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Poor compliance to COVID-19 preventive measures and low intention to vaccination prior to the second wave of the COVID-19 pandemic in Uganda

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-057322
Article Type:	Original research
Date Submitted by the Author:	14-Sep-2021
Complete List of Authors:	Wafula, Solomon; Makerere University College of Health Sciences, Department of Disease Control and Environmental Health Mugume, Innocent; Makerere University College of Health Sciences, Disease Control and Environmental Health Sensasi, Benjamin; World Health Organization Country Office for Uganda Okware, Solome; World Health Organization Country Office for Uganda Chimbaru, Alexander; World Health Organisation Sierra Leone Country Office Nanyunja, Miriam; World Health Organisation, Uganda Country Office, Disease Prevention Talisuna, Ambrose; Organisation mondiale de la Sante pour Afrique, Health Emergecy Programme; World Health Organisation, WHE Programme Kabanda, Richard ; Republic of Uganda Ministry of Health Bakyaita, Tabley; Republic of Uganda Ministry of Health Wanyenze, Rhoda K; Makerere University, School of Public Health Byakika-Tusiime, Jayne; World Health Organization Country Office for Uganda
Keywords:	COVID-19, Public health < INFECTIOUS DISEASES, EPIDEMIOLOGY

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Original Research
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Poor compliance to COVID-19 preventive measures and low intention to vaccination prior to the second wave of the COVID-19 pandemic in Uganda

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Abstract

Objectives Resurgences in cases and deaths due to COVID-19 in many countries suggest complacency in adhering to COVID-19 prevention guidelines. Vaccination therefore remains a key intervention in mitigating the impact of the COVID-19 pandemic. This investigated the level of adherence to COVID-19 preventive measures and intention to receive COVID-19 vaccine among Ugandans.

Design, setting and participants A nationwide cross-sectional survey of 1053 Ugandan adults was conducted in March 2021 using telephone interviews.

Main outcomes measures : Participants reported on risk perceptions, adherence to COVID-19 prevention measures and intention to be vaccinated with COVID-19 vaccines.

Results Overall, 10.2% of the respondents adhered to the COVID-19 prevention guidelines. Compared to females, males were less likely to adhere to COVID-19 guidelines (OR = 0.64, 95% CI 0.41 to 0.99). Participants from the northern (4.0%, OR =0.28, 95%CI 0.12 to 0.92), western (5.1%, OR = 0.30, 95% CI 0.14 to 0.65, and eastern regions (6.5%, OR=0.47, 95% CI 0.24 to 0.92) respectively had lower odds to adhere to the COVID-19 guidelines than those from the central region (14.7%) . A monthly income of ≥ USD 137 (OR= 2.31, 95%CI 1.14 to 4.58) and history of chronic disease (OR=1.81, 95% CI 1.14 to 2.86) were predictors of adherence. Definite intention to receive COVID-19 vaccination was 57.8% (609/1053). Concerns about getting COVID-19 in the future (PR = 1.26, 95% CI 1.06 to1.48) and fear of severe COVID-19 infection (PR = 1.20, 95% CI 1.04 to1.38) were the strongest predictors for a definite intention while concerns of side effects was negatively associated with vaccination intent (PR = 0.75, 95% CI 0.68 to 0.83).

Conclusion Behaviour change programs need to be strengthened to promote adherence to COVID-19 prevention guidelines as vaccination is rolled out as another preventive measure. Dissemination of accurate safety and efficacy information about the vaccines is necessary to improve vaccine uptake.

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Strengths and limitations of this study

- Study offers insights on the level to adherence to COVID-19 guidelines and intention to receive vaccination using nationally representative population.
- Social desirability bias is associated with telephone interviews compared to face to face interviews.
- Causal inference cannot be established with cross-sectional study designs. Despite these limitations, the study findings provide valuable information about the levels of adherence to recommended COVID-19 prevention guidelines and intention to take COVID-19 vaccines

INTRODUCTION

The incidence of (severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection, has increased dramatically worldwide since December 2019, when the first case was detected among humans in Wuhan, Hubei Province, China [1]. As of 30th July 2021, over 196 million people had been infected with SARS-CoV 2 and about 4.2 million people were reported dead. In Africa, over 4.9 million people had been infected and of these, 116,100 had died [2]. Uganda confirmed its first coronavirus disease 2019 (COVID-19) case on 21 March 2020. As of 30th July 2021, Uganda had registered 93,282 COVID-19 cases and 2, 632 deaths (Case Fatality Rate (CFR)=2.82%). At the start of the pandemic, countries struggled to contain COVID-19 spread and instituted several preventive and control measures including travel restrictions, geographical lockdowns, quarantine as well as enforcement of public health guidelines such as hand hygiene, use of face masks, and social distancing [3] [4]. These measures were taken to prevent transmission of the virus as well as flatten the curve. The measures helped countries to contain the COVID-19 for some time. However, the resurgences in many countries were evidence that adherence to the measures had waned in the population and adherence to COVID-19 public health measures alone could not contain COVID-19 transmission [5].

One key strategy to stop the escalation of the COVID-19 pandemic is to develop and administer effective vaccines to the people. Towards the end of 2020, several vaccines against COVID-19 became available for public use including Pfizer/BioNTech, AstraZeneca-SK Bio, Janssen, Sinovac and Moderna vaccines which have since been

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given Emergency Use Listing approval by WHO [6]. Currently, vaccination against COVID-19 is ongoing in all high-income countries (HICs) as well as in most low-and middle-income countries (LMICs). In Uganda, as of February 2021, the National Drug Authority (NDA) approved AstraZeneca vaccine and vaccination was launched in March 2021 amidst reports of side effects such as dizziness, headache, weakness, fever, blood clots and even death in some countries[7].

Widespread vaccination with high coverage of the eligible population is important in containing the COVID-19 pandemic [8]. However, the availability of vaccines does not guarantee uptake as previous studies have highlighted [9-12]. Concerns for not intending to take COVID-19 vaccines have been premised around worries about the newness and the speed at which vaccines were developed, safety as well as potential side effects [4 13]. Some studies in sub-Saharan Africa (SSA) have shown low levels of vaccine acceptance [14 15]. Such low acceptance levels could be attributed to an increasing infodemic of false information and rumours that make it difficult to find credible sources of information. Further, given the low number of cases before the resurgence leads to the low-risk perception among members of the public, and thus contributing to hesitancy to get vaccinated. Given the high level of vaccine hesitancy reported at the global level and emerging concerns within communities in LMIC, assessing vaccine acceptance at the national level is essential [16].

Besides vaccines, large scale implementation of non-pharmaceutical interventions remains critical in COVID-19 prevention. This is especially crucial in the early phases of vaccination rollout before the attainment of herd immunity. It is also very important for vaccinated individuals to maintain adherence to these interventions since the full protective effect of the vaccine for individuals is attained after about two weeks of full vaccination[17 18] and there is a possibility of breakthrough infections[19]. However, evidence from SSA has indicated only moderate adherence to these public health measures. In Uganda, adherence to the COVID 19 measures was initially high[20] but the resurgence of infections suggests complacency in adhering to these measures fuelled by the low-risk perception among the population. Regarding vaccination, there is limited data on acceptance and intention to receive the COVID-19 vaccine in Uganda. In this study, we sought to investigate the level of adherence to COVID-19 preventive measures and intention to receive COVID-19 vaccine among Ugandans to inform decisions about the enhancement of both vaccine uptake and other public health measures.

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METHODS

Study design and population

This study was part of a multi-country knowledge, attitudes and practices survey to understand the drivers of non-adherence towards COVID-19 preventive measures in eastern and southern Africa using computer-assisted telephone interviews. A total of 1053 adults were interviewed from 60 districts distributed in the four regions of Uganda (Central, Eastern, Northern and Western) in March 2021. Random selection of participants was done based on quotas set on age, gender and location proportionate to national COVID-19 case distribution statistics at the time of the study. We included adults 18 years and older with access to cell phones and who had been residents in the study district for at least six months. Persons who were unable to communicate or declined to participate were excluded from the study.

Data collection

Data were collected through telephone interviews using a WHO survey tool for COVID-19 [21]. The questionnaire included questions on socio-demographic characteristics, knowledge and perceptions of COVD-19 prevention measures, perceptions of COVID19 risk and uptake of COVID-19 prevention measures. In addition, data on perceptions of safety and efficacy of the available COVID 19 vaccines and intention to take the COVID-19 vaccine were collected.

Knowledge on COVID-19 was assessed using four questions on the spread of COVID-19; signs and symptoms of COVID-19; preventive measures and treatment and containment approaches. Perceptions on the relevance of COVID-19 prevention measures were assessed on a Likert scale with four questions on wearing face masks; physical distancing of at least 2 meters; hand hygiene and respiratory etiquette. Questions on how participants adhered to five COVID-19 guidelines were assessed with options: “always”, “sometimes” and “never”. The five questions were on guidelines including mass gathering, physical distancing, mask-wearing, respiratory etiquette and hand hygiene.

Perception about the safety and efficacy of COVID-19 vaccines were measured on a Likert scale with the options: ‘strongly agree’, ‘agree’, ‘not sure’, ‘disagree’ or ‘strongly disagree’.

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Intention to take the COVID-19 vaccine was measured using a one-item question "If a vaccine against COVID-19 becomes available, would you take it?" whose response was categorized as "Definitely yes", "Probably yes", "Probably no" and "Definitely No".

The questionnaire was translated into eight local languages spoken in Uganda (*Luganda, Lusoga, Lunyakitara, Lugbara, Luo, Lugishu, Ateso, Ngakarimojong)*, and then programmed and uploaded to the Kobo Collect software installed on a tablet computer used for data collection.

Statistical analysis

Data were analyzed using Stata version 16 (StataCorp, Texas, US). Categorical data were summarized using frequencies and percentages and continuous data using median and interquartile range. Our primary definition for adherence was compliance with all personal public health and social measures for the prevention of COVID-19 as guided by WHO [22] including frequent hand hygiene, physical distancing, respiratory etiquette, proper use of masks and avoidance of mass gatherings. We developed a composite variable for adherence to COVID-19 prevention guidelines consisting of five variables which were coded 0, 1 and 2 to represent no adherence, adhere sometimes and always adhere respectively. We obtained a total score by adding the responses from the five questions and trichotomized the composite adherence variable, with those with score 10/10 considered to have good adherence, 8-9 out of 10 to have fair adherence and those scoring 7 and below as having poor adherence.

Before running multivariable regression, we dichotomized adherence with code "1" for good adherence (score 10/10) and code "0" for fair /poor adherence (score 0-9). We then conducted a multivariable logistic regression analysis with the dichotomous composite adherence score as the outcome, adjusting for age and gender at a 5% level of significance. We also performed a modified Poisson regression analysis to assess the predictors of definite intention to receive the COVID-19 vaccine. For this analysis, vaccination intention was dichotomized into "Definitely yes" and "Probably yes /Probably no /Definitely No". A modified Poisson regression was preferred instead of logistic regression to avoid overestimating relative risk since vaccine intention was high (prevalence > 10%) and to ensure robust standard errors [18]. Variables that had p values ≤0.2 at univariate analysis were considered in the model building and in the final model. Statistical significance was considered if variables had a p-value ≤ 0.05.

Patient and public involvement.

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No patients or the public were involved in the study design, setting the research questions, interpretation or writing up of results, or reporting of the research.

RESULTS

Sociodemographic characteristics of participants

Of the 1070 individuals engaged to take part in the study, 1053 (98.4%) agreed to participate in the study. The median age [IQR] of participants was 34 [18 – 80]. Six hundred fifty-one (61.8%) of the respondents were male and a half (50.3%) of the participants were aged between 18 and 34 years. Six hundred twenty-nine (59.8%) had attained secondary education as the highest level of education, 368 (35.0%) were self-employed and 235 (22.6%) earned USD 13.7 or less per month. Additional descriptive data are provided in Table 1.

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Table 1. Sociodemographic characteristics of study participants

Characteristics	Frequency, n (%)
Age (Median [IQR] = 34 [18 - 80]),	
18 – 34	530 (50.3)
35 – 54	419 (39.8)
55 – 64	73 (6.9)

65+	31 (2.9)
Gender	
Male	651 (61.8)
Female	402 (38.2)
Residence	
Rural	545 (51.8)
Urban	508 (48.2)
Education	
No formal Education	79 (7.5)
Primary	345 (32.8)
Secondary	386 (36.7)
Tertiary	243 (23.1)
Occupation	
Casual labourer	56 (5.3)
Farmer	260 (24.7)
Formally employed	171 (16.2)
Housewife	59 (5.6)
Self Employed	368 (35.0)
Unemployed	66 (6.3)
Student	46 (4.4)
Others	27 (2.6)
Monthly Income (USD 1= UGX 3650)	
≤ 13.7	235 (22.6)
13.7 – 27.4	165 (15.9)
27.4 – 54.8	197 (19.0)
54.8 – 137.0	289 (27.8)
137.0 – 274.0	98 (9.4)
≥ 274.0	54 (5.2)
Household size (median [IQR] = 5 [1 - 20])	
< 5	374 (35.5)
5 – 10	585 (55.6)
>10	94 (8.9)
History of COVID-19 among self or close relatives or friends	
No	794 (75.4)
Yes	259 (24.6)
Reported history of chronic disease (Cardiovascular disease, diabetes, HIV/AIDS, hypertension etc.)	
No	804 (76.4)
Yes	249 (23.6)

Knowledge about COVID-19 and sources of information

When asked how COVID-19 spreads, most participants stated physical contact with infected persons (74.6%) and inhalation of infected droplets (70.0%). The major symptoms mentioned included: sneezing (78.9%), coughing (77.9%) and fever (71.7%). Nearly all (99.1%) participants knew that COVID-19 can be prevented. When asked about the COVID-19 prevention measures they knew, most mentioned mask wearing (94.8%)

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and washing hands with soap and water or using alcohol hand rub or sanitiser (90.3%) while only half (51.6%) mentioned social distancing. The most trusted sources of information were radio (45.3%) and television (28.9%). Overall, 93.5% of the participants were considered to have high knowledge on COVID-19

COVID-19 risk and severity perception

Participants had a high perception of susceptibility to COVID-19. Majority (80.3%) stated that they were worried about getting COVID-19 in the next few months. Six hundred eighty-five (74.5%) agreed that the possibility of contracting COVID-19 was high if they didn't get vaccinated. Eight hundred (76.0%) felt that if they got a COVID-19 infection, it would be severe. Two hundred seventy (25.6%) believed that if they suffered from COVID-19, they would gain lifelong immunity, hence, they did not need to take precautions. About the relevance of each of the COVID-19 preventive measures, 97.2% (1024), 94.9% (999) and 98.2% (1034) agreed that masking, physical distancing and hand hygiene respectively were critical for preventing COVID-19. Overall, 89.7% had a positive perception of the preventive measures for COVID-19 *(Table 2).*

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Table 2. Participants' risk and disease severity perception about COVID-19 and its prevention measures

Attributes	Strongly agree / Agree	Strongly disagree / Disagree / not sure
Risk and disease severity perception		
▪ Worry about the likelihood of getting COVID-19	846 (80.3)	207 (19.7)
▪ Chance of being infected with COVID 19 are high before access to vaccination	785 (74.5)	268 (25.5)
▪ Will be very sick if I get COVID-19	800 (76.0)	253 (24.0)
▪ If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution	270 (25.6)	783 (74.4)
Perception of prevention measures		

▪ Wearing a mask in public is a good protective measure against COVID-19	1024 (97.2)	29 (2.8)
▪ Keeping a physical distance of at least 2 meters is good protective measure against COVID-19	999 (94.9)	54 (5.1)
▪ Frequent hand washing or using ABH sanitiser is a good protective measure against COVID-19	1034 (98.2)	19 (1.8)
▪ Covering mouth and nose with hand elbow when sneezing or coughing can protect the community from COVID-19	996 (94.6)	57 (5.4)

Uptake of COVID-19 prevention measures

Majority of participants (67.4%) had been to a large gathering in the previous 14 days. Regarding observance of each of the prevention measures, a physical distancing of at least 2 meters was reportedly observed by 88.9% (928/); 47.2% all the time and 41.7% sometimes while masking was observed by 97.3% (831); 69.0% always and 28.3% sometimes. Overall, 10.2% were considered to have good adherence to the COVID-19 prevention guidelines while 89.8% (946) were non-adherent. Participants were asked about the non-conventional approaches that members in their communities used to prevent COVID-19 infection. Four hundred forty-nine (42.6%) reported that their communities were using herbal remedies, 40.0% (421) were eating fruits and vegetables and 13.8% (145) steaming using local herbs *(Table 3)*.

Table 3: Uptake of COVID-19 prevention measures.

COVID-19 prevention measures	Frequency, n (%)
Been to a large gathering in the last 14 days*	
Yes	710 (67.4)
No	343 (32.6)
Maintain at least a 2-meter distance when interacting with other people*	
Yes	439 (41.7)
No	117 (11.1)
Sometimes	497 (47.2)
Wear a mask in public and when coughing and sneezing*	
Yes	727 (69.0)
No	28 (2.7)
Sometimes	298 (28.3)
Wash my hand with water and soap and sanitize regularly*	
Yes	682 (64.8)
No	21 (2.0)
Sometimes	350 (33.2)

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Cover mouth and nose with hand, elbow or handkerchief when coughing or sneezing*	
Yes Always	693 (65.8)
Yes, only when necessary	335 (31.8)
No	25 (2.4)
Adherence levels to COVID-19 preventive measures	
Adherence (10/10 practice score)	107 (10.2)
Non-Adherence (<10 practice score)	946 (89.8)
Non-conventional community prevention strategies against COVID -19	
Use of herbal remedies like garlic, ginger	449 (42.6)
Eating fruits and vegetables	421 (40.0)
Steaming using local herbs	145 (13.8)
Physical exercise	82 (7.8)
Others including drinking alcohol, sunbathing, not admitting strangers, etc.	208 (19.8)
Nothing	298 (28.3)

Note: Variables with * were used to calculate a composite COVID-19 prevention practice score

3.5. Factors associated with adherence to COVD-19 prevention guidelines

Using multivariable regression, we found the odds of adherence to preventive guidelines were lowest in Western (OR= 0.30, 95%CI 0.14 -0.65), Northern (OR= 0.28, 95%CI 0.12-0.92), and Eastern (OR= 0.47, 95%CI 0.24-0.92) regions compared to the central region. Male respondents had 35% lower odds to adhere to COVID-19 guidelines than the female counterparts (aOR= 0.65, 95%CI 0.41 – 0.99). Higher monthly income was associated with higher adherence to COVID-19 preventive guidelines; those who earned USD ≥ USD 274 (OR= 2.31, 95%CI 1.14 – 4.58) had higher odds to adhere to all COVID-19 guidelines than those who earned ≤ USD 13.7.

The odds of adherence to guidelines were higher in participants that reported a history of chronic illness compared to those with no reported history of chronic illness (aOR=1.81, 95%CI 1.14-2.86) *(Table 4).*

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Table 4: Factors associated with adherence to COVID-19 prevention guidelines

Characteristic		Adherent (n=107)	Non-adherent (n=946)	Adjusted OR (95% CI	*p*value
Region					
	Central	81 (14.7)	472 (85.4)	1	
	Eastern	11 (6.5)	158 (93.5)	0.47 (0.24 to 0.92)	**0.027**
	Northern	7 (4.0)	167 (96.0)	0.28 (0.12 to 0.63)	**0.002**
	Western	8 (5.1)	149 (94.9)	0.30 (0.14 to 0.65)	**0.002**
Age					
	18-34	59 (11.1)	471 (88.9)	1	
	35-54	38 (9.1)	381 (90.9)	0.75 (0.47 to 1.21)	0.235
	55-64	8 (11.0)	65 (89.0)	0.90 (0.39 to 2.07)	0.808
	65+	2 (6.4)	29 (93.6)	0.47 (0.11 to 2.13)	0.322
Gender					
	Female	50 (12.4)	352 (87.6)	1	
	Male	57 (8.8)	594 (91.2)	0.65 (0.42 to 0.99)	**0.047**
Household Size					
	<5	47 (12.6)	327 (87.4)	1	
	5 – 10	52 (8.9)	533 (91.1)	0.78 (0.50 to 1.23)	0.296
	>10	8 (8.5)	86 (91.5)	0.96 (0.41 to 2.22)	0.931
Monthly Income (USD)					
	≤ 13.7	18 (7.7)	217 (92.3)	1	
	13.7 – 27.4	13 (7.9)	152 (92.1)	0.98 (0.46 to 2.11)	0.968
	27.4 – 54.8	17 (8.6)	180 (91.4)	1.04 (0.51 to 2.13)	0.911
	54.8 – 137	33 (11.4)	256 (88.6)	1.49 (079 to 2.81)	0.216
	≥137	25 (16.4)	127 (83.6)	2.31 (1.16 to 4.58)	**0.017**
Reported history of chronic disease					
	No	71 (8.8)	733 (91.2)	1	
	Yes	36 (14.5)	213 (85.5)	1.81 (1.14 to 2.85)	**0.012**
Will be very sick if I get COVID-19					
	Strongly agree/Agree	77 (9.6)	723 (90.4)	1	
	Strongly disagree/Disagree	30 (11.9)	223 (88.1)	1.21 (0.76 to 1.93)	0.428
If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution					
	Strongly agree/Agree	33 (12.2)	237 (87.8)	1	
	Strongly disagree/Disagree	74 (9.4)	709 (90.6)	0.76 (0.48 to 1.21)	0.249

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Perception of efficacy and safety of COVID-19 vaccines

The majority (75.2%) indicated that getting the vaccine would make them feel less worried about contracting COVID-19. About 55.5% (584) were concerned about safety while 62.5% (658) had concerns about the efficacy of the COVID-19 vaccine.

Intention to take COVID-19 vaccine

Overall, 84.0% (887) participants responded yes to COVID-19 vaccine intent, while only 168 16.0% (168) responded no. Specifically, more than half 57.8% (609) responded “definitely yes” followed by “probably yes” 26.2% (276). Only 9.3% (98) responded “probably no” and 6.7% (70) “definitely no”

Factors associated with a definite intention to take a COVID-19 vaccine

After controlling for potential confounders including age, participants from northern (PR =1.24, 95% CI1.09 to 1.41) and western region (PR =1.36, 95% CI 1.20 to 1.54) respectively were more likely to have definite intention to take COVID-19 vaccine compared to those from the central region. Participants aged 55 to 64 were more likely to have a definite intention to take the vaccine compared to those aged 18 -34 years (PR = 1.20, 95%CI 1.01 to 1.43). Concern for being infected with COVID 19 (PR = 1.26, 95% CI 1.06 to1.48) and developing severe disease (PR = 1.20, 95%CI 1.04 to 1.38) were predictors of intention to get vaccinated. Those with concerns about the side effects of the vaccine were less likely to have a definite intention for vaccination (PR =0.75, 95% CI 0.68 to 0.83) (Table 5).

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Table 5: Factors associated with a definite intention to take a COVID-19 vaccine

Characteristic	Definitely Yes (n=609)	Probably yes/probably no/definitely no (n=444)	Adjusted PR (95% CI)	p-value
Region				
Central	292 (52.8)	261 (47.2)	1	
Eastern	94 (55.6)	75 (44.4)	1.05 (0.90 to 1.23)	0.508
Northern	114 (65.5)	60 (34.5)	1.24 (1.09 to 1.41)	**0.001**
Western	109 (69.4)	48 (30.6)	1.36 (1.20 to 1.54)	**<0.001**
Residence				
Rural	322 (59.1)	223 (40.9)		
Urban	287 (56.5)	221 (43.5)		
Age group				
18-34	284 (53.6)	246 (46.4)	1	
35-54	252 (60.1)	167 (39.9)	1.09 (0.98 to 1.22)	0.126
55-64	51 (69.9)	22 (30.1)	1.20 (1.01 to 1.43)	**0.047**
65+	22 (71.0)	9 (29.0)	1.25 (1.00 to 1.57)	**0.058**
Occupation				
Casual labourer	30 (53.6)	26 (46.4)	1	
Farmer	156 (60.0)	104 (40.0)	1.00 (0.77 to 1.31)	0.993
Formally Employed	109 (63.7)	62 (36.3)	1.12 (0.86 to 1.47)	0.394
Housewife	27 (45.8)	32 (54.2)	0.75 (0.52 to 1.08)	0.123
Self Employed	203 (55.2)	165 (44.8)	0.98 (0.76 to 1.28)	0.890
Unemployed	45 (68.2)	21 (21.8)	1.22(0.90 to 1.64)	0.200
Student	22 (47.8)	24(52.2)	0.92 (0.63 to 1.36)	0.695
Others	17 (63.0)	10 (37.0)	1.02 (0.69 to 1.53)	0.904
Perception of COVID-19 prevention measure				
Poor perception	53 (49.1)	55 (50.9)	1	
Good perception	556 (58.8)	389 (41.2)	1.14 (0.94 to 1.37)	0.191
Ever had experience with COVID-19				
No	450 (56.7)	344 (43.3)	1	
Yes	159 (61.4)	100 (38.6)	1.09 (0.97 to 1.22)	0.136
Reported history of chronic disease				
No	453 (56.3)	351 (43.7)	1	
Yes	156 (62.7)	93 (37.3)	1.09 (0.98 to 1.22)	0.124
Concerned about getting infected with COVID 19 in the future				
Strongly agree/Agree	514 (60.8)	332 (39.2)	1.26 (1.06 to 1.48)	**0.007**
Strongly disagree/Disagree	95 (45.9)	112 (54.1)	1	
Future changes before the vaccine are high				

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Strongly agree/Agree	474 (60.4)	311 (39.6)	1.12 (0.98 to 1.29)	0.097
Strongly Disagree/Disagree	135 (50.4)	133 (49.6)	1	
Will be very sick if I get COVID-19				
Strongly agree/Agree	489 (61.1)	311 (38.9)	1.20 (1.04 to 1.38)	**0.011**
Strongly disagree/Disagree	120 (47.4)	133 (52.6)	1	
Concerned about side effects of the COVID-19 Vaccine.				
Strongly disagree/Disagree	310 (66.1)	159 (33.9)	1	
Strongly agree/Agree	299 (51.2)	285 (48.8)	0.75 (0.68 to 0.83)	**<0.001**

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DISCUSSION

This study assessed reported adherence to COVID-19 prevention measures and intention to take the COVID-19 vaccine. We found that although knowledge levels on COVID-19, and its prevention and risk perceptions were high, adherence to all COVID-19 prevention guidelines was low. Adherence was higher among participants with high income and those with a reported history of chronic disease. More than half (57.8%) of the participants had definite intention to receive the COVID-19 vaccine and the definite intention was influenced by age of participants, region of residence, perceived susceptibility to COVID-19 and concerns about the safety of the vaccine.

In this study, 93.5% of the participants had high knowledge about COVID-19 and its prevention. This finding is not surprising because this study was conducted one year after the COVID-19 pandemic was confirmed in Uganda and hence most people had obtained basic information on the disease. The level of knowledge in this study is comparable to what was reported in an earlier study in Uganda [20], and other studies in China [23] and Vietnam[24] but higher than what was reported in Malaysia[25], Ethiopia [26], South Africa [27] and Bangladesh [28]. The observed discrepancies in knowledge about COVID-19 might be explained by the differences in the way the knowledge variable was ascertained across studies; the differences in study populations[29]; timing of the study period [30]; the level of information exchange; the sample size involved and methods of data collection. For instance, in Ethiopia, the study was conducted among health workers (HCWs) and observance of the preventive guidelines was based on a 3-point Likert scale and good compliance based on whether HCWs scored ≥75% or less[29]. Many of the studies which reported low knowledge were conducted in the early phase of the pandemic and knowledge would more likely have increased since then.

Our findings indicate a high level of perceived susceptibility to COVID-19 among participants implying that public enlightenment in terms of not underestimating the possibility of outbreak resurgence may have had an impact and should be continued until the disease is eliminated. High-risk perception plays a crucial role in influencing compliance with the public health and social measures for prevention of COVID-19 [31 32] and intention to receive vaccines [33 34]. Participants with higher COVID-19 risk perception showed higher intentions to receive the

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COVID-19 vaccine but few adopted all non-pharmaceutical preventive guidelines. Further studies are needed to understand why high-risk perception did not translate into the adoption of public health guidelines and consistent adherence.

Radio and television were the main and most trusted sources of information on COVID-19 among the population. This could, in part, be attributed to the fact that most information on COVID-19 by the president of Uganda and interactive communications by the Ministry of Health and partners was through mainly television and radio across the country hence making them popular. Radio and television ownership has also increased steadily in Uganda and most households have phones with radios which they use to access information on COVID-19. Our findings corroborate a previous Ugandan study among food vendors where radio and television emerged as major sources of information on COVID-19 [35] but contradicts another study that showed that friends and personal experiences were the major sources of information, with social media and radio ranking third among Ugandans in informal sectors[36]. The latter study was however conducted before the COVID-19 pandemic. Given the increased misinformation on COVID-19, accurate information and facts on COVID-19 should be aired more on radio and television since these remain the commonest and most trusted sources of COVID-19 information.

In this study, 71.7% of participants indicated the people in the community were using non-conventional approaches to prevent COVID-19. These approaches included using herbal remedies, steaming with local herbs, eating vegetables and fruits and physical exercises. These strategies are not scientifically proven tools to prevent COVID-19 and should be addressed through educational messaging. Similarly, a healthy diet is important for broader health benefits, but there is no evidence that diet alone is protective against COVID-19 infection and this should also be addressed in education messaging.

In this study, only 10.2% of the participants adhered to all COVID-19 preventive guidelines. Adherence to some measures was relatively high; for instance, 69.0% reported wearing face masks always when going out and 64.8% always washed hands with soap, but only 41.7% reported maintaining a social distance of 2 meters and 67% had been to a large gathering in the previous 14 days. The adherence level reported in our study is lower than that described in a previous study in Uganda [30]. Our findings suggest complacency in complying

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with MOH preventive measures. At the time of conducting this study, few confirmed cases and deaths of COVID-19 were being reported daily hence the public could have relaxed the observance of the measures with the belief that the disease was under control. This highlights the need to strengthen risk communication strategies and pillars responsible for COVID-19 response, to avoid possibilities of further resurgence. It's, therefore, important to strengthen enforcement of all COVID-19 preventive measures: physical distancing, hand hygiene and wearing masks, in order to control the pandemic and halt further viral transmission.

We also found that male participants had lower odds to adhere to all the COVID-19 guidelines than the females. A recent study in the United States indicated that women were more likely than men to follow guidelines outlined by medical experts to prevent the spread of COVID-19[37]. It's already known that men tend to have more challenges and less interest in taking up health behaviours [35]. Focused strategies should, therefore, be designed to encourage men to adhere to the guidelines. The level of adherence could be related to the occupations, where in many cases more men than women do outdoor jobs and socialize more in groups hence observance of the guidelines may be less seriously than men. We found that, unlike the Central region, participants from Northern, Eastern and Western regions had lower odds of adhering to all the preventive measures. The fact that approximately 55% of the COVID-19 cases at the time were registered in the central region could suggest a high-risk perception among participants in the central compared to other regions. Interventions targeting behaviour change should put special emphasis on these other regions to cover aspects of the risk perception.

Having a higher monthly income was related to higher odds of adhering to all the preventive guidelines. High incomes could be linked to higher education attainment which are important determinants of health. People with higher income can afford to procure masks and handwashing facilities and supplies for themselves making it easier to comply with all the preventive guidelines. A recent study on socioeconomic factors associated with self-protecting behaviour during the COVID-19 pandemic indicated that higher income influence the adoption of public health guidelines [38]. It was argued that adoption of the guidelines is a costly prospect, one that is easier for people with more income. People with low income

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should be prioritized when distributing free masks, hand hygiene supplies. More health education sessions are given to promote adherence to the recommended guidelines.

Further, we found that participants with a reported history of chronic disease were more likely to adhere to all the guidelines. It is not surprising that people with a history of chronic disease have better adherence because evidence indicates that they are at elevated risk of unfavourable outcomes such as severe disease and death [39] [40]. Campaigns to ensure sustained adherent behaviour among people with chronic illnesses are warranted and campaigns focused on those with no known chronic disease history should be intensified to raise risk perception among this group.

In this study, despite 84.0% expressing the intention to get vaccinated, only 57.8% had a definite intention to get vaccinated against COVID-19. Our findings are comparable to a study in China that found that 83.5% had the intention to get vaccinated against COVID-19 of which 30% had a definite intent [4] but contradicts with another study in Malaysia in which intention to get vaccinated against COVID-19 was higher (94.3%) of which, 48.2% had a higher definite intention[41]. A good comparison of vaccination intention levels between countries may not be ideal due to the limited evidence available as well as differences in access to vaccines in the countries. It has been suggested that for herd immunity to be attained for COVID-19, more than 70% of the population need to be vaccinated [42]. It's therefore important that health education is intensified to increase people's confidence in the vaccines so that they can get vaccinated as vaccines become available. Reported definite intention to take the vaccine was highest in Northern and Western regions. Sensitization to promote COVID-19 vaccine acceptance should be intensified in the Eastern and Central regions of Uganda.

We found that older people (at least 55 years) were more likely to have a definite intention to take the vaccine compared to young people (18-34 years). This could be related to the knowledge that vaccines could protect old people more since people in advanced age have a higher risk of getting severe COVID-19 than young people [43]. Strategies to promote definite intent to take the vaccine should be continued in old people but they should also be intensified in young people who may have a belief that they have a strong immune system to fight off the COVID-19 infection.

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Having concerns about the side effects of COVID-19 was associated with a low definite intention to take the vaccine. Our finding is consistent with that found in China in which concerns about side effects affected intention to take the vaccine[4]. Worries about side effects of the vaccine have been reported before whenever a new vaccine has been introduced [44]. It should be noted that although COVID-19 vaccination needs to be rolled out countrywide, the fears raised about the vaccine underscore the need to emphasize facts and accurate information to the public about the safety and efficacy of the vaccine to dispel any rumours or misinformation surrounding the COVID-19 vaccines. Addressing these issues will result in increased confidence and reduced hesitancy to take the vaccines.

Participants who had high perceived susceptibility to the disease and those who felt they would get severe disease if they got SARS-CoV-2 infection were significantly more likely to have definite intention to take the COVID-19 vaccine. One of the key drivers in people's vaccination decisions is the risk they associate with the disease the vaccine protects against [45]. Susceptibility perceptions are seen to be associated with emotional dimensions that often include fear and worry [46]. Previous studies have also indicated a predictive effect of perceived risk on vaccination intentions[47]. Its therefore important to keep emphasizing in health education and sensitization that COVID-19 is a real, dangerous and deadly disease so that people can take the vaccination seriously in addition to observing all the COVID-19 preventive guidelines.

There are some limitations in this study. First, social desirability bias is associated with telephone interviews compared to face to face interviews[48]. Second, causal inference cannot be established with cross-sectional study designs. Despite these limitations, the study findings provide valuable information about the levels of adherence to recommended COVID-19 prevention guidelines and intention to take COVID-19 vaccines.

Conclusions

The study findings indicate a low level of adherence to COVID-19 prevention guidelines despite high knowledge about COVID-19. Males and individuals from northern and western regions central had comparatively low reported adherence levels to public health and social

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measures. Participants with reported chronic disease history and higher-income had better-reported adherence levels. Our findings suggest that interventions to improve adherence to COVID-19 prevention guidelines should target males, low-income earners and people living in the northern, western, and western regions of Uganda more. More than half of the participants (57.8%) had a definite intent to take the vaccine. Higher perceived risk and severity of COVID-19 infection had a strong and positive effect on vaccination intention while concerns about the safety of the vaccine negatively influenced vaccination intention. Efforts should be directed to the promotion of a high definite intention to get vaccinated against COVID-19 by addressing the fears of side effects and doubts about vaccine effectiveness to enhance confidence and increase vaccine uptake among the population.

Acknowledgments

We thank World Health Organization Africa Regional Office, WHO AFRO, for funding this study. We are equally thankful to Prof Jayne Byakika-Tusiime and Prof Rhoda Wanyenze for providing technical review and intellectual content to the study protocol and drafting of the manuscript. We thank Mr Innocent Komakech (WHO Uganda) for his administrative guidance during the design and impmentation of the study. We are also indepbted to the research assistants who collected good quality data as well as the study participants for sparing time to participate in the study.

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Declarations

Data availability statement

The data used for this study should be requested from the WHO Africa Regional Office.

Ethical considerations

Ethical approval was obtained from the Makerere University Higher Degrees Research and Ethics Committee (HDREC), reference number HDREC 926, and the Uganda National Council of Science and Technology (UNCST) reference number SS862ES. We obtained verbal informed consent from participants. Confidentiality was observed throughout the study.

Patient consent for publication Not available

Competing interests

The authors declare no competing interests.

Funding This work was funded by the World Health Organization Africa Regional Office, WHO AFRO.(Award Number: N/A)

Authors' Contributions

STW, JBT, and RKW conceptualized and designed the study. STW, IBM and JBT performed data analysis, interpretation and wrote the first draft of the manuscript. RKW, BS, SO, AC, MN, AT, RK and TB critically reviewed the analysis and the first manuscript draft. JBT, AT and RKW provided technical and intellectual content review for the manuscript. All authors have read and approved the final version of the manuscript.

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Intention to vaccinate against COVID-19 and adherence to non-pharmaceutical interventions against COVID-19 prior to the second wave of the pandemic in Uganda

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-057322.R1
Article Type:	Original research
Date Submitted by the Author:	28-Feb-2022
Complete List of Authors:	Wafula, Solomon; Makerere University College of Health Sciences, Department of Disease Control and Environmental Health Mugume, Innocent; Makerere University College of Health Sciences, Disease Control and Environmental Health Sensasi, Benjamin; World Health Organization Country Office for Uganda Okware, Solome; World Health Organization Country Office for Uganda Chimbaru, Alexander; World Health Organisation Sierra Leone Country Office Nanyunja, Miriam; World Health Organisation, Uganda Country Office, Disease Prevention Talisuna, Ambrose; Organisation mondiale de la Sante pour Afrique, Health Emergecy Programme; World Health Organisation, WHE Programme Kabanda, Richard ; Republic of Uganda Ministry of Health Bakyaita, Tabley; Republic of Uganda Ministry of Health Wanyenze, Rhoda K; Makerere University, School of Public Health Byakika-Tusiime, Jayne; World Health Organization Country Office for Uganda
Primary Subject Heading:	Global health
Secondary Subject Heading:	Infectious diseases, Epidemiology, Global health
Keywords:	COVID-19, Public health < INFECTIOUS DISEASES, EPIDEMIOLOGY

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Original Research
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Intention to vaccinate against COVID-19 and adherence to non-pharmaceutical interventions against COVID-19 prior to the second wave of the pandemic in Uganda

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Abstract

Objectives Resurgences in cases and deaths due to COVID-19 in many countries suggest complacency in adhering to COVID-19 prevention guidelines. Vaccination therefore remains a key intervention in mitigating the impact of the COVID-19 pandemic. This study investigated the level of adherence to COVID-19 preventive measures and intention to receive COVID-19 vaccine among Ugandans.

Design, setting and participants A nationwide cross-sectional survey of 1,053 Ugandan adults was conducted in March 2021 using telephone interviews.

Main outcomes measures : Participants reported on adherence to COVID-19 prevention measures and intention to be vaccinated with COVID-19 vaccines.

Results Overall, 10.2% of the respondents adhered to the COVID-19 prevention guidelines and 57.8% stated definite intention to receive a SARS-CoV-2 vaccine. Compared to females, males were less likely to adhere to COVID-19 guidelines (OR = 0.64, 95% CI 0.41 to 0.99). Participants from the northern (4.0%, OR =0.28, 95%CI 0.12 to 0.92), western (5.1%, OR = 0.30, 95% CI 0.14 to 0.65, and eastern regions (6.5%, OR=0.47, 95% CI 0.24 to 0.92) respectively had lower odds to adhere to the COVID-19 guidelines than those from the central region (14.7%) . A higher monthly income of ≥ USD 137 (OR= 2.31, 95%CI 1.14 to 4.58) and history of chronic disease (OR=1.81, 95% CI 1.14 to 2.86) were predictors of adherence. Concerns about chances of getting COVID-19 in the future (PR = 1.26, 95% CI 1.06 to1.48) and fear of severe COVID-19 infection (PR = 1.20, 95% CI 1.04 to1.38) were the strongest predictors for a definite intention while concerns of side effects was negatively associated with vaccination intent (PR = 0.75, 95% CI 0.68 to 0.83).

Conclusion Behaviour change programs need to be strengthened to promote adherence to COVID-19 prevention guidelines as vaccination is rolled out as another preventive measure. Dissemination of accurate safety and efficacy information about the vaccines is necessary to enhance vaccine uptake.

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Strengths and limitations of this study

- The study assesed level to adherence to COVID-19 guidelines and intention to receive vaccination using a relatively large sample of adult Ugandan population with representation across different ages, gender and location hence making generalization possible.
- Strict definition of adherence to non phamacuetical measures (NPIs) against COVID-19 requiring that participants observe optimumly all the specific NPIs to be considered adherent.
- There is however, the limitation of social desirability bias which is more common with telephone interviews than the face to face interviews and this may result into overestimation of reported adherence and vaccination intent
- Causal inference between adherence and vaccination intent with other predictors cannot be established because the cross-sectional study design applied in this survey is not optimal for casual inference.
- Participation in the study was voluntary and thus self-selection bias is posible amd can affect the results.

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INTRODUCTION

The incidence of (severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection, has increased dramatically worldwide since December 2019, when the first case was detected among humans in Wuhan, Hubei Province, China [1]. As of 30th July 2021, over 196 million people had been infected with SARS-CoV 2 and about 4.2 million people were reported dead. In Africa, over 4.9 million people had been infected and of these, 116,100 had died [2]. Uganda confirmed its first coronavirus disease 2019 (COVID-19) case on 21 March 2020. As of 30th July 2021, Uganda had registered 93,282 COVID-19 cases and 2, 632 deaths (Case Fatality Rate (CFR)=2.82%). At the start of the pandemic, countries struggled to contain COVID-19 spread and instituted several preventive and control measures including travel restrictions, geographical lockdowns, quarantine as well as enforcement of public health guidelines such as hand hygiene, use

of face masks, and social distancing [3] [4]. These measures were taken to prevent transmission of the virus as well as flatten the curve. The measures helped countries to contain the COVID-19 for some time. However, the resurgences in many countries were evidence that adherence to the measures had waned in the population and adherence to COVID-19 public health measures alone could not contain COVID-19 transmission [5].

One key strategy to stop the escalation of the COVID-19 pandemic is to develop and administer effective vaccines to the people. Towards the end of 2020, several vaccines against COVID-19 became available for public use including Pfizer/BioNTech, AstraZeneca-SK Bio, Janssen, Sinovac and Moderna vaccines which have since been given Emergency Use Listing approval by WHO [6]. Currently, vaccination against COVID-19 is ongoing in all high-income countries (HICs) as well as in most low-and middle-income countries (LMICs). In Uganda, as of February 2021, the National Drug Authority (NDA) approved AstraZeneca vaccine and vaccination was launched in March 2021 amidst reports of side effects such as dizziness, headache, weakness, fever, blood clots and even death in some countries[7].

Widespread vaccination with high coverage of the eligible population is important in containing the COVID-19 pandemic [8]. However, the availability of vaccines does not guarantee uptake as previous studies have highlighted [9-12]. Concerns for not intending to take COVID-19 vaccines have been premised around worries about the newness and the speed at which vaccines were developed, safety as well as potential side effects [4] [13]. Some studies in sub-Saharan Africa (SSA) have shown low levels of vaccine acceptance [14] [15]. Such low acceptance levels could be attributed to an increasing infodemic of false information and rumours that make it difficult to find credible sources of information. Further, given the low number of cases before the resurgence leads to the low-risk perception among members of the public, and thus contributing to hesitancy to get vaccinated. Given the high level of vaccine hesitancy reported at the global level and emerging concerns within communities in LMIC, assessing vaccine acceptance at the national level is essential [16].

Besides vaccines, large scale implementation of non-pharmaceutical interventions remains critical in COVID-19 prevention. This is especially crucial in the early phases of vaccination rollout before the attainment of herd immunity. It is also very important for vaccinated individuals to maintain adherence to these interventions since the full protective effect of the vaccine for individuals is attained after about two weeks of full

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vaccination[17 18] and there is a possibility of breakthrough infections[19]. However, evidence from SSA has indicated only moderate adherence to these public health measures. In Uganda, adherence to the COVID 19 measures was initially high[20] but the resurgence of infections suggests complacency in adhering to these measures fuelled by the low-risk perception among the population. Regarding vaccination, there is limited data on acceptance and intention to receive the COVID-19 vaccine in Uganda. In this study, we sought to investigate the level of adherence to COVID-19 preventive measures and intention to receive COVID-19 vaccine among Ugandans to inform decisions about the enhancement of both vaccine uptake and other public health measures.

METHODS

Study design and population

This study was part of a multi-country knowledge, attitudes and practices survey to understand the drivers of non-adherence towards COVID-19 preventive measures in eastern and southern Africa using computer-assisted telephone interviews. A total of 1053 adults were interviewed from 60 districts distributed in the four regions of Uganda (Central, Eastern, Northern and Western) in March 2021. Random selection of participants was done based on quotas set on age, gender and location proportionate to national COVID-19 case distribution statistics at the time of the study. We included adults 18 years and older with access to cell phones and who had been residents in the study district for at least six months. Persons who were unable to communicate or declined to participate were excluded from the study.

Sample size and sampling

The sample size of 1070 was determined using sample size formula for cross-sectional studies[21] with the following assumptions, Two-sided Z statistic corresponding to 95% confidence interval (1.96), adherence level of 50% since no prior studies had measured the adherence to NPIs in the manner we planned to measure. We considered a 5% margin of error and a design effect of 2.5 to cater for potential clustering of participants by region. We also considered a non-response rate of 10%.

Regarding sampling, quotas were set on age, gender and location (region) proportionate to national COVID-19 case distribution statistics at the time. A recent analysis of the COVID-19 cases had showed the following distributions (proportions) per quota [22] as shown in table 1

- Age distribution as follows: 18-35 (51%), 36-55 (37%), 56-65 (8%), 65+ (4%)

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- Gender: the data show that male were ~60% and women ~40%
- Location: Central: 55%, Eastern/Western/Northern each 15%

Table 1 below shows the distribution based on the above distribution

Regions	Gender	Age distribution			
		18-35 (51%)	36-55 (37%)	56 -65 (8%)	65+ (4%)
Northern (n = 162)	Female (n = 65)	33	24	5	3
	Male (n = 97)	49	36	8	4
Eastern (n = 162)	Female (n = 65)	33	24	5	3
	Male (n = 97)	49	36	8	4
Central (n = 583)	Female (n = 233)	118	86	19	10
	Male (350)	178	130	28	14
Western (n = 162)	Female (n = 65)	33	24	5	3
	Male (n = 97)	49	36	8	4

With these quotas in place, we used excel contact database and a computer assisted program to randomly sample specific of participants per each quota. This probability sampling approach allowed for all individuals in the population of interest to have a relatively equal chance of being selected for the survey.

Data collection

Data were collected through telephone interviews using a WHO survey tool for COVID-19 [23] and this was pretested before actual data collection to address any ambiquities The questionnaire captured data on socio-demographic characteristics, knowledge and perceptions of COVD-19 prevention measuresand uptake of COVID-19 prevention measures. In addition, data on perceptions of safety and efficacy of the available COVID 19 vaccines and intention to take the COVID-19 vaccine were collected.

Knowledge on COVID-19 was assessed by dichotomizing a knowledge score based on blooms cutoff[24]using four questions. Each correct response was given 1 point and wrong answer was given 0.Providing 4 correct responses on the 4 questions meant good knowledge otherwise poor knowledge. Perceptions on the relevance of COVID-19 prevention measures were assessed on a Likert scale with four questions.Each of these were dichotomized with strongly agree/agree coded 1 while not sure disageee or strongly agree coded 0. Responding appropriately to 3 of the four perception questions was considered satisifactory otherwise unsatisfactory.

Questions on how participants adhered to five COVID-19 guidelines were assessed with options: “always”, “sometimes” and “never”. The five questions were based on guidelines

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including mass gathering, physical distancing, mask-wearing, respiratory etiquette and hand hygiene.

Perception about the safety and efficacy of COVID-19 vaccines were measured on a Likert scale with the options: 'strongly agree', 'agree', 'not sure', 'disagree' or 'strongly disagree'.

Intention to take the COVID-19 vaccine was measured using a one-item question "If a vaccine against COVID-19 becomes available, would you take it?" whose response was categorized as "Definitely yes", "Probably yes", "Probably no" and "Definitely No". This was later dichomotomized to Definitely yes (coded 1) otherwise No (coded 0). Data was collected on covariates such as participant age, gender, level of education, income, and occupation were obtained. Perceived risk of COVID-19 as well as perceptions on the safety and efficacy of the COVID-19 vaccine.

The questionnaire was translated into eight local languages spoken in Uganda (*Luganda, Lusoga, Lunyakitara, Lugbara, Luo, Lugishu, Ateso, Ngakarimojong)*, and then programmed and uploaded to the Kobo Collect software installed on a tablet computer used for data collection. The full English questionnaire is available as supplementary file-1

Statistical analysis

Data were analyzed using Stata version 16 (StataCorp, Texas, US). Categorical data were summarized using frequencies and percentages and continuous data using median and interquartile range. Our primary definition for adherence was compliance with all personal public health and social measures for the prevention of COVID-19 as guided by WHO [25] including frequent hand hygiene, physical distancing, respiratory etiquette, proper use of masks and avoidance of mass gatherings. We developed a composite variable for adherence to COVID-19 prevention guidelines consisting of five variables which were coded 0, 1 and 2 to represent no adherence, adhere sometimes and always adhere respectively. We obtained a total score by adding the responses from the five questions and trichotomized the composite adherence variable, with those with score 10/10 considered to have good adherence, 8-9 out of 10 to have fair adherence and those scoring 7 and below as having poor adherence. We dichotomized adherence with code "1" for good adherence (score 10/10) and code "0" for fair /poor adherence (score 0-9) before running regressions.

We conducted a multivariable logistic regression analysis with the dichotomous composite adherence score as the outcome, adjusting for age and gender at a 5% level of significance. We also performed a modified Poisson regression analysis to assess the

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predictors of definite intention to receive the COVID-19 vaccine. For this analysis, vaccination intention was dichotomized into "Definitely yes" and "Probably yes /Probably no /Definitely No"[4]. A modified Poisson regression was preferred instead of logistic regression to avoid overestimating relative risk since vaccine intention was high (prevalence > 10%) and to ensure robust standard errors [18]. Before running the multivariable regressions, we separately ran several simple regressions consisting of the outcome (Adherence or Vaccination intent) and single predictor at a time (supplementary file **2**). Variables that had p values ≤0.2 in these simple bivariate models were considered in the final model building. Statistical significance was considered if variables had a p-value ≤ 0.05.

Patient and public involvement.

No patients or the public were involved in the study design, setting the research questions, interpretation or writing up of results, or reporting of the research.

RESULTS

Sociodemographic characteristics of participants

Of the 1,070 individuals engaged to take part in the study, 1,053 (98.4%) agreed to participate in the study and were included in the analysis. The median age of participants [IQR] was 34 [18 – 80]. Six hundred fifty-one (61.8%) of the respondents were male and a half (50.3%) of the participants were aged between 18 and 34 years. Six hundred twenty-nine (59.8%) had attained secondary education as the highest level of education, 368 (35.0%) were self-employed and 235 (22.6%) earned USD 13.7 or less per month. Additional descriptive data are provided in Table 2.

Table 2. Sociodemographic characteristics of study participants

Characteristics	Frequency, n (%)
Age (Median [IQR] = 34 [18 - 80]),	
18 – 34	530 (50.3)
35 – 54	419 (39.8)
55 – 64	73 (6.9)
65+	31 (2.9)
Gender	
Male	651 (61.8)

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Female	402 (38.2)
Residence	
Rural	545 (51.8)
Urban	508 (48.2)
Education	
No formal Education	79 (7.5)
Primary	345 (32.8)
Secondary	386 (36.7)
Tertiary	243 (23.1)
Occupation	
Casual labourer	56 (5.3)
Farmer	260 (24.7)
Formally employed	171 (16.2)
Housewife	59 (5.6)
Self Employed	368 (35.0)
Unemployed	66 (6.3)
Student	46 (4.4)
Others	27 (2.6)
Monthly Income (USD 1= UGX 3650)	
≤ 13.7	235 (22.6)
13.7 – 27.4	165 (15.9)
27.4 – 54.8	197 (19.0)
54.8 – 137.0	289 (27.8)
137.0 – 274.0	98 (9.4)
≥ 274.0	54 (5.2)
Household size (median [IQR] = 5 [1 - 20])	
< 5	374 (35.5)
5 – 10	585 (55.6)
>10	94 (8.9)
History of COVID-19 among self or close relatives or friends	
No	794 (75.4)
Yes	259 (24.6)
Reported history of chronic disease (Cardiovascular disease, diabetes, HIV/AIDS, hypertension etc.)	
No	804 (76.4)
Yes	249 (23.6)

Knowledge about COVID-19 and sources of information

When asked how COVID-19 spreads, most participants stated physical contact with infected persons (74.6%) and inhalation of infected droplets (70.0%). The major symptoms mentioned included: sneezing (78.9%), coughing (77.9%) and fever (71.7%). Nearly all (99.1%) participants knew that COVID-19 could be prevented. When asked about the COVID-19 prevention measures they knew, most mentioned mask wearing (94.8%) and washing hands with soap and water or using alcohol hand rub or sanitiser (90.3%) while only half (51.6%) mentioned social distancing. The most trusted sources of

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information were radio (45.3%) and television (28.9%). Overall, 93.5% of the participants were considered to have high knowledge on COVID-19

COVID-19 risk and severity perception

Participants had a high perception of susceptibility to COVID-19. Majority (80.3%) were worried about getting COVID-19 in the next few months and 685 (74.5%) agreed that the possibility of contracting COVID-19 was high if they didn't get vaccinated. Eight hundred participants (76.0%) felt that if they got a COVID-19 infection, it would be severe. Two hundred seventy (25.6%) believed that they would gain lifelong immunity if they suffered from COVID-19 hence, find urgent need to take precautions. About the relevance of each of the COVID-19 preventive measures, 97.2% (1024), 94.9% (999) and 98.2% (1034) agreed that masking, physical distancing and hand hygiene respectively were critical for preventing COVID-19. Overall, 89.7% had a positive perception of the preventive measures for COVID-19 *(Table 3).*

Table 3. Participants' risk and disease severity perception about COVID-19 and its prevention measures

Attributes	Strongly agree / Agree	Strongly disagree / Disagree / not sure
Risk and disease severity perception		
▪ Worry about the likelihood of getting COVID-19	846 (80.3)	207 (19.7)
▪ Chance of being infected with COVID 19 are high before access to vaccination	785 (74.5)	268 (25.5)
▪ Will be very sick if I get COVID-19	800 (76.0)	253 (24.0)
▪ If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution	270 (25.6)	783 (74.4)
Perception of prevention measures		
▪ Wearing a mask in public is a good protective measure against COVID-19	1024 (97.2)	29 (2.8)
▪ Keeping a physical distance of at least 2 meters is good protective measure against COVID-19	999 (94.9)	54 (5.1)
▪ Frequent hand washing or using ABH sanitiser is a good protective measure against COVID-19	1034 (98.2)	19 (1.8)
▪ Covering mouth and nose with hand elbow when	996 (94.6)	57 (5.4)

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sneezing or coughing can protect the community from COVID-19	

Uptake of COVID-19 prevention measures

Sixty seven per cent of participants had been to a large gatherings in the preceeding 14 days. Regarding observance of the prevention measures, a physical distancing of at least 2 meters was reportedly observed by 88.9% (928); 47.2% all the time and 41.7% sometimes while masking was observed by 97.3% (831); 69.0% always and 28.3% sometimes. Overall, 10.2% were considered to have good adherence to the COVID-19 prevention guidelines while 89.8% (946) were non-adherent. Participants were asked about the non-conventional approaches that members in their communities used to prevent COVID-19 infection. Four hundred forty-nine (42.6%) reported that their communities were using herbal remedies, 40.0% (421) were eating fruits and vegetables and 13.8% (145) steaming using local herbs *(Table 4)*.

Table 4: Uptake of COVID-19 prevention measures.

COVID-19 prevention measures	Frequency, n (%)
Been to a large gathering in the last 14 days*	
Yes	710 (67.4)
No	343 (32.6)
Maintain at least a 2-meter distance when interacting with other people*	
Yes	439 (41.7)
No	117 (11.1)
Sometimes	497 (47.2)
Wear a mask in public and when coughing and sneezing*	
Yes	727 (69.0)
No	28 (2.7)
Sometimes	298 (28.3)
Wash my hand with water and soap and sanitize regularly*	
Yes	682 (64.8)
No	21 (2.0)
Sometimes	350 (33.2)
Cover mouth and nose with hand, elbow or handkerchief when coughing or sneezing*	
Yes Always	693 (65.8)
Yes, only when necessary	335 (31.8)
No	25 (2.4)
Adherence levels to COVID-19 preventive measures	
Adherence (10/10 practice score)	107 (10.2)
Non-Adherence (<10 practice score)	946 (89.8)

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Non-conventional community prevention strategies against COVID -19	
Use of herbal remedies like garlic, ginger	449 (42.6)
Eating fruits and vegetables	421 (40.0)
Steaming using local herbs	145 (13.8)
Physical exercise	82 (7.8)
Others including drinking alcohol, sunbathing, not admitting strangers, etc.	208 (19.8)
Nothing	298 (28.3)

Note: Variables with * were used to calculate a composite COVID-19 prevention practice score

3.5. Factors associated with adherence to COVD-19 prevention guidelines

Using multivariable regression, we found the odds of adherence to preventive guidelines were lowest for participants in Western (aOR= 0.30, 95%CI 0.14 -0.65), Northern (aOR= 0.28, 95%CI 0.12-0.92), and Eastern regions (aOR= 0.47, 95%CI 0.24-0.92) compared to the central region. Male respondents had 35% lower odds to adhere to COVID-19 guidelines than the female counterparts (aOR= 0.65, 95%CI 0.41 – 0.99). Higher monthly income was associated with higher adherence to COVID-19 preventive guidelines; those who earned USD ≥ USD 274 (OR= 2.31, 95%CI 1.14 – 4.58) had higher odds to adhere to all COVID-19 guidelines than those who earned ≤ USD 13.7.

The odds of adherence to guidelines were higher in participants that reported a history of chronic illness compared to those with no reported history of chronic illness (aOR=1.81, 95%CI 1.14-2.86) *(Table 5).*

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Table 5: Factors associated with adherence to COVID-19 prevention guidelines

Characteristic		Adherent (n=107)	Non-adherent (n=946)	Adjusted OR (95% CI	*p*value
Region					
	Central	81 (14.7)	472 (85.4)	1	
	Eastern	11 (6.5)	158 (93.5)	0.47 (0.24 to 0.92)	**0.027**
	Northern	7 (4.0)	167 (96.0)	0.28 (0.12 to 0.63)	**0.002**
	Western	8 (5.1)	149 (94.9)	0.30 (0.14 to 0.65)	**0.002**
Age					
	18-34	59 (11.1)	471 (88.9)	1	
	35-54	38 (9.1)	381 (90.9)	0.75 (0.47 to 1.21)	0.235
	55-64	8 (11.0)	65 (89.0)	0.90 (0.39 to 2.07)	0.808
	65+	2 (6.4)	29 (93.6)	0.47 (0.11 to 2.13)	0.322
Gender					
	Female	50 (12.4)	352 (87.6)	1	
	Male	57 (8.8)	594 (91.2)	0.65 (0.42 to 0.99)	**0.047**
Household Size					
	<5	47 (12.6)	327 (87.4)	1	
	5 – 10	52 (8.9)	533 (91.1)	0.78 (0.50 to 1.23)	0.296
	>10	8 (8.5)	86 (91.5)	0.96 (0.41 to 2.22)	0.931
Monthly Income (USD)					
	≤ 13.7	18 (7.7)	217 (92.3)	1	
	13.7 – 27.4	13 (7.9)	152 (92.1)	0.98 (0.46 to 2.11)	0.968
	27.4 – 54.8	17 (8.6)	180 (91.4)	1.04 (0.51 to 2.13)	0.911
	54.8 – 137	33 (11.4)	256 (88.6)	1.49 (079 to 2.81)	0.216
	≥137	25 (16.4)	127 (83.6)	2.31 (1.16 to 4.58)	**0.017**
Reported history of chronic disease					
	No	71 (8.8)	733 (91.2)	1	
	Yes	36 (14.5)	213 (85.5)	1.81 (1.14 to 2.85)	**0.012**
Will be very sick if I get COVID-19					
	Strongly agree/Agree	77 (9.6)	723 (90.4)	1	
	Strongly disagree/Disagree	30 (11.9)	223 (88.1)	1.21 (0.76 to 1.93)	0.428
If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution					
	Strongly agree/Agree	33 (12.2)	237 (87.8)	1	
	Strongly disagree/Disagree	74 (9.4)	709 (90.6)	0.76 (0.48 to 1.21)	0.249

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Perception of efficacy and safety of COVID-19 vaccines

The majority (75.2%) indicated that getting the vaccine would make them feel less worried about contracting COVID-19. About 55.5% (584) were concerned about safety while 62.5% (658) had concerns about the efficacy of the COVID-19 vaccine.

Intention to take COVID-19 vaccine

Overall, 84.0% (887) participants responded reported that they were likely to get the SARS-CoV-2 vaccine if it became available t, while only 168 16.0% (168) responded no. Specifically, more than half 57.8% (609) responded "definitely yes" followed by "probably yes" 26.2% (276). Only 9.3% (98) responded "probably no" and 6.7% (70) "definitely no" . Major reasons for responding no to the vaccine included: worry about side effects (45.8%), little information about the vaccine (42.9%), perception that vaccine was designed to harm them (31.0%) and that vaccine may not not effective (30.9%) (Table 5)

Table 1: Reasons for not intending to take the COVID-19 vaccine

Attributes	Number of participants, n (%)
Reasons for not intending to take the COVID-19 vaccine (n=168)	
Vaccine not effective	52 (30.9)
COVID-19 does not exist	16 (9.5)
Vaccine designed to harm us	52 (31.0)
Scared of vaccine side effects	77 (45.8)
Body naturally strong to fight the virus	19 (11.3)
Have little information about vaccine	72 (42.9)
Already had COVID-19 so, immune	5 (3.0)
COVID-19 pandemic finished in the country	2 (1.2)
Others	13 (7.7)
No reason	2 (1.2)

Predictors of a definite intention to take a COVID-19 vaccine

After controlling for potential confounders including age, participants from northern (PR =1.24, 95% CI1.09 to 1.41) and western region (PR =1.36, 95% CI 1.20 to 1.54) respectively were more likely to have definite intention to take COVID-19 vaccine compared to those from the central region. Participants aged 55 to 64 were more likely to have a definite intention to take the vaccine compared to those aged 18 -34 years (PR = 1.20, 95%CI 1.01 to 1.43). Concern for being infected with COVID 19 (PR = 1.26, 95% CI 1.06 to1.48) and developing severe disease (PR = 1.20, 95%CI 1.04 to 1.38) were

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predictors of intention to get vaccinated. Those with concerns about the side effects of the vaccine were less likely to have a definite intention for vaccination (PR =0.75, 95% CI 0.68 to 0.83) (Table 6).

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Table 6: Factors associated with a definite intention to take a COVID-19 vaccine

Characteristic	Definitely Yes (n=609)	Probably yes/probably no/definitely no (n=444)	Adjusted PR (95% CI)	p-value
Region				
Central	292 (52.8)	261 (47.2)	1	
Eastern	94 (55.6)	75 (44.4)	1.05 (0.90 to 1.23)	0.508
Northern	114 (65.5)	60 (34.5)	1.24 (1.09 to 1.41)	**0.001**
Western	109 (69.4)	48 (30.6)	1.36 (1.20 to 1.54)	**<0.001**
Residence				
Rural	322 (59.1)	223 (40.9)		
Urban	287 (56.5)	221 (43.5)		
Age group				
18-34	284 (53.6)	246 (46.4)	1	
35-54	252 (60.1)	167 (39.9)	1.09 (0.98 to 1.22)	0.126
55-64	51 (69.9)	22 (30.1)	1.20 (1.01 to 1.43)	**0.047**
65+	22 (71.0)	9 (29.0)	1.25 (1.00 to 1.57)	**0.058**
Occupation				
Casual labourer	30 (53.6)	26 (46.4)	1	
Farmer	156 (60.0)	104 (40.0)	1.00 (0.77 to 1.31)	0.993
Formally Employed	109 (63.7)	62 (36.3)	1.12 (0.86 to 1.47)	0.394
Housewife	27 (45.8)	32 (54.2)	0.75 (0.52 to 1.08)	0.123
Self Employed	203 (55.2)	165 (44.8)	0.98 (0.76 to 1.28)	0.890
Unemployed	45 (68.2)	21 (21.8)	1.22(0.90 to 1.64)	0.200
Student	22 (47.8)	24(52.2)	0.92 (0.63 to 1.36)	0.695
Others	17 (63.0)	10 (37.0)	1.02 (0.69 to 1.53)	0.904
Perception of COVID-19 prevention measure				
Poor perception	53 (49.1)	55 (50.9)	1	
Good perception	556 (58.8)	389 (41.2)	1.14 (0.94 to 1.37)	0.191
Ever had experience with COVID-19				
No	450 (56.7)	344 (43.3)	1	
Yes	159 (61.4)	100 (38.6)	1.09 (0.97 to 1.22)	0.136
Reported history of chronic disease				
No	453 (56.3)	351 (43.7)	1	
Yes	156 (62.7)	93 (37.3)	1.09 (0.98 to 1.22)	0.124
Concerned about getting infected with COVID 19 in the future				
Strongly agree/Agree	514 (60.8)	332 (39.2)	1.26 (1.06 to 1.48)	**0.007**
Strongly disagree/Disagree	95 (45.9)	112 (54.1)	1	
Future changes before the vaccine are high				

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Strongly agree/Agree	474 (60.4)	311 (39.6)	1.12 (0.98 to 1.29)	0.097
Strongly Disagree/Disagree	135 (50.4)	133 (49.6)	1	
Will be very sick if I get COVID-19				
Strongly agree/Agree	489 (61.1)	311 (38.9)	1.20 (1.04 to 1.38)	**0.011**
Strongly disagree/Disagree	120 (47.4)	133 (52.6)	1	
Concerned about side effects of the COVID-19 Vaccine.				
Strongly disagree/Disagree	310 (66.1)	159 (33.9)	1	
Strongly agree/Agree	299 (51.2)	285 (48.8)	0.75 (0.68 to 0.83)	**<0.001**

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DISCUSSION

This study assessed reported the adherence to COVID-19 prevention measures and intention to take the COVID-19 vaccine in a large, national survey in Uganda. We found that adherence to all COVID-19 prevention guidelines was low despite high knowledge levels on COVID-19, and its prevention and high risk perceptions. Adherence to NPIs was higher among participants with high income and those with a reported history of chronic disease. More than half (57.8%) of the participants had definite intention to receive the COVID-19 vaccine and the definite intention was influenced by age of participants, region of residence, perceived susceptibility to COVID-19 and concerns about the safety of the vaccine.

In this study, 93.5% of the participants had high knowledge about COVID-19 and its prevention. This finding is not surprising because this study was conducted one year after the COVID-19 pandemic was confirmed in Uganda and hence most people had obtained basic information on the disease. The level of knowledge in this study is comparable to what was reported in an earlier study in Uganda [20], and other studies in China [26] and Vietnam[27] but higher than what was reported in Malaysia[28], Ethiopia [29], South Africa [30] and Bangladesh [31]. The observed discrepancies in knowledge about COVID-19 might be explained by the differences in the way the knowledge variable was ascertained across studies; the differences in study populations[32]; timing of the study period [33]; the level of information exchange; the sample size involved and methods of data collection. For instance, in Ethiopia, the study was conducted among health workers (HCWs) and observance of the preventive guidelines was based on a 3-point Likert scale and good compliance based on whether HCWs scored ≥75% or less[32]. Many of the studies which reported low knowledge were conducted in the early phase of the pandemic and knowledge would more likely have increased since then.

Our findings indicate a high level of perceived susceptibility to COVID-19 among participants implying that public enlightenment in terms of not underestimating the possibility of outbreak resurgence may have had an impact and should be continued until the disease is eliminated. High-risk perception plays a crucial role in influencing compliance with the public health and social measures for prevention of COVID-19 [34 35] and intention to receive vaccines [36 37]. Participants with higher COVID-19 risk perception showed higher intentions to receive the

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COVID-19 vaccine but few adopted all non-pharmaceutical preventive guidelines. Further studies are needed to understand why high-risk perception did not translate into the adoption of public health guidelines and consistent adherence.

Radio and television were the main and most trusted sources of information on COVID-19 among the population. This could, in part, be attributed to the fact that most information on COVID-19 by the president of Uganda and interactive communications by the Ministry of Health and partners was through mainly television and radio across the country hence making them popular. Radio and television ownership has also increased steadily in Uganda and most households have phones with radios which they use to access information on COVID-19. Our findings corroborate a previous Ugandan study among food vendors where radio and television emerged as major sources of information on COVID-19 [38] but contradicts another study that showed that friends and personal experiences were the major sources of information, with social media and radio ranking third among Ugandans in informal sectors[39]. The latter study was however conducted before the COVID-19 pandemic. Given the increased misinformation on COVID-19, accurate information and facts on COVID-19 should be aired more on radio and television since these remain the commonest and most trusted sources of COVID-19 information.

In this study, 71.7% of participants indicated the people in the community were using non-conventional approaches to prevent COVID-19. These approaches included using herbal remedies, steaming with local herbs, eating vegetables and fruits and physical exercises. These strategies are not scientifically proven tools to prevent COVID-19 and should be addressed through educational messaging. Similarly, a healthy diet is important for broader health benefits, but there is no evidence that diet alone is protective against COVID-19 infection and this should also be addressed in education messaging.

In this study, only 10.2% of the participants adhered to all COVID-19 preventive guidelines. Adherence to some measures was relatively high; for instance, 69.0% reported wearing face masks always when going out and 64.8% always washed hands with soap, but only 41.7% reported maintaining a social distance of 2 meters and 67% had been to a large gathering in the previous 14 days. The adherence level reported in our study is lower than that described in a previous study in Uganda [33]. Our findings suggest complacency in complying

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with MOH preventive measures. At the time of conducting this study, few confirmed cases and deaths of COVID-19 were being reported daily hence the public could have relaxed the observance of the measures with the belief that the disease was under control. This highlights the need to strengthen risk communication strategies and pillars responsible for COVID-19 response, to avoid possibilities of further resurgence. It's, therefore, important to strengthen enforcement of all COVID-19 preventive measures: physical distancing, hand hygiene and wearing masks, in order to control the pandemic and halt further viral transmission.

We also found that male participants had lower odds to adhere to all the COVID-19 guidelines than the females. A recent study in the United States indicated that women were more likely than men to follow guidelines outlined by medical experts to prevent the spread of COVID-19[40]. It's already known that men tend to have more challenges and less interest in taking up health behaviours [38]. Focused strategies should, therefore, be designed to encourage men to adhere to the guidelines. The level of adherence could be related to the occupations, where in many cases more men than women do outdoor jobs and socialize more in groups hence observance of the guidelines may be less seriously than men. We found that, unlike the Central region, participants from Northern, Eastern and Western regions had lower odds of adhering to all the preventive measures. The fact that approximately 55% of the COVID-19 cases at the time were registered in the central region could suggest a high-risk perception among participants in the central compared to other regions. Interventions targeting behaviour change should put special emphasis on these other regions to cover aspects of the risk perception.

Having a higher monthly income was related to higher odds of adhering to all the preventive guidelines. High incomes could be linked to higher education attainment which are important determinants of health. People with higher income can afford to procure masks and handwashing facilities and supplies for themselves making it easier to comply with all the preventive guidelines. A recent study on socioeconomic factors associated with self-protecting behaviour during the COVID-19 pandemic indicated that higher income influence the adoption of public health guidelines [41]. It was argued that adoption of the guidelines is a costly prospect, one that is easier for people with more income. People with low income

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should be prioritized when distributing free masks, hand hygiene supplies. More health education sessions are given to promote adherence to the recommended guidelines.

Further, we found that participants with a reported history of chronic disease were more likely to adhere to all the guidelines. It is not surprising that people with a history of chronic disease have better adherence because evidence indicates that they are at elevated risk of unfavourable outcomes such as severe disease and death [42] [43]. Campaigns to ensure sustained adherent behaviour among people with chronic illnesses are warranted and campaigns focused on those with no known chronic disease history should be intensified to raise risk perception among this group.

In this study, despite 84.0% expressing the intention to get vaccinated, only 57.8% had a definite intention to get vaccinated against COVID-19. Our findings are comparable to a study in China that found that 83.5% had the intention to get vaccinated against COVID-19 of which 30% had a definite intent [4] but contradicts with another study in Malaysia in which intention to get vaccinated against COVID-19 was higher (94.3%) of which, 48.2% had a higher definite intention[44]. A good comparison of vaccination intention levels between countries may not be ideal due to the limited evidence available as well as differences in access to vaccines in the countries. It has been suggested that for herd immunity to be attained for COVID-19, more than 70% of the population need to be vaccinated [45]. It's therefore important that health education is intensified to increase people's confidence in the vaccines so that they can get vaccinated as vaccines become available. Reported definite intention to take the vaccine was highest in Northern and Western regions. Sensitization to promote COVID-19 vaccine acceptance should be intensified in the Eastern and Central regions of Uganda.

We found that older people (at least 55 years) were more likely to have a definite intention to take the vaccine compared to young people (18-34 years). This could be related to the knowledge that vaccines could protect old people more since people in advanced age have a higher risk of getting severe COVID-19 than young people [46]. Strategies to promote definite intent to take the vaccine should be continued in old people but they should also be intensified in young people who may have a belief that they have a strong immune system to fight off the COVID-19 infection.

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Having concerns about the side effects of COVID-19 was associated with a low definite intention to take the vaccine. Our finding is consistent with that found in China in which concerns about side effects affected intention to take the vaccine[4]. Worries about side effects of the vaccine have been reported before whenever a new vaccine has been introduced [47]. It should be noted that although COVID-19 vaccination needs to be rolled out countrywide, the fears raised about the vaccine underscore the need to emphasize facts and accurate information to the public about the safety and efficacy of the vaccine to dispel any rumours or misinformation surrounding the COVID-19 vaccines. Addressing these issues will result in increased confidence and reduced hesitancy to take the vaccines.

Participants who had high perceived susceptibility to the disease and those who felt they would get severe disease if they got SARS-CoV-2 infection were significantly more likely to have definite intention to take the COVID-19 vaccine. One of the key drivers in people's vaccination decisions is the risk they associate with the disease the vaccine protects against [48]. Susceptibility perceptions are seen to be associated with emotional dimensions that often include fear and worry [49]. Previous studies have also indicated a predictive effect of perceived risk on vaccination intentions[50]. Its therefore important to keep emphasizing in health education and sensitization that COVID-19 is a real, dangerous and deadly disease so that people can take the vaccination seriously in addition to observing all the COVID-19 preventive guidelines.

The strengths of our study include a large, representative sample of Ugandan population across age, gender and location. Some methodological limitations in this study include social desirability bias which is generally higher with telephone interviews compared to face to face interviews[51]. Secondly, our outcomes based on self-reported report of behaviour (adherence and vaccine intention), there is possible social desirability bias, which would make participants to potentially over-report socially desirable behaviours and the voluntary nature of the survey allows selection bias to creep in. Thirdly, causal inference cannot be established with cross-sectional study designs. Despite these limitations, the study findings provide valuable information about the levels of adherence to recommended COVID-19 prevention guidelines and intention to take COVID-19 vaccines.

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Conclusions

The study findings indicate a low level of adherence to COVID-19 prevention guidelines despite high knowledge about COVID-19. Male participants and those hailing in east, west and northern regions had comparatively low while participants with reported chronic disease history and higher-income had reported adherence levels to public health and social measures. Our findings suggest that interventions to improve adherence to COVID-19 prevention guidelines should target males, low-income earners and people living in the northern, western, and western regions of Uganda more. Over half of the participants intended to receive the vaccine. Higher perceived risk and severity of COVID-19 infection had a strong and positive effect on vaccination intention while concerns about the safety of the vaccine negatively influenced vaccination intention. Efforts should be directed to the promotion of a high definite intention to get vaccinated against COVID-19 by addressing the fears of side effects and doubts about vaccine effectiveness to enhance confidence and increase vaccine uptake among the population.

Acknowledgments

We thank World Health Organization Africa Regional Office, WHO AFRO, for funding this study. We are equally thankful to Prof Jayne Byakika-Tusiime and Prof Rhoda Wanyenze for providing technical review and intellectual content to the study protocol and drafting of the manuscript. We thank Mr Innocent Komakech (WHO Uganda) for his administrative guidance during the design and impmentation of the study. We are also indepbted to the research assistants who collected good quality data as well as the study participants for sparing time to participate in the study.

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Declarations

Data availability statement

The data used for this study should be requested from the WHO Africa Regional Office.

Ethical considerations

Ethical approval was obtained from the Makerere University Higher Degrees Research and Ethics Committee (HDREC), reference number HDREC 926, and the Uganda National Council of Science and Technology (UNCST) reference number SS862ES. We obtained verbal informed consent from participants. Confidentiality was observed throughout the study.

Patient consent for publication Not available

Competing interests

The authors declare no competing interests.

Funding This work was funded by the World Health Organization Africa Regional Office, WHO AFRO.(Award Number: N/A)

Authors' Contributions

STW, JBT, and RKW conceptualized and designed the study. STW, IBM and JBT performed data analysis, interpretation and wrote the first draft of the manuscript. RKW, BS, SO, AC, MN, AT, RK and TB critically reviewed the analysis and the first manuscript draft. JBT, AT and RKW provided technical and intellectual content review for the manuscript. All authors have read and approved the final version of the manuscript.

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Supplementary file1: Understanding the drivers of non-adherence towards COVID19 preventive measures in Uganda

No	Question	Response options
Questionnaire identifiers		
A1	District	_____
A2	Region	1. North 2. East 3. Central 4. West
A3	Area of residence	1. Rural 2. Urban
Socio-Demographic characteristics (*Circle the response given)*		
B1	Sex of the respondent	a) Male b) Female
B2	Education status of the respondent **(Highest level attained)**	a) No formal education b) Primary c) Secondary d) Tertiary
B3	Current occupation	a) Unemployed/retiree/housewife b) Employed c) Self-employed d) Casual labourers e) Farmer f) Others
B4	How many people stay in your home, currently? *Write the whole number*	
Knowledge on COVID-19 and the preventive measures		
C1	What are some of the ways in which COVID-19 can be spread from one person to another	a) Touching one's soft parts (eyes, north, mouth) with contaminated hands. b) inhaling of infected droplets from from coughing, sneezing, laughing c) Physical contact with an infected person d) Others
C2	List some of the symptoms of COVID-19 that you know	a) High temperature/ fever b) Coughing c) Sneezing d) Difficulty in breathing e) Sore throat f) Loss of sense of smell and taste g) Others (specify) h) None of the above

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C3	Have you heard about how to prevent the COVID_19? (If the interviewee is unresponsive, the facilitator asks a clarification question: It is also called COVID-19; Have you heard of how to prevent it?)	a) Yes b) No
C4	What are your sources of information on COVID-19	a) Family member b) Health staff (including VHT) c) Phone (messages and calls) d) Radio e) Television f) Church / Mosque g) Community member/ village health Team Member. h) Social media (Facebook, WhatsApp, twitter) i) Internet j) Others (specify
C5	Of these, what is your most trusted source of information on COVID-19	a. Family member b. Health staff (including VHT) c. Phone (messages and calls) d. Radio e. Television f. Church / Mosque g. Community member/ village health Team Member. h. Social media (Facebook, WhatsApp, twitter) i. Internet j. Others (specify
C6	How can COVID-19 be prevented? (Mention all prevention measures that you know)	a) Wearing a face mask in public spaces b) Regular and thorough washing hands with soap and water or an alcohol-based rub c) Covering mouth and nose with bent blow or tissue when coughing and sneezing d) Clean and disinfect surfaces that are regularly touched e) Keep at least two-meter distance between self and others f) Avoiding crowded places g) Avoid touching eyes, nose, and mouth h) Staying home if you have symptoms such as headache, cough or mild fever i) Refrain from smoking and other activities that weaken the lungs. j) Avoid unnecessary travels

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C7	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus.	a) Yes b) No c) I don't know

COVID-19 percieved risk and severity, and perceptions on COVID-19 preventive guidelines.

D. Perception on COVID-19 preventive measures

	To what extent do you agree or disagree with the following statements?	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
D1	My family and I are worried of the likelihood of getting COVID-19					
D2	Future chances of getting COVID-19 ibefore the vaccine are high					
D3	I will be very sick if I get COVID-19					
D4	If I suffer from COVID-19 it means I cannot be infected again hence I don't need to take precautions					
D5	Wearing a mask in public is a good protective measure against COVID-19.					
D6	Keeping social distance of 2 meters apart and beyond is a good protective measure against COVID-19 for me and my community.					
D7	Frequent hand washing or using alcohol based hand sanitizer is a good protective measure against COVID-19.					
D8	Covering my mouth and nose with hand or elbow when I sneeze, cough can protect my community from COVID-19					
D9	If vaccines are available, they will make me feel less worried about about catching COVID-19					
D10	I am worried that the side effects of vaccine will affect my health					
D11	I am concerned about whether the COVID-19 vaccine actually works or not					

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E1	Apart from MOH guidelines, what other approaches are community members using to avoid getting infected with COVID-19	a) Use herbal medications e.g garlic, ginger b) Steaming using herbs c) Eating more fruits and vegetables d) Doing exercise e) Other a) None
E2	Have you ever had experience with COVID-19	a) Yes b) No
E3	Have ever been diagnosed with a disease that lasts for over year and require continuous medical support	a) Yes b) No
E4	Within the last 14 days, I have been to a large gathering (burials, community meetings, church, parties etc)	c) Yes d) No
E5	I maintain a distance of at least 2m when interacting with other people	a) Yes b) sometimes c) No
E6	I wear a mask every time I leave my home to a public place and when I have coughing or sneezing symptoms	a) Yes b) sometimes c) No
E7	I wash my hands with water and soap/ sanitise frequently (after touching any surface or shared object)	a) Yes b) Sometimes c) No
E8	Do you cover your mouth and nose with hand or elbow when you cough or sneeze?	a) Yes, always b) Yes, only when necessary/ occasionally (public places) c) No
E9	Do you intend to take COVID-19 vaccines if they become available?	1. Definitely, Yes 2. Probably yes 3. Probably No 4. Definitely No
E10	If No, what are the reasons	a) I don't think COVID-19 exists b) I think the vaccine is not effective c) I think the vaccine is designed to harm us d) I am scared of side-effects of the vaccine e) My body is naturally strong, I don't need a vaccine to fight COVID-19 f) I already had COVID-19, so I think I am immune to the disease g) The COVID-19 pandemic is finished in my country, no need for a vaccine now h) Have little information about the vaccine i) None of the above j) Other reasons (please specify
AA1	Age of the respondent Hint: ask for date of birth	…… (in complete years)

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AA2	On average how much money do you earn per month?	1. ≤ 50,000 2. 50,001 – 100,000 3. 100,001 – 200,000 4. 200,001 – 500,000 5. 500,001 – 1000,000 6. 1000,001 and above

Thank you alot for your time. We really appreciate

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Bivariate Results

Table S2.1. Factors associated non-adherence to COVID-19 prevention guidelines / protocols (bivariate Analysis)

Characteristics				
	Nonadherent (n=946)	adherent (n=107)	Un-adjusted PR (95% CI)	P-value
Demographics				
Region				
Central	81 (14.7)	472 (85.4)	1	
Eastern	11 (6.5)	158 (93.5)	0.41 (0.21 – 0.78	0.007
Northern	7 (4.0)	167 (96.0)	0.24 (0.11 – 0.54)	< 0.001
Western	8 (5.1)	149 (94.9)	0.31 (0.15 – 0.66)	0.002
Residence				
Rural	484 (88.8)	61 (11.2)	1	
Urban	462 (90.9)	46 (9.1)	0.79 (0.53 – 1.18)	0.252
Age				
18-34	59 (11.1)	471 (88.9)	1	
35-54	38 (9.1)	381 (90.9)	0.80 (0.52 – 1.22)	0.298
55-64	8 (11.0)	65 (89.0)	0.98 (0.45 – 2.14)	0.965
65+	2 (6.4)	29 (93.6)	0.55 (0.13 – 2.37)	0.422
Gender				
Female	50 (12.4)	352 (87.6)	1	
Male	57 (8.8)	594 (91.2)	0.68 (0.45 – 1.01)	0.056
Education				
No formal Education	71 (89.9)	8 (10.1)	1	
Primary	311 (90.1)	34 (9.9)	0.97 (0.43 – 2.19)	0.942
Secondary	345 (89.4)	41 (10.6)	1.05 (0.47 – 2.35)	0.896
Tertiary	219 (90.1)	24 (9.9)	0.97 (0.42 – 2.26)	0.949
Occupation				
Casual Labourer	49 (87.5)	7 (12.5)	1	
Farmer	237 (91.2)	23 (8.9)	0.68 (0.28 – 1.67)	0.400
Formally Employed	156 (91.3)	15 (8.8)	0.67 (0.26 – 1.75)	0.415
House Wife	55 (93.2)	4 (6.8)	0.51 (0.14 – 1.84)	0.304
Self Employed	323 (87.8)	45 (12.2)	0.98 (0.42 – 2.28)	0.954
Unemployed	59 (89.4)	7 (10.6)	0.83 (0.27 – 2.53)	0.744
Student	43 (93.5)	3 (6.5)	0.49 (0.12 – 2.01)	0.320
Others	24 (88.9)	3 (11.1)	0.88 (0.21 – 3.69)	0.856
Household Size				
<5	47 (12.6)	327 (87.4)	1	
5 – 10	52 (8.9)	533 (91.1)	0.68 (0.45 – 1.03)	
>10	8 (8.5)	86 (91.5)	0.65 (0.29 – 1.42)	
Monthly Income (USD)				
≤ 13.7	18 (7.7)	217 (92.3)	1	
13.7 – 27.4	13 (7.9)	152 (92.1)	1.03 (0.49 – 2.17)	0.936
27.4 – 54.8	17 (8.6)	180 (91.4)	1.14 (0.57 – 2.27)	0.713
54.8 – 137	33 (11.4)	256 (88.6)	1.55 (0.85 – 2.83)	0.151
≥137	25 (16.4)	127 (83.6)	2.37 (1.24 – 4.52)	0.09
COVID-19 Knowledge Level				

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Low	61(88.4)	8 (11.6)	1	
High	885 (89.9)	99 (10.1)	0.85 (0.40 – 1.83)	0.684
Perception of COVID-19 prevention measure				
Poor perception	100 (92.6)	8 (7.4)	1	
Good perception	846 (89.5)	99 (10.5)	1.46 (0.69 – 3.10)	0.320
Ever had experience with COVID-19				
No	712 (89.7)	82 (10.3)	1	
Yes	234 (90.4)	25 (9.7)	0.93 (0.58 – 1.49)	0.755
Reported history of chronic disease				
No	733 (91.2)	71 (8.8)	1	
Yes	213 (85.5)	36 (14.5)	1.74 (1.14 – 2.68)	0.010
Worry about the likelihood of getting COVID-19				
Strongly agree/Agree	763 (90.2)	83 (9.8)	1	
Strongly disagree/Disagree	183 (88.4)	24 (11.6)	1.21 (0.74 – 1.95)	0.447
Future chances before the vaccine are high				
Strongly agree/Agree	707 (90.1)	78 (9.9)	1	
Strongly Disagree/Disagree	239 (89.2)	29 (10.8)	1.10 (0.70 – 1.73)	0.679
Will be very sick if I get COVID-19				
Strongly agree/Agree	77 (9.6)	723 (90.4)	1	
Strongly disagree/Disagree	30 (11.9)	223 (88.1)	1.26 (0.81 – 1.98)	0.306
If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution				
Strongly agree/Agree	33 (12.2)	237 (87.8)	1	
Strongly disagree/Disagree	74 (9.4)	709 (90.6)	0.75 (0.48 – 1.16)	0.195

Table S2.2: Factors associated with a definite intention to take a COVID-19 vaccine ((bivariate Analysis)

Characteristics				
	Definitely Yes (n=609)	**Probably yes/Probably no/Definitely no (n=444)**	**Un-adjusted PR (95% CI)**	**P-value**
Demographics				
Region				
Central	292 (52.8)	261 (47.2)	1	
Eastern	94 (55.6)	75 (44.4)	1.05 (0.90-1.23)	0.514
Northern	114 (65.5)	60 (34.5)	1.24 (1.09-1.42)	0.002
Western	109 (69.4)	48 (30.6)	1.31 (1.15-1.50)	<0.001
Residence				

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Rural	322 (59.1)	223 (40.9)	1	
Urban	287 (56.5)	221 (43.5)	0.96 (0.86-1.06)	0.397
Age				
18-34	284 (53.6)	246 (46.4)	1	
35-54	252 (60.1)	167 (39.9)	1.12 (1.01-1.25)	0.042
55-64	51 (69.9)	22 (30.1)	1.30 (1.10-1.55)	0.002
65+	22 (71.0)	9 (29.0)	1.32 (1.04-1.68)	0.021
Gender				
Female	238 (59.2)	164 (40.8)	1	
Male	371 (57.0)	280 (43.0)	0.96 (0.87-1.07)	0.477
Education				
No formal Education	47 (59.5)	32 (40.5)	1	
Primary	198 (57.4)	147 (42.6)	0.96 (0.79-1.18)	0.729
Secondary	220 (57.0)	166 (43.0)	0.96 (0.78-1.17)	0.677
Tertiary	144 (59.3)	99 (40.7)	1.00 (0.81-1.23)	0.971
Occupation				
Casual Labourer	30 (53.6)	26 (46.4)	1	
Farmer	156 (60.0)	104 (40.0)	1.12(0.86-1.46)	0.399
Formally Employed	109 (63.7)	62 (36.3)	1.19 (0.91-1.56)	0.205
House Wife	27 (45.8)	32 (54.2)	0.85 (0.59-1.24)	0.404
Self Employed	203 (55.2)	165 (44.8)	1.03 (0.79-1.34)	0.826
Unemployed	45 (68.2)	21 (21.8)	1.27 (0.95-1.71)	0.108
Student	22 (47.8)	24(52.2)	0.89 (0.61-1.32)	0.567
Others	17 (63.0)	10 (37.0)	1.18 (0.80-1.72)	0.403
COVID-19 Knowledge Level				
Low	37 (53.6)	32 (46.4)	1	
High	572 (58.1)	412 (41.9)	1.08 (0.86-1.36)	0.484
Perception of COVID-19 prevention measure				
Poor perception	53 (49.1)	55 (50.9)	1	
Good perception	556 (58.8)	389 (41.2)	1.20 (0.98-1.46)	0.075
Ever had experience with COVID-19				
No	450 (56.7)	344 (43.3)	1	
Yes	159 (61.4)	100 (38.6)	1.08 (0.97-1.21)	0.170
Ever diagnosed with chronic disease				
No	453 (56.3)	351 (43.7)	1	
Yes	156 (62.7)	93 (37.3)	1.11 (0.99-1.25)	0.067
Worry about the likelihood of getting COVID-19				
Strongly agree/Agree	514 (60.8)	332 (39.2)	1.32 (1.13-1.55)	<0.001
Strongly disagree/Disagree	95 (45.9)	112 (54.1)	1	
Future chances before the vaccine are high				

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Strongly agree/Agree	474 (60.4)	311 (39.6)	1.20 (1.05-1.37)	0.007
Strongly Disagree/Disagree	135 (50.4)	133 (49.6)	1	
Will be very sick if I get COVID-19				
Strongly agree/Agree	489 (61.1)	311 (38.9)	1.29 (1.12-1.48)	<0.001
Strongly disagree/Disagree	120 (47.4)	133 (52.6)	1	
If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution				
Strongly agree/Agree	154 (57.0)	116 (43.0)	0.98 (0.87-1.11)	0.760
Strongly disagree/Disagree	455 (58.1)	328 (41.9)	1	
Concerned about the side effects of the COVID-19				
Strongly disagree/Disagree	310 (66.1)	159 (33.9)	1	
Strongly agree/Agree	299 (51.2)	285 (48.8)	0.77 (0.70 – 0.86)	< 0.001
Concerned about the efficacy of the COVID-19 vaccines				
Strongly disagree/Disagree	231 (58.5)	164 (41.5)	1	
Strongly agree/Agree	378 (57.5)	280 (42.5)	0.98 (0.88 – 1.09)	0.742

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Intention to vaccinate against COVID-19 and adherence to non-pharmaceutical interventions against COVID-19 prior to the second wave of the pandemic in Uganda: a cross sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-057322.R2
Article Type:	Original research
Date Submitted by the Author:	09-May-2022
Complete List of Authors:	Wafula, Solomon; Makerere University College of Health Sciences, Department of Disease Control and Environmental Health Mugume, Innocent; Makerere University College of Health Sciences, Disease Control and Environmental Health Sensasi, Benjamin; World Health Organization Country Office for Uganda Okware, Solome; World Health Organization Country Office for Uganda Chimbaru, Alexander; World Health Organisation Sierra Leone Country Office Nanyunja, Miriam; World Health Organisation, Uganda Country Office, Disease Prevention Talisuna, Ambrose; Organisation mondiale de la Sante pour Afrique, Health Emergecy Programme; World Health Organisation, WHE Programme Kabanda, Richard ; Republic of Uganda Ministry of Health Bakyaita, Tabley; Republic of Uganda Ministry of Health Wanyenze, Rhoda K; Makerere University, School of Public Health Byakika-Tusiime, Jayne; World Health Organization Country Office for Uganda
Primary Subject Heading:	Global health
Secondary Subject Heading:	Infectious diseases, Epidemiology, Global health
Keywords:	COVID-19, Public health < INFECTIOUS DISEASES, EPIDEMIOLOGY

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Original Research
BMJ Open

Intention to vaccinate against COVID-19 and adherence to non-pharmaceutical interventions against COVID-19 prior to the second wave of the pandemic in Uganda: a cross-sectional study

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Abstract

Objectives Resurgences in cases and deaths due to COVID-19 in many countries suggest complacency in adhering to COVID-19 prevention guidelines. Vaccination, therefore, remains a key intervention in mitigating the impact of the COVID-19 pandemic. This study investigated the level of adherence to COVID-19 preventive measures and intention to receive the COVID-19 vaccine among Ugandans.

Design, setting and participants A nationwide cross-sectional survey of 1,053 Ugandan adults was conducted in March 2021 using telephone interviews.

Main outcomes measures : Participants reported on adherence to COVID-19 prevention measures and intention to be vaccinated with COVID-19 vaccines.

Results Overall, 10.2% of the respondents adhered to the COVID-19 prevention guidelines and 57.8% stated definite intention to receive a SARS-CoV-2 vaccine. Compared to females, males were less likely to adhere to COVID-19 guidelines (OR = 0.64, 95% CI 0.41 to 0.99). Participants from the northern (4.0%, OR =0.28, 95%CI 0.12 to 0.92), western (5.1%, OR = 0.30, 95% CI 0.14 to 0.65, and eastern regions (6.5%, OR=0.47, 95% CI 0.24 to 0.92) respectively had lower odds to adhere to the COVID-19 guidelines than those from the central region (14.7%) . A higher monthly income of ≥ USD 137 (OR= 2.31, 95%CI 1.14 to 4.58) and a history of chronic disease (OR=1.81, 95% CI 1.14 to 2.86) were predictors of adherence. Concerns about the chances of getting COVID-19 in the future (PR = 1.26, 95% CI 1.06 to1.48) and fear of severe COVID-19 infection (PR = 1.20, 95% CI 1.04 to1.38) were the strongest predictors for a definite intention while concerns of side effects were negatively associated with vaccination intent (PR = 0.75, 95% CI 0.68 to 0.83).

Conclusion Behaviour change programs need to be strengthened to promote adherence to COVID-19 prevention guidelines as vaccination is rolled out as another preventive measure. Dissemination of accurate safety and efficacy information about the vaccines is necessary to enhance vaccine uptake.

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Strengths and limitations of this study

- The study assessed the level of adherence to COVID-19 guidelines and intention to receive vaccination using a relatively large sample of adult Ugandan population with representation across different ages, gender and location hence making generalization possible.
- Strict operational definition of adherence to non phamacuetical measures (NPIs) against COVID-19 where all participants needed to always observe all the specific NPIs to be considered adherent.
- There is, however, the limitation of social desirability bias which is more common with telephone interviews than the face to face interviews and this may result in overestimation of reported adherence and vaccination intent
- Causal inference between adherence and vaccination intent with other predictors cannot be established because the cross-sectional study design applied in this survey is not optimal for causal inference.
- Participation in the study was voluntary and thus self-selection bias is possible and can affect the results.

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INTRODUCTION

The incidence of (severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection, has increased dramatically worldwide since December 2019, when the first case was detected among humans in Wuhan, Hubei Province, China [1]. As of 6th May 2022, over 513 million people had been infected with SARS-CoV 2 and about 6.2 million people were reported dead. In Africa, over 8.8 million people had been infected and of these, 116,100 had died [2]. Uganda confirmed its first coronavirus disease 2019 (COVID-19) case on 21 March 2020. As of 6th May 2022, Uganda had registered 164,118 COVID-19 cases and 3,598 deaths (Case Fatality Rate (CFR)=2.19%). At the start of the pandemic, countries struggled to contain COVID-19 spread and instituted several preventive and control measures including travel restrictions, geographical lockdowns, quarantine as well as enforcement of public health guidelines such as hand hygiene, use

of face masks, and social distancing [3] [4]. These measures were taken to prevent transmission of the virus as well as flatten the curve. The measures helped countries to contain COVID-19 for some time. However, the resurgences in many countries were evidence that adherence to the measures had waned in the population and adherence to COVID-19 public health measures alone could not contain COVID-19 transmission [5].

One key strategy to stop the escalation of the COVID-19 pandemic was to develop and administer effective vaccines to the people. Towards the end of 2020, several vaccines against COVID-19 became available for public use including Pfizer/BioNTech, AstraZeneca-SK Bio, Janssen, Sinovac and Moderna vaccines which have since been given Emergency Use Listing approval by WHO [6]. Currently, vaccination against COVID-19 is ongoing in all high-income countries (HICs) as well as in most low-and middle-income countries (LMICs). In Uganda, as of February 2021, the National Drug Authority (NDA) approved the AstraZeneca vaccine and the vaccination was launched in March 2021 amidst reports of side effects such as dizziness, headache, weakness, fever, blood clots and even death in several countries[7].

Widespread vaccination with high coverage of the eligible population is important in containing the COVID-19 pandemic [8]. However, the availability of vaccines does not guarantee uptake as previous studies have highlighted [9-12]. Concerns for not intending to take COVID-19 vaccines have been premised around worries about the newness and the speed at which vaccines were developed, safety as well as potential side effects [4] [13]. Some studies in sub-Saharan Africa (SSA) have shown low levels of vaccine acceptance [14] [15]. Such low acceptance levels could be attributed to an increasing infodemic of false information and rumours that make it difficult to find credible sources of information. Further, the low incident cases reported prior to the resurgence could lead to a low-risk perception among members of the public, thus contributing to hesitancy to get vaccinated. Given the high level of vaccine hesitancy reported at the global level and emerging concerns within communities in LMIC, assessing vaccine acceptance at the national level is essential [16].

Besides vaccines, large scale implementation of non-pharmaceutical interventions remains critical in COVID-19 prevention. This is especially crucial in the early phases of vaccination rollout before the attainment of herd immunity. It is also very important for vaccinated individuals to maintain adherence to these interventions since the full protective effect of the vaccine for individuals is attained after about two weeks of full

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vaccination[17 18] and there is a possibility of breakthrough infections[19]. However, evidence from SSA has indicated only moderate adherence to these public health measures. In Uganda, adherence to the COVID 19 measures was initially high[20] but the resurgence of infections suggests complacency in adhering to these measures fuelled by the low-risk perception among the population. Regarding vaccination, there is limited data on acceptance and intention to receive the COVID-19 vaccine in Uganda. In this study, we sought to investigate the level of adherence to COVID-19 preventive measures and intention to receive COVID-19 vaccine among Ugandans to inform decisions about the enhancement of both vaccine uptake and other public health measures.

METHODS

Study design and population

This study was part of a multi-country knowledge, attitudes and practices survey to understand the drivers of non-adherence towards COVID-19 preventive measures in eastern and southern Africa using computer-assisted telephone interviews. A total of 1053 adults were interviewed from 60 districts distributed in the four regions of Uganda (Central, Eastern, Northern and Western) in March 2021. Random selection of participants was done based on quotas set on age, gender and location proportionate to national COVID-19 case distribution statistics at the time of the study. We included adults 18 years and older with access to cell phones and who had been residents in the study district for at least six months. Persons who were unable to communicate or declined to participate were excluded from the study.

Sample size and sampling

The sample size of 1070 was determined using the Kish Leslie formula for cross-sectional studies[21] with the following assumptions, Two-sided Z statistic corresponding to a 95% confidence interval (1.96), adherence level of 50% since no prior studies had measured the adherence to NPIs in the manner we planned to measure. We considered a 5% margin of error and a design effect of 2.5 to cater for the potential clustering of participants by region. We also considered a non-response rate of 10%.

Regarding sampling, quotas were set on age, gender and location (region) proportionate to national COVID-19 case distribution statistics at the time. A recent analysis of the COVID-19 cases had shown the following distributions (proportions) per quota [22] as shown in table 1

- Age distribution as follows: 18-35 (51%), 36-55 (37%), 56-65 (8%), 65+ (4%)

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- Gender: the data show that males were ~60% and women ~40%
- Location: Central: 55%, Eastern/Western/Northern each 15%

Table 1 below shows the distribution based on the above distribution

Regions	Gender	Age distribution			
		18-35 (51%)	36-55 (37%)	56 -65 (8%)	65+ (4%)
Northern (n = 162)	Female (n = 65)	33	24	5	3
	Male (n = 97)	49	36	8	4
Eastern (n = 162)	Female (n = 65)	33	24	5	3
	Male (n = 97)	49	36	8	4
Central (n = 583)	Female (n = 233)	118	86	19	10
	Male (350)	178	130	28	14
Western (n = 162)	Female (n = 65)	33	24	5	3
	Male (n = 97)	49	36	8	4

With these quotas in place, we used an excel contact database and a computer-assisted program to randomly sample specific participants per each quota. This probability sampling approach allowed for all individuals in the population of interest to have a relatively equal chance of being selected for the survey.

Data collection

Data were collected through telephone interviews using a WHO survey tool for COVID-19 [23] and this was pretested before actual data collection to address any ambiguities. The questionnaire captured data on socio-demographic characteristics, knowledge and perceptions of COVD-19 prevention measures and uptake of COVID-19 prevention measures. In addition, data on perceptions of safety and efficacy of the available COVID 19 vaccines and intention to take the COVID-19 vaccine were collected.

Knowledge of COVID-19 was assessed by dichotomizing a knowledge score based on blooms cutoff[24]using four questions. Each correct response was given 1 point and the wrong answer was given 0. Providing 4 correct responses to the 4 questions meant good knowledge otherwise poor knowledge. Perceptions on the relevance of COVID-19 prevention measures were assessed on a Likert scale with four questions. Each of these was dichotomized with strongly agree/agree coded 1 while not sure disagree or strongly agree coded 0. Responding appropriately to 3 of the four perception questions was considered satisfactory otherwise unsatisfactory.

Questions on how participants adhered to five COVID-19 guidelines were assessed with options: “always”, “sometimes” and “never”. The five questions were based on guidelines

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including mass gathering, physical distancing, mask-wearing, respiratory etiquette and hand hygiene.

Perception about the safety and efficacy of COVID-19 vaccines were measured on a Likert scale with the options: 'strongly agree', 'agree', 'not sure', 'disagree' or 'strongly disagree'.

Intention to take the COVID-19 vaccine was measured using a one-item question "If a vaccine against COVID-19 becomes available, would you take it?" whose response was categorized as "Definitely yes", "Probably yes", "Probably no" and "Definitely No". This was later dichotomized to Definitely yes (coded 1) otherwise No (coded 0). Data was collected on covariates such as participant age, gender, level of education, income, and occupation were obtained. Perceived risk of COVID-19 as well as perceptions on the safety and efficacy of the COVID-19 vaccine.

The questionnaire was translated into eight local languages spoken in Uganda (*Luganda, Lusoga, Lunyakitara, Lugbara, Luo, Lugishu, Ateso, Ngakarimojong)*, and then programmed and uploaded to the Kobo Collect software installed on a tablet computer used for data collection. The full English questionnaire is available as supplementary file-1

Statistical analysis

Data were analyzed using Stata version 16 (StataCorp, Texas, US). Categorical data were summarized using frequencies and percentages and continuous data using the median and interquartile range. Our primary definition for adherence was compliance with all personal public health and social measures for the prevention of COVID-19 as guided by WHO [25] including frequent hand hygiene, physical distancing, respiratory etiquette, proper use of masks and avoidance of mass gatherings. We developed a composite variable for adherence to COVID-19 prevention guidelines consisting of five variables which were coded 0, 1 and 2 to represent no adherence, adhere sometimes and always adhere respectively. We obtained a total score by adding the responses from the five questions and trichotomized the composite adherence variable, with those with a score of 10/10 considered to have good adherence, 8-9 out of 10 to have fair adherence and those scoring 7 and below as having poor adherence. We dichotomized adherence with code "1" for good adherence (score 10/10) and code "0" for fair /poor adherence (score 0-9) before running regressions.

We conducted a multivariable logistic regression analysis with the dichotomous composite adherence score as the outcome, adjusting for age and gender at a 5% level of significance. We also performed a modified Poisson regression analysis to assess the

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predictors of definite intention to receive the COVID-19 vaccine. For this analysis, vaccination intention was dichotomized into “Definitely yes” and “Probably yes /Probably no /Definitely No”[4]. A modified Poisson regression was preferred instead of logistic regression to avoid overestimating relative risk since vaccine intention was high (prevalence > 10%) and to ensure robust standard errors[26]. Before running the multivariable regressions, we separately ran several simple regressions consisting of the outcome (Adherence or Vaccination intent) and a single predictor at a time (supplementary file **2**). Variables that had p values ≤0.2 in these simple bivariate models were considered in the final model building. Statistical significance was considered if variables had a p-value ≤ 0.05.

Patient and public involvement.

No patients or the public were involved in the study design, setting the research questions, interpretation or writing up of results, or reporting of the research.

RESULTS

Sociodemographic characteristics of participants

Of the 1,070 individuals engaged to take part in the study, 1,053 (98.4%) agreed to participate in the study and were included in the analysis. The median age of participants [IQR] was 34 [18 – 80]. Six hundred fifty-one (61.8%) of the respondents were male and a half (50.3%) of the participants were aged between 18 and 34 years. Six hundred twenty-nine (59.8%) had attained secondary education as the highest level of education, 368 (35.0%) were self-employed and 235 (22.6%) earned USD 13.7 or less per month. Additional descriptive data are provided in Table 2.

Table 2. Sociodemographic characteristics of study participants

Characteristics	Frequency, n (%)
Age (Median [IQR] = 34 [18 - 80]),	

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18 – 34	530 (50.3)
35 – 54	419 (39.8)
55 – 64	73 (6.9)
65+	31 (2.9)
Gender	
Male	651 (61.8)
Female	402 (38.2)
Residence	
Rural	545 (51.8)
Urban	508 (48.2)
Education	
No formal Education	79 (7.5)
Primary	345 (32.8)
Secondary	386 (36.7)
Tertiary	243 (23.1)
Occupation	
Casual labourer	56 (5.3)
Farmer	260 (24.7)
Formally employed	171 (16.2)
Housewife	59 (5.6)
Self Employed	368 (35.0)
Unemployed	66 (6.3)
Student	46 (4.4)
Others	27 (2.6)
Monthly Income (USD 1= UGX 3650)	
≤ 13.7	235 (22.6)
13.7 – 27.4	165 (15.9)
27.4 – 54.8	197 (19.0)
54.8 – 137.0	289 (27.8)
137.0 – 274.0	98 (9.4)
≥ 274.0	54 (5.2)
Household size (median [IQR] = 5 [1 - 20])	
< 5	374 (35.5)
5 – 10	585 (55.6)
>10	94 (8.9)
History of COVID-19 among self or close relatives or friends	
No	794 (75.4)
Yes	259 (24.6)
Reported history of chronic disease (Cardiovascular disease, diabetes, HIV/AIDS, hypertension etc.)	
No	804 (76.4)
Yes	249 (23.6)

Knowledge about COVID-19 and sources of information

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When asked how COVID-19 spreads, most participants stated physical contact with infected persons (74.6%) and inhalation of infected droplets (70.0%). The major symptoms mentioned included: sneezing (78.9%), coughing (77.9%) and fever (71.7%). Nearly all (99.1%) participants knew that COVID-19 could be prevented. When asked about the COVID-19 prevention measures they knew, most mentioned mask wearing (94.8%) and washing hands with soap and water or using alcohol hand rub or sanitiser (90.3%) while only half (51.6%) mentioned social distancing. The most trusted sources of information were radio (45.3%) and television (28.9%). Overall, 93.5% of the participants were considered to have high knowledge of COVID-19

COVID-19 risk and severity perception

Participants had a high perception of susceptibility to COVID-19. Majority (80.3%) were worried about getting COVID-19 in the next few months and 685 (74.5%) agreed that the possibility of contracting COVID-19 was high if they didn't get vaccinated. Eight hundred participants (76.0%) felt that if they got a COVID-19 infection, it would be severe. Two hundred seventy (25.6%) believed that they would gain lifelong immunity if they suffered from COVID-19 hence, find no urgent need to take precautions. About the relevance of each of the COVID-19 preventive measures, 97.2% (1024), 94.9% (999) and 98.2% (1034) agreed that masking, physical distancing and hand hygiene respectively were critical for preventing COVID-19. Overall, 89.7% had a positive perception of the preventive measures for COVID-19 *(Table 3).*

Table 3. Participants' risk and disease severity perception about COVID-19 and its prevention measures

Attributes	Strongly agree / Agree	Strongly disagree / Disagree / not sure
Risk and disease severity perception		
▪ Worry about the likelihood of getting COVID-19	846 (80.3)	207 (19.7)
▪ Chance of being infected with COVID 19 is high before access to vaccination	785 (74.5)	268 (25.5)
▪ Will be very sick if I get COVID-19	800 (76.0)	253 (24.0)
▪ If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precautions	270 (25.6)	783 (74.4)
Perception of prevention measures		
▪ Wearing a mask in public is a good protective		

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measure against COVID-19	1024 (97.2)	29 (2.8)
▪ Keeping a physical distance of at least 2 meters is good protective measures against COVID-19	999 (94.9)	54 (5.1)
▪ Frequent hand washing or using ABH sanitiser is a good protective measure against COVID-19	1034 (98.2)	19 (1.8)
▪ Covering mouth and nose with a hand elbow when sneezing or coughing can protect the community from COVID-19	996 (94.6)	57 (5.4)

Uptake of COVID-19 prevention measures

Sixty-seven per cent of participants had been to a large gathering in the preceding 14 days. Regarding observance of the prevention measures, a physical distancing of at least 2 meters was reportedly observed by 88.9% (928); 47.2% all the time and 41.7% sometimes while masking was observed by 97.3% (831); 69.0% always and 28.3% sometimes. Overall, 10.2% were considered to have good adherence to the COVID-19 prevention guidelines while 89.8% (946) were non-adherent. Participants were asked about the non-conventional approaches that members of their communities used to prevent COVID-19 infection. Four hundred forty-nine (42.6%) reported that their communities were using herbal remedies, 40.0% (421) were eating fruits and vegetables and 13.8% (145) reported steaming using local herbs *(Table 4)*.

Table 4: Uptake of COVID-19 prevention measures.

COVID-19 prevention measures	Frequency, n (%)
Been to a large gathering in the last 14 days*	
Yes	710 (67.4)
No	343 (32.6)
Maintain at least a 2-meter distance when interacting with other people*	
Yes	439 (41.7)
No	117 (11.1)
Sometimes	497 (47.2)
Wear a mask in public and when coughing and sneezing*	
Yes	727 (69.0)
No	28 (2.7)
Sometimes	298 (28.3)
Wash my hand with water and soap and sanitize regularly*	
Yes	682 (64.8)
No	21 (2.0)

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Sometimes	350 (33.2)
Cover mouth and nose with hand, elbow or handkerchief when coughing or sneezing*	
Yes Always	693 (65.8)
Yes, only when necessary	335 (31.8)
No	25 (2.4)
Adherence levels to COVID-19 preventive measures	
Adherence (10/10 practice score)	107 (10.2)
Non-Adherence (<10 practice score)	946 (89.8)
Non-conventional community prevention strategies against COVID -19	
Use of herbal remedies like garlic, ginger	449 (42.6)
Eating fruits and vegetables	421 (40.0)
Steaming using local herbs	145 (13.8)
Physical exercise	82 (7.8)
Others include drinking alcohol, sunbathing, not admitting strangers, etc.	208 (19.8)
Nothing	298 (28.3)

Note: Variables with * were used to calculate a composite COVID-19 prevention practice score

3.5. Factors associated with adherence to COVD-19 prevention guidelines

Bivariable analysis found significant associations between adherence with region, chronic disease history and monthly income (supplementary file2). Using multivariable regression, we found the odds of adherence to preventive guidelines were lowest for participants in Western (aOR= 0.30, 95%CI 0.14 -0.65), Northern (aOR= 0.28, 95%CI 0.12-0.92), and Eastern regions (aOR= 0.47, 95%CI 0.24-0.92) compared to the central region. Male respondents had 35% lower odds to adhere to COVID-19 guidelines than their female counterparts (aOR= 0.65, 95%CI 0.41 – 0.99). Higher monthly income was associated with higher adherence to COVID-19 preventive guidelines; those who earned USD ≥ USD 274 (OR= 2.31, 95%CI 1.14 – 4.58) had higher odds to adhere to all COVID-19 guidelines than those who earned ≤ USD 13.7.

The odds of adherence to guidelines were higher in participants that reported a history of chronic illness compared to those with no reported history of chronic illness (aOR=1.81, 95%CI 1.14-2.86) *(Table 5).*

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Table 5: Factors associated with adherence to COVID-19 prevention guidelines

Characteristic		Adherent (n=107)	Non-adherent (n=946)	Adjusted OR (95% CI	*p*value
Region					
	Central	81 (14.7)	472 (85.4)	1	
	Eastern	11 (6.5)	158 (93.5)	0.47 (0.24 to 0.92)	**0.027**
	Northern	7 (4.0)	167 (96.0)	0.28 (0.12 to 0.63)	**0.002**
	Western	8 (5.1)	149 (94.9)	0.30 (0.14 to 0.65)	**0.002**
Age					
	18-34	59 (11.1)	471 (88.9)	1	
	35-54	38 (9.1)	381 (90.9)	0.75 (0.47 to 1.21)	0.235
	55-64	8 (11.0)	65 (89.0)	0.90 (0.39 to 2.07)	0.808
	65+	2 (6.4)	29 (93.6)	0.47 (0.11 to 2.13)	0.322
Gender					
	Female	50 (12.4)	352 (87.6)	1	
	Male	57 (8.8)	594 (91.2)	0.65 (0.42 to 0.99)	**0.047**
Household Size					
	<5	47 (12.6)	327 (87.4)	1	
	5 – 10	52 (8.9)	533 (91.1)	0.78 (0.50 to 1.23)	0.296
	>10	8 (8.5)	86 (91.5)	0.96 (0.41 to 2.22)	0.931
Monthly Income (USD)					
	≤ 13.7	18 (7.7)	217 (92.3)	1	
	13.7 – 27.4	13 (7.9)	152 (92.1)	0.98 (0.46 to 2.11)	0.968
	27.4 – 54.8	17 (8.6)	180 (91.4)	1.04 (0.51 to 2.13)	0.911
	54.8 – 137	33 (11.4)	256 (88.6)	1.49 (079 to 2.81)	0.216
	≥137	25 (16.4)	127 (83.6)	2.31 (1.16 to 4.58)	**0.017**
Reported history of chronic disease					
	No	71 (8.8)	733 (91.2)	1	
	Yes	36 (14.5)	213 (85.5)	1.81 (1.14 to 2.85)	**0.012**
Will be very sick if I get COVID-19					
	Strongly agree/Agree	77 (9.6)	723 (90.4)	1	
	Strongly disagree/Disagree	30 (11.9)	223 (88.1)	1.21 (0.76 to 1.93)	0.428
If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precautions					
	Strongly agree/Agree	33 (12.2)	237 (87.8)	1	
	Strongly disagree/Disagree	74 (9.4)	709 (90.6)	0.76 (0.48 to 1.21)	0.249

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Perception of efficacy and safety of COVID-19 vaccines

The majority (75.2%) indicated that getting the vaccine would make them feel less worried about contracting COVID-19. About 55.5% (584) were concerned about safety while 62.5% (658) had concerns about the efficacy of the COVID-19 vaccine.

Intention to take COVID-19 vaccine

Overall, 84.0% (887) participants reported that they were likely to get the SARS-CoV-2 vaccine if it became available, while only 168 16.0% (168) responded no. Specifically, more than half 57.8% (609) responded “definitely yes” followed by “probably yes” 26.2% (276). Only 9.3% (98) responded “probably no” and 6.7% (70) “definitely no”. Major reasons for responding no to the vaccine included: worry about side effects (45.8%), little information about the vaccine (42.9%), the perception that vaccine was designed to harm them (31.0%) and that vaccine may not be efficacious (30.9%) (Table 5)

Table 1: Reasons for not intending to take the COVID-19 vaccine

Attributes	Number of participants, n (%)
Reasons for not intending to take the COVID-19 vaccine (n=168)	
Vaccine not effective	52 (30.9)
COVID-19 does not exist	16 (9.5)
Vaccines designed to harm us	52 (31.0)
Scared of vaccine side effects	77 (45.8)
Body naturally strong to fight the virus	19 (11.3)
Have little information about vaccine	72 (42.9)
Already had COVID-19 so, immune	5 (3.0)
COVID-19 pandemic finished in the country	2 (1.2)
Others	13 (7.7)
No reason	2 (1.2)

Predictors of a definite intention to take a COVID-19 vaccine

At bivariable analysis, intention to receive vaccination was associated with region, age, fear of COVID-19 infection and severe disease and worries about side effects (supplementary file 2). After controlling for potential confounders including age, participants from northern (PR =1.24, 95% CI1.09 to 1.41) and western regions (PR =1.36, 95% CI 1.20 to 1.54) respectively were more likely to have a definite intention to

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take COVID-19 vaccine compared to those from the central region. Participants aged 55 to 64 were more likely to have a definite intention to take the vaccine compared to those aged 18-34 years (PR = 1.20, 95%CI 1.01 to 1.43). Concerns about the possibility of being infected with COVID 19 (PR = 1.26, 95% CI 1.06 to1.48) and developing severe disease (PR = 1.20, 95%CI 1.04 to 1.38) were predictors of intention to get vaccinated. Those with concerns about the side effects of the vaccine were less likely to have a definite intention for vaccination (PR =0.75, 95% CI 0.68 to 0.83) (Table 6).

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Table 6: Factors associated with a definite intention to take a COVID-19 vaccine

Characteristic	Definitely Yes (n=609)	Probably yes/probably no/definitely no (n=444)	Adjusted PR (95% CI)	p-value
Region				
Central	292 (52.8)	261 (47.2)	1	
Eastern	94 (55.6)	75 (44.4)	1.05 (0.90 to 1.23)	0.508
Northern	114 (65.5)	60 (34.5)	1.24 (1.09 to 1.41)	**0.001**
Western	109 (69.4)	48 (30.6)	1.36 (1.20 to 1.54)	**<0.001**
Residence				
Rural	322 (59.1)	223 (40.9)		
Urban	287 (56.5)	221 (43.5)		
Age group				
18-34	284 (53.6)	246 (46.4)	1	
35-54	252 (60.1)	167 (39.9)	1.09 (0.98 to 1.22)	0.126
55-64	51 (69.9)	22 (30.1)	1.20 (1.01 to 1.43)	**0.047**
65+	22 (71.0)	9 (29.0)	1.25 (1.00 to 1.57)	**0.058**
Occupation				
Casual labourer	30 (53.6)	26 (46.4)	1	
Farmer	156 (60.0)	104 (40.0)	1.00 (0.77 to 1.31)	0.993
Formally Employed	109 (63.7)	62 (36.3)	1.12 (0.86 to 1.47)	0.394
Housewife	27 (45.8)	32 (54.2)	0.75 (0.52 to 1.08)	0.123
Self Employed	203 (55.2)	165 (44.8)	0.98 (0.76 to 1.28)	0.890
Unemployed	45 (68.2)	21 (21.8)	1.22(0.90 to 1.64)	0.200
Student	22 (47.8)	24(52.2)	0.92 (0.63 to 1.36)	0.695
Others	17 (63.0)	10 (37.0)	1.02 (0.69 to 1.53)	0.904
Perception of COVID-19 prevention measure				
Poor perception	53 (49.1)	55 (50.9)	1	
Good perception	556 (58.8)	389 (41.2)	1.14 (0.94 to 1.37)	0.191
Ever had experience with COVID-19				
No	450 (56.7)	344 (43.3)	1	
Yes	159 (61.4)	100 (38.6)	1.09 (0.97 to 1.22)	0.136
Reported history of chronic disease				
No	453 (56.3)	351 (43.7)	1	
Yes	156 (62.7)	93 (37.3)	1.09 (0.98 to 1.22)	0.124
Concerned about getting infected with COVID 19 in the future				
Strongly agree/Agree	514 (60.8)	332 (39.2)	1.26 (1.06 to 1.48)	**0.007**
Strongly disagree/Disagree	95 (45.9)	112 (54.1)	1	
Future changes before the vaccine are high				
Strongly agree/Agree	474 (60.4)	311 (39.6)	1.12 (0.98 to 1.29)	0.097

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Strongly Disagree/Disagree	135 (50.4)	133 (49.6)	1	
Will be very sick if I get COVID-19				
Strongly agree/Agree	489 (61.1)	311 (38.9)	1.20 (1.04 to 1.38)	**0.011**
Strongly disagree/Disagree	120 (47.4)	133 (52.6)	1	
Concerned about side effects of the COVID-19 Vaccine.				
Strongly disagree/Disagree	310 (66.1)	159 (33.9)	1	
Strongly agree/Agree	299 (51.2)	285 (48.8)	0.75 (0.68 to 0.83)	**<0.001**

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DISCUSSION

This study assessed reported adherence to COVID-19 prevention measures and intention to take the COVID-19 vaccine in a large, national survey in Uganda. We found that adherence to all COVID-19 prevention guidelines was low despite high knowledge levels on COVID-19, and its prevention and high risk perceptions. Adherence to NPIs was higher among participants with high income and those with a reported history of chronic disease. More than half (57.8%) of the participants had a definite intention to receive the COVID-19 vaccine and the definite intention was influenced by age of participants, region of residence, perceived susceptibility to COVID-19 and concerns about the safety of the vaccine.

In this study, 93.5% of the participants had high knowledge about COVID-19 and its prevention. This finding is not surprising because this study was conducted one year after the COVID-19 pandemic was confirmed in Uganda and hence most people had obtained basic information on the disease. The level of knowledge in this study is comparable to what was reported in an earlier study in Uganda [20], and other studies in China [27] and Vietnam[28] but higher than what was reported in Malaysia[29], Ethiopia [30], South Africa [31] and Bangladesh [32]. The observed discrepancies in knowledge about COVID-19 might be explained by the differences in the way the knowledge variable was ascertained across studies; the differences in study populations[33]; timing of the study period [34]; the level of information exchange; the sample size involved and methods of data collection. For instance, in Ethiopia, the study was conducted among health workers (HCWs) and observance of the preventive guidelines was based on a 3-point Likert scale and good compliance based on whether HCWs scored ≥75% or less[33]. Many of the studies which reported low knowledge were conducted in the early phase of the pandemic and knowledge would more likely have increased since then.

Our findings indicate a high level of perceived susceptibility to COVID-19 among participants implying that public enlightenment in terms of not underestimating the possibility of outbreak resurgence may have had an impact and should be continued until the disease is eliminated. High-risk perception plays a crucial role in influencing compliance with the public health and social measures for the prevention of COVID-19 [35 36] and intention to receive vaccines [37 38]. Participants with higher COVID-19 risk perception showed higher intentions to receive the

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COVID-19 vaccine but few adopted all non-pharmaceutical preventive guidelines. Further studies are needed to understand why high-risk perception did not translate into the adoption of public health guidelines and consistent adherence.

Radio and television were the main and most trusted sources of information on COVID-19 among the population. This could, in part, be attributed to the fact that most information on COVID-19 by the president of Uganda and interactive communications by the Ministry of Health and partners was through mainly television and radio across the country hence making them popular. Radio and television ownership has also increased steadily in Uganda and most households have phones with radios which they use to access information on COVID-19. Our findings corroborate a previous Ugandan study among food vendors where radio and television emerged as major sources of information on COVID-19 [39] but contradict another study that showed that friends and personal experiences were the major sources of information, with social media and radio ranking third among Ugandans in the informal sectors[40]. The latter study was however conducted before the COVID-19 pandemic. Given the increased misinformation on COVID-19, accurate information and facts on COVID-19 should be aired more on radio and television since these remain the commonest and most trusted sources of COVID-19 information.

In this study, 71.7% of participants indicated the people in the community were using non-conventional approaches to prevent COVID-19. These approaches included using herbal remedies, steaming with local herbs, eating vegetables and fruits and physical exercises. These strategies are not scientifically proven tools to prevent COVID-19 and should be addressed through educational messaging. Similarly, a healthy diet is important for broader health benefits, but there is no evidence that diet alone is protective against COVID-19 infection and this should also be addressed in education messaging.

In this study, only 10.2% of the participants adhered to all COVID-19 preventive guidelines. Adherence to some measures was relatively high; for instance, 69.0% reported wearing face masks always when going out and 64.8% always washed hands with soap, but only 41.7% reported maintaining a social distance of 2 meters and 67% had been to a large gathering in the previous 14 days. The adherence level reported in our study is lower than that described in a previous study in Uganda [34]. Our findings suggest complacency in complying

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with MOH preventive measures. At the time of conducting this study, few confirmed cases and deaths of COVID-19 were being reported daily hence the public could have relaxed the observance of the measures with the belief that the disease was under control. This highlights the need to strengthen risk communication strategies and pillars responsible for COVID-19 response, to avoid possibility of further resurgence. It's, therefore, important to strengthen enforcement of all COVID-19 preventive measures: physical distancing, hand hygiene and wearing masks, in order to control the pandemic and halt further viral transmission.

We also found that male participants had lower odds to adhere to all the COVID-19 guidelines than females. A recent study in the United States indicated that women were more likely than men to follow guidelines outlined by medical experts to prevent the spread of COVID-19[41]. It's already known that men tend to have more challenges and less interest in taking up health behaviours [39]. Focused strategies should, therefore, be designed to encourage men to adhere to the guidelines. The level of adherence could be related to the occupations, where in many cases more men than women do outdoor jobs and socialize more in groups hence observance of the guidelines may be less seriously than men. We found that, unlike the Central region, participants from Northern, Eastern and Western regions had lower odds of adhering to all the preventive measures. The fact that approximately 55% of the COVID-19 cases at the time were registered in the central region could suggest a high-risk perception among participants in the central compared to other regions. Interventions targeting behaviour change should put special emphasis on these other regions to cover aspects of risk perception.

Having a higher monthly income was related to higher odds of adhering to all the preventive guidelines. High incomes could be linked to higher education attainment which are important determinants of health. People with higher income can afford to procure masks and handwashing facilities and supplies for themselves making it easier to comply with all the preventive guidelines. A recent study on socioeconomic factors associated with self-protecting behaviour during the COVID-19 pandemic indicated that higher income influence the adoption of public health guidelines [42]. It was argued that the adoption of the guidelines is a costly prospect, one that is easier for people with more income. People with low income

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should be prioritized when distributing free masks and hand hygiene supplies. More health education sessions are given to promote adherence to the recommended guidelines.

Further, we found that participants with a reported history of chronic disease were more likely to adhere to all the guidelines. It is not surprising that people with a history of chronic disease have better adherence because evidence indicates that they are at elevated risk of unfavourable outcomes such as severe disease and death [43] [44]. Campaigns to ensure sustained adherent behaviour among people with chronic illnesses are warranted and campaigns focused on those with no known chronic disease history should be intensified to raise risk perception among this group.

In this study, despite 84.0% expressing the intention to get vaccinated, only 57.8% had a definite intention to get vaccinated against COVID-19. Our findings are comparable to a study in China that found that 83.5% had the intention to get vaccinated against COVID-19 of which 30% had a definite intent [4] but contradicts another study in Malaysia in which intention to get vaccinated against COVID-19 was higher (94.3%) of which, 48.2% had a higher definite intention[45]. A good comparison of vaccination intention levels between countries may not be ideal due to the limited evidence available as well as differences in access to vaccines in the countries. It has been suggested that for herd immunity to be attained for COVID-19, more than 70% of the population needs to be vaccinated [46]. It's therefore important that health education is intensified to increase people's confidence in the vaccines so that they can get vaccinated as vaccines become available. Reported definite intention to take the vaccine was highest in Northern and Western regions. Sensitization to promote COVID-19 vaccine acceptance should be intensified in the Eastern and Central regions of Uganda.

We found that older people (at least 55 years) were more likely to have a definite intention to take the vaccine compared to young people (18-34 years). This could be related to the knowledge that vaccines could protect old people more since people of advanced age have a higher risk of getting severe COVID-19 and other adverse outcomes than young people [47]. Strategies to promote definite intent to take the vaccine should be continued in old people but they should also be intensified in young people who may have a belief that they have a strong immune system to fight off the COVID-19 infection.

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Having concerns about the side effects of COVID-19 was associated with a low definite intention to take the vaccine. Our finding is consistent with that found in China in which concerns about side effects affected intention to take the vaccine[4]. Worries about the side effects of the vaccine have been reported before whenever a new vaccine has been introduced [48]. It should be noted that although COVID-19 vaccination needs to be rolled out countrywide, the fears raised about the vaccine underscore the need to emphasize facts and accurate information to the public about the safety and efficacy of the vaccine to dispel any rumours or misinformation surrounding the COVID-19 vaccines. Addressing these issues will result in increased confidence and reduced hesitancy to take the vaccines.

Participants who had high perceived susceptibility to the disease and those who felt they would get severe disease if they got SARS-CoV-2 infection were significantly more likely to have a definite intention to take the COVID-19 vaccine. One of the key drivers in people's vaccination decisions is the risk they associate with the disease the vaccine protects against [49]. Susceptibility perceptions are seen to be associated with emotional dimensions that often include fear and worry [50]. Previous studies have also indicated a predictive effect of perceived risk on vaccination intentions[51]. Its therefore important to keep emphasizing in health education and sensitization that COVID-19 is a real, dangerous and deadly disease so that people can take the vaccination seriously in addition to observing all the COVID-19 preventive guidelines.

The strengths of our study include a large, representative sample of the Ugandan population across age, gender and location. Some methodological limitations in this study include social desirability bias which is generally higher with telephone interviews compared to face to face interviews[52]. Secondly, our outcomes are based on a self-reported report of behaviour (adherence and vaccine intention), there is possible social desirability bias, which would make participants potentially over-report socially desirable behaviours and the voluntary nature of the survey allows selection bias to creep in. Thirdly, causal inference cannot be established with cross-sectional study designs. Despite these limitations, the study findings provide valuable information about the levels of adherence to recommended COVID-19 prevention guidelines and intention to take COVID-19 vaccines.

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Conclusions

The study findings indicate a low level of adherence to COVID-19 prevention guidelines despite high knowledge about COVID-19. Male participants and those hailing from the east, west and northern regions had comparatively low while participants with reported chronic disease history and higher income had reported adherence levels to public health and social measures. Our findings suggest that interventions to improve adherence to COVID-19 prevention guidelines should target males, low-income earners and people living in the northern, western, and western regions of Uganda more. Over half of the participants intended to receive the vaccine. Higher perceived risk and severity of COVID-19 infection had a strong and positive effect on vaccination intention while concerns about the safety of the vaccine negatively influenced vaccination intention. Efforts should be directed to the promotion of a high definite intention to get vaccinated against COVID-19 by addressing the fears of side effects and doubts about vaccine effectiveness to enhance confidence and increase vaccine uptake among the population.

Acknowledgments

We thank World Health Organization Africa Regional Office, WHO AFRO, for funding this study. We are equally thankful to Prof Jayne Byakika-Tusiime and Prof Rhoda Wanyenze for providing technical review and intellectual content to the study protocol and drafting of the manuscript. We thank Mr Innocent Komakech (WHO Uganda) for his administrative guidance during the design and implementation of the study. We are also indebted to the research assistants who collected good quality data as well as the study participants for sparing time to participate in the study.

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Declarations

Data availability statement

The data used for this study should be requested from the WHO Africa Regional Office.

Ethical considerations

Ethical approval was obtained from the Makerere University Higher Degrees Research and Ethics Committee (HDREC), reference number HDREC 926, and the Uganda National Council of Science and Technology (UNCST) reference number SS862ES. We obtained verbal informed consent from participants. Confidentiality was observed throughout the study.

Patient consent for publication Not available

Competing interests

The authors declare no competing interests.

Funding This work was funded by the World Health Organization Africa Regional Office, WHO AFRO. (Award Number: N/A)

Authors' Contributions

STW, JBT, and RKW conceptualized and designed the study. STW, IBM and JBT performed data analysis, and interpretation and wrote the first draft of the manuscript. RKW, BS, SO, AC, MN, AT, RK and TB critically reviewed the analysis and the first manuscript draft. JBT, AT and RKW provided a technical and intellectual content review for the manuscript. All authors have read and approved the final version of the manuscript.

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Supplementary file1: Understanding the drivers of non-adherence towards COVID19 preventive measures in Uganda

No	Question	Response options
Questionnaire identifiers		
A1	District	_____
A2	Region	1. North 2. East 3. Central 4. West
A3	Area of residence	1. Rural 2. Urban
Socio-Demographic characteristics (*Circle the response given)*		
B1	Sex of the respondent	a) Male b) Female
B2	Education status of the respondent **(Highest level attained)**	a) No formal education b) Primary c) Secondary d) Tertiary
B3	Current occupation	a) Unemployed/retiree/housewife b) Employed c) Self-employed d) Casual labourers e) Farmer f) Others
B4	How many people stay in your home, currently? *Write the whole number*	
Knowledge on COVID-19 and the preventive measures		
C1	What are some of the ways in which COVID-19 can be spread from one person to another	a) Touching one's soft parts (eyes, north, mouth) with contaminated hands. b) inhaling of infected droplets from from coughing, sneezing, laughing c) Physical contact with an infected person d) Others
C2	List some of the symptoms of COVID-19 that you know	a) High temperature/ fever b) Coughing c) Sneezing d) Difficulty in breathing e) Sore throat f) Loss of sense of smell and taste g) Others (specify) h) None of the above

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C3	Have you heard about how to prevent the COVID_19? (If the interviewee is unresponsive, the facilitator asks a clarification question: It is also called COVID-19; Have you heard of how to prevent it?)	a) Yes b) No
C4	What are your sources of information on COVID-19	a) Family member b) Health staff (including VHT) c) Phone (messages and calls) d) Radio e) Television f) Church / Mosque g) Community member/ village health Team Member. h) Social media (Facebook, WhatsApp, twitter) i) Internet j) Others (specify
C5	Of these, what is your most trusted source of information on COVID-19	a. Family member b. Health staff (including VHT) c. Phone (messages and calls) d. Radio e. Television f. Church / Mosque g. Community member/ village health Team Member. h. Social media (Facebook, WhatsApp, twitter) i. Internet j. Others (specify
C6	How can COVID-19 be prevented? (Mention all prevention measures that you know)	a) Wearing a face mask in public spaces b) Regular and thorough washing hands with soap and water or an alcohol-based rub c) Covering mouth and nose with bent blow or tissue when coughing and sneezing d) Clean and disinfect surfaces that are regularly touched e) Keep at least two-meter distance between self and others f) Avoiding crowded places g) Avoid touching eyes, nose, and mouth h) Staying home if you have symptoms such as headache, cough or mild fever i) Refrain from smoking and other activities that weaken the lungs. j) Avoid unnecessary travels

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C7	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus.	a) Yes b) No c) I don't know

COVID-19 percieved risk and severity, and perceptions on COVID-19 preventive guidelines.

D. Perception on COVID-19 preventive measures

	To what extent do you agree or disagree with the following statements?	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
D1	My family and I are worried of the likelihood of getting COVID-19					
D2	Future chances of getting COVID-19 ibefore the vaccine are high					
D3	I will be very sick if I get COVID-19					
D4	If I suffer from COVID-19 it means I cannot be infected again hence I don't need to take precautions					
D5	Wearing a mask in public is a good protective measure against COVID-19.					
D6	Keeping social distance of 2 meters apart and beyond is a good protective measure against COVID-19 for me and my community.					
D7	Frequent hand washing or using alcohol based hand sanitizer is a good protective measure against COVID-19.					
D8	Covering my mouth and nose with hand or elbow when I sneeze, cough can protect my community from COVID-19					
D9	If vaccines are available, they will make me feel less worried about about catching COVID-19					
D10	I am worried that the side effects of vaccine will affect my health					
D11	I am concerned about whether the COVID-19 vaccine actually works or not					

Experiences and uptake of COVID-19 prevention measures

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E1	Apart from MOH guidelines, what other approaches are community members using to avoid getting infected with COVID-19	a) Use herbal medications e.g garlic, ginger b) Steaming using herbs c) Eating more fruits and vegetables d) Doing exercise e) Other a) None
E2	Have you ever had experience with COVID-19	a) Yes b) No
E3	Have ever been diagnosed with a disease that lasts for over year and require continuous medical support	a) Yes b) No
E4	Within the last 14 days, I have been to a large gathering (burials, community meetings, church, parties etc)	c) Yes d) No
E5	I maintain a distance of at least 2m when interacting with other people	a) Yes b) sometimes c) No
E6	I wear a mask every time I leave my home to a public place and when I have coughing or sneezing symptoms	a) Yes b) sometimes c) No
E7	I wash my hands with water and soap/ sanitise frequently (after touching any surface or shared object)	a) Yes b) Sometimes c) No
E8	Do you cover your mouth and nose with hand or elbow when you cough or sneeze?	a) Yes, always b) Yes, only when necessary/ occasionally (public places) c) No
E9	Do you intend to take COVID-19 vaccines if they become available?	1. Definitely, Yes 2. Probably yes 3. Probably No 4. Definitely No
E10	If No, what are the reasons	a) I don't think COVID-19 exists b) I think the vaccine is not effective c) I think the vaccine is designed to harm us d) I am scared of side-effects of the vaccine e) My body is naturally strong, I don't need a vaccine to fight COVID-19 f) I already had COVID-19, so I think I am immune to the disease g) The COVID-19 pandemic is finished in my country, no need for a vaccine now h) Have little information about the vaccine i) None of the above j) Other reasons (please specify
AA1	Age of the respondent Hint: ask for date of birth	…… (in complete years)

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AA2	On average how much money do you earn per month?	1. ≤ 50,000 2. 50,001 – 100,000 3. 100,001 – 200,000 4. 200,001 – 500,000 5. 500,001 – 1000,000 6. 1000,001 and above

Thank you alot for your time. We really appreciate

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Spplementary file2: Bivariate Results

Table S2.1. Factors associated non-adherence to COVID-19 prevention guidelines / protocols (bivariate Analysis)

Characteristics				
	adherent (n=107)	Nonadherent (n=1946)	Un-adjusted PR (95% CI)	P-value
Demographics				
Region				
Central	81 (14.7)	472 (85.4)	1	
Eastern	11 (6.5)	158 (93.5)	0.41 (0.21 – 0.78	0.007
Northern	7 (4.0)	167 (96.0)	0.24 (0.11 – 0.54)	< 0.001
Western	8 (5.1)	149 (94.9)	0.31 (0.15 – 0.66)	0.002
Residence				
Rural	484 (88.8)	61 (11.2)	1	
Urban	462 (90.9)	46 (9.1)	0.79 (0.53 – 1.18)	0.252
Age				
18-34	59 (11.1)	471 (88.9)	1	
35-54	38 (9.1)	381 (90.9)	0.80 (0.52 – 1.22)	0.298
55-64	8 (11.0)	65 (89.0)	0.98 (0.45 – 2.14)	0.965
65+	2 (6.4)	29 (93.6)	0.55 (0.13 – 2.37)	0.422
Gender				
Female	50 (12.4)	352 (87.6)	1	
Male	57 (8.8)	594 (91.2)	0.68 (0.45 – 1.01)	0.056
Education				
No formal Education	71 (89.9)	8 (10.1)	1	
Primary	311 (90.1)	34 (9.9)	0.97 (0.43 – 2.19)	0.942
Secondary	345 (89.4)	41 (10.6)	1.05 (0.47 – 2.35)	0.896
Tertiary	219 (90.1)	24 (9.9)	0.97 (0.42 – 2.26)	0.949
Occupation				
Casual Labourer	49 (87.5)	7 (12.5)	1	
Farmer	237 (91.2)	23 (8.9)	0.68 (0.28 – 1.67)	0.400
Formally Employed	156 (91.3)	15 (8.8)	0.67 (0.26 – 1.75)	0.415
House Wife	55 (93.2)	4 (6.8)	0.51 (0.14 – 1.84)	0.304
Self Employed	323 (87.8)	45 (12.2)	0.98 (0.42 – 2.28)	0.954
Unemployed	59 (89.4)	7 (10.6)	0.83 (0.27 – 2.53)	0.744
Student	43 (93.5)	3 (6.5)	0.49 (0.12 – 2.01)	0.320
Others	24 (88.9)	3 (11.1)	0.88 (0.21 – 3.69)	0.856
Household Size				
<5	47 (12.6)	327 (87.4)	1	
5 – 10	52 (8.9)	533 (91.1)	0.68 (0.45 – 1.03)	0.069
>10	8 (8.5)	86 (91.5)	0.65 (0.29 – 1.42)	0.278
Monthly Income (USD)				
≤ 13.7	18 (7.7)	217 (92.3)	1	
13.7 – 27.4	13 (7.9)	152 (92.1)	1.03 (0.49 – 2.17)	0.936
27.4 – 54.8	17 (8.6)	180 (91.4)	1.14 (0.57 – 2.27)	0.713
54.8 – 137	33 (11.4)	256 (88.6)	1.55 (0.85 – 2.83)	0.151
≥137	25 (16.4)	127 (83.6)	2.37 (1.24 – 4.52)	0.009
COVID-19 Knowledge Level				

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Low	61(88.4)	8 (11.6)	1	
High	885 (89.9)	99 (10.1)	0.85 (0.40 – 1.83)	0.684
Perception of COVID-19 prevention measure				
Poor perception	100 (92.6)	8 (7.4)	1	
Good perception	846 (89.5)	99 (10.5)	1.46 (0.69 – 3.10)	0.320
Ever had experience with COVID-19				
No	712 (89.7)	82 (10.3)	1	
Yes	234 (90.4)	25 (9.7)	0.93 (0.58 – 1.49)	0.755
Reported history of chronic disease				
No	733 (91.2)	71 (8.8)	1	
Yes	213 (85.5)	36 (14.5)	1.74 (1.14 – 2.68)	0.010
Worry about the likelihood of getting COVID-19				
Strongly agree/Agree	763 (90.2)	83 (9.8)	1	
Strongly disagree/Disagree	183 (88.4)	24 (11.6)	1.21 (0.74 – 1.95)	0.447
Future chances before the vaccine are high				
Strongly agree/Agree	707 (90.1)	78 (9.9)	1	
Strongly Disagree/Disagree	239 (89.2)	29 (10.8)	1.10 (0.70 – 1.73)	0.679
Will be very sick if I get COVID-19				
Strongly agree/Agree	77 (9.6)	723 (90.4)	1	
Strongly disagree/Disagree	30 (11.9)	223 (88.1)	1.26 (0.81 – 1.98)	0.306
If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution				
Strongly agree/Agree	33 (12.2)	237 (87.8)	1	
Strongly disagree/Disagree	74 (9.4)	709 (90.6)	0.75 (0.48 – 1.16)	0.195

Table S2.2: Factors associated with a definite intention to take a COVID-19 vaccine ((bivariate Analysis)

Characteristics				
	Definitely Yes (n=609)	**Probably yes/Probably no/Definitely no (n=444)**	**Un-adjusted PR (95% CI)**	**P-value**
Demographics				
Region				
Central	292 (52.8)	261 (47.2)	1	
Eastern	94 (55.6)	75 (44.4)	1.05 (0.90-1.23)	0.514
Northern	114 (65.5)	60 (34.5)	1.24 (1.09-1.42)	0.002
Western	109 (69.4)	48 (30.6)	1.31 (1.15-1.50)	<0.001

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Residence				
Rural	322 (59.1)	223 (40.9)	1	
Urban	287 (56.5)	221 (43.5)	0.96 (0.86-1.06)	0.397
Age				
18-34	284 (53.6)	246 (46.4)	1	
35-54	252 (60.1)	167 (39.9)	1.12 (1.01-1.25)	0.042
55-64	51 (69.9)	22 (30.1)	1.30 (1.10-1.55)	0.002
65+	22 (71.0)	9 (29.0)	1.32 (1.04-1.68)	0.021
Gender				
Female	238 (59.2)	164 (40.8)	1	
Male	371 (57.0)	280 (43.0)	0.96 (0.87-1.07)	0.477
Education				
No formal Education	47 (59.5)	32 (40.5)	1	
Primary	198 (57.4)	147 (42.6)	0.96 (0.79-1.18)	0.729
Secondary	220 (57.0)	166 (43.0)	0.96 (0.78-1.17)	0.677
Tertiary	144 (59.3)	99 (40.7)	1.00 (0.81-1.23)	0.971
Occupation				
Casual Labourer	30 (53.6)	26 (46.4)	1	
Farmer	156 (60.0)	104 (40.0)	1.12(0.86-1.46)	0.399
Formally Employed	109 (63.7)	62 (36.3)	1.19 (0.91-1.56)	0.205
House Wife	27 (45.8)	32 (54.2)	0.85 (0.59-1.24)	0.404
Self Employed	203 (55.2)	165 (44.8)	1.03 (0.79-1.34)	0.826
Unemployed	45 (68.2)	21 (21.8)	1.27 (0.95-1.71)	0.108
Student	22 (47.8)	24(52.2)	0.89 (0.61-1.32)	0.567
Others	17 (63.0)	10 (37.0)	1.18 (0.80-1.72)	0.403
COVID-19 Knowledge Level				
Low	37 (53.6)	32 (46.4)	1	
High	572 (58.1)	412 (41.9)	1.08 (0.86-1.36)	0.484
Perception of COVID-19 prevention measure				
Poor perception	53 (49.1)	55 (50.9)	1	
Good perception	556 (58.8)	389 (41.2)	1.20 (0.98-1.46)	0.075
Ever had experience with COVID-19				
No	450 (56.7)	344 (43.3)	1	
Yes	159 (61.4)	100 (38.6)	1.08 (0.97-1.21)	0.170
Ever diagnosed with chronic disease				
No	453 (56.3)	351 (43.7)	1	
Yes	156 (62.7)	93 (37.3)	1.11 (0.99-1.25)	0.067
Worry about the likelihood of getting COVID-19				
Strongly agree/Agree	514 (60.8)	332 (39.2)	1.32 (1.13-1.55)	<0.001
Strongly disagree/Disagree	95 (45.9)	112 (54.1)	1	

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Future chances before the vaccine are high				
Strongly agree/Agree	474 (60.4)	311 (39.6)	1.20 (1.05-1.37)	0.007
Strongly Disagree/Disagree	135 (50.4)	133 (49.6)	1	
Will be very sick if I get COVID-19				
Strongly agree/Agree	489 (61.1)	311 (38.9)	1.29 (1.12-1.48)	<0.001
Strongly disagree/Disagree	120 (47.4)	133 (52.6)	1	
If I suffer from COVID-19, I cannot be infected again and will not need to take preventive precaution				
Strongly agree/Agree	154 (57.0)	116 (43.0)	0.98 (0.87-1.11)	0.760
Strongly disagree/Disagree	455 (58.1)	328 (41.9)	1	
Concerned about the side effects of the COVID-19				
Strongly disagree/Disagree	310 (66.1)	159 (33.9)	1	
Strongly agree/Agree	299 (51.2)	285 (48.8)	0.77 (0.70 – 0.86)	< 0.001
Concerned about the efficacy of the COVID-19 vaccines				
Strongly disagree/Disagree	231 (58.5)	164 (41.5)	1	
Strongly agree/Agree	378 (57.5)	280 (42.5)	0.98 (0.88 – 1.09)	0.742

For peer review only