Is it COVID-19 vaccine hesitancy or inquisitiveness? Factors associated with COVID-19 vaccine acceptance among the adult population in Northern Uganda. A cross-sectional study.

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Research Article

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Abstract

Background

When the COVID-19 vaccines arrived in Uganda in early March of 2021, there was a lack of information on the vaccine acceptance in the population due to many factors, mainly misinformation and disinformation circulating in the Ugandan social and mainstream media. This study aimed to determine factors associated with COVID-19 vaccine acceptance among the adult population in northern Uganda.

Methods

We conducted a cross-sectional study among the 723-adult population in northern Uganda. Participants were selected randomly from the nine districts of the Acholi sub-region. Ethical approval was obtained from a local IRB, and SPSS version 20.0 was used for data analysis at a multivariable logistic regression. A p-value less than 0.05 was considered significant.

Results

The most significant finding was that COVID-19 vaccine acceptance among the adult population in northern Uganda was at 580/723(80.22%) and was significantly associated with those with comorbidities AoR = 0.397, 95%CI: 0.233,0.674; p = 0.001; those who agreed that vaccines in health facilities in northern Uganda were safe AoR = 0.724, 95%CI:0.597,0.878;p = 0.001; graduates AoR = 2.781,95%CI:1.278,6.052;p = 0.010; females AoR = 0.616, 95%CI:0.396,0.957; p = 0.031; Catholics AoR = 1.703,95%CI:1.048,2.765;p = 0.032; Baganda tribe AoR = 3.829,95%CI:1.170,7.790;p = 0.026; non-smokers AoR = 7.349,95%CI:1.767,30.566;p = 0.006; ex-smokers AoR = 8.687,95%CI:1.052,71.734;p = 0.045; Agago district AoR = 2.950,95%CI: 1.118,7.789; p = 0.029, and Lamwo district AoR = 2.781, 95%CI:1.278,6.052; p = 0.010.

Conclusion

COVID-19 vaccine acceptance among the study population was encouragingly high despite the disinformation and misinformation in the Ugandan media. The independent determinants of COVID-19 vaccine acceptance were among females, those who agreed that vaccines in health facilities were safe, those with comorbidities, graduates, Catholics, Baganda tribe, ex-smokers and non-smokers, and participants from Agago and Lamwo districts. The fear of contracting the coronavirus and the fear of death if not vaccinated contributed significantly to the COVID-19 vaccine acceptance in northern Uganda. There is a need for health managers to engage, sensitize and mobilize the population on the COVID-19 vaccine and vaccination using the VHTs and the catholic church structures, which remain critically important for the vaccination campaign if the high COVID-19 vaccine acceptance in the sub-region is to be maintained or improved.

Introduction

Coronavirus disease 2019 (COVID-19) is one of the world's most significant public health worries [1, 2]. Much effort has been devoted to implementing control strategies for the COVID-19 pandemic globally, for example, lockdown measures, travel bans, isolation of confirmed cases and close contacts, social distancing, wearing face masks, and other hygiene measures, but the transmission of the virus is likely to backfire when these strategies are lifted [2]. Many scholars, academicians, physicians, and public health specialists have observed that of the many approaches to control this pandemic, mass COVID-19 vaccination is one of the top priority interventions [3].

COVID-19 vaccines can potentially decrease the spread of the virus by reducing the incidence of infection, risks of developing severe disease, and hospitalization in the general population, and they have generated a lot of debate in the population [4]. The Vaccine Alliance found that wealthier nations had hoarded so much of the COVID-19 vaccines that it was predicted that many of the low-to-middle-income countries would most likely not receive the vaccines in 2021 [5]. In Africa, where most vaccines for many killer diseases have been very successful in reducing infant and child mortality rates and increasing the lifespans of the current population, false rumors and conspiracy theories have led to hesitancy in getting COVID-19 vaccines, thus jeopardizing critical efforts to stop the spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) in the African continent [5]. Also, vaccine safety and access to the COVID-19 vaccines were the top concerns of most respondents in a survey conducted by GeoPoll in sub-Saharan Africa [5]. The survey showed that 23% of the respondents believed that whoever could pay for the vaccine got it first, thus highlighting the inequity in healthcare resources, especially in sub-Saharan Africa [5]. Vaccine hesitancy has been described as one of the top ten commonest threats to global health security in 2019 [6]. Vaccine hesitancy, as defined by the World Health Organization (WHO), is the reluctance or refusal of a person to be vaccinated despite the availability of vaccines [6]. According to WHO, some reasons people choose not to vaccinate include the lack of trust in the healthcare systems, complacency, and inconvenience in getting the vaccine [6]. On the other hand, vaccine acceptance is defined as the degree to which individuals accept, question, or refuse vaccination [7]. Vaccine acceptance is a determinant of vaccine uptake rate and vaccine distribution successes [7].

A recent report from the Amuru district local government in northern Uganda showed that most COVID-19 vaccines sent for the health workers have not been used, and the Resident District Commissioner (RDC) of the district issued an ultimatum to health workers to either get vaccinated or quit their jobs [8]. Looking at vaccine hesitancy in Uganda, it was observed that approximately 60%(600/1,000) of the respondents were interested in getting the COVID-19 vaccine [8].

As seen in many reports on the management of diseases with epidemic potential, education of the population so that they are part of the prevention and control strategies remains critical, particularly to inform the people to change habits and behaviors and holistically tackle the spread of the virus [10]. Despite

this vast knowledge of the role played by the population's goodwill in managing the epidemics, some African Governments are still planning to cut health education-related budgets in response to the pandemic [10]. Such moves on health budget cuts during the pandemic could hamper efforts to effectively educate and vaccinate the general population in many African countries.

A study conducted among medical students in the United States of America showed that there was COVID-19 vaccine hesitancy and that 23% were unwilling to take the COVID-19 vaccine [11]. Apprehensions raised by students included issues around the trust of the public healthcare systems and the side effects of the COVID-19 vaccines [11]. Similar findings among university students in Italy, the United Kingdom, and Turkey have shown high COVID-19 vaccine hesitancy ranging from 14–31% [12]. The uncertainties surrounding the origin of the SAR-CoV-2 virus could be the profound underlying reason for the COVID-19 vaccine hesitancy [13]. The study found that COVID-19 vaccine hesitancy was associated with beliefs in the qualms about the origin of the SAR-CoV-2 virus [13]. Most people who believed in the natural evolution of the SAR-CoV-2 virus were more likely to accept the vaccines than those who thought that the virus was manufactured [13].

In Jordan and Kuwait, a study investigating COVID-19 vaccine hesitancy found that misinformation and disinformation among the population, especially on social media, and various conspiracy theories extensively played a part in vaccine hesitancy in that population [14]. In the same study: 28% of the participants believed the COVID-19 vaccine was intended to introduce microchips into recipients' bodies, and 23% thought the vaccine was to reduce fertility among the population [14].

Similarly, a study on COVID-19 vaccine hesitancy in healthcare workers in two large academic centers in South Africa found that 90% of the 1308 sampled population accepted the vaccine [15]. However, Healthcare workers with lower educational status and those who had refused other vaccines in the past were less likely to get the COVID-19 vaccine [15]. Additionally, Ahmed and colleagues researching the COVID-19 vaccine acceptability in Somalia found that 23% of their survey population were reluctant to get the COVID-19 vaccine, and being a female was associated with vaccine hesitancy [16]. Little is known or published in Uganda on COVID-19 vaccine acceptance in the general Ugandan population. Because of this, several questions have been raised, and many more answers are required to know the level of vaccine hesitancy/inquisitiveness and acceptance in Uganda.

This study aimed to determine factors associated with COVID-19 vaccine acceptance among the adult population of northern Uganda.

Methods

Study design: This cross-sectional study was conducted in northern Uganda from March to April 2022.

Study sites: This study was conducted in twenty-four health facilities in the nine districts in the Acholi sub-region of northern Uganda; Namukora HC IV, Kitgum Government, and St. Joseph's Hospitals in Kitgum; Padibe HC IV, Palabek HC III, and Madi Open HC IV in Lamwo; Pajule HC IV, Lacekocot HC IV and Pader HC III in Pader district, Kalongo Hospital and Patongo HC IV in Agago district; Lalogi HC IV, Opit HC III and Odek HC III in Omoro district; Anaka Hospital and Koch Goma HC III in Nwoya district; Atiak HC IV, Pabbo HVC III and Amuru HC III in Amuru district, St. Mary's Hospital Lacor, Independent Hospital, Gulu Regional Referral Hospital in Gulu City; Awach HC IV and Cwero HC III in Gulu district. These health centers were selected based on their participation in offering COVID-19 vaccination to the region's population.

Study population: We recruited participants (adults/≥18 years) who were admitted or clients to outpatient clinics of health facilities in northern Uganda's nine districts of the Acholi sub-region.

Selection criteria: We recruited adults 18 years and above and those that consented to the study. Those who were critically ill and were unable to answer research questions were excluded.

Sample size estimation: The sample size was calculated based on the Raosoft sample size calculation. The computation was based on a 50% response distribution, 5% margin of error, and 95% Confidence Interval. The online software foundation is based on widely utilized descriptive studies sample size estimation formula [17, 18]. The research team chose this software calculator because Raosoft, Inc. form and survey software comprise a database management system of great strength and reliability that communicates with other proprietary formats. Raosoft database is a highly robust, proven system with high data integrity and security [17, 18].

$$\text{The sample size was calculated using the formula} = \frac{(\text{z-score})^2 \times \text{StdDev} \times (1-\text{StdDev})}{(\text{Confidence Interval})^2}$$

Based on the assumption of a population size of 45,000 clients and visitors in one month in all health facilities in the Acholi subregion, the minimum sample size based on the above assumptions and factoring in a 10% non-response rate is 396 participants.

Sampling technique: A simple random sampling technique was used to recruit participants from the Acholi sub-region for this study. We chose this sampling technique because it is considered one of the most popular and simple data collection methods in research fields (in terms of probability, statistics, and mathematics). It allows for unbiased data collection, aiding studies in arriving at unbiased conclusions.

Variables: The dependent variable was COVID-19 vaccine acceptance ("Have you received a jab of COVID-19 vaccine? And the answer was either "Yes" or "No.")

The independent variables were the socio-demographic characteristics: age, sex, occupation, religion, level of education, tribe, marital status, district, presence of comorbidities, nationality, race, health insurance coverage, and participants' self-confidence that the vaccines that are available in health facilities in

northern Uganda were safe.

Data collection methods: Data were collected using face-to-face questionnaire interviews by our research team, strictly following the country's standard COVID-19 infection, prevention, and control (IPC) guidelines. We used a questionnaire to obtain data from our study participants. The questionnaire was constructed in English and consisted of questions on socio-demographic characteristics and views on vaccines in health facilities in the sub-region (Additional file 1). The study instrument (questionnaire) was developed and grounded on literature reviews and discussions with the research team [19, 20]. Participants were selected randomly and recruited consecutively by our research team. The questionnaire was pretested among outpatients in Gulu Regional Referral Hospital. The questionnaire had an internal validity of Cronbach's α = 0.772. Participants were assured of confidentiality and privacy of their responses to reduce the potential bias introduced by self-reported data. In addition, the questionnaire was designed to minimize lethargy in the questionnaire and participants' responses.

Data management: Data obtained from participants were de-identified. Only the principal investigator and supervisors had access to and were stored in a database with restricted access. It was later archived at the Gulu University, Faculty of Medicine, Department of Surgery.

Data analysis: Data analysis was performed using SPSS statistical software version 20.0. Continuous variables are presented in means, histograms, standard deviations, modes, medians, and interquartile ranges depending on the distribution of the data. Categorical data are presented as frequencies and percentages. The Chi-square and crosstabs tests were performed on categorical data when comparing two or more groups. Multivariable Logistic regression analyses were conducted to identify independent factors associated with the COVID-19 vaccine acceptance and the relationships between independent and dependent variables. A p-value less than 0.05 was considered statistically significant.

Ethical Approval: This study was approved by the St. Mary's Hospital, Lacor Institutional, Ethics, and Review Committee (Lacor IREC). Administrative clearance was obtained from the twenty-four health facilities in the Acholi sub-region. In addition, informed consent was obtained from each participant before recruitment into the study. The research team ensured that confidentiality of personal information was maintained during the investigation, and unique identifiers of participants were retained on the public records. The Principal Investigator had access to the database during the study period. At the end of the project, the database was archived at the Gulu University, Faculty of Medicine, Department of Surgery.

Results

The most significant finding from this study was that COVID-19 vaccine acceptance among participants in northern Uganda was 580/723(80.22%), and only 143/723(19.78%) had not taken a COVID-19 jab.

Table 1 describes the sociodemographic characteristics of participants: males 329(54.5%), 20-29 years old 279(38.59%), married 377(52.14%), Catholics 354(48.96%), Acholi tribe 446(61.69%), from Gulu district 364(50.35%), had secondary level of education 237(32.78%), non-health workers 518(71.65%), had no health insurance coverage 666(92.12%) %), Ugandans 577(79.81%) and black Africans 578(79.94%).

Figure 1 shows the age distribution of the study participants: mean age is 31.36 years SD $\pm$10.074 at 95% CI:30.62-32.10; the median age is 30.0 years, the minimum age is 18 years, and the maximum age is 75 years. The interquartile range is 14 years with a range of 57.

Table 2 shows perceptions of COVID-19 among study participants in northern Uganda. Most participants had been exposed to coronavirus 407(56.29%); most were worried about getting infected with the virus 491(67.91%); had got vaccinated with the COVID-19 vaccines 580(80.22%); had got vaccinated with AstraZeneca 414(57.26%), had received all the two doses 392(54.22%) and agreed that vaccines in health facilities in the region were safe 379/723(52.4%).

Table 3 shows why participants in this study population accepted the COVID-19 vaccine (taking a jab) at bivariate analysis. Participants considered exposure to COVID-19 χ^2=5.183; p=0.023; fear of getting infected χ^2=14.614; p=0.000; fear of death χ^2=4.892; p=0.027; fear of a family member getting infected χ^2=3.679; p=0.055; worries of being forced to take a COVID-19 medications χ^2=4.661; p=0.031; worries of being forced to take a COVID-19 vaccine χ^2=8.297; p=0.004; and those who had no worries at all about the COVID-19 vaccines χ^2=13.320; p=0.000.

Table 4 shows the symptoms and signs experienced by participants who received the COVID-19 vaccines. It offers significant differences in signs and symptoms shared among the age groups, especially excessive sweating χ^2=10.163(p=0.038) and fear of death χ^2=16.608(p=0.002), particularly among the older age groups. In the districts, joint pains χ^2=13.633(p=0.058), loss of appetite χ^2=16.573(p=0.020), blood clots χ^2=22.710(p=0.002), the fear of death χ^2=35.083(p=0.000), and excessive sweating χ^2=24.31. Blood clots χ^2=18.431(p=0.002) and fear of death χ2=14.298(p=0.014) were reported at the educational level. For the occupation, blood clots χ^2=8.656(p=0.003) and fear of death χ^2=4.936(p=0.026) were reported, while blood clots χ^2=7.878(p=0.005) and the fear of death χ^2=15.454(p=0.000) were reported in those with comorbidities.

Table 5 shows the preferred COVID-19 vaccine among the study participants (N=723). The table shows there was a significant difference in taking a COVID-19 jab between males and females χ^2=22.362; p=0.001; age groups χ^2=52.887; p=0.001; religious groups χ^2=36.560; p=0.048; districts χ^2=83.192; p=0.000; tribal groups χ^2=43.666; p=0.008; Those with and without comorbidities χ^2=23.532; p=0.001.

Table 6 shows the COVID-19 positive status of participants and socio-demographic characteristics at bivariate analysis using Chi-square tests. The table shows that COVID-19 positive status for participants was significantly different in the districts χ^2=18.141; p=0.010. Among family members in age groups χ^2=9.156; p=0.057 and religious denominations χ^2=9.907; p=0.042 while with friends, among tribes χ^2=10.180; p=0.037, districts χ^2=9.277; p=0233, at the level of education χ^2=15.829; p=0.007, and occupation χ^2=7.605; p=0.006. While among colleagues of participants, age groups χ^2=26.306; p=0.000, marital status χ^2=11.833; p=0.019, districts χ^2=18.422; p=0.010, level of education χ^2=22.498; p=0.000 and occupation χ^2=50.261; p=0.000. As for their

neighbors, among the age groups, χ^2=11.112; p=0.025. For participants who had no one who tested positive, it was significant among age groups χ^2=35.197; p=0.000, marital status χ^2=21.504; p=0.000, level of education χ^2=37.899; p=0.000 and occupation χ^2=48.698; p=0.000.

Table 7 shows the COVID-19 vaccine acceptance and sociodemographic characteristics at bivariate analysis. The table shows the COVID-19 vaccine acceptance was statistically significant among the districts χ^2=21.359; p=0.003; higher levels of education χ^2=14.635; p=0.012; non-health workers χ^2=4.473; p=0.029; ex-smokers and non-smokers χ^2=6.373; p=0.029; participants who agreed that vaccines in health facilities in the region were safe χ^2=18.654; p=0.000; and the presence of comorbidities χ^2=6.373; p=0.012.

Table 8 is a multivariable logistic regression analysis on factors associated with COVID-19 vaccine acceptance among the study population. The table shows the independent factors statistically and significantly associated with the COVID-19 vaccine acceptance among participants in northern Uganda; those with comorbidities AoR=0.397,95%CI: 0.233,0.674;p=0.001, those who agreed that vaccines in health facilities in northern Uganda were safe AoR=0.724,95%CI:0.597,0.878;p=0.001, Graduates AoR=2.781, 95%CI:1.278,6.052; p=0.010, participants from Agago district AoR=2.950,95%CI:1.118,7.789;p=0.029, Lamwo district AoR=4.104,95%CI:1.247,6.052;p=0.020, Tribe (Baganda) AoR=3.829,95%CI:1.170,7.790;p=0.026, Religion (Catholics) AoR=1.703,95%CI:1.048,2,765;p=0.032, Females AoR=0.616,95%CI:0.396,0.957;p=0.026, non-smokers AoR=7.347,95%CI:1.767,30.566;p=0.006 and ex-smokers AoR=8.687, 95%CI:1.052,71.734;p=0.020.

Table 1: The socio-demographic characteristics of participants

s/no	Variables	Freq (N=723)	Percent (%)
1	**Sex**		
	Males	394	54.50
	Females	329	45.50
2	**Age groups (years)**		
	<20	80	11.07
	20-29	279	38.59
	30-39	225	31.12
	40-49	95	13.14
	≥50	44	6.09
3	**Marital status**		
	Single	316	43.71
	Separated	2	0.28
	Married	377	52.14
	Divorced	23	3.18
	widowed	5	0.69
4	**Religion**		
	Catholics	354	48.96
	Protestants	226	31.26
	Born Again	112	15.49
	Muslims	26	3.60
	Others	5	0.69
5	**Tribes**		
	Acholi	446	61.69
	Lango	82	11.34
	Baganda	49	6.78
	Itesot	22	3.04
	Others	124	17.15
6	**Districts**		
	Gulu	364	50.35
	Agago	83	11.48
	Pader	132	18.26
	Kitgum	57	7.88
	Amuru	12	1.66
	Lamwo	62	8.58
	Omoro	9	1.24
	Nwoya	4	0.55
7	**Level of education**		
	No education	18	2.49
	Primary	61	8.44
	Secondary	237	32.78
	Diploma	146	20.19
	Graduates	200	27.66
	Postgraduate	61	8.44
8	**Occupation**		
	Health workers	205	28.35
	Non-health workers	518	71.65
9	**Health Insurance Coverage**		
	With Insurance	57	7.88
	Without Insurance	666	92.12
10	**Nationality**		
	Ugandans	577	79.81
	American	1	0.14
	Italian	1	0.14
	Kenyan	1	0.14
11	**Race**		
	Black Africans	578	79.94
	White	2	0.28

Table 1 shows that most participants were males 329(54.5%); 20-29 years 279(38.59%); married 377(52.14%); Catholics 354(48.96%); Acholi 446(61.69%); from Gulu district 364(50.35%), had a secondary level of education 237(32.78%), non-health workers 518(71.65%); had no health insurance coverage 666(92.12%); Ugandans 577(79.81%); and black Africans 578(79.94%).

Table 2: Views on COVID-19 among participants in northern Uganda

s/no	Variables	Yes (%)	No (%)
1.0	Have you been exposed to the coronavirus?	407(56.29)	316(43.71)
2.0	What are you most worried about during this COVID-19 pandemic?		
(i)	Fear of getting infected with the virus	491(67.91)	232(32.09)
(ii)	Fear of a family member getting infected with the virus	440(60.86)	283(39.14)
(iii)	Fear of death	462(63.90)	261(36.10)
(iv)	Financial related worries	325(44.95)	398(55.05)
(v)	Food insecurity worries	163(22.54)	560(77.46)
(vi)	Unavailability of vaccines	114(15.77)	609(84.23)
(vii)	Coronavirus is a plot or a conspiracy theory	62(8.58)	661(91.42)
(viii)	I may be forced to take medicine for the virus	59(8.16)	664(91.84)
(ix)	I may be forced to take the COVID-19 vaccine	158(21.85)	565(78.15)
(x)	I am not worried about any COVID-19 issues	34(4.70)	689(95.30)
3.0	Have you got a jab of the COVID-19 vaccine?	580(80.22)	143(19.78)
4.0	Which COVID-19 vaccine have you received?		
(i)	AstraZeneca	414(57.26)	
(ii)	Johnson and Johnson	17(2.35)	
(iii)	Modena	117(16.18)	
(iv)	Pfizer	14(1.96)	
(v)	Sinovac	13(1.80)	
(vi)	Sputnik	7(0.97)	
(vii)	None	141(19.50)	
5.0	How many doses of the COVID-19 vaccine have you received?		
(i)	One	189(26.14)	
(ii)	Two	392(54.22)	
(iii)	None	142(19.64)	
6.0	The vaccines we currently use in our health facilities are safe.		
(i)	Agree	379(52.4)	
(ii)	Disagree	164(22.7)	
(iii)	Neutral	180(24.9)	

Table 2 shows that most participants had been exposed to the virus 407(56.29%); most worried about getting infected with the virus 491/723(67.91%); had got vaccinated with the COVID-19 vaccines 580/723(80.22%); had got vaccinated with AstraZeneca 414/723(57.26%), had received all the two doses 392(54.22%) and agreed that vaccines in health facilities in the region were safe 379/723(52.4%).

Table 3: Reasons why participants accepted the COVID-19 vaccine (taking a jab) at bivariate analysis

s/no	Variables	Yes (%)	No (%)	χ^2	p-value
1	Those who were exposed to the Coronavirus	337(46.6)	243(33.6)	5.183	0.023
2	Fear of getting infected with the virus	413(57.1)	167(23.1)	14.614	0.000
3	Fear of death	382(52.8)	198(27.1)	4.892	0.027
4	Fear of a family member getting infected	363(50.2)	217(30.0)	3.679	0.055
5	Financial worries	268(37.1)	312(43.2)	1.867	0.172
6	Job-related worries	152(21.0)	428(59.2)	0.183	0.669
7	Food insecurity worries	134(18.5)	446(61.7)	0.524	0.469
8	Worries about the unavailability of vaccines	96(13.3)	484(66.9)	1.357	0.244
9	Worries that COVID-19 is a plot or conspiracy theory	47(6.5)	533(73.7)	0.833	0.361
10	Worries of being forced to take a COVID-19 medication	41(5.7)	539(74.6)	4.661	0.031
11	Worries about being forced to take a COVID-19 vaccine	114(15.8)	466(64.5)	8.297	0.004
12	No worries on issues of COVID-19 vaccine	19(2.6)	561(77.6)	13.32	0.000

Table 3 shows why participants accepted the COVID-19 vaccine (taken a jab) at bivariate analysis. Participants considered exposure to COVID-19 χ^2=5.183; p=0.023; the fear of getting infected χ^2=14.614; p=0.000; the fear of death χ^2=4.892; p=0.027; fear of a family member getting infected χ^2=3.679; p=0.055; worries of being forced to take a COVID-19 medication χ^2=4.661; p=0.031; worries of being forced to take a COVID-19 vaccine χ^2=8.297; p=0.004; and those who had no worries about the COVID-19 vaccines χ^2=13.320; p=0.000.

Table 4: Symptoms and signs experienced by participants who received the COVID-19 vaccines

Variables	Age groups	Marital status	Religion	Tribe	Districts	Level of Education	Occupation	Nationality	Race	Com
Fever	3.146(p=0.534)	4.786(p=0.310)	2.453(p=0.653)	2.148(p=0.709)	7.582(p=0.371)	4.694(p=0.454)	0.072(p=0.789)	0.224(p=0.974)	0.149(p=0.699)	0.442
Joint pains	2.069(p=0.723)	1.355(p=0.852)	0.353(p=0.983)	5.094(p=0.278)	13.633(p=0.058)	8.871(p=0.114)	0.264(p=0.607)	0.090(p=0.993)	0.060(p=0.807)	2.037
Loss of appetite	3.927(p=0.416)	1.311(p=0.846)	1.592(p=0.810)	6.284(p=0.179)	16.573(p=0.020)	3.593(p=0.609)	1.395(p=0.237)	0.025(p=0.999)	0.017(p=0.899)	1.440
Steven-Johnson's reaction	4.980(p=0.289)	0.657(p=0.957)	2.455(p=0.653)	7.494(p=0.112)	6.137(p=0.524)	2.722(p=0.743)	0.336(p=0.562)	0.021(p=0.999)	0.014(p=0.906)	1.966
Blot clot	6.509(p=0.164)	4.895(p=0.298)	6.335(p=0.176)	16.284(p=0.003)	22.710(p=0.002)	18.431(p=0.002)	8.656(p=0.003)	6.108(p=0.106)	1.971(p=0.160)	7.878
Feeling dizzy	0.691(p=0.952)	0.461(p=0.977)	1.549(p=0.818)	8.880(p=0.064)	3.060(p=0.879)	5.532(p=0.354)	0.890(p=0.346)	0.108(p=0.991)	0.072(p=0.789)	1.870
Death	16.608(p=0.002)	8.350(p=0.080)	6.892(p=0.142)	4.099(p=0.393)	35.083(p=0.000)	14.298(p=0.014)	4.936(p=0.026)	0.307(p=0.946)	0.246(p=0.620)	15.454
Feeling uncomfortable	4.402(p=0.354)	0.786(p=0.940)	1.762(p=0.779)	3.335(p=0.503)	4.855(p=0.678)	3.971(p=0.554)	1.023(p=0.312)	0.064(p=0.994)	0.042(p=0.837)	1.078
Body pains and weakness	6.383(p=0.172)	10.042(p=0.040)	5.340(p=0.254)	5.998(p=0.199)	6.898(p=0.440)	8.933(p=0.112)	0.291(p=0.589)	6.842(p=0.077)	0.307(p=0.579)	0.974
Getting the virus after vaccination	0.880(p=0.927)	18.387(p=0.001)	3.361(p=0.499)	4.538(p=0.503)	11.458(p=0.120)	5.611(p=0.346)	1.001(p=0.317)	0.034(p=0.998)	0.022(p=0.881)	0.038
Fear of the COVID-19 vaccine	3.636(p=0.458)	0.321(p=0.988)	0.793(p=0.939)	10.482(p=0.033)	2.563(p=0.922)	0.876(p=0.972)	0.037(p=0.848)	0.013(p=0.998)	0.008(p=0.927)	1.176
Heart complications	7.793(p=0.099)	5.193(p=0.268)	4.412(p=0.353)	2.369(p=0.668)	7.936(p=0.922)	2.683(p=0.749)	0.348(p=0.998)	0.042(p=0.998)	0.028(p=0.867)	2.413
Excessive sweating	10.163(p=0.038)	0.693(p=0.952)	0.793(p=0.939)	10.158(p=0.038)	24.316(p=0.001)	2.730(p=0.742)	0.037(p=0.848)	0.013(p=1.000)	0.008(p=0.927)	1.176
No Side-effects	5.088(p=0.278)	0.311(p=0.989)	26.833(p=0.000)	4.812(p=0.307)	7.236(p=0.405)	4.584(p=0.469)	2.394(p=0.122)	0.025(p=0.999)	0.017(p=0.897)	0.390

Table 4 shows significant differences in signs and symptoms shared among the age groups, especially excessive sweating χ^2=10.163(p=0.038) and the fear of death χ^2=16.608(p=0.002), particularly among the older age groups. In districts, joint pains χ^2=13.633(p=0.058), loss of appetite χ^2=16.573(p=0.020), blood clots χ^2=22.710(p=0.002), fear of death χ^2=35.083(p=0.000), and excessive sweating χ^2=24.316(p=0.001). Blood clots χ^2=18.431(p=0.002) and fear of death χ^2=14.298(0.014) were reported at the educational level. For the occupation, blood clots χ^2=8.656(p=0.003) and the fear of death χ^2=4.936(p=0.02). Blood clots χ^2=7.878(p=0.005) and the fear of death χ^2=15.454(p=0.000) were reported on those with comorbidities.

Table 5: The preferred COVID-19 vaccine among participants (N=723) at bivariate analysis

	Variables	AZ	J&J	Moderna	Pfizer	Sinovac	Sputnik	None	Chi	df	p-value
1	**Sex**										
	Female	91(12.6%)	109(15.1%)	34(4.7%)	6(0.8%)	0(0.0%)	1(0.1%)	88(12.2%)	22.362	6	0.001
	Male	115(15.9%)	141(19.5%)	26(3.6%)	30(4.1%)	3(0.4%)	2(0.3%)	77(10.7%)			
2	**Age groups (years)**										
	<20	21(2.9%)	28(3.9%)	8(1.1%)	4(0.6%)	0(0.0%)	0(0.0%)	19(2.6%)	52.877	24	0.001
	20-29	77(10.7%)	82(11.3%)	25(3.5%)	14(1.9%)	1(0.1%)	1(0.1%)	78(10.84%)			
	30-39	73(10.19%)	79(10.9%)	12(1.7%)	15(2.1%)	0(0.0%)	0(0.0%)	45(6.2%)			
	40-49	21(2.9%)	42(5.8%)	15(2.1%)	2(0.3%)	0(0.0%)	0(0.0%)	15(2.1%)			
	≥50	14(1.9%)	19(2.6%)	0(0.0%)	1(0.1%)	2(0.3%)	2(0.3%)	8(1.1%)			
3	**Marital status**										
	Divorced	4(0.6%)	11(1.5%)	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	7(1.0%)	20.763	24	0.653
	Married	99(13.7%)	141(19.5%)	37(5.1%)	16(2.2%)	2(0.3%)	3(0.4%)	79(10.9%)			
	Separated	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	1(0.1%)			
	Single	100(13.8%)	96(13.3%)	21(2.9%)	20(2.8%)	1(0.1%)	0(0.0%)	1(0.1%)			
	widowed	2(0.3%)	2(0.3%)	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	78(10.8%)			
4	**Religion**										
	Born Again	28(3.9%)	31(4.3%)	7(1.0%)	9(1.2%)	0(0.0%)	1(0.1%)	36(5.0%)	36.56	24	0.048
	Catholics	98(13.6%)	142(19.6%)	21(2.9%)	16(2.2%)	2(0.3%)	2(0.3%)	73(10.1%)			
	Muslims	7(1.0%)	8(1.1%)	4(0.6%)	1(0.1%)	0(0.0%)	0(0.0%)	6(0.8%)			
	Protestants	69(9.5%)	69(9.5%)	28(3.9%)	9(1.2%)	1(0.1%)	0(0.0%)	50(6.9%)			
	Others	4(0.6%)	0(0.0%)	0(0.0%)	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)			
5	**Tribes**										
	Acholi	130(18.0%)	163(22.3%)	38(5.3%)	10(1.4%)	3(0.4%)	3(0.4%)	99(13.7%)	43.666	24	0.008
	Itesot	7(1.0%)	9(1.2%)	1(0.1%)	2(0.4%)	0(0.0%)	0(0.0%)	3(0.4%)			
	Lango	25(3.5%)	24(3.3%)	9(1.2%)	2(0.3%)	0(0.0%)	0(0.0%)	0(0.0%)			
	Baganda	15(2.1%)	16(2.2%)	2(0.3%)	8(1.1%)	0(0.0%)	0(0.0%)	0(0.0%)			
	Others	29(4.0%)	38(5.3%)	10(1.4%)	14(1.9%)	0(0.0%)	0(0.0%)	33(4.6%)			
6	**Districts**										
	Agago	28(3.8%)	22(3.0%)	8(1.1%)	0(0.0%)	1(0.1%)	0(0.0%)	24(3.3%)	83.912	42	0.000
	Amuru	4(0.6%)	1(0.1%)	1(0.1%)	1(0.1%)	0(0.0%)	0(0.0%)	5(0.7%)			
	Gulu	105(14.5%)	111(15.4%)	19(2.6%)	28(3.9%)	2(0.3%)	0(0.0%)	99(13.7%)			
	Kitgum	20(2.8%)	19(2.6%)	8(1.1%)	2(0.3%)	0(0.0%)	0(0.0%)	8(1.1%)			
	Lamwo	17(2.4%)	26(3.6%)	10(1.4%)	2(0.3%)	0(0.0%)	1(0.1%)	6(0.8%)			
	Nwoya	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	3(0.4%)			
	Omoro	4(0.6%)	5(0.7%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)			
	Pader	27(3.7%)	66(9.1%)	14(1.9%)	3(0.4%)	0(0.0%)	2(0.3%)	20(2.8%)			
7	**Level of education**										
	No Education	3(04%)	7(1.0%)	2(0.3%)	0(0.0%)	0(0.0%)	1(0.1%)	5(0.7%)	39.053	30	0.125
	Primary	15(2.1%)	22(3.0%)	7(1.0%)	3(0.4%)	0(0.0%)	0(0.0%)	14(1.9%)			
	Secondary	74(10.2%)	77(10.7%)	24(3.3%)	10(1.4%)	0(0.0%)	2(0.3%)	50(6.9%)			
	Diploma	37(5.1%)	58(8.0%)	12(1.7%)	10(1.4%)	2(0.3%)	0(0.0%)	27(3.7%)			
	Degree	61(8.4%)	70(9.7%)	11(1.5%)	11(1.5%)	1(0.1%)	0(0.0%)	46(6.4%)			
	Postgraduate	16(2.2%)	16(2.2%)	4(0.6%)	2(0.3%)	0(0.0%)	0(0.0%)	23(3.2%)			
8	**Occupations**										
	Health workers	60(8.3%)	78(10.8%)	13(1.8%)	12(1.7%)	0(0.0%)	0(0.0%)	42(5.8%)			
	Non-health workers	146(20.2%)	172(23.8%)	47(6.5%)	123(19.0%)	24(3.3%)	3(0.4%)	3(0.4%)	5.875	6	0.437
9	**Health Insurance coverage**										
	Yes	20(2.8%)	18(2.5%)	3(0.4%)	2(0.3%)	0(0.0%)	0(0.0%)	14(1.4%)	2.657	6	0.850
	No	186(25.7%)	232(32.1%)	57(7.9%)	34(4.7%)	3(0.4%)	3(0.4%)	151(20.9%)			
10	**Comorbidities**										
	Yes	46(6.4%)	78(10.8%)	27(3.7%)	11(1.5%)	1(0.1%)	3(0.4%)	37(5.1%)	23.532	6	0.001
	No	160(22.1%)	172(23.8%)	33(4.6%)	25(3.5%)	2(0.3%)	0(0.0%)	128(17.7%)			

Table 5 shows there was a significant difference in the preferred COVID-19 vaccine jab taken between males and females χ^2=22.362; p=0.001; age groups χ^2=52.887; p=0.001; Religious groups χ^2=36.560; p=0.048; Districts χ^2=83.192; p=0.000; Tribal groups χ^2=43.666; p=0.008; those with and without comorbidities χ^2=23.532; p=0.001

Table 6: COVID-19 positive status of participants and socio-demographic characteristics (Chi-square tests)

Variables	Participants	Family members	Friends	Colleagues	Neighbors	No one
Age groups	2.958(p=0.565)	9.156(p=0.057)	6.803(p=0.147)	26.306(p=0.000)	11.112(p=0.025)	35.197(p=0.000)
Marital status	2.628(p=0.622)	4.786(p=0.310)	8.025(p=0.091)	11.833(p=0.019)	2.919(p=0.571)	21.504(p=0.000)
Religion	4.421(p=0.352)	9.907(p=0.042)	2.678(p=0.613)	14.559(p=0.006)	4.758(p=0.313)	4.087(p=0.394)
Tribe	6.086(p=0.193)	3.734(p=0.443)	10.180(p=0.037)	6.420(p=0.170)	8.053(p=0.328)	1.409(p=0.843)
Districts	18.141(p=0.010)	12.265(p=0.092)	9.277(p=0233)	18.422(p=0.010)	8.053(p=0.328)	9.882(p=0.195)
Level of education	4.075(p=0.539)	2.411(p=0.790)	15.829(p=0.007)	22.498(p=0.000)	2.300(p=0.806)	37.899(p=0.000)
Occupation	1.975(p=0.160)	1.971(p=0.160)	7.605(p=0.006)	50.261(p=0.000)	0.243(p=0.622)	48.698(p=0.000)
Nationality	0.461(p=0.929)	4.926(p=0.177)	3.828(p=0.281)	4.889(p=0.180)	0.417(p=0.937)	5.073(p=0.167)
Race	0.307(p=0.579)	1.354(p=0.245)	0.760(p=0.383)	1.334(p=0.248)	0.278(p=0.598)	0.375(p=0.540)

Table 6 shows COVID-19 positive status for participants was significantly different in the districts of northern Uganda χ^2=18.141(p=0.010). Among family members in age groups χ^2=9.156(p=0.057) and religious denominations χ^2=9.907(p=0.042), while with friends, among tribes χ^2=10.180(p=0.037), districts χ^2=9.277(p=0233), level of education χ^2=15.829(p=0.007), and occupation χ^2=7.605(p=0.006). Among colleagues of participants, age groups χ^2=26.306(p=0.000), marital status χ^2=11.833(p=0.019), districts χ^2=18.422(p=0.010), level of education χ^2=22.498(p=0.000) and occupation χ^2=50.261(p=0.000). As for their neighbors, among the age groups χ^2=11.112(p=0.025). For participants who had no one that tested positive, it was significant among age groups χ^2=35.197(p=0.000), marital status χ^2=21.504(p=0.000), level of education χ^2=37.899(p=0.000) and occupation χ^2=48.698(p=0.000).

Table 7: COVID-19 vaccine acceptance and sociodemographic characteristics at bivariate analysis

s/no	Variables	Freq (N=723)	Percent (%)	Chi-square	df	p-value
1	Ages (years)					
	<20	62	8.58	3.956	4	0.142
	20-29	228	31.54			
	30-39	174	24.07			
	40-49	77	10.65			
	≥50	39	5.39			
2	Marital status					
	Married	301	41.63	1.313	4	0.859
	Single	255	35.27			
	Separated	1	0.14			
	Divorced	19	2.63			
	Widowed	4	0.55			
3	Religion					
	Catholics	295	40.80	4.445	4	0.349
	Protestants	176	24.34			
	Born Again	85	11.76			
	Muslims	20	2.77			
	Others	4	0.55			
4	Tribe					
	Acholi	352	48.69	5.492	4	0.240
	Lango	69	9.54			
	Baganda	44	6.09			
	Itesot	19	2.63			
	Others	95	13.14			
5	Districts					
	Gulu	276	38.17	21.359	7	0.003
	Pader	108	14.94			
	Agago	76	10.51			
	Kitgum	41	5.67			
	Lamwo	58	8.02			
	Nwoya	3	0.41			
	Amuru	10	1.38			
	Omoro	8	1.11			
6	Level of Education attained					
	No education	14	1.94			
	Primary	49	6.78			
	Secondary	183	25.31			
	Diploma	118	16.32			
	Degree	175	24.20	14.635	5	0.012
	Postgraduate	41	5.67			
7	Occupation					
	Health workers	175	24.20			
	Non-Health workers	405	56.02	4.773	1	0.029
8	Nationality					
	Ugandan	577	79.81	0.743	3	0.863
	American	1	0.14			
	Kenyan	1	0.14			
	Italian	1	0.14			
9	Race					
	Black African	578	79.94	0.494	1	0.482
	White	2	0.28			
10	Comorbidities					
	Yes	175	24.20	6.373	1	0.012
	No	28	3.90			
11	Sex					
	Females	256	35.40	2.210	1	0.137
	Males	324	44.80			
12	Smoking status of participants					
	Ex-smokers	10	1.40	6.373	2	0.029
	Non-smokers	564	78.00			
	Smokers	6	0.80			
13	Participants who agreed that vaccines in health facilities were safe	379	52.40	18.654	2	0.000

Table 7 shows the COVID-19 vaccine acceptance was statistically significant in the districts (χ^2=21.359; p=0.003); higher levels of education (graduates) (χ^2=14.635; p=0.012); non-health workers (χ^2=4.473; p=0.029); Ex-smokers and non-smokers (χ^2=6.373; p=0.029); participants who agreed that vaccines in health facilities in the region were safe (χ^2=18.654; p=0.000); and the presence of comorbidities (χ^2=6.373; p=0.012).

Table 8: The multivariable logistic regression analysis on factors associated with COVID-19 vaccine acceptance among the study participants

s/no	Variables	AoR	95% CI	p-value
1.	Presence of comorbidities	0.397	0.233-0.674	0.001
2.	Those who agreed that vaccines in health facilities were safe	0.724	0.597-0.878	0.001
3.	Level of Education (Graduates)	2.781	1.278-6.052	0.010
4.	Agago District	2.950	1.118-7.789	0.029
5.	Lamwo District	4.104	1.247-6.052	0.020
6.	Tribe (Baganda)	3.829	1.170-7.790	0.026
7.	Sex (Females)	0.616	0.396-0.957	0.031
8.	Non-Smokers	7.349	1.767-30.566	0.006
9.	Ex-smokers	8.687	1.052-71.734	0.045
10.	Religion (Catholics)	1.703	1.048-2.765	0.032

Table 8 shows the independent factors statistically and significantly associated with the COVID-19 vaccine acceptance among participants in northern Uganda. Those with comorbidities AoR=0.397; 95%CI:0.233,0.674; p=0.001, those who agreed that vaccines in health facilities in northern Uganda were safe AoR=0.724,95%CI: 0.597,0.878;p=0.001, Graduates AoR=2.781;95%CI:1.278,6.052;p=0.010, Agago district AoR=2.950,95%CI:1.118,7.789;p=0.029, Lamwo district AoR=4.104; 95%CI:1.247,6.052;p=0.020, Tribe (Baganda) AoR=3.829, 95%CI:1.170,7.790, p=0.026, Religion (Catholics) AoR=1.703, 95%CI:1.048,2,765;p=0.032, Females AoR=0.616,95%CI:0.396,0.957;p=0.026, non-smokers AoR=7.347, 95%CI:1.767,30.566;p=0.006 and ex-smokers AoR=8.687, 95%CI:1.052,71.734;p=0.020.

Discussions

The most significant findings from this study population (Table 1 and Figure 1) were that the COVID-19 vaccine acceptance rate was high at 580/723(80.22%) (Table 2). This COVID-19 vaccine acceptance rate could be attributed to the commendable work of health managers in northern Uganda in conducting consistent community sensitization, mobilization, and engagement using the village health teams (VHTs), which might have helped turn a vaccine-hesitant/inquisitive population into the opposite. This is consistent with other findings: stakeholder engagement, social mobilization, and equitable distribution of vaccines increase vaccine acceptance in low-income countries [21,22,23]. Thus, the authors suggest that the approach used to achieve this high COVID-19 vaccine acceptance rate in northern Uganda could be replicated in other parts of the country especially using the VHTs as agents of change.

Likewise, the COVID-19 vaccine acceptance was statistically and significantly associated with females, those with comorbidities, those who agreed that vaccines in health facilities in northern Uganda were safe, graduates, Catholics, Baganda tribe, districts of Lamwo and Agago, and non-smokers and ex-smokers.

The current study's finding that the female gender was an independent predictor of COVID-19 vaccine acceptance in northern Uganda (Table 8) is not new, as other studies elsewhere in the world [24,25] have had similar findings. For example, high COVID-19 vaccine acceptance rates have been recorded among pregnant women in Northwestern Ethiopia [24] and Saudi Arabia [25]. Relatedly, many studies in Uganda show that females have better health-seeking behaviors than males [26,27,28,29]. Females' better health-seeking behaviors than males have been similarly observed in many health activities implemented in northern Ugandan communities [27]. Additionally, females are more receptive to new health messages from the Ugandan government and have been at the forefront of fighting against many infectious diseases, including malaria [28]. Their compliance with health messages from the Ugandan Ministry of Health has been positive on several occasions. This includes reproductive health services, vaccination of children, voluntary counseling and testing for HIV and AIDs, cancer screening, and many health prevention and promotion activities [29]. However, a systematic review and meta-analysis by Stephanie showed that males had a more likely intention to get vaccinated against COVID-19 than females [30].

However, our findings that females were independent predictors of the COVID-19 vaccine acceptance in northern Uganda are new and contrast with many studies conducted in Uganda and Somalia [16,31,32]. This may be attributed to the rural nature of our study population, the study area, and the timing when the COVID-19 vaccine acceptance study was conducted in northern Uganda. The authors argue that the statistically significant association between the female gender and COVID-19 acceptance in northern Uganda has implications that the Ugandan Ministry of Health could deliberately bring on board females to work as behavior change communication agents in support of the ministry of health's programs, including COVID-19 vaccine acceptance in communities.

Many studies in Uganda showed that those with comorbidities, particularly diabetes, hypertension, obesity, heart diseases, chronic obstructive pulmonary diseases (COPD), HIV, and AIDS, were more at risk of developing severe COVID-19 illness, and higher chances of hospitalization, and death [32,33,34,35,36]. Messages on the increased risks and susceptibility to the virus, getting the severe form of the disease, chances of hospitalization, and death had been spread widely through the mainstream and social media to the population, and most people had become aware. In addition, the Ugandan Ministry of Health prioritized the vaccination of the elderly and those with comorbidities in the early phases of the COVID-19 vaccine rollout in Uganda [32]. Participants in this study accepted the vaccination for many reasons, including the fear of getting infected, infecting a family member, fear of death, and worries that the COVID-19 medications would be forced on them if they did not get vaccinated (Table 3 and Table 4). Most notable was that the vaccines preferred by participants were provided, and choices on the type of COVID-19 vaccine were participants' decisions (Table 5). Furthermore, some participants and their associates had tested positive for the coronavirus (Table 6) and had the disease experience, which impacted their decision to get vaccinated. So, the authors argue that whereas this was a timely intervention by the Ugandan Ministry of Health, in the future, a comprehensive study should be conducted to document the effects and impacts of the COVID-19 vaccination on the quality of life of participants with comorbidities.

Graduates were more likely to accept the COVID-19 vaccines than other educational strata (Table 7). This was statistically significant in bivariate and multivariable logistic regression analyses (Table 7 and Table 8) like another study conducted in Uganda [36]. We can attribute this to the vast information and knowledge on the coronavirus received through numerous sources that informed their decisions. However, findings from this study noted that previous

exposure to the virus, the fear of death, the fear of getting infected with the virus, and worries that they would be forced to take COVID-19 medication contributed significantly to their decision to accept the COVID-19 vaccine (Table 3, Table 4, Table 6). This finding concurs with many African studies, which showed that higher educational levels were associated with the COVID-19 vaccine acceptance [15,25,36].

In addition, the Ugandan Ministry of Health prioritized COVID-19 vaccines for institutions, particularly the security forces, health workers, government parastatals, and learning institutions, in the first batch of the vaccine rollout in Uganda in early 2021 [32]. The Ugandan government advised teachers not to enter classrooms without proof of COVID-19 vaccination for fear of spreading the virus to pupils and students. This directive was followed and enforced by the management of most teaching institutions. In addition, most employees of these institutions mentioned above were graduates. Thus, considering the enforcement of directives instituted on these institutions, we, the authors, argue that graduates' acceptance of the COVID-19 vaccine was either voluntary or coercion since some jobs were conditionally tagged with a COVID-19 certificate, especially those in educational training institutions. We believe these issues should be reviewed in future comprehensive studies.

Participants from the districts of Agago 76/83(91.57%) and Lamwo 58/62(93.55%) showed a higher COVID-19 vaccine acceptance rate compared to the other seven districts in the Acholi subregion (Table 8). Most participants from the two districts agreed that vaccines in their health facilities were safe (Table 2), and this was significantly associated with the COVID-19 vaccine acceptance (Table 7). Studies show that vaccine acceptance is linked to the community's confidence in the healthcare systems, the health workers, cultural background, attitudes, beliefs, perception, political, environmental, personal factors, and compliance to face mask-wearing guidelines [11,37,38,39]. The authors found that the two districts, just like the others, set up COVID-19 district task forces layered to the village health teams (VHTs) who promoted COVID-19 vaccinations at all levels [40]. The village health teams are vital in connecting the community with the health care systems [40]. Authors argue that the roles of VHT in disease prevention and promotion in the Ugandan healthcare systems are sometimes under-looked by some policymakers. Still, they are critical change agents, and their position in the Ugandan health delivery systems should be promoted to enhance their contribution to the healthcare systems. This finding implies that for the Ugandan Ministry of Health to achieve higher COVID-19 vaccine acceptance in the region, the model of layered task forces up to the village level using the VHTs should be adopted. The authors believe that VHTs have played a significant role in convincing the community to accept the COVID-19 vaccine in the two districts.

Interestingly, we found that the religious denomination Catholic was more likely to accept the COVID-19 vaccine 295/354(83.33%) than the others (Table 8). Too, among the catholic participants, 53/354(14.97%) had been infected with coronavirus, 51/354(14.41%) had a family member infected; 89/354(25.14%) a friend; 75/354(21.89%) a colleague and 52/354(14.69%) a neighbor. The nature and experience of the COVID-19 illness contributed to their decision to accept the COVID-19 vaccine. In addition, most of the study population in the Acholi sub-region were Catholics (Table 1). Furthermore, many large health facilities run by the Catholic church are well distributed in the sub-region. These include three major hospitals, three health centers, for example, St. Mary's hospital, Lacor in Gulu, and its two health centers of Opit HCIII in Omoro and Amuru HC III in Amuru districts. In Kitgum, St. Joseph's hospital serves Kitgum, Lamwo, Agago, and Pader districts, and an HC III in Padibe in the Lamwo district. In the Agago district, Kalongo Hospital serves the Agago, Kitgum, and Pader populations. These catholic founded health facilities were centers actively involved in the COVID-19 vaccination rollout in the region. In addition, clear messages from the Catholic institutions, including its leader, the Archbishop of Gulu, urging the population to get vaccinated, contributed significantly to the COVID-19 acceptance in the region.

Furthermore, radio recorded messages from the Archbishop urging the people to vaccinate with the COVID-19 vaccines were consistently aired in the local media and the church-founded radio stations (Radio Maria and Radio Pacis) in support of COVID-19 vaccination campaigns. In this, the authors propose that the Ugandan Government could use the catholic church structures to deliver and implement health programs in the region successfully. In addition, the authors found that the most hesitant religious denomination was the Muslims, where only 20/26(76.9%) had accepted the COVID-19 vaccine (Table 3), and most participants cited the lack of confidence in the government programs and their messages. Because of this, we propose that those practicing the Muslim faith should be approached and engaged to participate more in health activities in the future to achieve better health campaign results.

Furthermore, most of the Baganda tribe that participated in the research got vaccinated with the COVID-19 vaccine 44/49(89.89%) (Table 7). Although the tribe was an independent predictor of COVID-19 vaccine acceptance in this study population, this finding should be interpreted with caution as there were only 49/723(6.77%) participants from this tribe in the study population. The fear of having been exposed to the virus, the fear of death, the fear of infecting family members, and the fear of being forced to take the COVID-19 medication were part of the reasons for accepting the COVID-19 vaccine (Table 3). In addition, factors around their ill health and those close to them could have equally contributed to the COVID-19 vaccine acceptance; for example, 6/49(12.24%) had been infected with the virus; 12/49(24.49%) had a family member; 18/49(36.73%) had friends; 5/49(10.20%) had colleagues, and 5/49(10.20%) had neighbors infected respectively. Thus, factors surrounding these participants significantly contributed to the COVID-19 acceptance among this tribal group as COVID-19 vaccine acceptability has been found to depend on one's cultural background, attitudes, beliefs, perception, political, environmental, personal factors, or compliance to face mask-wearing guidelines [37,38,39].

Finally, the findings that non-smokers and ex-smokers were independent predictors of COVID-19 vaccine acceptance in this study population have attracted much interest (Table 8). These participants were more confident in the COVID-19 vaccine's ability to reduce the virus's chances of infecting them. Still, they were driven by the fear factor and worries about the possibility of being forced to take the medication or miss out on their jobs (Table 3). This is like findings in a refugee camp in Bidibidi in Uganda, where the Authors found that the COVID-19 vaccine acceptance rate among the refugees was 78% and was associated with the beliefs that the vaccine would stop the spread of the virus [41] as seen in these groups of non-smokers and ex-smokers. In addition, findings show that respondents that were uncertain whether the COVID-19 vaccine would stop transmissions were less likely to get the vaccine (adjusted odds ratio, aOR = 0.70; 95% confidence interval, CI = 0.51–0.96) than respondents that were not uncertain. Respondents who did not want to go to health facilities (aOR = 0.61; 95% CI = 0.44–0.84) were also less likely to accept the COVID-19 vaccine than their counterparts who wanted to go to health facilities [41].

In summary, our current study found a high COVID-19 vaccine acceptance rate of 580/723 (80.22%) in a rural population of northern Uganda. This survey was conducted after the second wave of COVID-19 in Uganda, where several prominent people lost their lives. This current acceptance rate in northern Uganda was lower than a South African study at 90% [15] but higher than a Somali study at 77% [16] and another Ugandan study at 60% [8]. Whether the high burden of COVID-19 in South Africa could have contributed to the significantly higher vaccine acceptance rate will be reviewed in future studies.

Therefore, these authors propose that the most effective strategy for reducing the COVID-19 vaccine hesitancy in the Ugandan setting should include educating the population on COVID-19 and its vaccines. Authors suggest that educating the people through a community engagement strategy remains the best way to dispel the myths, misconceptions, rumors, conspiracy theories, and fears about the virus. Thus, the authors argue that encouraging healthy behaviors toward coronavirus will keep Ugandans safe, a virus that has ravaged the world so much.

Strengths and limitations of this study

The study has limitations in the study design, cross-sectional study where one-time information from participants is gathered and analyzed. These have shortcomings in that the views and opinions of participants are not static; they vary according to the prevailing environmental situations. In this, we suggest a need for a prospective or a longitudinal assessment of the COVID-19 vaccine acceptance in the future, ensuring that all data are measured and recorded accordingly. This data is vital as it is one of the well-documented and completed data for over 723 participants from the Acholi subregion regarding COVID-19 vaccine acceptance in the recent period. Findings from this study show a high acceptance rate despite results from other parts of Uganda.

Generalizability of the results

These findings should be cautiously interpreted and generalized to regions with low-resource settings in Uganda.

Conclusion

COVID-19 vaccine acceptance rate among the study population was encouragingly high despite the disinformation and misinformation in the Ugandan media. The independent predictors of COVID-19 vaccine acceptance were observed among females, those who agreed that vaccines in health facilities in the region were safe, those with comorbidities, graduates, Catholics, Baganda tribe, ex-smokers and non-smokers, and participants from Agago and Lamwo districts. The fear of contracting the coronavirus and fear of death if not vaccinated contributed significantly to the COVID-19 vaccine acceptance in Northern Uganda. There is a need for health managers to engage, sensitize and mobilize the population on the COVID-19 vaccine and vaccination using the VHTs and the catholic church structures, which remain critically important if the high COVID-19 vaccine acceptance in the subregion is maintained or improved.

Declarations

Ethics approval and consent to participate: The St. Mary's Lacor Hospital Institutional and Ethics Committee approved this study. In addition, the study was conducted following the relevant institutional guidelines and regulations.

Availability of data and material: All datasets supporting the conclusion in this article is within this article and is accessible by a reasonable request to the corresponding author.

Competing interests: All authors declare no conflict of interest.

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Authors' contributions: DLK, ENI, JNO, JA, JO, and FWDO participated in designing the study, JA, JNO, FWDO, and DLK were responsible for supervising data collection, ENI and DLK were responsible for data analysis and interpretation, BS, CO, NOA, DA, JNO, DO, POO, SGO, ENI, FWDO, JA, DLK for writing and revising the manuscript. All Authors approved the manuscript.

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Figures

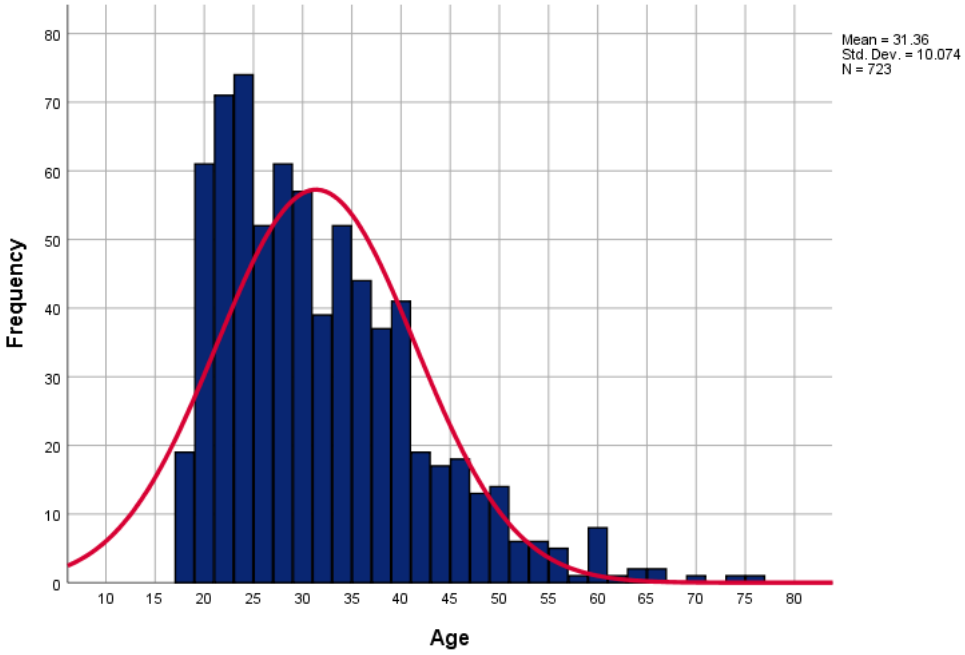

Figure 1

The age distribution of participants

Figure 1 is a histogram showing the normal age distribution of participants with a mean age of 31.36 years SD ±10.074 at 95% CI:30.62-32.10; the median age of 30.0 years, minimum age of 18 years, and a maximum of 75 years. The interquartile range of 14, and the range of 57.

Supplementary Files

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