 (14.7)
Truck driver	80 (18.7)	42 (9.8)	122 (14.3)
Sex worker	73 (17.1)	20 (4.7)	93 (10.9)
Health worker	31 (7.3)	22 (5.2)	53 (6.2)
Other category[a]	7 (1.6)	135 (31.6)	142 (16.6)
Highest level of education			
No formal education	9 (2.1)	22 (5.2)	31 (3.6)
Primary	198 (46.4)	156 (36.5)	354 (41.5)
Secondary	160 (37.5)	171 (40.1)	331 (38.8)
Tertiary	60 (14.1)	78 (18.3)	138 (16.2)
Marital status			
Single	66 (15.5)	178 (41.7)	244 (28.6)
Married	271 (63.4)	221 (51.7)	492 (57.6)
Separated/divorced/widowed	90 (21.1)	28 (6.6)	118 (13.8)
Religion			
Anglican	104 (24.4)	75 (17.6)	179 (20.9)
Catholic	156 (36.5)	218 (51.1)	374 (43.8)
Moslem	98 (23.0)	86 (20.1)	184 (21.6)
Seventh Day Adventist	6 (1.4)	9 (2.1)	15 (1.8)
Pentecostal	63 (14.8)	39 (9.1)	102 (11.9)
Employment status			
Unemployed	3 (0.7)	10 (2.3)	13 (1.5)
Employed	190 (44.5)	212 (49.7)	402 (47.1)
Self-employed	234 (54.8)	205 (48.0)	439 (51.4)
Average income per month (USD)			
<=131	344 (80.6)	337 (78.9)	681 (79.7)
131–394	70 (16.4)	68 (15.9)	138 (16.2)
> 394	13 (3.0)	22 (5.2)	35 (4.1)

[a]This category included cargo loaders and off-loaders, cleaners, truck mechanics, foreign exchange workers, boda-boda cyclists, hawkers, bar waiters and waitresses, salon attendants, security guards, tailors, hotel managers, and housewives

respondents had primary or secondary education as their highest level of education (80.3%, *n*=685), 57.6% (*n*=492) were currently married, 64.7% (*n*=553) ascribed to the Anglican or Catholic religion; 51.4% (*n*=439) were self-employed, while 80% (*n*=681) were low-income earners (with an average monthly income of US$131 or less).

Perceptions about the COVID-19 vaccine

Table 2 shows the respondents' perceptions about the COVID-19 vaccine, overall and across study sites. In response to a series of statements about the COVID-19 vaccine, 81.0% (*n*=692) agreed with the statement, "*COVID-19 vaccine is effective against COVID-19*", 74.1% (*n*=633) agreed with the statement, "*COVID-19 vaccine prevents one from getting severe disease*", 51.9% (*n*=443) agreed with the statement, "*COVID-19 vaccine has side effects*", while 49.3% (*n*=421) agreed with the statement, "*People vaccinated against COVID-19 will not contract the coronavirus*". Despite the high level of agreement with most of these statements, we noted some differences

Table 2 Perceptions about the COVID-19 vaccine among high-risk populations at two land border points of entry into Uganda

Perceptions	Total	Malaba	Mutukula	Pearson's Chi square *p*-value
	(*N* = 854, %)	(*n* = 427, %)	(*n* = 427, %)	
COVID-19 vaccine is effective against coronavirus disease				
No	58 (6.8)	32 (7.5)	26 (6.1)	< 0.001
Yes	692 (81.0)	368 (86.2)	324 (75.9)	
Don't know	104 (12.2)	27 (6.3)	77 (18.0)	
People vaccinated against COVID-19 will not contract the coronavirus				
Agree	421 (49.3)	193 (45.2)	228 (53.4)	0.024
Disagree	301 (35.2)	169 (39.6)	132 (30.9)	
Neutral	132 (15.4)	65 (15.2)	67 (15.7)	
COVID-19 vaccine has side effects				
No	314 (36.8)	183 (42.9)	131 (30.7)	0.001
Yes	443 (51.9)	204 (47.8)	239 (55.9)	
Don't know	97 (11.3)	40 (9.4)	57 (13.4)	
COVID-19 vaccine prevents one from getting severe disease				
No	102 (11.9)	73 (17.1)	29 (6.8)	< 0.001
Yes	633 (74.1)	299 (70.0)	334 (78.2)	
Don't know	119 (13.9)	55 (12.9)	64 (15.0)	

between sites. For instance, the proportion of respondents agreeing with the statement, "*COVID-19 vaccine is effective against COVID-19*" was higher in Malaba than in Mutukula (86.2%, *n* = 368 vs. 75.9% *n* = 324, respectively). Conversely, a higher proportion of respondents in Mutukula believed that the COVID-19 vaccine prevents one from getting severe disease than those in Malaba (78.2%, *n* = 334 vs. 70%, *n* = 229, respectively).

Uptake of the COVID-19 vaccine

Table 3 shows the uptake of the COVID-19 vaccine at Malaba and Mutukula land border points of entry, overall and across the different background characteristics. Overall, 80.3% (*n* = 686) of the respondents reported that they received at least one vaccine dose, with a higher proportion in Malaba (94.4%, *n* = 403) than in Mutukula (66.3%, *n* = 283). When asked what type of vaccine they received, the majority respondents in Malaba (75.9%, *n* = 306) and 41.0% (*n* = 116) in Malaba reported that they received *AstraZeneca* and *Johnson and Johnson*. Nearly half of the respondents in Mutukula (47.4%, *n* = 134) did not know which type of vaccine they received compared to 12.4% (*n* = 50) of those in Malaba. Of those who received at least one vaccine dose, 59.6% (*n* = 409) reported that they received a complete dose of vaccination, with a higher proportion in Mutukula (68.9% (*n* = 195) than in Malaba (53.1%, *n* = 214). However, none of those who received a complete dose of vaccination reported receiving a booster dose at either study site.

Uptake of at least one vaccine dose increased with increasing age, from 66.3% (*n* = 110) among those aged 18–24 years to 93.1% (*n* = 161) among those aged 45 + years but was similar between males and females. Uptake by population category was highest among health workers (92.5%, *n* = 49) followed by truck drivers (90.9%, *n* = 111) and female sex workers (86%, *n* = 80), in that order. Uptake was higher among those with primary (82.2%, *n* = 291) or secondary education (80.1%, *n* = 265) than those with no education at all (67.7%, *n* = 21) and among those who were separated/divorced/widowed (87.3%, *n* = 103) than those who were single (68.9%, *n* = 168). By income status, nearly all (97.1%, *n* = 34) of those earning an average monthly income of more than US$394 per month received at least one vaccine dose compared to 78.8% (*n* = 537) among those who earned less than or equal to US$131.

Factors associated with COVID-19 vaccine uptake

Table 4 shows the factors associated with COVID-19 vaccine uptake at bivariate and multivariable analysis levels. At bivariate analysis, the factors that were positively associated with COVID-19 vaccine uptake were: older age-group (i.e., those aged 25–34 years, 35–44 years and 45 + years were significantly more likely to have received the COVID-19 vaccine than those aged 18–24 years), being a health worker [crude PR [cPR] (95% CI) = 1.12 (1.00, 1.25)], being currently married [cPR (95% CI) = 1.23 (1.12, 1.34)] or separated/divorced/widowed [cPR (95% CI) = 1.27 (1.14, 1.41)]; earning an average monthly income of more than US$394 per month [cPR (95% CI) = 1.23 (1.15, 1.32)], and the belief that the COVID-19 vaccine is effective [cPR (95% CI) = 1.31 (1.09, 1.59)]. On the other hand, factors that were negatively associated with COVID-19 vaccine uptake were being Catholic [cPR (95% CI) = 0.85 (0.78, 0.92)], not believing that one was at risk of contracting the coronavirus [cPR (95% CI) = 0.91 (0.85, 0.99)] and living in Mutukula [cPR (95% CI) = 0.70 (0.65, 0.75)].

Table 3 Uptake of COVID-19 vaccine among high-risk populations at two border points of entry into Uganda

Characteristic	Total		Malaba		Mutukula	
	N	*n* (%)	*N*	*n* (%)	*N*	*n* (%)
All	854	686 (80.3)	427	403 (94.4)	427	283 (66.3)
Age-group (years)						
18–24	166	110 (66.3)	38	30 (79.0)	128	80 (62.5)
25–34	297	230 (77.4)	143	133 (93.0)	154	97 (63.0)
35–44	218	185 (84.9)	129	125 (96.9)	89	60 (67.4)
45+	173	161 (93.1)	117	115 (98.3)	56	46 (82.1)
Sex						
Male	502	397 (79.1)	229	221 (96.5)	273	176 (64.5)
Female	352	289 (82.1)	198	182 (91.9)	154	107 (69.5)
Category of respondent						
Market vendor	126	104 (82.5)	87	83 (95.4)	39	21 (53.9)
Local business traders	127	102 (80.3)	75	69 (92.0)	52	33 (63.5)
Sex worker	93	80 (86.0)	73	68 (93.2)	20	12 (60.0)
Truck driver	122	111 (90.9)	80	77 (96.3)	42	34 (81.0)
Point of entry customs officer	191	150 (78.5)	74	71 (96.0)	117	79 (67.5)
Health worker	53	49 (92.5)	31	30 (96.8)	22	19 (86.4)
Other category	142	90 (63.4)	7	5 (71.4)	135	85 (63.0)
Highest level of education						
No formal education	31	21 (67.7)	9	8 (88.9)	22	13 (59.1)
Primary	354	291 (82.2)	198	192 (97.0)	156	99 (63.5)
Secondary	331	265 (80.1)	160	150 (93.8)	171	115 (67.3)
Tertiary	138	109 (78.9)	60	53 (88.3)	78	56 (71.8)
Marital status						
Single	244	168 (68.9)	66	59 (89.4)	178	109 (61.2)
Married	492	415 (84.4)	271	257 (94.8)	221	158 (71.5)
Separated/divorced/Widowed	118	103 (87.3)	90	87 (96.7)	28	16 (57.1)
Religion						
Anglican	179	157 (87.7)	104	97 (93.3)	75	60 (80.0)
Catholic	374	278 (74.3)	156	146 (93.6)	218	132 (60.6)
Moslem	184	156 (84.8)	98	95 (96.9)	86	61 (70.9)
Seventh-Day Adventist	15	12 (80.0)	6	6 (100.0)	9	6 (66.7)
Pentecostal	102	83 (81.4)	63	59 (93.7)	39	24 (61.5)
Employment status						
Unemployed	13	9 (69.2)	3	2 (66.7)	10	7 (70.0)
Employed	402	332 (82.6)	190	181 (95.3)	212	151 (71.2)
Self-employed	439	345 (78.6)	234	220 (94.0)	205	125 (60.9)
Average income per month (USD)						
<=131	681	537 (78.8)	344	323 (93.9)	337	214 (63.5)
131–394	138	115 (83.3)	70	67 (95.7)	68	48 (70.6)
> 394	35	34 (97.1)	13	13 (100.0)	22	21 (95.5)

At multivariable analysis, after adjusting for potential and suspected confounders, the factors that were positively associated with COVID-19 vaccine uptake were: age-group 35–44 years [adjusted Prevalence Ratio [aPR] (95% CI) = 1.13 (1.01, 1.27)] or 45 + years [aPR (95% CI) = 1.19 (1.07, 1.33)] relative to 18–24 years; being a truck driver [aPR (95% CI) = 1.16 (1.04, 1.29)] or health worker [aPR (95% CI) = 1.18 (1.05, 1.32)]; earning an average monthly income of more than US$394 per month [aPR (95% CI) = 1.19 (1.08, 1.30)], and the belief that the COVID-19 vaccine is effective against the coronavirus [aPR (95% CI) = 1.32 (1.10, 1.58)]. The only factor that was negatively associated with COVID-19 vaccine uptake at the multivariable analysis was residence in Mutukula [aPR (95% CI) = 0.73 (0.68, 0.78)].

Willingness to take the COVID-19 vaccine among those that were not yet vaccinated

Table 5 shows the distribution of willingness to take the COVID-19 vaccine, overall and by study site, across different background characteristics. Overall, 19.7% (n = 168) of the respondents reported that they had not

Table 4 Factors associated with vaccine uptake among high-risk populations at two border points of entry into Uganda

Characteristic	Total		Crude Prevalence Ratio [cPR], 95% CI	Adjusted PR [aPR], (95% CI)
	N	*n* (%)		
Age-group (years)				
18–24	166	110 (66.3)	Ref	Ref
25–34	297	230 (77.4)	1.17 (1.03–1.32)	1.06 (0.94–1.19)
35–44	218	185 (84.8)	1.28 (1.13–1.45)	1.13 (1.01–1.27)
45+	173	161 (93.1)	1.40 (1.25–1.58)	1.19 (1.07–1.33)
Sex				
Male	502	397 (79.1)	Ref	Ref
Female	352	289 (82.1)	1.04 (0.97–1.11)	1.02 (0.96.1.08)
Category of respondent				
Market vendor	126	104 (82.5)	Ref	Ref
Local business traders	127	102 (80.3)	0.97 (0.86–1.09)	1.05 (0.94–1.16)
Sex worker	93	80 (86.0)	1.04 (0.93–1.17)	1.07 (0.96–1.19)
Truck driver	122	111 (90.9)	1.10 (0.99–1.23)	1.16 (1.04–1.29)
Point of entry customs officers	191	150 (78.5)	0.95 (0.85–1.06)	1.11 (0.99–1.29)
Health worker	53	49 (92.5)	1.12 (1.00-1.25)	1.18 (1.05–1.32)
Other category	142	90 (63.4)	0.77 (0.66–0.89)	1.05 (0.89–1.23)
Highest level of education				
No formal education	31	21 (67.7)	Ref	Ref
Primary	354	291 (82.2)	1.21 (0.95–1.56)	1.05 (0.83–1.33)
Secondary	331	265 (80.1)	1.18 (0.92–1.52)	1.09 (0.86–1.37)
Tertiary	138	109 (78.9)	1.27 (0.90–1.51)	0.99 (0.77–1.28)
Marital status				
Single	244	168 (68.9)	Ref	Ref
Married	492	415 (84.4)	1.23 (1.12–1.34)	1.03 (0.92–1.15)
Separated/divorced/Widowed	118	103 (87.3)	1.27 (1.14–1.41)	0.99 (0.88–1.13)
Religion				
Anglican	179	157 (87.7)	Ref	Ref
Catholic	374	278 (74.3)	0.85 (0.78–0.92)	0.89 (0.83–0.96)
Moslem	184	156 (84.8)	0.97 (0.89–1.05)	0.99 (0.91–1.07)
Seventh-Day Adventist	15	12 (80.0)	0.91 (0.70–1.18)	0.93 (0.74–1.17)
Pentecostal	102	83 (81.4)	0.93 (0.83–1.03)	0.93 (0.84–1.02)
Average income per month (USD)				
<=131	681	537 (78.9)	Ref	Ref
131–394	138	115 (83.3)	1.06 (0.97–1.15)	1.01 (0.92–1.09)
> 394	35	34 (97.1)	1.23 (1.15–1.32)	1.19 (1.08–1.30)
COVID-19 vaccine is effective				
No	58	38 (65.5)	Ref	Ref
Yes	692	595 (85.9)	1.31 (1.09–1.59)	1.32 (1.10–1.58)
Don't know	104	53 (50.9)	0.78 (0.59–1.01)	0.85 (0.66–1.10)
Being at risk of contracting COVID-19				
Agree				
Neutral	560	465 (3.0)	Ref	Ref
Disagree	28	19 (67.9)	0.82 (0.63–1.06)	0.89 (0.71–1.13)
	266	202 (75.9)	0.91 (0.85–0.99)	0.94 (0.88–1.01)
Border point of entry				
Malaba	427	403 (94.4)	Ref	Ref
Mutukula	427	283 (66.3)	0.70 (0.65–0.75)	0.73 (0.68–0.78)

been vaccinated against COVID-19. Of these, 58.9% (n=99) were willing to take the COVID-19 vaccine if availed to them free of charge, with similar proportions in Malaba (58.3%, n=14) and Mutukula (59.0%, n=85). Willingness to take the vaccine increased with increasing age from 53.6% (n=30) among those aged 18–24 years to 69.7% (n=23) among those aged 35–44 years but was lower among those aged 45+years (33.3%, n=4).

Table 5 Willingness to take the COVID-19 vaccine among high-risk populations who had not yet been vaccinated

Characteristic	Total		Malaba		Mutukula	
	N	*n* (%)	*N*	*n* (%)	*N*	*n* (%)
All	168	99 (58.9)	24	14 (58.3)	144	85 (59.0)
Age-group (years)						
18–24	56	30 (53.6)	8	3 (37.5)	48	27 (56.3)
25–34	67	42 (62.7)	10	8 (80.0)	57	34 (59.7)
35–44	33	23 (69.7)	4	3 (75.0)	29	20 (69.0)
45+	12	4 (33.3)	2	0 (0.0)	10	4 (40.0)
Sex						
Male	105	62 (59.1)	8	5 (62.5)	97	57 (58.8)
Female	63	37 (58.7)	16	9 (56.3)	47	28 (59.6)
Category of respondent						
Market vendor	22	14 (63.6)	4	2 (50.0)	18	12 (66.7)
Local business traders	25	13 (52.0)	6	5 (83.3)	19	8 (42.1)
Sex worker	13	8 (61.5)	5	3 (60.0)	8	5 (62.5)
Truck driver	11	8 (72.7)	3	1 (33.3)	8	7 (87.5)
Point of entry customs officer	41	22 (53.7)	3	1 (33.3)	38	21 (55.3)
Health worker	4	1 (25.0)	1	1 (100.0)	3	0 (0.0)
Other category	52	33 (63.5)	2	1 (50.0)	50	32 (64.0)
Highest level of education						
No formal education	10	7 (70.0)	1	1 (100.0)	9	6 (66.7)
Primary	63	42 (66.7)	6	1 (16.7)	57	41 (71.9)
Secondary	66	34 (51.5)	10	5 (50.0)	56	29 (51.8)
Tertiary	29	16 (55.2)	7	7 (100.0)	22	9 (40.9)
Marital status						
Single	76	47 (61.0)	7	3 (42.9)	69	37 (53.6)
Married	77	40 (52.6)	14	8 (57.1)	63	39 (61.9)
Divorced/separated/Widowed	15	12 (80.0)	3	3 (100.0)	12	9 (75.0)
Religion						
Anglican	22	11 (50.0)	7	4 (57.1)	15	7 (46.7)
Catholic	96	60 (62.5)	10	6 (60.0)	86	54 (62.8)
Moslem	28	19 (67.9)	3	3 (100.0)	25	16 (64.0)
Seventh Day Adventist	3	1 (33.3)	0	0 (0.0)	3	1 (33.3)
Pentecostal	19	8 (42.1)	4	1 (25.0)	15	7 (46.7)
Employment status						
Unemployed	4	2 (50.0)	1	0 (0.0)	3	2 (66.7)
Employed	70	43 (61.4)	9	5 (55.6)	61	38 (62.3)
Self-employed	94	54 (57.5)	14	9 (64.3)	80	45 (56.3)
Average income per month (USD)						
< 131	129	79 (61.2)	18	11 (61.1)	111	68 (61.3)
≥ 131	39	20 (51.3)	6	3 (50.0)	33	17 (51.5)

Willingness to take the vaccine was similar between males and females (males: 59.1%, $n=62$; females: 58.7%, $n=37$). Over half of almost every category of respondents were willing to take the vaccine, with a higher proportion reported among truck drivers (72.7%, $n=8$) than the other categories, but willingness to take the vaccine was lower among health workers (25%, $n=1$).

Factors associated with willingness to take the COVID-19 vaccine

Table 6 shows the factors associated with willingness to take the COVID-19 vaccine at the bivariate and multivariable analysis levels. At bivariate analysis, the factors that were positively associated with willingness to take the vaccine were: the belief that the COVID-19 vaccine is effective against the coronavirus [cPR (95% CI)=2.22 (1.28, 3.83)]; the belief that one can contract the coronavirus if not vaccinated [cPR (95% CI)=5.34 (2.52, 11.30)]; the belief that people vaccinated against COVID-19 would not contract the virus [cPR (95% CI)=1.33 (1.06, 1.67)] and the belief that the community in which they lived was at risk of COVID-19 [cPR (95% CI)=2.39 (1.65, 3.47)]. Being neutral regarding whether people vaccinated against COVID-19 would contract or

Table 6 Factors associated with willingness to take the COVID-19 vaccine among high-risk populations who had not yet been vaccinated

Characteristic	Total		Crude PR [cPR], (95% CI)	Adjusted PR [aPR], (95% CI)[a]
	N	*n* (%)		
Age-group (years)				
18–24	56	30 (53.6)	Ref	Ref
25–34	67	42 (62.7)	1.17 (0.86–1.59)	1.35 (0.98–1.88)
35–44	33	23 (69.7)	1.30 (0.93–1.81)	1.40 (0.96–2.03)
45+	12	4 (33.3)	0.62 (0.27–1.44)	1.30 (0.71–2.31)
Sex				
Male	105	62 (59.1)	Ref	Ref
Female	63	37 (58.7)	0.99 (0.77–1.29)	0.91 (0.69–1.20)
Category of respondent				
Market vendor	22	14 (63.6)	Ref	Ref
Local business traders	25	13 (52.0)	0.82 (0.50–1.34)	1.24 (0.85–1.82)
Sex worker	13	8 (61.5)	0.97 (0.57–1.65)	1.44 (0.96–2.15)
Truck driver	11	8 (72.7)	1.14 (0.71–1.85)	1.00 (0.70–1.44)
Point of entry customs officer	41	22 (53.7)	0.84 (0.55–1.29)	1.15 (0.79–1.69)
Health worker	4	1 (25.0)	0.39 (0.07–2.22)	0.40 (0.08–2.11)
Other category	52	33 (63.5)	0.10 (0.68–1.46)	1.35 (0.99–1.84)
Border point of entry				
Malaba	24	14 (58.3)	Ref	Ref
Mutukula	144	85 (59.0)	1.01 (0.70–1.46)	0.81 (0.59–1.11)
COVID-19 vaccine is effective against coronavirus disease				
No	111	9 (33.3)	Ref	Ref
Yes	27	82 (73.9)	2.22 (1.28–3.83)	1.30 (0.84–2.01)
Don't know	30	8 (26.7)	0.80 (0.36–1.78)	0.97 (0.49–1.92)
Do you think you can contract COVID-19?				
No	118	6 (14.3)	Ref	Ref
Yes	42	90 (76.3)	5.34 (2.52–11.30)	3.67 (1.90–7.10)
Don't know	8	3 (37.5)	2.63 (0.82–8.42)	2.28 (0.88–5.93)
People vaccinated against COVID-19 will not contract the coronavirus				
Agree	85	51 (60.0)	Ref	Ref
Neutral	38	12 (31.6)	0.53 (0.32–0.89)	0.86 (0.56–1.30)
Disagree	45	36 (80.0)	1.33 (1.-06-1.67)	1.15 (0.94–1.41)
COVID-19 vaccine has side effects				
No	95	25 (73.5)	Ref	Ref
Yes	34	50 (52.6)	0.72 (0.54–0.95)	0.90 (0.68–1.19)
Don't know	39	24 (61.5)	0.84 (0.61–1.15)	1.07 (0.78–1.47)
COVID-19 still exists in Uganda				
Agree	91	23 (25.3)	Ref	Ref
Neutral	15	5 (33.3)	0.89 (0.61–1.30)	1.07 (0.75–1.53)
Disagree	62	41 (66.1)	0.45 (0.31–0.66)	0.59 (0.42–0.82)
Thought their communities are at risk of COVID-19				
No	59	20 (33.9)	Ref	Ref
Yes	79	64 (81.0)	2.39 (1.65–3.47)	1.86 (1.33–2.62)
Don't know	30	15 (50.0)	1.48 (0.89–2.45)	1.54 (0.99–2.40)

[a]Adjusted for: average monthly income, religious affiliation, marital status, and highest level of education. None of these factors were found to be significantly associated with willingness to take the COVID-19 vaccine

not contract the coronavirus [cPR (95% CI)=0.53 (0.32, 0.89)]; the belief that the COVID-19 vaccine has side effects [cPR (95% CI)=0.72% (0.54, 0.95)] and not believing that COVID-19 still existed in Uganda [cPR (95% CI)=0.45 (0.31, 0.66) were negatively associated with willingness to receive the COVID-19 vaccine at this level. At multivariable analysis, the factors that were positively associated with willingness to receive the COVID-19 vaccine were: the belief that one can contract the coronavirus if not vaccinated [aPR (95% CI)=3.67 (1.90, 7.10)] and

the belief that the community in which they lived was at risk of COVID-19 [aPR (95% CI) = 1.86 (1.33, 2.62)]. Not believing that COVID-19 still existed in Uganda was negatively associated with willingness to take the COVID-19 vaccine [aPR (95% CI) = 0.59 (0.42, 0.82)].

Discussion

Our study of the uptake and willingness to take the COVID-19 vaccine among unvaccinated Ugandans at two land border points of entry into Uganda (Malaba and Mutukula) at least one year following the ease of COVID-19 lockdown restrictions, shows that: (a) eight out of every ten respondents received at least one vaccine dose; (b) nearly six out of every ten respondents, who received at least one vaccine dose, reported that they received a complete dose of vaccination; (c) none of those who received a complete dose of vaccination reported receiving a booster dose; while (d) six out of every ten unvaccinated respondents expressed willingness to receive the vaccine. Although COVID-19 vaccine uptake was high, the fact that none of the fully vaccinated individuals reported that they received a booster dose suggest that many of the vaccinated individuals did not receive ongoing protection from COVID-19. These findings call for a need for increased health promotion to improve the population's appreciation of the need for full and ongoing vaccination given the continued risk of COVID-19 in the community.

Our findings show that vaccination uptake at the two border points of entry was much higher than among the general population in Uganda. Based on the data available on the WHO dashboard on COVID-19 vaccinations, only 48% of Ugandans received at least one vaccination dose with only 29% of those vaccinated reporting that they received a complete dose, while only 2% reported that they received a booster dose as of November 26th, 2023 [7]. It is not surprising that the vaccination uptake at the land border points of entry was higher than among members of the general population, given that at all points of entry, including land and air, all point of entry workers, cross-border travelers and residents living at those sites were required to have evidence of vaccination. It was mandatory to show possession of a vaccination card before travelers were allowed to cross country borders. Besides the government mandate to ensure maximum vaccination, there were also more targeted interventions towards points of entry, including initiatives to fund vaccination promotion campaigns at these points of entry [24, 27]. Border points of entry were targeted for COVID-19 vaccination campaigns as these areas not only serve as points of entry of people and goods into the country but also as points of entry of infectious diseases that are spread from one country to the other. Thus, efforts to enforce COVID-19 vaccination at the border points of entry are crucial for sustained control of the spread of infectious diseases globally [28].

It is not known why the proportion of vaccinated individuals who received at least one vaccine dose were likely to be residents of Mutukula yet overall vaccine uptake at Mutukula was much lower than those of Malaba. Indeed, vaccination uptake at Mutukula was lower than that at Malaba despite the fact that enforcement of COVID-19 vaccination happened at the same sites. However, because Mutukula is closer to Tanzania which initially expressed reservations about the existence of COVID-19, and thus was slow in enforcing COVID-19 prevention measures [29, 30]; this might be the reason why people in Mutukula did not feel obliged to go for vaccination as those in Malaba. Requirements for entry into Kenya during the active phase of COVID-19 were much stricter than those for entry into Tanzania. However, this still does not help to explain why the percentage of respondents with a complete dose of vaccination was higher among residents of Mutukula than those of Malaba. It is likely that we recruited respondents that were already motivated to accept the COVID-19 vaccine and that the differences in COVID-19 vaccine uptake between the two sites may be due to chance rather than related to their exact locations. Additional inquiry may be necessary to understand the surprisingly higher uptake of a complete vaccination dose at a site that was closer to a country that initially opposed the existence of COVID-19.

We found that none of those who reported receiving a complete dose of COVID-19 vaccination had received any booster dose. The demand for booster doses is generally low in some settings, ranging between 8 and 39.5% across studies [31–33]. The low demand for booster doses may be due to the fear of side-effects, the perception that the booster would not provide additional protection over the vaccines already received, and concerns about booster safety or that it would not protect from the coronavirus infection [33]. The low demand for booster doses, coupled with the low demand for COVID-19 vaccines among unvaccinated population, has led to a large number of vaccines expiring in the stores [34, 35]. These findings call for a need for evidence-based public health interventions to improve COVID-19 uptake such as raising awareness of the effectiveness of COVID-19 vaccine, reducing barriers to vaccination, and integration of COVID-19 vaccination into the primary healthcare system [36]. Indeed, as of February 2024, over 100 individuals tested positive for COVID-19 in Uganda [7] while two people died of COVID-19 in Uganda in January 2024 [37]. This is a clear indication that the COVID-19 threat is still apparent and that the need for ongoing COVID-19 vaccination, including targeting currently unvaccinated individuals as well those who are due for their booster doses, is well justified.

We found that nearly 60% of the high-risk populations that had not yet been vaccinated at the time of the study were willing to take the COVID-19 vaccine, with a similar proportion in Mutukula and Malaba land points of entry into Uganda. This level of willingness to take the vaccine is definitely lower than previously reported in studies conducted between 2020 and 2022, during the active phase of the pandemic or immediately before or during the introduction of COVID-19 vaccines [38–40]. For instance, Kanyanda et al. [39] found between 64.5% and 97.9% willingness to accept the vaccine in a study conducted in six sub-Saharan African countries between September and December 2020 while Bongomin et al. [38] found 70% willingness to accept the vaccine in a Ugandan study conducted in March/April 2021. However, it was surprising that, over one year after the ease of restrictions (which were eased in September 2021), the proportion of those who were willing to get vaccinated against COVID-19 was still as high as 60%. One probable explanation for this relatively high willingness to take the vaccine could be due to continued fears of vaccination mandates where the possession of a COVID-19 vaccination certificate might be required in future border crossings or movements to other countries. However, with countries easing the need to show evidence of full vaccination across the globe, it is likely that the demand for COVID-19 vaccination has substantively gone down. Indeed, countries are now reporting vaccine expiries due to the low demand for COVID-19 vaccines [34, 41]. As of 31 December 2022, 23,511,577 million expired doses had been reported to the WHO African Regional Office, representing 3.1% of doses received in the African region. Algeria, Senegal, Madagascar, the Democratic Republic of Congo, and Nigeria accounted for 65% of the expired doses reported in the African region [41]. A recent audit report in Uganda suggests that over 5.6 million doses of COVID-19 vaccines, purchased through a World Bank loan by the Ugandan government, have expired [35]. Valued at 28.1 billion Ugandan shillings ($7.3 m; £5.8 m), these vaccines will be withdrawn from health facilities and destroyed [35].

This study had several limitations and strengths. Our estimation of the proportion of respondents who received a complete dose of vaccination is based on those who reported that they received at least one vaccine dose. While this is safe and includes those who received a vaccine that required only one vaccine dose for complete vaccination, our estimate of the full dose of vaccination is affected by the fact that nearly half (47%) of respondents at Mutukula did not know what type of vaccine they received. Thus, our estimation of the complete dose of vaccination should be interpreted with caution given that we could not tell what type of vaccine some of the participants received and whether or not those vaccines required a single dose or two doses to have a complete dose of vaccination. Besides, while we don't have any reasons to believe that participants' responses to questions about COVID-19 vaccination were not honest, we think that the existence of COVID-19 mandates that were in place regarding cross-border traveling during the COVID-19 period (e.g., presentation of a COVID-19 vaccination certificate) may have influenced the findings both positively and negatively. In a positive sense, the presence of these mandates could have motivated people to go for vaccination [42–44], suggesting that the reported COVID-19 uptake may have been a true reflection of the vaccination uptake in this population. However, in a negative sense, the COVID-19 mandates may have led to a social desirability bias: some participants may have opted to report that they received the vaccine when they actually did not receive it due to the need to conform with community expectations of being fully vaccinated. Either way, the presence of a social desirability bias may have led to under- or over-reporting of the vaccination uptake, yet we did not ask to take a look at the vaccination cards, among those who self-reported that they were already vaccinated. Further research is warranted to determine the actual COVID-19 vaccination uptake, including a need to verify the vaccination status through checking the vaccination card. The other limitation is that the study was conducted at least one year after the ease of COVID-19 lockdown restrictions. Therefore, the willingness to take the vaccine reported in this paper may reflect the perceptions of those that were interviewed (who might have been a self-selected, motivated group) rather than a representation of the different categories of the population that were targeted for interview or the general population in the study sites. However, given that some people still considered themselves or their community to be at risk of COVID-19, it is likely that the willingness to take the vaccine that is reported in this paper may suggest that there are some people out there who are willing to take the COVID-19 vaccine even after the lockdown was lifted.

It is important to note that the study findings reported in this paper are based on data that were collected from a convenient sample that was not representative of the different categories of respondents interviewed. It is likely that the people we interviewed may have been a motivated group that came to our recruitment venues/sites but who might be different from those that did not come to those sites. Thus, our study findings may not be generalizable to the respective respondent categories or to the general population at the respective study sites. The main strength is that this is one among a few studies conducted at border points of entry into Uganda after the ease of COVID-19 lockdown restrictions to assess people's willingness to take the COVID-19 vaccine at a time

when most of the available vaccines are already expiring in the stores. Although the study was conducted at two of Uganda's 36 points of entry, we believe that the study findings can help to inform efforts to increase health promotion and continued sensitization to encourage people at all border points of entry to take up the vaccines, including booster doses, given that there is ongoing risk for contracting new COVID-19 variants [45] and other infectious diseases in the community.

Conclusion

We found a high uptake of the COVID-19 vaccine and a moderate level of willingness to take the vaccine among respondents that were unvaccinated at the time of the study. Both the uptake and willingness to take the vaccine were influenced by respondents' age (both increased with increasing age), nature of occupation (high among truck drivers and health workers) and perceptions about the efficacy of the vaccine coupled with potential risks of COVID-19 infection, especially among those that considered COVID-19 to still be a health threat in Uganda. Our findings call for a need for continued health promotion to encourage unvaccinated Ugandans to take up the available vaccines, including booster doses, to reduce the risk of contracting new COVID-19 variants and other infectious diseases.

Abbreviations

aPR	Adjusted Prevalence Ratio
cPR	Crude Prevalence Ratio
CI	Confidence Interval
COVID	Coronavirus Disease
PR	Prevalence Ratio
UGX	Uganda Shillings
US	United States
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-024-20823-z.

Supplementary Material 1: Study tool. Study Questionnaire.

Acknowledgements

We acknowledge support from the District Health Officers in Kyotera and Tororo districts in the implementation of this study. We also acknowledge the research assistants for conducting the interviews and the study participants for participating in this study.

Author contributions

J.K.B.M. and R.N. conceived the study, supervised data collection and drafted the manuscript. C.A. coordinated the study and contributed to the writing of the initial draft. O.T. and L.T. conducted the analysis and contributed to the writing of the initial draft of this paper. E.B. and D.M. guided the initial conceptualization of the study, provided scientific oversight during study implementation, and reviewed the final manuscript for substantial intellectual content. All authors read and approved the final manuscript.

Funding

This work was funded by the Government of Uganda through the Makerere University Research and Innovations Fund. The funder had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was reviewed and approved by the Makerere University School of Public Health Research and Ethics Committee (Protocol#: 833) and cleared by the Uganda National Council for Science and Technology (Protocol#: HS848ES). All participants provided written informed consent prior to participation in the study. This study was conducted in accordance with the 1964 Declaration of Helsinki (as amended).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Makerere University School of Public Health, P.O. Box 7072, Kampala, Uganda
[2]Faculty of Health Sciences, Busitema University, Mbale, Uganda

Received: 1 May 2024 / Accepted: 21 November 2024
Published online: 27 November 2024

References

1. Falzon D, Zignol M, Bastard M, Floyd K, Kasaeva T. The impact of the COVID-19 pandemic on the global tuberculosis epidemic. Front Immunol. 2023;14:1234785.
2. Deb P, Furceri D, Ostry JD, Tawk N. The economic effects of COVID-19 containment measures. Open Econ Rev. 2022;33(1):1–32.
3. Akat M, Karataş K. Psychological effects of COVID-19 pandemic on society and ıts reflections on education. Turk Stud. 2020;15(4):1–13.
4. Ceylan RF, Ozkan B, Mulazimogullari E. Historical evidence for economic effects of COVID-19. Eur J Health Econ. 2020;21(6):817–23.
5. Nuwematsiko R, Nabiryo M, Bomboka JB, Nalinya S, Musoke D, Okello D, et al. Unintended socio-economic and health consequences of COVID-19 among slum dwellers in Kampala, Uganda. BMC Public Health. 2022;22:1–13.
6. Musoke D, Nalinya S, Lubega GB, Deane K, Ekirapa-Kiracho E, McCoy D. The effects of COVID-19 lockdown measures on health and healthcare services in Uganda. PLOS Glob Public Health. 2023;3(1):e0001494.
7. WHO. WHO COVID-19 dashboard, Geneva. Switzerland: WHO; 2024. https://data.who.int/dashboards/covid19/about. Accessed September 8, 2024.
8. WHO. Controlling the spread of COVID-19 at ground crossings. Geneva: WHO. 2020. https://iris.who.int/bitstream/handle/10665/332165/WHO-2019-nCoV-Ground_crossings-2020.1-eng.pdf?sequence=1&isAllowed=y. Accessed September 8, 2024.
9. Social Science in Humanitarian Action Platform (SSHAP). COVID-19 Risk Communication and Community Engagement Strategies for Cross-Border Movement in Eastern and Southern Africa. https://www.socialscienceinaction.org/resources/covid-19-rcce-strategies-for-cross-border-movement-in-eastern-and-southern-africa/. Accessed September 8, 2024.
10. MOH. Guidelines on Quarantine of Individuals in the Context of Containment of Coronavirus Disease (COVID-19) in Uganda. Kampala: Ministry of Health; April, 2020. Available from: Updated-Guide-Draft_24April20_CLEAN.pdf (health.go.ug). Accessed September 8, 2024.
11. Kitara DL, Ikoona EN. COVID-19 pandemic, Uganda's story. Pan Afr Med J. 2020;35(21):51.
12. WHO. Vaccine efficacy, effectiveness and protection, Geneva. WHO; 2021. https://www.who.int/news-room/feature-stories/detail/vaccine-efficacy-effectiveness-and-protection. Accessed September 8, 2024.

13. Coccia M. Optimal levels of vaccination to reduce COVID-19 infected individuals and deaths: a global analysis. Environ Res. 2022;204:112314.
14. Liu Y, Procter SR, Pearson CA, Montero AM, Torres-Rueda S, Asfaw E, et al. Assessing the impacts of COVID-19 vaccination programme's timing and speed on health benefits, cost-effectiveness, and relative affordability in 27 African countries. BMC Med. 2023;21(1):85.
15. Raji T, Fallah MP, Dereje N, Kakooza F, Ndembi N, Abdulaziz M, et al. Efficacy and effectiveness of COVID-19 vaccines in Africa: a systematic review. PLoS ONE. 2024;19(6):e0306309.
16. Ministry of Health, Uganda (MoH). Uganda Launches the Covid-19 Vaccination Campaign. Kampala: MoH, March. 2021. https://www.health.go.ug/2021/03/15/uganda-launches-the-covid-19-vaccination-campaign/. Accessed September 9, 2024.
17. World Health Organization. WHO Sage Roadmap for Prioritizing Uses of COVID-19 Vaccines in the Context of Limited Supply. https://www.who.int/docs/default-source/immunization/sage/covid/sage-prioritization-roadmap-covid19-vaccines.pdf. Accessed November 11, 2024.
18. Ministry of Health, Uganda (MoH). COVID-19 vaccination update: PowerPoint Presentation. Kampala: MoH; June; 2023.
19. Odyek J. 5 million doses of COVID-19 vaccines expire. https://www.newvision.co.ug/category/news/5-million-doses-of-covid-19-vaccines-expire-NV_178460. Accessed September 9, 2024.
20. Observer Newspaper. Govt dismisses reports of new Covid-19 variant in Uganda. https://observer.ug/news/headlines/80279-govt-dismisses-reports-of-new-covid-19-variant-in-uganda. Accessed on September 10, 2024.
21. Bajunirwe F, Izudi J, Asiimwe S. Long-distance truck drivers and the increasing risk of COVID-19 spread in Uganda. Int J Infect Dis. 2020;98:191–3.
22. Wells CR, Sah P, Moghadas SM, Pandey A, Shoukat A, Wang Y, et al. Impact of international travel and border control measures on the global spread of the novel 2019 coronavirus outbreak. Proc Natl Acad Sci. 2020;117(13):7504–9.
23. Alexander AM, Finnoff DC, Shogren JF. Human migration, border controls, and infectious disease emergence. New directions in conservation medicine: Applied cases of Ecological Health. New York, NY: Oxford University Press; 2012. pp. 179–91.
24. Nabatanzi V. COVID-19 vaccination drive at border points successful – officials: Kampala: New Vision; July 13, 2023. https://www.newvision.co.ug/category/health/covid-19-vaccination-drive-at-border-points-s-NV_164940. Accessed September 9, 2024.
25. Olum R, Bongomin F. Uganda's first 100 COVID-19 cases: Trends and lessons. Int J Infect Dis. 2020;96:517–8.
26. Cochran W. Sampling Techniques. New York: Ohn Wiley & Sons Inc; 1997. https://www.academia.edu/29684662/Cochran_1977_Sampling_Techniques_Third_Edition. Accessed September 9, 2024.
27. WHO. COVID-19 Vaccination in Tororo District: Ensuring that No one is Left Behind. Uganda: WHO, April. 2021. https://www.afro.who.int/news/covid-19-vaccination-tororo-district-ensuring-no-one-left-behind. Accessed September 9, 2024.
28. Chung S-C, Marlow S, Tobias N, Alogna A, Alogna I, You S-L, et al. Lessons from countries implementing find, test, trace, isolation and support policies in the rapid response of the COVID-19 pandemic: a systematic review. BMJ Open. 2021;11(7):e047832.
29. Advox. In Tanzania, full-throttle COVID-19 denial leaves citizens without access to public health information. https://advox.globalvoices.org/2021/01/26/in-tanzania-full-throttle-covid-19-denial-leaves-citizens-without-access-to-public-health-information/. Accessed Sept 10, 2024.
30. Buguzi S. COVID-19: counting the cost of denial in Tanzania. BMJ. 2021;373:n1052.
31. Kassanjee R, Davies MA, Heekes A, Mahomed H, et al. COVID-19 vaccine uptake and effectiveness by time since vaccination in the Western Cape Province, South Africa: an observational cohort study during 2020–2022. Vaccines (Basel). 2024;12(6):628.
32. Lu PJ, Srivastav A, Vashist K, Black CL, Kriss JL, et al. COVID-19 Booster Dose Vaccination Coverage and Factors Associated with Booster vaccination among adults, United States, March 2022. Emerg Infect Dis. 2023;29(1):133–40.
33. Jacobs ET, Cordova-Marks FM, Farland LV, et al. Understanding low COVID-19 booster uptake among US adults. Vaccine. 2023;41(42):6221–6.
34. Africanews. Uganda to destroy expired Covid vaccines worth $7m. https://www.africanews.com/2024/01/10/uganda-to-destroy-expired-covid-vaccines-worth-7m//. Accessed September 9, 2024.
35. Agbetiloye A. Uganda to destroy $7.3m expired Covid vaccines purchased through World Bank loan. Business Insider Africa. https://africa.businessinsider.com/local/markets/uganda-to-destroy-dollar73m-expired-covid-vaccines-purchased-through-world-bank-loan/4v84fdt. Accessed September 9, 2024.
36. Mirza I, Ameda IM, Ba AE, Traore C, Hagos MT, Gbaya AA, Schreiber B. COVID-19 vaccination integration: efforts in 11 African countries to strengthen the primary Health Care System. Glob Health Sci Pract. 2024;12(Suppl 1):e2300251.
37. Nantaba L. Covid kills two in Kabale. Nilepost news. https://nilepost.co.ug/index.php/ugandan%20newsnda/187314/covid-kills-two-in-kabale. Accessed September 9, 2024.
38. Bongomin F, Olum R, Andia-Biraro I, Nakwagala FN, Hassan KH, Nassozi DR, et al. COVID-19 vaccine acceptance among high-risk populations in Uganda. Ther Adv Infect Dis. 2021;8:20499361211024376.
39. Kanyanda S, Markhof Y, Wollburg P, Zezza A. Acceptance of COVID-19 vaccines in sub-saharan Africa: evidence from six national phone surveys. BMJ Open. 2021;11(12):e055159.
40. Kisaakye P, Bukuluki P, Matovu JK. COVID-19 vaccine acceptance among refugees in Bidibidi Refugee settlement, Northern Uganda. J Glob Health. 2022;6:e2022013.
41. Mboussou F, Farham B, Nsasiirwe S, Atagbaza A, Oyaole D, Atuhebwe PL, et al. COVID-19 vaccination in the WHO African region: progress made in 2022 and factors associated. Vaccines (Basel). 2023;11(5):1010.
42. Uganda Legal Information Institute. Public Health (Prohibition of Entry into Uganda) Order, 2020: Uganda Gazette. Vol. CXIII (Statutory Instrument, Supplement No. 53). Kampala: Uganda Legal Information Institute. 2024. https://ulii.org/akn/ug/act/si/2020/53/eng@2020-05-20/source.pdf. Accessed September 9, 2024.
43. Ministry of Health (MoH). Update on the COVID-19 pandemic situation and vaccination program. Press Statement. Kampala: MoH, May. 5, 2021. https://www.health.go.ug/wp-content/uploads/2021/05/22nd-Ministerial-address-to-the-nation.pdf. Accessed September 10, 2024.
44. Karaivanov A, Kim D, Lu SE, Shigeoka H. COVID-19 vaccination mandates and vaccine uptake. Nat Hum Behav. 2022;6(12):1615–24.
45. AfricaCDC. Statement on the, New COVID, Strain, EG.5 SARS-COV-2 Subvariant. Addis Ababa: AfricaCDC; 2023. https://africacdc.org/news-item/statement-on-the-new-covid-strain-eg-5-sars-cov-2-subvariant/. Accessed September 10, 2024.

Publisher's note