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Misperceived norms and willingness to get a COVID-19 vaccine: a whole-population study of adults in rural Uganda

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ABSTRACT

Background: Perceptions about others' willingness to get vaccinated for COVID-19 are understudied in HIV-endemic settings. Perceived social norms influence engagement in other protective behaviors. Information about COVID-19 vaccine norms could inform future HIV vaccination efforts.

Methods: All adults across 8 villages in Uganda completed a survey in 2021–2022. Participants reported personal willingness to take a COVID-19 vaccine (definitely yes vs any hesitance) and estimated how many village adults would take a COVID-19 vaccine ("all or almost all," "more than half," "less than half," "very few or no one," "do not know"). Participants also reported COVID-19 related beliefs, whether they knew someone who had COVID-19, personal HIV status, and sociodemographic characteristics. A multivariable Poisson regression model estimated associations between perceptions about others' willingness to get a vaccine and personal willingness to get a vaccine.

Results: Among 1561 participants (>90% response rate), 1163 (75%) were willing to get a COVID-19 vaccine. One in three vaccine-hesitant participants and 1 in 10 vaccine-willing participants incorrectly thought most adults in their village would not get vaccinated. Compared to participants who thought more than half of villagers were willing to get vaccinated, those who mistakenly thought fewer than half (adjusted relative risk [aRR] = 0.81; 95% confidence interval [CI]: 0.70–0.94) or few to none (aRR = 0.65; 95% CI: 0.50–0.85) were willing were less likely to report willingness themselves.

Conclusions: Overall, one-fifth of adults mistakenly thought most other villagers were unwilling to get vaccinated. Adults with this misperception were less willing to get a COVID-19 vaccine themselves. Strategies that provide information about vaccine effectiveness and communicate that most adults are willing to get vaccinated may increase uptake. Changing perceived norms about vaccine uptake may also foster conversations about accessing vaccines and reduce vaccine-related stigma, important considerations with an HIV vaccine on the horizon.

1. Introduction

Coronavirus disease 2019 (COVID-19) is a severe acute respiratory virus that is particularly dangerous for immunocompromised individuals and people with comorbidities [1]. People with HIV are at a higher risk for developing severe COVID-19 outcomes and requiring hospitalization [2–4]. Evidence from eastern and southern Africa suggests a high prevalence of HIV and COVID-19 coinfections, increased relative risk of severe COVID-19, and a higher rate of death due to COVID-19 among people living with HIV [4,5].

COVID-19 vaccines are highly protective against severe COVID-19 infections [6]. However, vaccination uptake during the COVID-19 pandemic did not reach targeted rates in many countries [7]. Vaccination continues to be a priority for individuals at greater risk of disease

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severity. Vaccination efforts in HIV-endemic settings play an important role in protecting immunocompromised individuals from negative COVID-19-related health outcomes [8]. In Uganda, a substantial minority of individuals with HIV were COVID-19 vaccine hesitant [9]. Research on drivers of COVID-19 vaccination acceptance in HIV-endemic settings could inform efforts to support promotion of critical vaccine uptake for people with HIV. Additionally, scientific advancements around HIV vaccine development are promising [10]. Findings about drivers of COVID-19 vaccine uptake may inform future HIV vaccine immunization programs.

Drivers of COVID-19 vaccine acceptance include perceptions of disease risk and severity, knowledge about the virus, trust in vaccines, positive perceptions about the COVID-19 vaccine, and having relatives infected by COVID-19 [11–15]. Age and education are also associated with COVID-19 vaccine uptake [16–18]. Additionally, perceived norms (i.e., beliefs about what most others do and support) around COVID-19 vaccine acceptance, intentions, and uptake are associated with personal indicators of vaccine acceptance and uptake [19–21]. Among a study of Malawian adults, perceived pro-vaccination norms within the community and family were associated with personal willingness to get vaccinated [22].

Relevant to behavior change strategy, perceived social norms about health-related behaviors are often incorrect [23], with individuals often overestimating the prevalence of health risk behaviors and underestimating the prevalence of health promotive behaviors [24–27]. Regarding COVID-19 vaccines, for example, many college students in the United States underestimated peer support for vaccination [28]. Among adults in Italy, many vaccine hesitant adults underestimated city-wide vaccine acceptance rates [29]. These misperceptions matter for public health because people shape their personal behaviors around their perceptions, regardless of perceptual accuracy [30,31].

Little is known about the extent of misperceived norms about COVID-19 vaccination acceptance across a general adult population in an HIV-endemic context. Moreover, no studies about vaccine uptake in HIV-endemic settings have assessed the extent of misperceived norms representing false consensus (i.e., mistakenly thinking everyone is like me [32]) and pluralistic ignorance (i.e., mistakenly thinking everyone is different from me [33]). Both types of misperception represent entry points to flip individual and community scripts and motivate behavior change through conversation at the individual and community levels. If pro-vaccination attitudes and behaviors are common but underestimated within a community, an opportunity exists to use a norms correction strategy to change behavior [34]. Prior research has found that highlighting actual health-promoting norms among relevant social groups can change perceptions, which in turn, can promote personal health-promoting behavior and prevent health risk behavior [35,36]. For example, a social norm intervention targeting UK parents' overestimation of vaccine conspiracy theory endorsements reduced parents' own negative vaccine beliefs [37]. Similarly, an intervention providing normative information about vaccination intentions corrected norm misperceptions among individuals displaying vaccine hesitancy [38].

In Uganda, the COVID-19 pandemic resulted in strict lockdowns in 2020 and 2021 [39]. Initial vaccination rollout in March 2021 focused on sub-populations at greatest risk (e.g., health workers, persons with co-morbidities) [40], and subsequent vaccination campaigns extended to the general public. Although vaccination was initially offered at static sites, outreach eventually expanded to other public meeting settings [40]. A household survey conducted in February 2021 found that 97% of adults in Uganda's capital and 87% of adults in the southwest region had heard of the COVID-19 vaccine [41]. Despite some concerns about vaccine safety and effectiveness, most survey respondents (85%) expressed an interest in receiving the vaccine [41]. By June 2022, 63% of the Ugandan population had received at least one dose of the COVID-19 vaccine, and in the southwest region, 33% of the population had received the recommended number of doses [40].

This whole-population study of adults in southwestern Uganda explores associations between misperceived local norms about COVID-19 vaccine acceptance and personal willingness to take a COVID-19 vaccine. Specifically, the study assesses how many people misperceived local vaccination norms, whether those misperceptions reflect false consensus or pluralistic ignorance, and whether perceived norms were associated with personal vaccine acceptance. These findings can inform the design of social norms interventions to promote vaccine uptake in this setting. As an HIV vaccine moves toward availability, findings may also help identify misperceptions that could otherwise become barriers to HIV vaccine acceptance in HIV-endemic settings like rural Uganda.

2. Methods

2.1. Study design, participants, and setting

The study team conducted a cross-sectional, whole-population study of all individuals aged 18 years and older who were permanent residents of one of the eight villages constituting an administrative parish in Rwampara District. This parish is located in rural southwestern Uganda, approximately 20 km from Mbarara City. It was identified as an appropriate site of study because of its geographic size, tractable population, and similarity to other rural areas in Uganda [40]. As with similar low-resource rural contexts in eastern and southern Africa, most of the village households participate in agriculture-based economy or small-scale trading/enterprise. In this context, concerns around household food and water insecurity are prevalent, and household access to electricity and piped water is uncommon [42]. During the COVID-19 pandemic, Uganda experienced significant economic, social, education, and public health consequences[43]. However, the district where this study took place experienced relatively few COVID-19 cases in comparison to urban settings, a pattern similar to other rural areas in Uganda [44].

2.2. Study procedures

Research assistants fluent in the local language (Runyankore) collected data from February 2021 to August 2022. Using a continuously updated census list of all adults whose main household was in the study parish (i.e., all eligible adults), research assistants contacted potential participants and engaged them in an informed consent process. Research assistants explained that the study focused on social connections, health, and wellbeing, and participants indicated their consent with a signature or thumbprint if unable to write. Almost all interviews (96%) took place by phone due to COVID-19 restrictions with the team transitioning to in-person data collection in summer 2022. When data collection was conducted by phone, participants were permitted to provide oral consent. Parish residents were excluded from participation if they were incapacitated at the time of data collection, had died during the study period before being interviewed, or had permanently moved away.

Research assistants collected data through a computer-assisted, survey-based interview tool. While survey questions were originally written in English, the study team translated the questionnaire into Runyankore and subsequently re-translated the questions into English to ensure reliability of the translation. The study team utilized an iterative process in question piloting and translation. Data collection occurred either by phone or in person at a private location near the participant's home. Incentives for study participation included a kilogram of sugar or a bar of soap (per local norms), delivered by study team members to participants' homes at a later date when in-person visits were permitted.

2.3. Measures

Participants were asked to rate their willingness to receive a COVID-19 vaccine if it were free and available on a 4-point Likert-type scale ranging from “Definitely Yes” to “Definitely No”. Do not know was also a

valid response. Data were dichotomized as 'vaccine willing' (definitely yes) versus 'vaccine hesitant' (any other response). Participants also reported their perception about the local norm. Specifically, participants were asked, "According to your perception, how many adults aged 18 years or older who stay in your village would be willing to get the coronavirus vaccine?" Based on pilot testing, response categories included "All or almost all" (> 90%), "More than half" (>50%), "Fewer than half" (10- < 50%),"Very few" (10% to none) or "Do not know". Prior studies have assessed vaccine hesitancy and perceived norms in similar ways with a single item about perceived norms [28]. Cognitive pre-testing of the norm response categories indicated that study participants easily interpreted these quantities. Additional pre-testing indicated that "other adults in your village" was a meaningful social reference group for this population [28,45]. The village was a concrete referent for estimating norms because they were small and most social ties were largely within-village [46,47].

Other questions elicited whether a participant had previously refused a vaccine as an adult (yes/no), personal belief in the protective nature of the COVID-19 vaccine against infection (4-point Likert-type scale ranging from definitely yes to definitely no), belief that the coronavirus was manufactured for population control purposes (yes/no/do not know), perceived personal risk of contracting COVID-19 (4-point Likert-type scale ranging from no risk to high risk and do not know), and personally knowing someone infected with COVID-19 (yes/no). Additionally, participants reported on their sociodemographic characteristics including age, sex, marital status (not married/not cohabiting versus married/cohabiting), religion, education (no education/some primary education versus primary education or more), household asset wealth, and HIV status. Household asset wealth was calculated using a household asset-based index [48].

2.4. Analysis

First, we aggregated at the village level personal vaccine willingness to determine actual local norms. Willingness to get a COVID-19 vaccine was classified as normative (in the study population and in each village) if more than 50% of participants in a village were willing to get vaccinated. A similar threshold to identify actual norms has been used in the social norms literature in Uganda and in other settings [25,26,49,50].

Second, we compared individuals' perceptions about vaccine willingness among their village peers with the actual local norm to determine how many participants misperceived local norms. A participant was categorized as misperceiving the norm if his or her perception of the village norm did not match the actual village norm. For example, if a participant lived in a village where most adults were willing to get vaccinated, but s/he nonetheless (mistakenly) thought that most others in this village were unwilling to get vaccinated, then s/he would be categorized as misperceiving the norm. This approach to measuring misperceived norms by comparing perceived norms to actual norms in a whole-population study draws on methods from previous studies [51,52].

Next, we assessed the extent to which participants' misperceptions of local norms were concordant or discordant with their self-reported personal vaccination willingness. If one's personal willingness was consistent with the misperception (e.g., a participant reported being unwilling to get vaccinated while falsely believing that most others in the village were also unwilling to get vaccinated), then the participant was considered to be in a state of false consensus. If personal willingness was inconsistent with the misperception (e.g., a participant was willing to get vaccinated while falsely believing that most others in the village were unwilling to get vaccinated), then the participant was considered to be in a state of pluralistic ignorance.

Finally, we fitted a multivariable Poisson regression model to estimate associations between perceived norms and personal willingness to get a COVID-19 vaccine while adjusting for other factors. With a binary dependent variable, the Poisson regression model with robust estimates of variance ("modified Poisson") has been shown to yield estimated incidence rate ratios that can be interpreted straightforwardly as relative risk ratios [53]. The model adjusted for sociodemographic factors, other COVID-19 related variables, and interview date (specified as a continuous variable in days, with the start date of February 10, 2021 designed as "0"), and used cluster-correlated robust estimates of variance to account for potential clustering of study participants at the village level.

3. Results

Using a population census list representing 1840 adult residents within the targeted study parish, the study team interviewed 1566 individuals from February 2021 to August 2022. Among those not interviewed, 157 persons were study eligible individuals representing 80 who refused to participate, 64 who were not found (frequently away from home), 9 who were sick, and 4 who were incarcerated. An additional 117 individuals on the census list were determined to be ineligible by the end of the data collection period: 73 left the parish permanently, 12 died, and the remaining 32 were deemed permanently incapable of participating due to inability to hear, speak, or understand the questions (not related to temporary illness). Thus, the overall response rate from the eligible study population was 90.9%. Five additional participants were dropped from analyses for this study as they did not provide data for the outcome nor the main explanatory factor. Thus, the final analytical sample included 1561 study participants.

Just over half of study participants (865 [55%]) identified as female. On average, participants were 42 years old (standard deviation [sd] = 16 years). Most participants were married/cohabiting ($n = 1019$ [65%]); most identified as Protestant ($n = 1118$ [72%]); and most completed primary education or more ($n = 937$ [60%]). Eleven percent ($n = 180$) reported an HIV-positive serostatus. Most participants ($n = 1433$ [92%]) had never refused a vaccine as an adult. Although 923 participants (59%) agreed with the conspiracy theory that the coronavirus had been manufactured for population control, 1043 participants (67%) believed that the vaccine could definitely protect adults from COVID-19 infection. Overall, 790 (51%) did not know someone infected with COVID-19, and 564 (36%) perceived their personal COVID-19 risk as medium or high.

Regarding willingness to get a COVID-19 vaccine, 1163 (75%) were definitely willing to get vaccinated, 241 (15%) were probably willing to get vaccinated, 67 (4%) were probably not willing to get vaccinated, 81 (5%) were definitely not willing to get vaccinated, and 9 did not know. Most participants in each village were definitely willing to get a COVID-19 vaccine (68 to 82% across villages). Thus, vaccine hesitancy was not locally normative in this area. Table 1 provides the sociodemographic distribution of participants overall and the distribution of willingness to get vaccinated by subgroup.

In terms of perceived norms about other villagers' willingness to get vaccinated against COVID-19, 498 (32%) participants believed that all or almost all villagers were willing to get vaccinated, 747 (48%) believed that more than half were willing to get vaccinated, 225 (14%) believed that less than half were willing to get vaccinated, and 52 (3%) believed that few or no adults were willing to get vaccinated. Overall, 277 (18%) participants misperceived the norm, reporting that most other village adults would be unwilling to get a COVID-19 vaccine. Thirty-nine (2.5%) participants reported not knowing how many adults were willing to get vaccinated.

Among 398 vaccine hesitant participants, 133 (33%) misperceived the norm. These participants were in a state of false consensus. They mistakenly thought that, similar to themselves, most others were unwilling to get vaccinated. Among the 1163 participants who were willing to get vaccinated, 145 (12%) misperceived the norm. These participants were in a state of pluralistic ignorance. They mistakenly thought that, unlike themselves, most others were unwilling to get vaccinated.

Estimates from a modified multivariable Poisson regression model

Table 1
Personal willingness to take a COVID-19 vaccine among adults in Rwampara District, southwestern Uganda ($N = 1561$).

	Study participants ($N = 1561$)		Study participants who are definitely willing to get a COVID-19 vaccine ($n = 1163$)	
	n	Column %	n	Row %
Perception about other village adults' willingness to get vaccinated against COVID-19				
All or almost all	498	32%	460	92%
More than half	747	48%	542	73%
Less than half	225	14%	121	54%
Few or no one	52	3%	23	44%
Did not know	39	3%	17	44%
Believes vaccine can protect adults from COVID-19 infection				
Definitely yes	1043	67%	976	94%
No/Unsure	518	33%	187	36%
Refused a vaccine as an adult				
No	1433	92%	1066	74%
Yes	128	8%	97	76%
Knew someone who had COVID-19				
No	790	51%	578	73%
Yes	771	49%	585	76%
Perceived personal COVID-19 risk				
None	557	36%	460	83%
Low	427	27%	279	65%
Medium	234	15%	171	73%
High	330	21%	244	74%
Unknown	13	1%	9	69%
Believes coronavirus conspiracy theory				
No	569	36%	439	77%
Yes	923	59%	673	73%
Don't know	69	4%	51	74%
HIV status				
Negative/unknown	1381	88%	1020	74%
Positive	180	12%	143	79%
Age (years)				
18–25	241	15%	174	72%
26–35	373	24%	281	75%
36–45	339	22%	249	73%
46–55	287	18%	221	77%
56+ yr	304	19%	224	74%
Unknown	17	1%	14	82%
Sex				
Male	696	45%	506	73%
Female	865	55%	657	76%
Marital Status				
Not married/cohabiting	542	35%	387	71%
Married/cohabiting	1019	65%	776	76%
Religion				
Catholic	343	22%	280	82%
Muslim	22	1%	15	68%
Protestant	1118	72%	814	73%
Other	78	5%	54	69%
Education				
None/some primary	624	40%	467	75%
Completed primary education or more	937	60%	696	74%
Household asset wealth				
1st quintile (poorest)	313	20%	234	75%
2nd quintile	311	20%	225	72%
3rd quintile	313	20%	239	76%
4th quintile	312	20%	239	77%
5th quintile (least poor)	312	20%	226	72%
Village				
A	224	14%	176	79%
B	229	15%	178	78%
C	205	13%	141	69%
D	206	13%	155	75%
E	122	8%	90	74%
F	225	14%	166	74%
G	135	9%	111	82%
H	215	14%	146	68%
Interview Date				
Feb 2021–Apr 2021	242	16%	197	81%
May 2021–Jul 2021	481	31%	334	69%
Aug 2021–Oct 2021	364	23%	248	68%
Nov 2021–Jan2022	143	9%	106	74%
Feb 2022–Apr 2022	125	8%	106	85%
May 2022–Jul 2022	166	11%	141	85%
Aug 2022–Oct 2022	40	3%	31	78%

indicated that perception about others' vaccine acceptance was associated with personal vaccine acceptance (Table 2). For example, participants who believed that all or almost all same-village adults were willing to get vaccinated were more likely to accept the vaccine themselves (adjusted relative risk [aRR] = 1.15; 95% confidence interval [CI]: 1.13–1.17; $p < 0.001$) compared to participants who thought that most but not all adults in their village were willing to get vaccinated. Participants who mistakenly thought less than half of same-village adults were willing to get vaccinated were personally less willing to get vaccinated themselves (aRR = 0.81; 95% CI: 0.70–0.94, $p = 0.005$) when compared to adults who thought most but not all adults in their village would vaccinate. Similarly, participants who mistakenly thought few or no same-village adults were willing to get vaccinated were also less willing to get vaccinated (aRR = 0.65; 95% CI: 0.50–0.85; $p = 0.001$). Given the small number of villages ($n = 8$), we also fit a model with village fixed effects and robust standard errors; estimates were similar.

Belief in the protective nature of the vaccine against infection was also associated with increased personal willingness to get vaccinated against COVID-19 (aRR = 2.42; 95% CI: 2.13–2.74; $p < 0.001$). Sociodemographic factors associated with being personally willing to get vaccinated against COVID-19 included being a woman (aRR = 1.05; 95% CI: 1.02–1.08; $p = 0.002$) and being Catholic (aRR = 1.07; 95% CI: 1.03–1.11; $p = 0.001$).

4. Discussion

This cross-sectional study of almost all permanent resident adults across eight villages in rural southwestern Uganda assessed perceived and actual behavioral norms about willingness to get a COVID-19 vaccine, the prevalence of norm misperceptions, and the extent to which perceived norms were associated with personal vaccine acceptance. There were two key findings. First, almost 1 in 5 adults mistakenly thought that most other villagers were unwilling to get vaccinated. False consensus and pluralistic ignorance were both present, representing different entry points for strategies to correct misperceptions and motivate change at the individual and community levels. Second, participants who perceived that most other villagers were willing to get vaccinated against COVID-19 were themselves more willing to get vaccinated when compared to participants who mistakenly thought that most would not get a COVID-19 vaccine. Results from this study are supported by studies from other settings finding associations between social norms and willingness to receive a COVID-19 vaccine [54–57].

These results highlight the potential benefit of flipping the

Table 2
Modified Poisson regression model estimating associations between personal willingness to get a COVID-19 vaccine and sociodemographic factors, personal beliefs, and perceived norms among adults across eight villages in Rwampara District, southwestern Uganda (N = 1561 adults).

	Definitely willing to get a COVID-19 vaccine (vs. any hesitance)		
	aRR	(95% CI)	*p*-value
Perceived norm about COVID-19 vaccine uptake willingness among adults in own village			
Thought that all or almost all village peers were willing to get vaccinated	1.15	(1.13–1.17)	<0.001
Thought that more than half but not all village peers were willing to get vaccinated	REF	–	–
Mistakenly thought that less than half but more than a few village peers were willing to get vaccinated	0.81	(0.70–0.94)	0.005
Mistakenly thought few or no village peers would get vaccinated	0.65	(0.50–0.85)	0.001
Did not know how many village peers would get vaccinated	0.76	(0.56–1.02)	0.066
Vaccine effectiveness			
Believed vaccine is definitely protective	2.42	(2.13–2.74)	<0.001
Did not think vaccine is protective	REF	–	–
Past vaccine refusal as adult			
Yes	1.06	(0.95–1.18)	0.304
No	REF	–	–
Knew someone who had COVID-19			
Yes	1.02	(0.98–1.06)	0.408
No	REF	–	–
Perceived personal COVID-19 risk			
None	REF	–	–
Low	0.92	(0.86–0.97)	0.004
Medium	1.00	(0.93–1.08)	0.976
High	0.95	(0.90–1.01)	0.136
Unknown	1.08	(0.73–1.60)	0.701
Believes coronavirus conspiracy theory			
Yes	0.97	(0.92–1.03)	0.313
Unknown	0.93	(0.81–1.08)	0.340
No	REF	–	–
HIV status			
Yes	1.05	(0.96–1.15)	0.307
No/unknown	REF	–	–
Sex			
Female	1.05	(1.02–1.08)	0.002
Male	REF	–	–
Age (years)			
18–25	REF	–	–
26–35	1.04	(0.95–1.14)	0.372
36–45	1.00	(0.92–1.07)	0.908
46–55	1.09	(0.98–1.20)	0.108
56+ yr	1.02	(0.95–1.10)	0.607
Unknown	1.11	(0.97–1.28)	0.135
Marital Status			
Not married/cohabiting	REF	–	–
Married/cohabiting	1.04	(0.99–1.09)	0.141
Religion			
Catholic	1.07	(1.03–1.11)	0.001
Muslim	0.96	(0.73–1.27)	0.778
Protestant	REF	–	–
Other	0.96	(0.86–1.08)	0.536
Education			
None/some primary	REF	–	–
Completed primary education or more	1.00	(0.95–1.04)	0.855
Household asset wealth			
1st quintile (poorest)	1.02	(0.94–1.11)	0.596
2nd quintile	0.97	(0.92–1.02)	0.234
3rd quintile	1.02	(0.96–1.09)	0.487
4th quintile	1.00	(0.93–1.08)	0.968
5th quintile (least poor)	REF	–	–
Interview date (consecutive days since baseline)	1.00	(1.00–1.00)	0.580

aRR = adjusted relative risk ratio, CI = confidence interval.

misperceived social norm scripts that many people hold. This study builds on a growing body of research indicating that correcting misperceived norms about COVID-19 vaccination willingness among peers could bolster individuals' willingness to get a COVID-19 vaccine [23,38]. Educating community members about actual community vaccination rates has increased vaccination uptake across multiple low- and middle-income countries [58]. In Uganda, learning about local rates of vaccine acceptance among peers could motivate those who were previously unwilling to get the vaccine. Promotion of accurate norms could also improve willingness to get vaccinated against COVID-19 among those who might not have been previously influenced by misperceived norms. Additionally, learning about actual local norms could prompt adults to initiate discussions about the benefits of COVID-19 vaccination and how to navigate access barriers. Likewise, individuals who were already willing to get a vaccine, but who thought their stance was uncommon, may be more willing to talk about the vaccine in a positive light.

In addition to encouraging unvaccinated individuals to consider vaccination, disseminating information about local norms around vaccine uptake could increase booster vaccine access in local communities as COVID-19 continues to circulate among vulnerable populations [59]. Furthermore, as scientists work toward the development of an HIV vaccine, these findings have direct translational effects for public health interventions to maximize future HIV vaccination uptake [60]. While HIV vaccination is of particular relevance to this population, these findings likely extend to vaccines across a range of health contexts. Future research should explore whether similar misperceived norm patterns replicate for other vaccines relevant to rural Ugandan communities, including those for malaria, Ebola, and other infectious diseases [61,62]. Likewise, misperceived norms may exist around vaccines for other sexually transmitted diseases like HPV given the stigma and secrecy that could be associated with such prevention measures [63]. By pairing a social norms campaign promoting real local norms in support of vaccination with other strategies targeting direct behavior change (e.g., reminders, incentives, default appointments) [64], or with strategies addressing vaccine efficacy and trustworthiness [65], vaccine acceptance may increase.

Other factors in this study are worth noting. Belief that the COVID-19 vaccine protects against infection was strongly associated with personal willingness to get vaccinated, suggesting that social norms messaging alone may not be sufficient. If someone doubts whether the vaccine actually works, knowing that others are willing to get vaccinated may not be enough to shape behavior. Norms-correction campaigns should thus be paired with efforts to correct misinformation about vaccine efficacy and safety [66].

Findings also suggest that outreach may need to be adapted for different groups. Women reported greater vaccination willingness than men. Thus, outreach efforts directed at men may require additional strategies. Women could play a role in encouraging uptake among family and community members. Being of Catholic religion was also associated with greater willingness to get vaccinated. Religious institutions are central to daily life in rural Uganda, and faith leaders are often among the most trusted figures in their communities. Partnering with church leaders to share accurate information about local vaccination norms and vaccine efficacy may be a promising strategy. The association with Catholic affiliation also raises questions about whether members of other religious groups hold specific concerns that should be explored and addressed through engagement with their own religious leaders. These same faith-based partnerships could be relevant for building receptivity to a future HIV vaccine.

There are limitations to this study. First, the data are cross-sectional and causality cannot be inferred. Second, injunctive norms (i.e., expectations about others' attitudes) about COVID-19 vaccination were not assessed. Future research should consider exploring the influence of injunctive norms on willingness to receive a COVID-19 vaccine. Third, findings cannot be generalized beyond the study context. However, most Ugandans live in rural regions of the country, and the targeted study

area is similar to areas across eastern and southern Africa. Fourth, the study does not assess COVID-19 diagnosis history and actual vaccine uptake. The study began in 2021 before many participants in the study setting had anecdotally reported contracting COVID and before COVID-19 vaccines were widely available and accessible in Uganda. Thus, the study does not explore how misperceived norms affect actual vaccine uptake. Future studies should investigate the link between social norms and receiving a COVID-19 vaccine. Fifth, personal willingness and perceived norms were each assessed with single items adapted for this setting rather than previously validated scales. The norm item also used broad categorical ranges rather than a continuous estimate. Use or development of parallel validated scales for this setting, one assessing personal vaccine COVID-19 hesitancy and the other assessing perceived peer norms, would allow direct comparison of the two measures and strengthen future work in this area.

Despite these limitations, this study contributes important evidence on the extent to which social norms, and specifically misperceived norms, can influence personal attitudes about COVID-19 vaccination. Creating a positive foundation for HIV vaccination warrants particular attention in this setting. Uganda continues to bear a significant HIV burden, and a future HIV vaccine would be an important prevention tool in rural communities where access to other prevention methods can be limited. As a vaccine is still under development, public attitudes toward an HIV vaccine are not yet established, meaning there is still time to identify and address misperceptions before they take root. Historical experiences with clinical research in eastern and southern Africa, including concerns about exploitation, informed consent, and control have fostered skepticism toward externally introduced health interventions. In rural Uganda, trust in health interventions may often be shaped by community relationships and local norms. Understanding pandemic-era norm misperceptions may provide a window into understanding barriers that may arise around HIV vaccine acceptance.

5. Conclusions

COVID-19 vaccination remains a relevant public health concern, particularly in populations with higher rates of HIV. This study found that perceived social norms were associated with personal willingness to get vaccinated against COVID-19, yet almost one-fifth of adults mistakenly believed that most other adults in their village were unwilling to receive a COVID-19 vaccine. These findings suggest that interventions correcting misperceived norms about peers' willingness to get vaccinated could increase personal vaccine acceptance. Such efforts may be most effective when paired with activities that address misinformation about vaccine safety and efficacy, and when messaging is designed to reach specific groups (e.g., by sex, religious affiliation). Understanding how norm misperceptions and mistrust affect vaccine willingness in settings like rural Uganda could inform efforts to support uptake of a future HIV vaccine.

AI declaration

During revisions of this work, the authors used Claude Opus 5 for improving readibility and removing redundancies after drafts were closely read and revised by human authors. The author(s) reviewed and edited the output as needed and take full responsibility for the content of the published article.

CRediT authorship contribution statement

Jessica M. Perkins: Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Sarah Sowell Van Dyk:** Writing – review & editing, Formal analysis. **Charles Baguma:** Writing – review & editing, Project administration. **Calista B. Pointer:** Writing – review & editing, Writing – original draft. **Sehee Jeon:** Writing – original draft, Data curation, Conceptualization. **Melissa Luong:** Writing – review & editing. **Viola Kyokunda:** Writing – review & editing, Investigation, Data curation. **Patrick Gumisiriza:** Writing – review & editing, Investigation, Data curation. **Emily N. Satinsky:** Writing – review & editing, Project administration. **Bernard Kakuhikire:** Writing – review & editing, Project administration, Conceptualization.

Ethics declaration

Written informed consent to take part in the study and to publish the article has been obtained from all participants or their legal representatives. The privacy rights of participants have been observed.

This study was performed in compliance with relevant laws, regulatory frameworks and guidelines where the research took place.

This study was approved by the Mbarara University of Science and Technology Research Ethics Committee. (Approval No. 07/10-12)

Declaration of competing interest

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Data availability

Data will be made available on request.

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