Perceptions of COVID-19 vaccination among different adult age group populations in Northern Uganda. A cross-sectional study.

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Research Article

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Abstract

Introduction: Although COVID-19 first spread slowly in the African continent, confirmed virus cases have risen steadily since March 2020. The rapid spread of SARS-CoV-2 can be attributed to its numerous characteristics, including its high transmissibility, asymptomatic persons' ability to shed the virus, vast numbers of asymptomatic persons, or mild symptoms but with the ability to transmit the virus, new variants, and super-spreading events. Poor public health practices, disbeliefs, myths, and misconceptions about the virus and its origin in many African communities are the other reasons for its rapid spread. This study aimed to determine the perceptions of the adult population in northern Uganda on the COVID-19 vaccine acceptance, disaggregated by age groups.

Methods: A cross-sectional study was conducted between March and April 2022 to assess COVID-19 vaccine acceptance among seven hundred and twenty-three adult populations selected randomly from the nine districts of the Acholi sub-region. A five-point Likert scale with responses categorized as Strongly Agree, "SA," Agree, "A," Neutral, "N," Disagree, "DA," and Strongly Disagree, "SD" was used to assess participants' acceptance of the COVID-19 vaccines. Ethical approval was obtained from a local IRB, and SPSS version 20.0 was used to perform multivariable logistic regression to identify factors associated with vaccine acceptance. 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 disaggregated by age groups was not statistically significant (χ^2=3.956; p=0.142). COVID-19 vaccine acceptance among the age groups was associated with trust in the information from the mainstream media χ^2=20.105; p=0.000; Government of Uganda χ^2=19.900; p=0.028 and social media 10.745; p=0.030. The independent predictors on perceptions of the COVID-19 vaccine acceptance among age groups were; Participants strongly agreed on its importance to protect them from the virus AoR=4.99;95% CI:1.626-15.337;p=0.005; Agreed that the vaccine would protect them from the virus AoR=3.44;95%CI:1.225-9.650;p=0.019; strongly agreed that the side effects of the vaccine would stop them from receiving the vaccine AoR=0.330; 95%CI:0.125-0.856; p=0.023; They were neutral on whether the side effects of the COVID-19 vaccine would stop them from getting a COVID-19 jab AoR= 0.320; 95%CI:0.108-0.952;p=0.027; would not accept to pay for the COVID-19 vaccine AoR=0.280;95%CI:0.093-0.866; p=0.027; Agreed that children could take a COVID-19 vaccine AoR= 0.260; 95%CI:0.105-0.626;p=0.003; Strongly agreed that children could return to school before the COVID-19 vaccination AoR= 2.330; 95%CI:1.103-4.916;p=0.027; and agreed that children could return to school before taking COVID-19 vaccines AoR= 3.320; 95%CI:1.225-9.014;p=0.018.

Conclusion: COVID-19 vaccine acceptance among the study population disaggregated by age group was not significant despite the disinformation and misinformation in the Ugandan media. The independent determinants of COVID-19 vaccine acceptance were the importance of the vaccine in protecting against the virus, that the vaccine's side effects could stop them from taking the vaccine, and that children could take the COVID-19 jab but could return to school before taking the COVID-19 jab. The fear of family members contracting the virus and self-isolation when infected contributed significantly to the COVID-19 vaccine acceptance among participants in northern Uganda. There is a need for health managers to engage, sensitize and mobilize the population by addressing concerns about long-term and immediate side effects to increase the COVID-19 vaccine uptake in this community.

Introduction

COVID-19 first spread slowly in the African continent, however, confirmed cases of the virus have risen steadily since March 2020 [1]. The rapid spread of SARS-CoV-2 can be attributed to its numerous characteristics, including its high transmissibility, asymptomatic persons' ability to shed the virus, vast numbers of asymptomatic persons or mild symptoms but with the ability to transmit the virus, the emergence of new variants, and super-spreading events [2,3]. Poor public health practices, disbeliefs, myths, and misconceptions about the virus and its origin in many African communities, are the other reasons for its rapid spread [2,3]. There was a lack of information on COVID-19 vaccine acceptance in the Ugandan population due to many factors, mainly misinformation and disinformation circulating in the Ugandan social and mainstream media [4]. The most trusted source of COVID-19 information among the age groups in Uganda differed, whereby the younger age groups relied on radios and other sources [5]. In contrast, older people relied on the COVID-19 information from the Government of Uganda, the internet, and social and mainstream media [5]. This may have created different perceptions of COVID-19 vaccines and acceptance, considering the many conspiracy theories, misconceptions, myths, and disbeliefs in the African communities [6].

According to the World Health Organization (WHO), vaccine acceptance is the degree to which individuals accept, question, or refuse vaccination [7]. It determines the uptake rate and vaccine distribution successes [7]. As the mass inoculation program began in the African continent, one potential impediment was vaccine hesitancy (i.e., unwillingness to receive the vaccine) [8,9]. This was further compounded by a recent systematic review on vaccine hesitancy which suggested that the willingness to accept the COVID-19 vaccine ranged from 27.7 to 91.3% across the world [10]. Further, age, educational status, trust in healthcare, and health insurance have all been associated with willingness to receive the COVID-19 vaccine [10-12]. So, differences in perceptions of the COVID-19 vaccine acceptance among age groups would create challenges for health managers on vaccine distribution and uptake in communities in northern Uganda. This study aimed to determine factors associated with COVID-19 vaccine acceptance disaggregated by age group in northern Uganda.

Methods

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

Study sites: The 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. The age groups were categorized as <20 years, 20-29years, 30-39 years, 40-49 years, and ≥50 years.

Selection criteria: Adults 18 years and above who consented to the study were recruited. 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 [13,14]. 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 [13,14].

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, and health insurance coverage among participants.

The second variable was participants' perceptions of the COVID-19 vaccines and vaccinations. There were seventeen questions on perceptions of the COVID-19 vaccines for the study population, which were based on the five-point-Likert scale as Strongly Agree, "SA," Agree, "A," Neutral, "N," Disagree, "DA," and Strongly Disagree, "SD." These seventeen questions and statements were.

1. Do you think it is important to get COVID-19 vaccines to protect you against the coronavirus?
2. Do you think the Ugandan Government will develop a safe and effective COVID-19 vaccine?
3. Do you think the big pharmaceutical companies have developed safe and effective COVID-19 vaccines?
4. Do you believe that COVID-19 vaccines made in Europe or America are safer than those made in other countries?
5. Which of the following COVID-19 vaccines do you prefer to use in the future?
6. I would take a jab of the COVID-19 vaccine to protect me against the virus and disease.
7. My concerns about the related side effects will stop me from taking the COVID-19 vaccine to prevent the virus
8. Which side effects worry you the most about taking the COVID-19 vaccine?
9. I will recommend to my family and friends a jab of the COVID-19 vaccine
10. COVID-19 vaccine may be faulty or fake
11. COVID-19 vaccine was rapidly developed and approved.
12. COVID-19 vaccine might have some unforeseen future side effects.
13. COVID-19 vaccine is being promoted for commercial gains.
14. The Government of Uganda should make the COVID-19 vaccine available to all citizens for free.
15. Would you accept your children getting vaccinated with the COVID-19 vaccine?
16. Would you accept that your children return to school before being vaccinated with the COVID-19 vaccine?
17. Health facilities and health workers have provided me with confidence in the COVID-19 vaccines

There was one additional question on the perceptions of participants on the COVID-19 vaccine, "Would you be willing to pay for a COVID-19 vaccine privately?" and the responses of "Yes," "Not sure," and "No" were recorded by participants.

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 perceptions of participants on COVID-19 vaccines and vaccinations in the Acholi sub-region (Additional file 1). The study instrument (questionnaire) was developed and grounded on literature reviews and discussions with the research team [15,16]. 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. In addition, participants

were assured of confidentiality and privacy of their responses to reduce the potential bias introduced by self-reported data. Furthermore, 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 were presented in means, standard deviations, variance, standard errors, kurtosis, skewness, medians, ranges, and interquartile ranges, depending on the distribution of the data. Categorical data were presented as frequencies and percentages. The Chi-square and crosstabs tests were performed on categorical data when comparing two or more groups. Furthermore, 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 disaggregated by age groups of participants. A p-value less than 0.05 was considered statistically significant.

Ethical Approval: The study was approved by the St. Mary's Hospital, Lacor Institutional, Ethics, and Review Committee (Lacor Hospital 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. Furthermore, only 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

Table 1 is the age groups of participants; <20 years 41(5.67%); 20-29 years 318(43.98%); 30-39 years 225(31.12%); 40-49 years 95(13.14%) and ≥50 years 44(6.09%). The associations between the COVID-19 vaccine acceptance among participants' age groups were <20 years 22(8.06%); 20-29 years 247(34.16%); 30-39 years 174(24.07%); 40-49 years 77(10.65%) and ≥50 years 39(5.39%) using the Chi Square test was not significant χ^2=3.956; df=4; p=0.142.

Table 2 shows that the acceptance of the COVID-19 vaccine among age groups was significantly associated with the fear of a family member becoming infected χ^2=15.412; p=0.004 and the fear of being self-isolated χ^2=23.999; p=0.003.

Table 3 shows the most trusted source of information on COVID-19 among the age groups. The Government of Uganda χ^2=19.90; p=0.028; the mainstream media χ^2=20.105; p=0.000 and social media χ^2=10.745; p=0.030.

Table 4 shows the factors associated with the COVID-19 vaccine acceptance among the age groups. These were; its importance in providing protection against the coronavirus χ^2=28.044; df=16; p=0.032; beliefs that vaccines from the western world were safer χ^2=29.193; df=16; p=0.023; AstraZeneca was the preferred COVID-19 vaccine χ^2=52.877; df=24; p=0.001; most worrying side effects was the fear of death χ^2=16.608; df=4; p=0.002; that the COVID-19 vaccine could be faulty or fake χ^2=27.978; df=16; p=0.032; the COVID-19 vaccine could have some unforeseen side effects χ^2=36.619; df=16; p=0.001; the COVID-19 vaccines are being promoted for commercial gains χ^2=27.795; df=16; p=0.019 and they would accept children to get vaccinated with the COVID-19 vaccine χ^2=29.831; df=16; p=0.019.

Table 5 shows the independent determinants of COVID-19 vaccine acceptance among the study population disaggregated by age groups. Participants strongly agreed that the COVID-19 jab provides protection against the virus AoR=4.99;95% CI:1.626-15.337;p=0.005; Agreed that the vaccine would protect them against coronavirus AoR=3.44;95%CI:1.225-9.650;p=0.019; strongly agreed that the side effects of the vaccine would stop them from receiving the vaccine AoR=0.330; 95%CI:0.125-0.856; p=0.023; some participants were neutral on whether the side effects of the COVID-19 vaccine would stop them from getting the COVID-19 vaccine jab AoR= 0.320; 95%CI:0.108-0.952;p=0.027; they would not accept to pay for the COVID-19 vaccine privately AoR=0.280;95%CI:0.093-0.866; p=0.027; Agreed that children could take the COVID-19 vaccine AoR= 0.260; 95%CI:0.105-0.626;p=0.003; Strongly agreed that children could return to school before taking the COVID-19 vaccine AoR= 2.330; 95%CI:1.103-4.916;p=0.027; and agreed that children could return to school before taking the COVID-19 vaccines AoR= 3.320; 95%CI:1.225-9.014;p=0.018.

Table 1: Age groups of participants

Age groups (years)	<20 years	20-29 years	30-39 years	40-49 years	≥50 years
Total N=723(%)	41(5.67%)	318(43.98%)	225(31.12%)	95(13.14%)	44(6.09%)
Mean	18.54	24.06	34.09	43.31	56.34
The standard error (SE)	0.08	0.16	0.19	0.29	0.96
95% Confidence Interval (CI)	18.38-18.70	23.74-24.37	33.71-34.04	42.73-43.88	54.42-58.27
5% Trimmed mean	18.54	24.01	34.04	43.18	55.74
Median	19.00	24.00	34.00	43.00	54.50
Variance	0.23	8.14	8.15	7.85	40.09
Standard Deviation (SD)	0.51	2.85	2.86	2.80	6.33
Minimum	18.00	20.00	30.00	40.00	50.00
Maximum	19.00	29.00	39.00	49.00	75.00
Range	1.00	9.00	9.00	9.00	25.00
Interquartile range	1.00	5.00	4.00	5.00	8.00
Skewness	-0.152(SE=0.369)	0.203(SE=0.137)	0.122(SE=0.162)	0.438(SE=0.247)	1.178(SE=0.357)
Kurtosis	-2.081(SE=0.724)	-1.201(SE=0.273)	-1.111(SE=0.323)	-0.936(SE=0.490)	1.100(SE=0.702)

Table 1 shows the characteristics of participants disaggregated by age groups 41(5.67%) were <20 years; 318(43.98%) were 20-29 years; 225(31.12%) were 30-39 years; 95(13.14%) were 40-49 years, and 44(6.09%) were ≥50 years.

: Perceptions of the COVID-19 vaccine and acceptance among participants at bivariate analysis

es	Age groups	Marital status	Religion	Tribe	Districts	Level of Education	Occupation
r of ıg l	8.375(p=0.079)	5.082(p=0.279)	5.801(p=0.215)	5.652(p=0.227)	13.689(p=0.057)	9.321(p=0.097)	1.044(p=0.307)
r of a nember ıg l with s	15.412(p=0.004)	7.007(p=0.136)	6.773(p=0.148)	1.101(p=0.894)	7.886(p=0.343)	14.701(p=0.012)	1.499(p=0.221)
r of	5.737(p=0.220)	0.319(p=0.989)	8.183(p=0.085)	10.321(p=0.035)	19.085(p=0.008)	22.335(p=0.000)	3.569(p=0.059)
al worries	0.837(p=0.933)	9.350(p=0.053)	5.603(p=0.231)	3.592(p=0.464)	17.748(p=0.013)	3.703(p=0.593)	0.127(p=0.721)
.ted	5.979(p=0.201)	5.509(p=0.239)	10.616(p=0.031)	9.370(p=0.052)	13.720(p=0.056)	2.492(p=0.778)	0.007(p=0.935)
ity- worries	4.696(p=0.320)	5.507(p=0.239)	To determine	2.747(p=0.601)	22.154(p=0.002)	3.720(p=0.590)	1.507(p=0.220)
ability ines	7.328(p=0.120)	3.034(p=0.552)	1.594(p=0.810)	11.733(p=0.019)	7.553(p=0.374)	2.435(p=0.786)	0.005(p=0.942)
19 nspiracy	3.006(p=0.557)	0.863(p=0.930)	5.749(p=0.219)	2.904(p=0.573)	10.292(p=0.173)	8.068(p=0.153)	0.175(p=0.676)
be o take 19 ions	6.190(p=0.185)	3.894(p=0.930	4.683(p=0.321)	3.321(p=0.506)	9.643(p=0.210)	5.266(p=0.384)	2.524(p=0.112)
e forced the	8.814(p=0.066)	3.354(p=0.500)	1.449(p=0.836)	2.215(p=0.696)	5.518(p=0.597)	14.031(p=0.015)	4.148(p=0.042)
t about ıe	9.502(p=0.050)	5.056(p=0.282)	7.250(p=0.123)	3.856(p=0.426)	8.816(p=0.266)	2.138(p=0.830)	0.846(p=0.358)
r of elf- l	23.999(p=0.003)	2.206(p=0.974)	4.410(p=0.818)	5.457(p=0.708)	12.685(p=0.551)	12.918(p=0.228)	0.794(p=0.672)
vaccine u d?	35.372(p=0.063)	22.429(p=0.554)	25.924(p=0.357)	71.881(p=0.000)	118.358(p=0.000)	78.592(p=0.005)	18.564(p=0.005)

Table 2 shows that acceptance of COVID-19 among age groups was associated with the fear of a family member becoming infected χ^2=15.412; p=0.004 and the fear of self-isolated χ^2=23.999; p=0.003.

The most trusted sources of COVID-19 information among participants

;	Sex	Age groups	Marital status	Religion	Tribe	Districts	Level of Education	Occ
	6.170(p=0.013)	9.781(p=0.044)	2.966(p=0506)	3.772(p=0.438)	5.747(p=0.219)	24.201(p=0.001)	13.643(p=0.018)	0.5(
:	2.645(p=0.104)	1.264(p=0.867)	3.317(p=0.506)	4.453(p=0.348)	10.972(p=0.027)	10.144(p=0.181)	16.460(p=0.006)	10.3
ily	0.039(p=0.843)	2.165(p=0.705)	3.574(p=0.467)	1.750(p=0.782)	4.788(p=0.310)	17.627(p=0.014)	5.351(p=0.375)	0.92
re ;	1.964(p=0.161)	5.860(p=0.210)	13.431(p=0.009)	5.627(p=0.310)	1.234(p=0.872)	47.581(p=0.000)	11.233(p=0.047)	15.3
ent a	11.758(p=0.001)	19.900(p=0.028)	7.915(p=0.095)	16.791(p=0.002)	5.462(p=0.243)	8.525(p=0.289)	12.977(p=0.024)	7.61
am	0.005(p=0.945)	20.105(p=0.000)	5.991(p=0.200)	7.419(p=0.115)	11.185(p=0.025)	66.038(p=0.000)	15.509(p=0.008)	7.78
	4.622(p=0.032)	1.431(p=0.839)	3.936(p=0.415)	12.718(p=0.013)	3.837(p=0.428)	33.192(p=0.000)	3.600(p=0.608)	0.04
	3.720(p=0.054)	10.745(p=0.030)	8.081(p=0.051)	8.081(p=0.089)	6.108(p=0.191)	43.263(p=0.000)	1.636(p=0.897)	2.91

Table 3 shows that the most trusted source of information on COVID-19 among the age group was the Government of Uganda χ^2=19.90; p=0.028; the mainstream media χ^2=20.105; p=0.000 and social media χ^2=10.745; p=0.030.

Table 4: Perceptions of the COVID-19 vaccines and vaccination among the study population disaggregated by age groups

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total (%)	Chi-Square	df	p-value
Do you think it is important to get COVID-19 vaccination to protect yourself against the virus?									
<20	30(4.10%)	32(4.40%)	7(1.00%)	2(0.30%)	9(1.2%)	80(11.07%)	28.044	16	0.031
20-29	94(13.00%)	100(13.80%)	48(6.60%)	19(2.60%)	18(2.60%)	279(38.60%)			
30-39	90(12.90%)	79(10.90%)	28(3.90%)	16(2.20%)	12(1.70%)	225(31.10%)			
40-49	33(4.60%)	47(6.50%)	8(1.10%)	6(0.80%)	1(0.10%)	95(13.10%)			
≥50	22(3.00%)	16(2.20%)	2(0.30%)	1(0.10%)	3(0.40%)	44(6.10%)			
Subtotal	269(37.20%)	274(37.90%)	93(12.90%)	44(6.10%)	43(5.90%)	723(100%)			
Do you think the Ugandan Government will develop a safe and effective COVID-19 vaccine?									
<20	21(2.90%)	28(3.90%)	16(2.20%)	7(1.00%)	8(1.10%)	80(11.07%)	15.283	16	0.504
20-29	45(6.20%)	89(12.30%)	73(10.10%)	37(5.10%)	35(4.80%)	279(38.60%)			
30-39	43(5.90%)	69(9.50%)	47(6.50%)	34(4.70%)	32(4.40%)	225(31.10%)			
40-49	12(1.70%)	34(4.70%)	24(3.30%)	15(2.10%)	10(1.40%)	95(13.10%)			
≥50	12(1.70%)	16(2.20%)	8(1.10%)	5(0.70%)	3(0.40%)	44(6.10%)			
Subtotal	133(18.40%)	236(32.60%)	168(23.20%)	98(13.60%)	88(12.20%)	723(100.0%)			
Do you think the big pharmaceutical companies have developed safe and effective COVID-19 vaccines?									
<20	18(2.60%)	23(3.20%)	20(2.80%)	12(1.70%)	7(1.00%)	80(11.07%)	12.57	16	0.704
20-29	43(5.90%)	94(13.00%)	74(10.20%)	47(6.50%)	21(2.90%)	279(38.60%)			
30-39	39(5.40%)	79(10.90%)	55(7.60%)	35(4.80%)	17(2.40%)	225(31.10%)			
40-49	16(2.20%)	37(5.10%)	21(2.90%)	16(2.20%)	5(0.70%)	95(13.10%)			
≥50	13(1.80%)	17(2.40%)	10(1.40%)	3(0.40%)	1(0.10%)	44(6.10%)			
Subtotal	129(17.80%)	250(34.60%)	180(24.90%)	113(15.60%)	51(7.10%)	723(100.0%)			
Do you believe that COVID-19 vaccines made in Europe or America are safer than those made in other countries?									
<20	18(2.60%)	14(1.90%)	19(2.60%)	15(2.10%)	14(1.90%)	80(11.07%)	29.193	16	0.023
20-29	43(5.90%)	70(9.70%)	82(11.30%)	48(6.60%)	36(4.90%)	279(38.60%)			
30-39	34(4.70%)	51(7.10%)	59(8.20%)	58(8.10%)	23(3.20%)	225(31.10%)			
40-49	20(2.80%)	24(3.30%)	23(3.20%)	24(3.30%)	4(0.60%)	95(13.10%)			
≥50	2(0.30%)	8(1.10%)	19(2.60%)	12(1.70%)	3(0.40%)	44(6.10%)			
Subtotal	117(16.20%)	167(23.10%)	202(27.90%)	157(21.70%)	80(11.07%)	723(100.0%)			
Which of the following COVID-19 vaccines do you prefer to use in the future?									
	AstraZeneca	J&J	Moderna	Pfizer	Sinovac	Sputnik			
<20	21(2.9%)	28(3.9%)	8(1.1%)	4(0.6%)	0(0.0%)	0(0.0%)	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%)			
30-39	73(10.19%)	79(10.9%)	12(1.7%)	15(2.1%)	0(0.0%)	0(0.0%)			
40-49	21(2.9%)	42(5.8%)	15(2.1%)	2(0.3%)	0(0.0%)	0(0.0%)			
≥50	14(1.9%)	19(2.6%)	0(0.0%)	1(0.1%)	2(0.3%)	2(0.3%)			
Subtotal	206(28.49%)	250(34.58%)	60(8.30%)	36(4.98%)	3(0.40%)	3(0.40%)			
I would take a jab of the COVID-19 vaccine to protect me against the disease.									
<20	26(3.60%)	29(4.00%)	5(0.70%)	11(1.50%)	9(1.20%)	80(11.07%)	25.061	16	0.069
20-29	72(10.00%)	122(16.90%)	36(4.90%)	23(3.20%)	26(3.60%)	279(38.60%)			
30-39	65(9.00%)	94(13.00%)	35(4.80%)	20(2.80%)	11(1.50%)	225(31.10%)			
40-49	32(4.40%)	41(5.70%)	9(1.20%)	9(1.20%)	4(0.60%)	95(13.10%)			
≥50	20(2.80%)	16(2.20%)	4(0.60%)	0(0.00%)	4(0.60%)	44(6.10%)			
Subtotal	215(29.70%)	302(41.80%)	89(12.30%)	63(8.70%)	54(7.60%)	723(100.0%)			

My concerns about the related side effects will stop me from taking the COVID-19 vaccine to prevent the virus.									
<20	15(2.10%)	25(3.50%)	10(1.40%)	20(2.80%)	10(1.40%)	80(11.07%)	25.125	16	0.068
20-29	73(10.10%)	68(9.40%)	42(5.80%)	57(7.90%)	39(5.40%)	279(38.60%)			
30-39	49(6.80%)	68(9.40%)	22(3.10%)	65(9.00%)	21(3.00%)	225(31.10%)			
40-49	15(2.10%)	29(4.00%)	15(2.10%)	23(3.20%)	13(1.80%)	95(13.10%)			
≥50	5(0.70%)	8(1.10%)	5(0.70%)	17(2.40%)	9(1.20%)	44(6.10%)			
Subtotal	157(21.70%)	198(27.40%)	94(13.0%)	182(25.2%)	92(12.70%)	723(100.0%)			
Which side do effects worry you the most about taking the COVID-19 vaccine?									
Variables	<20	20-29	30-39	40-49	≥50	Total	Chi	df	p-value
Fever	6(0.80%)	22(3.00%)	17(2.40%)	4(0.60%)	1(0.10%)	50(6.92%)	3.146	4	0.534
Joint pains	2(0.30%)	10(1.40%)	7(1.00%)	2(0.30%)	2(0.30%)	21(2.9%)	2.069	4	0.723
Blood clots	6(0.80%)	40(5.50)	42(5.80%)	14(1.90%)	5(0.70%)	107(14.80%)	6.509	4	0.164
Dizziness	3(0.40%)	8(1.10%)	9(1.20%)	3(0.40%)	2(0.30%)	25(3.50%)	0.691	4	0.952
Fear of death	16(2.20%)	34(4.70%)	13(1.80%)	14(1.90%)	2(0.30%)	79(10.90%)	16.608	4	0.002
Body pains and weakness	11(1.50%)	47(6.50%)	24(3.40%)	8(1.10%)	6(1.00%)	96(13.30%)	6.383	4	0.172
Subtotal	44(6.10%)	161(22.27%)	112(15.49%)	45(6.22%)	18(2.49%)	378(52.28%)			
I will recommend a jab of the COVID-19 vaccine to my family and friends.									
<20	25(3.50%)	38(5.30%)	5(0.70%)	6(0.80%)	6(0.80%)	80(11.07%)	19.064	16	0.265
20-29	80(11.10%)	122(16.90%)	37(5.10%)	16(2.20%)	24(3.30%)	279(38.60%)			
30-39	72(10.0%)	90(12.40%)	34(4.70%)	18(2.50%)	11(1.50%)	225(31.10%)			
40-49	30(4.10%)	39(5.40%)	14(1.90%)	9(1.20%)	3(0.040%)	95(13.10%)			
≥50	22(3.10%)	13(1.80%)	4(0.60%)	3(0.40%)	2(0.30%)	44(6.10%)			
Subtotal	229(31.70%)	302(41.8%)	94(13.00%)	52(7.20%)	46(6.40%)	723(100.0%)			
COVID-19 vaccine may be faulty or fake									
<20	16(2.20%)	18(2.50%)	19(2.60%)	19(2.60%)	8(1.10%)	80(11.07%)	27.978	16	0.032
20-29	45(6.20%)	76(10.50%)	75(10.40%)	47(6.50%)	36(5.00%)	279(38.60%)			
30-39	37(5.10%)	48(6.60%)	40(5.50%)	72(10.00%)	28(3.90%)	225(31.10%)			
40-49	10(1.40%)	28(3.90%)	20(2.80%)	21(2.90%)	16(2.20%)	95(13.10%)			
≥50	5(0.70%)	7(0.90%)	10(1.40%)	15(2.10%)	7(1.00%)	44(6.10%)			
Subtotal	113(15.60%)	177(24.50%)	164(22.70%)	174(24.1%)	95(13.10%)	723(100.0%)			
COVID-19 vaccine was rapidly developed and approved									
<20	20(2.80%)	32(4.40%)	17(2.40%)	7(1.00%)	4(0.60%)	80(11.07%)	24.583	16	0.078
20-29	89(12.30%)	105(14.50%)	43(5.90%)	24(3.30%)	18(2.50%)	279(38.60%)			
30-39	86(11.90%)	90(12.40%)	20(2.80%)	23(3.20%)	6(0.80%)	225(31.10%)			
40-49	30(4.10%)	39(5.40%)	13(1.80%)	8(1.10%)	5(0.70%)	95(13.10%)			
≥50	13(1.80%)	13(1.80%)	11(1.50%)	7(1.00%)	0(0.00%)	44(6.10%)			
Subtotal	238(32.90%)	279(38.60%)	104(14.40%)	69(9.50%)	33(4.60%)	723(100.0%)			
COVID-19 vaccine might have some unforeseen future side-effect									
<20	21(2.90%)	22(3.10%)	19(2.60%)	12(1.70%)	6(0.80%)	80(11.07%)	36.619	16	0.001
20-29	99(13.70%)	100(13.80%)	52(7.20%)	18(2.50%)	10(1.40%)	279(38.60%)			
30-39	79(10.90%)	64(8.90%)	43(5.90%)	25(3.50%)	14(1.90%)	225(31.10%)			
40-49	18(2.50%)	40(5.50%)	23(3.20%)	8(1.10%)	6(0.80%)	95(13.10%)			
≥50	7(1.00%)	12(1.50%)	19(2.60%)	5(0.70%)	1(0.10%)	44(6.10%)			
Subtotal	224(31.00%)	238(32.90%)	156(21.60%)	68(9.40%)	37(5.10%)	723(100.0%)			
COVID-19 vaccine is being promoted for commercial gains									
<20	19(2.60%)	18(2.50%)	19(2.60%)	20(2.80%)	4(0.30%)	80(11.07%)	27.795	16	0.019
20-29	72(10.00%)	68(9.40%)	65(9.00%)	50(6.90%)	24(3.30%)	279(38.60%)			
30-39	52(7.20%)	61(8.40%)	48(6.60%)	43(5.90%)	21(2.90%)	225(31.10%)			
40-49	16(2.20%)	28(3.90%)	23(3.20%)	19(2.60%)	9(1.20%)	95(13.10%)			
≥50	1(0.10%)	6(0.80%)	12(1.50%)	17(2.30%)	8(1.10%)	44(6.10%)			
Subtotal	160(22.10%)	181(25.00%)	167(23.10%)	149(20.60%)	66(9.10%)	723(100.0%)			
The Government of Uganda should make the COVID-19 vaccine available for all citizens for free?									
<20	40(5.50%)	28(3.90%)	4(0.60%)	3(0.40%)	5(0.70%)	80(11.07%)	9.645	16	0.884
20-29	133(18.40%)	88(12.20%)	31(4.30%)	10(1.40%)	17(2.40%)	279(38.60%)			
30-39	108(14.90%)	72(10.00%)	21(2.90%)	10(1.40%)	14(1.90%)	225(31.10%)			
40-49	42(5.80%)	34(4.70%)	9(1.20%)	6(0.80%)	4(0.60%)	95(13.10%)			
≥50	24(3.30%)	11(1.50%)	2(0.30%)	4(0.30%)	3(0.40%)	44(6.10%)			
Subtotal	347(48.00%)	233(32.20%)	67(9.30%)	33(4.60%)	43(5.90%)	723(100.0%)			
Would you be willing to pay for a COVID-19 vaccine privately?									
	No	Not Sure	Yes						
<20	65(9.00%)	11(1.50%)	4(0.60%)			80(11.07%)	10.979	8	0.202
20-29	214(29.60%)	41(5.70%)	24(3.30%)			279(38.60%)			
30-39	186(25.70%)	22(3.00%)	17(2.40%)			225(31.10%)			
40-49	67(9.30%)	16(2.20%)	12(1.70%)			95(13.10%)			
≥50	32(4.40%)	5(0.70%)	7(1.00%)			44(6.10%)			
Subtotal	564(78.00%)	95(13.10%)	64(8.9%)			723(100.0%)			
Would you accept your children getting vaccinated with the COVID-19 vaccine?									
<20	20(2.80%)	30(4.10%)	10(1.40%)	8(1.10%)	12(1.70%)	80(11.07%)	29.831	16	0.019
20-29	50(6.90%)	99(13.70%)	49(6.80%)	33(4.60%)	48(6.60%)	279(38.60%)			
30-39	37(5.10%)	86(11.90%)	27(3.70%)	41(5.70%)	34(4.70%)	225(31.10%)			
40-49	18(2.50%)	43(5.90%)	12(1.70%)	12(1.70%)	10(1.40%)	95(13.10%)			
≥50	17(2.40%)	18(2.50%)	1(0.10%)	1(0.10%)	3(0.40%)	44(6.10%)			
Subtotal	142(19.60%)	276(38.2%)	95(13.1%)	95(13.1%)	107(14.80%)	723(100.0%)			
Would you accept that your children return to school before being vaccinated with the COVID-19 vaccine?									
<20	21(2.90%)	25(3.50%)	8(1.10%)	15(2.10%)	11(1.50%)	80(11.07%)	14.438	16	0.566
20-29	76(10.50%)	76(10.50%)	38(5.30%)	42(5.80%)	47(6.50%)	279(38.60%)			

30-39	45(6.20%)	78(10.80%)	26(3.60%)	50(6.90%)	26(3.60%)	225(31.10%)			
40-49	19(2.60%)	30(4.10%)	16(2.20%)	16(2.20%)	14(1.90%)	95(13.10%)			
≥50	12(1.70%)	14(1.90%)	5(0.70%)	7(1.00%)	6(0.80%)	44(6.10%)			
Subtotal	173(23.90%)	223(30.80%)	93(12.90%)	130(18.00%)	104(14.40%)	723(100.0%)			
Health facilities and health workers have given me confidence in the COVID-19 vaccines.									
<20	22(3.00%)	34(4.70%)	10(1.40%)	8(1.10%)	6(0.80%)	80(11.07%)	20.236	16	0.210
20-29	53(7.30%)	112(15.50%)	48(6.60%)	36(5.00%)	30(4.10%)	279(38.60%)			
30-39	63(8.70%)	75(10.40%)	28(3.90%)	38(5.30%)	20(2.80%)	225(31.10%)			
40-49	26(3.60%)	36(5.00%)	12(1.70%)	16(2.20%)	5(0.70%)	95(13.10%)			
≥50	15(2.10%)	19(2.60%)	5(0.70%)	3(0.40%)	2(0.30%)	44(6.10%)			
Subtotal	179(24.80%)	276(38.20%)	103(14.30%)	101(14.0%)	63(8.90%)	723(100.0%)			

J&J=Johnson and Johnson

Table 4 shows the factors associated with the COVID-19 vaccine acceptance among the age groups. These were; it importance in protecting against coronavirus χ^2=28.044; df=16 p=0.032; believed that vaccines from the western world were safer χ^2=29.193; df=16 p=0.023; AstraZeneca was the preferred vaccine χ^2=52.877; df=24; p=0.001; the most worrying side effects was the fear of death χ^2=16.608; df=4 p=0.002; that the COVID-19 vaccine could be faulty or fake χ^2=27.978; df=16 p=0.032; the COVID-19 vaccine could have some unforeseen side effects χ^2=36.619; df=16 p=0.001; the COVID-19 vaccines are being promoted for commercial gains χ^2=27.795; df=16 p=0.019 and they would accept children to get vaccinated with the COVID-19 vaccine χ^2=29.831; df=16 p=0.019.

5: The independent factors associated with perceptions of COVID-19 vaccine acceptance among participants in northern a disaggregated by age groups

Variables	AoR	95% CI	p-value
I strongly Agree to take the COVID-19 vaccine jab to protect me from the virus?	4.99	1.626-15.337	0.005
I Agree to take the jab to protect me from the virus?	3.44	1.225-9.650	0.019
I strongly agree that the side effects of the vaccine will stop me from getting a jab	0.33	0.125-0.856	0.023
I am neutral on whether the side effects of the vaccine will stop me from taking a jab	0.32	0.108-0.952	0.041
5: I would not accept to pay for the COVID-19 vaccine	0.28	0.093-0.866	0.027
6: I would accept my children to take a COVID-19 vaccine jab	0.26	0.105-0.626	0.003
7: I strongly agree that my children can go to school before taking the COVID-19 vaccine jab	2.33	1.103-4.916	0.027
7: I agree that my children can go to school before taking the COVID-19 vaccine jab	3.32	1.225-9.014	0.018

Table 5 shows the independent determinants of COVID-19 vaccine acceptance disaggregated by age groups among the study population. Participants strongly agreed that the COVID-19 jab provides protection against the virus AoR=4.99;95% CI:1.626-15.337;p=0.005; Agreed that the vaccine would protect them AoR=3.44;95%CI:1.225-9.650;p=0.019; strongly agreed that the side effects of the vaccine would stop them from receiving the vaccine AoR=0.330; 95%CI:0.125-0.856; p=0.023; They were neutral on whether the side effects of the COVID-19 vaccine would stop them from getting a jab AoR= 0.320; 95%CI:0.108-0.952;p=0.027; would not accept to pay for the COVID-19 vaccine AoR=0.280;95%CI:0.093-0.866; p=0.027; Agreed that children could take a COVID-19 vaccine AoR= 0.260; 95%CI:0.105-0.626;p=0.003; Strongly agreed that children could return to school before the COVID-19 vaccination AoR= 2.330; 95%CI:1.103-4.916;p=0.027; and agreed that children could return to school before taking a COVID-19 vaccines AoR= 3.320; 95%CI:1.225-9.014;p=0.018.

Discussion

The most significant finding from this study was that COVID-19 vaccine acceptance among the study population disaggregated by age groups was not statistically significant (Table 1 and Table 2). Interestingly, the age groups received information on COVID-19 vaccines and vaccinations from various preferred sources (Table 3). The older age groups were more willing to accept the COVID-19 vaccine than the younger ones, although this difference was not statistically significant (Table 3). The current study's findings contrast those of another study conducted in southwestern Uganda that found that younger age groups were more likely to get the COVID-19 vaccine [18]. Like the current research, the 2021 study in Ohio, USA, found that the younger age groups were less likely to accept the COVID-19 vaccine [17]. The inconsistent findings about the association between age and COVID-19 vaccine acceptance in these two studies raise the need for more research to investigate the influence of contextual issues such as the influence of differences in countries' socio-economic dynamics, population structures, cultures, beliefs, perceptions, and understanding of the COVID-19 vaccine in different geographical regions and people.

Nevertheless, the uniform or lack of difference in the COVID-19 vaccine acceptance among age groups in this study population is essential in that the community can be engaged and sensitized to accept the COVID-19 vaccine by using the same method of information delivery in future vaccine rollout. In addition, it will not require the Ugandan Ministry of Health to make special arrangements for the vaccination campaign for any age group as all agree on the importance of COVID-19 vaccination (Table 4 and Table 5). This finding agrees with those of other studies, for example, in Uganda [19] and Ontario, Canada [20], and among medical students in Sudan [21].

There were several determinants of COVID-19 vaccine acceptance among the study population (Table 5). Of particular interest was that they strongly agreed that the COVID-19 vaccine could protect them against coronavirus, a finding like that of other studies in Uganda [4,18,19] and other African countries [10,21]. It is observed that where the population has a high-risk perception of COVID-19, they readily accept the COVID-19 vaccine and vice versa [10,11,12]. These

authors argue that the intensity of the COVID-19 second wave experienced in Uganda, the personal experience of the illness, and the mortality among high-profile personalities experienced by communities in this region may have helped communities accept the vaccination against the virus.

Secondly, the fear of the vaccine's side effects is another factor that determined the community's unwillingness to vaccinate against the coronavirus (Table 4 and Table 5). The barricades of side effects, including the fear of death, blood clots, mental health complications, and general body weakness, have been extensively reported (Table 4). Many participants opined that these side effects dissuaded them from accepting the COVID-19 vaccine (Table 4 and Table 5). These findings agree with those of many other studies in Uganda and elsewhere, where the fear of the possible side effects of the COVID-19 vaccine led to vaccine hesitancy [18,19,20]. These authors propose that mass education, sensitization, mobilization, and community engagement could allay these fears and therefore remains cardinal for the success of future COVID-19 campaigns. In addition, if a prompt and timely provision of remedies to the complications are provided at the nearest health facilities or by village health teams, it will minimize the fears related to the vaccine administration.

The unwillingness of the community to privately pay for the COVID-19 vaccine has raised great interest (Table 5). Most participants were not shielded under any known health insurance coverage except for a few educated white-collar job workers. This finding has raised the interest of the authors that most study population was not covered under any health insurance [4]. In times of epidemics/pandemics, people find themselves at crossroads. Authors have argued that most Ugandans' lack of health insurance coverage is a time bomb ready to detonate. The country is experiencing increasing incidence and prevalence of infectious diseases, non-communicable conditions, and lifestyle diseases. The Ugandan Government could avert this situation by legislating on the proposed Health Insurance Bill, which the Ugandan Parliament has shelved for many years. The astronomical medical bills served to clients in private health facilities during the treatment of COVID-19 patients were some of the challenges noticed during the second wave of COVID-19 in Uganda. A single person's treatment for two or more weeks ranged between $20,000-40,000, which was unaffordable for many Ugandan patients. The lack of health insurance coverage other than the out-of-pocket payments remained a serious challenge, depleting hard-earned resources and leading some families to severe debts and ultimately down the poverty line. These authors argue that the sooner this country discusses the health insurance bill and passes it into law, the more it and the population will suffer from more severe resource depletion in treating diseases such as COVID-19.

Interestingly, the return of children to school before the COVD-19 vaccination was an independent determinant factor among participants (Table 5). The general opinion among these community members was that the children should be vaccinated against the virus (Table 5) but also noted that the virus did not cause severe disease to the children [4,22]. This has been shown by many studies in Uganda, where children experienced milder forms of the disease with limited symptoms' burden and duration of the illness [22]. These findings among children were encouraging information that the Ugandan Ministry of Health could use to encourage children to adopt other public health approaches, such as wearing masks instead of the mass vaccine rollout among these age groups [22]. However, with many uncertainties about the virus and the development of new variants in the unvaccinated population, some scholars and physicians argue that it would not be suitable for the country to rely on the current findings as new variants may eventually affect the unvaccinated population; thus, destroying the successes already achieved. Because of many uncertainties about the COVID-19 vaccine and that the vaccines were developed so rapidly and with unsuspecting unforeseen side effects, it would be a balanced decision to-way in the argument that it would not be wise to vaccinate children who have a longer life ahead-considering inadequate data on the long-term effects of the vaccine on children in Uganda. The authors believe that vaccination of children with COVID-19 should be halted for the moment until sufficient data on the long-term impacts of the COVID-19 vaccines have been determined.

The strengths: This study was conducted in a rural population using a face-to-face interview which enabled the research team to obtain up-to-date information from the study population. The sampled population was large enough to get generalizable information on the COVID-19 vaccination in the sub-region.

Limitations: This was a one-of assessment of views of participants; these authors reckon that there may have been some social desirability biases that the research team could not control among the research participants and, therefore, the need for more studies in the future, taking into consideration factors that may influence behaviors of participants.

Generalizability of the results obtained: Findings from this study should be interpreted in the context of a rural population that had just experienced a severe wave of COVID-19 in Uganda. We may not be entirely sure that similar findings would have been obtained before the second wave or just after the first wave of COVID-19 in Uganda.

In Conclusion

COVID-19 vaccine acceptance among the study population disaggregated by age group was insignificant despite the misinformation in the Ugandan media. The independent determinants of COVID-19 vaccine acceptance were the importance of the vaccine for protection against the virus, the vaccine's side effects could stop them from taking the jab, children could take the COVID-19 vaccine, and they could return to school before taking the COVID-19 jab. The fear of family members contracting the virus and self-isolation when infected contributed significantly to the COVID-19 vaccine acceptance among participants in northern Uganda. There is a need for health managers to engage, sensitize and mobilize the population by addressing concerns about long-term and immediate side effects to increase the COVID-19 vaccine uptake in this community.

Declarations

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

Availability of data and material: All datasets supporting this article's conclusion are within this article and are 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, SB, LO, and FWDO participated in designing the study, JA, JNO, PA, FWDO, and DLK were responsible for supervising data collection, ENI, LO, and DLK were responsible for data analysis and interpretation, SB, CO, PA, NOA, DA, JNO, DO, POO, SGO, FPP, ENI, FWDO, JA, LO, DLK for writing and revising the manuscript. All Authors approved the manuscript.

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