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Exploring SARS-CoV-2 vaccine acceptance in Sierra Leone and Zimbabwe

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Abstract

Background & Aims. The coronavirus disease 2019 (COVID-19) has caused millions of deaths worldwide, making the uptake of effective vaccines critical to saving lives. In Sierra Leone and Zimbabwe, two countries selected for focus in a privately funded project to boost COVID-19 vaccination coverage through interventions carried out by faith-based networks in Africa, both supply- and demand-side challenges have made high rates of vaccination difficult to achieve. The current study seeks to describe vaccination rates and reasons for vaccine hesitancy in both Sierra Leone and Zimbabwe.

Methods. A cross-sectional survey was conducted face-to-face in Sierra Leone and Zimbabwe. This study uses frequency statistics and multivariate regression analysis to identify key demographic predictors of COVID-19 vaccination acceptance and to examine perceived COVID-19 infection vulnerability in both countries. The Health Belief Model was used as a framework for sorting and understanding findings.

Results and Conclusions. Individuals who were older, from Zimbabwe, and were healthcare workers or community leaders were more likely to be vaccinated. Those who were from Zimbabwe, had secondary or tertiary education, and were community leaders were more likely to be concerned about catching COVID-19 than community members. Faith leaders were less likely to be concerned about catching COVID-19 in public. These findings add to our understanding of attitudes that lead to vaccine hesitancy and uptake.

Keywords: COVID-19, vaccine acceptance, Sierra Leone, Zimbabwe

Introduction

Since the first reported case in late 2019, the coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 has led to approximately 676 million cases and 6.88 million deaths worldwide for a case fatality rate (CFR) of 1.0%.[1,2] With a population of approximately 15.5 million, Zimbabwe has experienced 5,671 COVID-19 deaths and 264,276 cases for a CFR of 2.15.[1] Sierra Leone, home to 8.42 million people, has experienced 126 COVID-19 deaths and 7,760 cases for a CFR of 1.62.

Highly effective vaccines first became available in 2021, however, both "supply side" and "demand side" challenges, together with misinformation, have become major obstacles to achieving vaccine uptake and national targets for vaccine coverage in Sierra Leone and Zimbabwe. "Supply-side" problems stemming from inequity in vaccine availability globally, vaccine distribution, and subsequent vaccine access are common in low-income countries.[3,4] As of March 2023, 69.8% of the world population, compared to only 28.4% of people residing in low-income nations, had received at least one dose of a COVID-19 vaccine.[5] When vaccines are made available, vaccine hesitancy, a "demand side" problem defined by the World Health Organization (WHO) as a "delay in acceptance or refusal of vaccines despite the availability of vaccination services," presents an equally daunting hurdle for public health.[6] The rapid development of COVID-19 vaccines appears to have only exacerbated vaccine anxiety and hesitancy around the globe, including in many African nations.[7] Only half (50%) of Zimbabweans surveyed indicated they would accept the vaccine, with 31% reporting undecided and 19% reporting they would reject the vaccine.[8] Respondents expressed concern that the vaccine would not be effective in preventing infection or reducing COVID-19 symptoms if infected. Just over half of all Zimbabweans have cited a lack of trust in government and other authorities in ensuring the safety and efficacy of COVID-19 vaccines.[8,9] Misinformation regarding vaccines generally has been a challenge in Zimbabwe since at least 2010, when a religious-led campaign discouraging vaccine uptake led to a measles outbreak in the country.[10] Recent studies have noted the discrediting of vaccines by religious organizations has greatly impacted Zimbabweans' decision to refuse the vaccine and has increased vaccine hesitancy generally.[11,12] COVID-19 prevention efforts in Sierra Leone have been similarly challenging due to distrust of the healthcare system, generally, and low trust in vaccines, specifically,[13] which may explain why vaccination rates in Sierra Leone are lower than in most developing nations.[12] A 2021 survey of Sierra Leoneans identified significant concerns related to the COVID-19 vaccines, including 1) safety and efficacy given their rapid development and approval; 2) distrust of the government and healthcare system; and 3) disbelief in the reality of the COVID-19 pandemic.[14] The spread of misinformation in Sierra Leone regarding the legitimacy of the virus and the safety of the COVID-19 vaccine has increased vaccine hesitancy throughout the country. Some healthcare workers, including physicians, nurses, and medical students in Sierra Leone, have also remained hesitant.[15]

Faith-based organizations (FBOs), including both faith communities and faith leaders, can be instrumental in health promotion efforts. FBOs often enjoy access to, and influence with individuals and communities that government and other non-government organizations have difficulty reaching or influencing. Health promotion efforts inclusive of FBOs stand to benefit on a variety of levels, from tangible existing networks, lines of communication, and large numbers of volunteers to the intangible trust in, reverence for, and sway of faith leaders.[16] Outcomes improve when government and NGO partners collaborate with FBOs early during the developmental stages of a project rather than contracting with them later to accomplish predefined goals and objectives.[17] While FBOs did not have a significant role in developing the initial Ebola response, their role in mobilization and community engagement, specifically addressing high-risk burial procedures, was significant in eventually halting disease

transmission.[17] More recently, faith leaders have used religious texts to combat vaccine hesitancy and support public health messaging.[18] In Sierra Leone, vaccine confidence was highest among those who received immunization information from faith leaders.[19]

Constructs of the Health Belief Model (HBM) are beneficial in understanding, analyzing, and predicting the acceptance of health-promoting behaviors like vaccinations.[20] The HBM is a value expectancy theory postulating that an individual's desire to prevent an illness (value) and one's belief that a specific health action available would prevent or ameliorate illness (expectancy) is predictive of specific health behaviors. Key constructs of the HBM include *perceived susceptibility*, or an individual's subjective perception of her risk of contracting a health condition, and *perceived severity*, an individual's opinion of how serious a condition and its symptoms or health consequences would be if contracted or infected.[21] The combination of *perceived severity* and *perceived susceptibility* equates to an individual's *perceived threat*. The HBM theorizes that for behavior change or action to occur, individuals must feel threatened by their current choices and the subsequent expected outcomes. The HBM also includes the constructs of *perceived benefits* and *perceived barriers* of action, which also impact health behavior change efforts. *Perceived benefits* highlight what can be expected, typically the positive effects of a specific action.[21] *Perceived barriers* refer to the tangible and psychological costs of the health-promoting action. Finally, *cues to action* include information, people, and events that guide an individual to a specific health action. Accuracy in perceiving both benefits and barriers, together with timely and appropriate cues to a particular action, requires the gaining of new knowledge or information as well as the correcting of existing misinformation.[21] The HBM has been used as a theoretical framework for predicting the uptake of numerous health-promoting behaviors, including COVID-19 vaccine uptake intentions.[22,23] Wong et al. found HBM constructs to be predictive of potential COVID-19 vaccine acceptance in an online cross-sectional survey completed by a large sample of Malaysians.[22] Zampetakis and Melas similarly found support for HBM constructs in predicting COVID-19 vaccine uptake among a study sample of online cross-sectional respondents in Greece.[23]

Gaining insight and understanding of the attitudes regarding COVID-19 vaccine safety and effectiveness that led to vaccine acceptance or refusal is a priority in both Sierra Leone and Zimbabwe for future pandemics. Sheku et al. report that 20% of respondents to an online survey administered in Sierra Leone would reject the COVID-19 vaccines.[14] In a similar online survey, Faye et al. found that 50% of respondents in Sierra Leone were accepting of COVID-19 vaccines, and 61% reported feeling at risk of getting infected with the virus.[24] The strongest predictors of vaccine acceptance were perceived effectiveness and perceived safety of the vaccines. Demographic variables such as sex, rural/urban residence, and educational attainment were not significant factors associated with COVID-19 vaccine intentions in the study.[24] Mundagowa et al. similarly used an online survey to examine vaccine hesitancy in Zimbabwe.[8] Approximately half (49%) indicated that they would accept the COVID-19 vaccines. Vaccine hesitancy among this sample was primarily driven by concerns of vaccine effectiveness (76%) and vaccine safety (55%). Low perceived severity of COVID-19 infection was also a deterrent to vaccine uptake as those respondents who had previously contracted COVID-19 indicated that their infection was not severe (37%) or that they had not experienced severe symptoms due to infection (14%). Demographic factors associated with vaccine acceptance among the study sample included being a healthcare worker, male, and having at least one chronic health condition.[8] Results reported by Mundagowa et al. [8] were similar to those of McAbee et al.,[9] who found 56% of their study sample from Eastern Zimbabwe were accepting of the COVID-19 vaccines. Vaccine acceptance was associated with confidence in vaccine safety, being a male head of household,

and higher educational attainment.[9] The study conducted by McAbee et al. in Zimbabwe is unique in that it is one of the few studies utilizing in-person data collection.[9] To date, most studies exploring COVID-19 attitudes and intentions related to vaccine acceptance have used online survey instruments. In addition, no studies to date have collaborated with FBOs, generally, or utilized the extensive network of various Christian Health Associations, specifically, for data collection. The current study uses an in-person data collection design as part of the Africa Christian Health Associations Platform (ACHAP) CoV-FaB project titled *Promoting COVID-19 Vaccine Equity through Faith-Based Networks in Africa* to address COVID-19 attitudes and predictors of vaccine acceptance in both Sierra Leone and Zimbabwe. The current study adopted the following study aims: 1) describe COVID-19 related attitudes and practices among adults in Sierra Leone and Zimbabwe; 2) identify key demographic predictors of COVID-19 vaccination acceptance; and 3) gauge perceived COVID-19 infection vulnerability in both countries.

Methods

Design. Data for this study came from a cross-sectional survey conducted simultaneously in Sierra Leone and Zimbabwe during July and August of 2022. In both countries, assessments were conducted face-to-face using a survey instrument designed by ACHAP with the agreement of consortium partners, IMA World Health, Internews, and in-country implementing partners, the Christian Health Association of Sierra Leone (CHASL) and Zimbabwe Association of Church-Related Hospitals (ZACH).

A mix of qualitative and quantitative methods was used to gather and analyze data/information. This assessment included secondary data as well as primary data based on the results framework and its indicators of the project. The project adapted the Centers for Disease Control and Prevention (CDC) Rapid Community Assessment guide for COVID-19 vaccines for both the community survey tool and the CDC COVID-19 Rapid Assessment Focus Group Discussion (FDG) guide, plus the Implementation Guide for Key Informant Interviews (KIIs) and Listening Sessions Guide for COVID-19 Vaccine Hesitancy in collecting quantitative and qualitative data.

Sample. Participants in this study were members, both congregants and leaders, of ACHAP in either Sierra Leone's affiliate (CHASL) or Zimbabwe's equivalent (ZACH). These countries were selected because they presented diverse settings for the study, had a strong affiliate relationship with ACHAP, and were able to participate in the study. ACHAP's leadership made potential respondents from among its members aware of the study via an email sent during the month of July 2022. Respondents were recruited from among the ACHAP members in designated areas to mirror national distributions of gender and urban/rural populations as both characteristics could influence vaccine hesitancy. Respondents willing to participate met enumerators during designated times when the enumerators were in the area. Specifically, mirroring national distributions of gender and urban/rural living were targeted as both characteristics that could influence vaccine hesitancy. In Sierra Leone, 1,158 responses were collected with 1,154 responses in Zimbabwe. The total sample included 2,312 respondents.

Procedure. Participants were recruited from the communities within the project catchment to participate in the face-to-face survey and were asked to acknowledge their interest and willingness by providing their contact information and scheduling a date to meet with the data collection team. Data were collected by trained enumerators contracted by CHASL in Sierra Leone and ZACH in Zimbabwe. Enumerators traveled to respondents' homes and obtained informed consent before completing the 20-minute interview. Respondents were assured that their participation was voluntary. Inclusion criteria included being 18 years of age or older and the ability to speak English. Ethical clearance for publication of this study's data was approved

by the Brigham Young University Institutional Review Board (IRB#: IRB2023-026).

Measurement. The questionnaire (see Appendix A) used in this study was constructed collaboratively and included inputs from ACHAP, IMA World Health, Internews, CHASL, and ZACH. The instrument was designed in English, and specific items were tested in focus groups conducted in Sierra Leone and Zimbabwe. The instrument was then revised in accordance with the feedback, and all partners agreed upon the final version. The questionnaire consisted of five sections, including demographics, personal experiences with COVID-19, vaccination likelihood, vaccination confidence, and exposure to vaccine information.

Demographic items included age, gender, employment, level of education obtained, and information about pre-existing medical conditions. Experience with COVID-19 included whether the respondent had ever had COVID-19 and the perceived potential severity of COVID-19. Items about vaccination likelihood were designed to measure the extent to which respondents would receive a COVID-19 vaccine if or when it was available. Multiple items were used to measure respondents' confidence in the COVID-19 vaccine and asked them to state their perceptions on the safety of the vaccine and what information they would need to feel more confident in COVID-19 vaccines. In the final section, respondents were asked to recall the types and sources of COVID-19 information to which they had been exposed. This included the extent to which they felt that information from sources such as the Ministry of Health was sufficient and accurate.

Analysis. STATA 17 (College Station, Texas) was used for all analyses. Data were cleaned prior to analysis. Frequency statistics were computed to describe the study sample. Multivariate regression analysis was used to explore the factors associated with vaccination likelihood, vaccination confidence, and exposure to vaccine information. All models included independent variables for gender, age, level of education obtained, country/setting, and role or relationship within ACHAP.

Results

More women were surveyed in Zimbabwe (57.0%), while slightly more men (51.1%) were interviewed in Sierra Leone (see Table 1). Approximately half (50.3%) of all respondents were between 25 and 49 years of age. Most respondents in both Zimbabwe (67.0%) and Sierra Leone (51.9%) had a secondary education. Most respondents were community members (68.2%); followed by "other" (13.9%), which was comprised primarily of teachers, farmers, business people, and community leaders (8.5%). Just over a quarter (27.6%) of respondents had an existing health condition.

Table 1. Demographics

	Zimbabwe N=1154	Sierra Leone N=1158	Total Indicator
Female	57.0	48.9	52.9
Age (years)			
18-19	9.8	9.6	9.7
20-24	13.2	23.2	18.2
25-49	48.1	52.4	50.3
50+	28.9	14.8	21.8
Education			
Primary	25.2	20.5	22.9
Secondary	67.0	51.9	59.5
Tertiary	7.8	27.6	17.7
Group			
Community member	68.9	67.5	68.2
Faith leader	4.2	6.6	5.4
Healthcare worker	1.5	6.6	4.0
Community leader	5.6	11.4	8.5
Other	19.9	7.9	13.9
Has a health condition	26.2	29.0	27.6

Every COVID-19 vaccine indicator is presented for Zimbabwe and Sierra Leone separately and combined (see Table 2). While nearly half (43.8%) of all respondents received a COVID-19 vaccine, the total varied by country with 55.6% and 32.0% of respondents in Zimbabwe and Sierra Leone respectively received the vaccine. Only 10.5% respondents in Zimbabwe and 31.0% in Sierra Leone reported that the vaccine was risky, while just over half of Zimbabweans (50.9%) and less than half (36.2%) of those in Sierra Leone considered it to be very safe. Most Zimbabweans (66.8%) and 32.8% of respondents from Sierra Leonians were likely to recommend the vaccine to others. Most respondents from Zimbabwe were likely to take the vaccine if it were free (59.9%), believe it was easy to receive (62.0%), knew where to get accurate and timely COVID information (75.4%), were concerned about getting infected at work (52.1%) and in public (54.6%), and concerned about infecting others (59.4%). Less than half of Sierra Leoneans were likely to get the vaccine if free (37.0%), believed it would be easy to receive the vaccine (39.0%), knew where to get accurate and timely COVID information (46.1%), were concerned about getting infected at work (39.8%) and in public (40.6%), and concerned about infecting others (48.6%).

Table 2. Key COVID Vaccine Indicators

Indicator	Zimbabwe	Sierra Leone	Total
Received vaccine	55.6	32.0	43.8
Believes vaccine is extremely risky	10.5	31.0	20.7
Very likely would take vaccine if free	59.9	37.0	48.5
Very likely to recommend vaccine to others	66.8	38.2	52.5
Believes it would be very easy to receive vaccine	62.0	39.0	50.4
Believes the vaccine is very safe	50.9	36.2	43.6
Knows where to get accurate, timely COVID-19 vaccination information	75.4	46.1	60.8
Refused to be vaccinated	37.2	66.2	50.3
Personally know someone who became seriously ill or died from COVID	40.4	13.1	26.8
Very concerned about getting infected at work	52.1	39.8	45.9
Very concerned about getting infected in public	54.6	40.6	47.6
Very concerned will infect family or friends	59.4	48.6	54.0

Results of logistic regression modeling are found in Table 3. Respondents who were older, from Zimbabwe, healthcare workers and community leaders (compared to community members), were all more likely to be vaccinated.

Table 3. Predictors of Vaccination (Logistic regression)

	Coef.	St. Err.	t-value	p-value	95% CI	Sig
Gender (Ref: male)						
Female	.947	.087	-0.59	.554	(.792, 1.133)	
Age	1.466	.082	6.82	0	(1.313, 1.636)	***
Country (Ref: Zimbabwe)						
Sierra Leone	.324	.032	-11.40	0	(.267, .393)	***
Education (Ref: primary)						
secondary	.942	.108	-0.52	.603	(.752, 1.18)	
tertiary	1.09	.165	0.57	.571	(.809, 1.467)	
Role (Ref: community member)						
faith leader	1.458	.297	1.85	.065	(.977, 2.174)	*
healthcare worker	5.027	1.233	6.59	0	(3.109, 8.129)	***
community leader	2.654	.45	5.75	0	(1.903 3.701)	***
other	1.254	.165	1.72	.086	(.968, 1.624)	*
Mean dependent var.	0.44		SD dependent var.		0.50	
Pseudo r-squared	0.09		Number of obs.		2277	
Chi-square	285.76		Prob > chi2		0.00	
Akaike crit. (AIC)	2854.05		Bayesian crit. (BIC)		2911.36	

Notes. *** p<.01, ** p<.05, * p<.1

Results of linear regression modeling are presented in Tables 4, 5, and 6. Study participants who were older, from Zimbabwe, had secondary or tertiary education and were community leaders (compared to community members), were all more likely to be concerned about catching COVID at work (see Table 4). Similarly, those who were older, from Zimbabwe, had secondary or tertiary education and were community leaders (compared to community members), were all more likely to be concerned about catching COVID in public (see Table 5). Conversely, faith leaders were less concerned than community members regarding catching COVID in public. Respondents most concerned about infecting others were women, older, from Zimbabwe, had secondary or tertiary education, and were community leaders (compared to community members) (see Table 6).

Table 4. Predictors of Those Concerned They Will Become Infected at Work (Linear regression)

	Coef.	St. Err.	t-value	p-value	95% CI	Sig
Gender (Ref: male)						
Female	.038	.048	0.79	.428	(-.056, .132)	
Age	.154	.029	5.34	0	(.097, .21)	***
Country (Ref: Zimbabwe)						
Sierra Leone	-.39	.051	-7.66	0	(-.489, -.29)	***
Education (Ref: primary)						
secondary	.186	.06	3.09	.002	(.068, .304)	***
tertiary	.407	.079	5.13	0	(.251, .562)	***
Role (Ref: community member)						
faith leader	-.081	.107	-0.76	.448	(-.291, .129)	
healthcare worker	.011	.125	0.09	.929	(-.233, .256)	
community leader	.217	.089	2.45	.014	(.043, .391)	**
other	-.084	.071	-1.19	.234	(-.222, .054)	
Mean dependent var.	2.93		SD dependent var.		1.15	
R-squared	0.05		Number of obs.		2260	
F-test	14.41		Prob > F		0.00	
Akaike crit. (AIC)	6947.62		Bayesian crit. (BIC)		7004.86	

Notes. *** p<.01, ** p<.05, * p<.1

Table 5. Predictors of Those Concerned They Will Become Infected in Public (Linear regression)

	Coef.	St. Err.	t-value	p-value	95% CI	Sig
Gender (Ref: male)						
Female	.075	.046	1.64	.102	(-.015, .166)	
Age	.156	.028	5.64	0	(.102, .211)	***
Country (Ref: Zimbabwe)						
Sierra Leone	-.503	.049	-10.29	0	(-.598, -.407)	***
Education (Ref: primary)						
secondary	.191	.058	3.29	.001	(.077, .304)	***
tertiary	.432	.076	5.67	0	(.282, .581)	***
Role (Ref: community member)						
faith leader	-.225	.104	-2.16	.031	(-.429, -.021)	**
healthcare worker	.088	.12	0.73	.463	(-.147, .323)	
community leader	.231	.085	2.71	.007	(.064, .398)	***
other	-.296	.068	-4.36	0	(-.429, -.163)	***
Mean dependent var.	2.98		SD dependent var.		1.13	
R-squared	0.08		Number of obs.		2273	
F-test	22.86		Prob > F		0.00	
Akaike crit. (AIC)	6814.15		Bayesian crit. (BIC)		6871.43	

Notes. *** p<.01, ** p<.05, * p<.1

Table 6. Predictors of Those Concerned They Will Infect Family and Friends (Linear regression)

	Coef.	St. Err.	t-value	p-value	95% CI		Sig
Gender (Ref: male)							
Female	.092	.045	2.05	.041	.004	.179	**
Age	.14	.027	5.21	0	.088	.193	***
Country (Ref: Zimbabwe)							
Sierra Leone	-.363	.047	-7.64	0	-.456	-.269	***
Education (Ref: primary)							
secondary	.151	.056	2.68	.007	.04	.261	***
tertiary	.394	.074	5.32	0	.248	.539	***
Role (Ref: community member)							
faith leader	-.056	.1	-0.55	.579	-.252	.141	
healthcare worker	.052	.117	0.44	.658	-.178	.281	
community leader	.22	.083	2.66	.008	.058	.383	***
other	-.218	.066	-3.30	.001	-.347	-.088	***
Mean dependent var.	3.13		SD dependent var.		1.08		
R-squared	0.06		Number of obs.		2272		
F-test	15.76		Prob > F		0.00		
Akaike crit. (AIC)	6681.81		Bayesian crit. (BIC)		6739.09		

Notes. *** p<.01, ** p<.05, * p<.1

Discussion

The objective of this study was not to compare COVID-19 attitudes and practices in Sierra Leone and Zimbabwe. Indeed, results varied greatly between the two countries as might be expected among any two nations with distinct geographic, social, cultural, and political landscapes. Rather this study sought to describe COVID-related attitudes and practices generally, identify key demographic predictors of COVID-19 vaccination acceptance; and gauge perceived COVID-19 infection vulnerability in both countries. The study also explored how key constructs of the HBM may influence COVID-related attitudes and behavior and juxtapose the study's findings with the extant literature. Among participants in the current study, vaccine uptake in Sierra Leone was significantly lower (32%) than in Zimbabwe (55%). These findings vary somewhat from current estimates for all of Sierra Leone and Zimbabwe. These differences are likely due, at least in part, to selection bias in our current study and the resulting inability to generalize our uptake rates to the entire country. Reporting on the COVID-19 dashboard, maintained by the Johns Hopkins University Coronavirus Resource Center until March 10, 2023, indicates that 59% of Sierra Leoneans received at least one dose of the COVID-19 vaccines compared to 44% of Zimbabweans.[25] Zimbabwean respondents in the current study, thus, may not be representative of the country at large. Nonetheless, Zimbabwean respondents in the current study were more trusting of COVID-19 vaccines generally and were more likely to consider the vaccines safe. Nearly one-third of respondents from Sierra Leone considered COVID-19 vaccines to be risky, and approximately two-thirds indicated they would not recommend the vaccines to others. Leach et al. identified common vaccine-related concerns among residents of two villages in Sierra Leone.[26] A wide variety of concerns were expressed, ranging from the speed at which the COVID-19 vaccines were developed and approved to the suspicion that powerful foreign

governments had engineered the virus and pandemic response to reduce fertility on the African continent.

The HBM would assume increased motivation for COVID-19 vaccine uptake with increases in perceived severity and perceived susceptibility of the virus. The current study found that approximately 25% more Zimbabwean respondents received the vaccine than Sierra Leonean respondents. Significantly more Zimbabweans in the current study also reported personally knowing someone who had been seriously ill or died from COVID-19. The HBM would predict that proximity to morbidity and mortality caused by the COVID-19 virus increases both perceived susceptibility and perceived severity. By contrast, in their study on vaccine anxiety and preparedness, Leach et al. note that Sierra Leoneans did not consider COVID-19 to be a serious disease, especially when compared to Ebola, which killed more than 4,000 Sierra Leoneans — 32 times the number of lives lost to COVID-19 in a similar three-year period.[7,26] Few Sierra Leoneans had known someone who had experienced COVID-19 symptoms in their area, leading to decreased perceptions of susceptibility and severity.[26] Indeed, COVID-19 cases and mortality have varied greatly between Zimbabwe and Sierra Leone and may help to explain the current study's findings. As of March 10, 2023, when the Corona Virus Resource Center at Johns Hopkins University stopped collecting data, there were a total of 264,276 reported cases and 5,671 reported deaths in Zimbabwe compared to just 7,760 reported cases and 126 reported deaths in Sierra Leone.[1,2,25] This equates to approximately one death for every 2,724 people living in Zimbabwe and only one death for every 66,809 people living in Sierra Leone. The CFR for Zimbabwe is also 25% higher than that of Sierra Leone.

While not unique to West Africa, inadequate testing and underreporting in Sierra Leone may explain some of the current study's findings. Nonetheless, the massive disparities in recognized COVID-19 cases and deaths helps to explain Zimbabweans' increased concern for getting infected at work and getting infected in public as well as their heightened concern for infecting others. When findings of the current study and others are considered in aggregate, Zimbabweans appear to maintain a higher perception of threat based upon an increased perceived susceptibility and perceived severity when compared to Sierra Leoneans. Examples of increased perceived susceptibility for contracting COVID-19 both in public or at work identified in the current study included being older, being from Zimbabwe, having a secondary or tertiary education, and being a community leader. These findings are logical based on the heightened perceived severity of COVID-19 among Zimbabweans and are further predictive of vaccine acceptance and willingness to receive the vaccine based on the HBM.

According to the HBM, perceived benefits of vaccination are predictive of vaccine uptake, while perceived costs are predictive of vaccine hesitancy. Leach et al. identified a common belief that COVID-19 vaccines are both unproven and unnecessary if an individual is asymptomatic or not currently infected to be a driver of vaccine hesitancy and refusal in Sierra Leone.[26] Community members may perceive fewer benefits to vaccination than healthcare workers and community leaders, given their potentially decreased exposure to COVID-19 morbidity, mortality, and information.[26] It is also possible that Zimbabweans, older respondents, community leaders, and those with secondary or tertiary education in this study may have perceived additional benefits to vaccination given the potential for increased exposure to COVID-19 in Zimbabwe, increased risk of COVID-19 mortality due to age, greater access to COVID-19 information and messaging related to community leadership, greater exposure to vaccine information generally due to educational exposure. Consequently, Zimbabweans' comparatively low perceived costs and high perceived benefits to COVID-19 vaccines, as manifested by their being significantly less likely to consider the vaccine risky, significantly more likely to recommend the vaccine to others and significantly more likely to receive the

vaccine is perhaps indicative of greater exposure to, and the heavier burden of, COVID-19 in their country. Findings from the current study are generally consistent with those of Acheampong et al. in Ghana, where intended vaccine uptake was highest for older respondents and respondents with secondary education (62%), master's degree (59%), and bachelor's degree (51%).[27] Acheampong et al. identified the three primary reasons for vaccine acceptance among Ghanaians in their study: 1) it will help protect family, friends, and community members; 2) the vaccine is effective at preventing contraction of the virus; and 3) a public health responsibility to help fight the pandemic.[27]

This study's finding that faith leaders were significantly less concerned than other community members about contracting COVID-19 in public is challenging to explain and should be the focus of follow up studies. Health promotion efforts can greatly benefit from those faith leaders supportive of health messaging, but when faith leaders are skeptical or suspicious of such messaging, their influence and sway can prove detrimental. Resistance to health messaging may relate to doctrines within some faith groups that reject modern medical interventions, such as vaccinations, in favor of divine protection. Kulkarni et al. found that information sources greatly impacted attitudes and behaviors in Sierra Leone.[19] Specifically, information received from health facilities, faith leaders, and community health workers was associated with an increased likelihood of vaccine acceptance. The authors conclude that vaccine acceptance was highest when multiple sources provided consistent and accurate vaccine information. It is essential that faith leaders support the health-promoting messages delivered by healthcare workers and community leaders.

The current study's findings on COVID-19 vaccine uptake and hesitancy should be considered in light of an emerging narrative related to vaccinations generally. Cooper et al. explored vaccine hesitancy in South Africa and concluded that public health communication strategies must be responsive to and thoughtfully consider how personal beliefs, experiences, culture, religion, and political leanings impact vaccine decisions.[28] Framing vaccine hesitancy simply as ignorance requiring reforming the uneducated public fails to acknowledge and address the impact of lived experiences, public mistrust, or historically compromised relations between the public and authority figures such as governments and healthcare providers. Drawing on this "knowledge deficit model," which paints ignorant public citizens as the primary barriers to immunization, similarly allows governments to avoid responsibility for ongoing "supply side" vaccination challenges.[7] Vandeslott et al. note that presenting public ignorance as the primary barrier to vaccine uptake in Sierra Leone helps to hide an underfunded public health workforce and likely barriers to uptake, including cold-chain issues.[7] Vanderslott and colleagues persuasively argue that the public ignorance narrative blaming vaccine hesitancy on a lack of public knowledge is overly simplistic, overlooks important contextual factors, fails to adequately listen to individuals and groups, and diverts needed attention from historical and systemic realities which must be addressed if vaccination efforts are to be successful. Leach et al. similarly discuss the problems of characterizing vaccine hesitancy as a "deficit" in public understanding and suggest re-casting hesitancy as anxiety.[26] The concept of vaccine anxiety, both positive and negative, allows for the exploration and examination of context-specific concerns and individual decision-making. This conceptualization diverts focus from what people do not think, know, or understand — a deficit or ignorance model — to what they do think, know, and understand. Utilizing a vaccine anxiety lens, Leach et al. examined public responses to the COVID-19 vaccine roll-out in Sierra Leone.[26] The authors identified a host of key factors associated with COVID-19 vaccine anxiety among Sierra Leoneans: 1) a belief that vaccines are for children only and unnecessary for adults; 2) the harsh public health procedures and treatments implemented during the 2014-15 Ebola outbreak fueled concerns about the COVID-19 response and vaccine; 3) a realization that COVID-19 is

comparatively less severe than Ebola and thus of little or no concern; 4) a belief that the vaccine is unnecessary if an individual is asymptomatic or not currently infected; 5) a belief that the COVID-19 vaccine is unproven; 6) a belief that COVID-19 is not new and that individuals had lived with it previously without harm; 7) few COVID-19 cases in the surrounding areas; 8) frustration concerning lock-down control measures when few in the surrounding areas were infected and the symptoms were mild; and 9) speculation that COVID-19 had been bioengineered by the United States or Chinese to weaken Africa by reducing fertility.[26] Using the vaccine anxiety framework presented by Leach et al. and more fully considering an individual's ideas and beliefs in the context of their lived experience will likely prove more effective for those promoting COVID-19 vaccines than immediately casting a judgment of ignorance.

The vaccine anxiety framework presents challenges related to trust generally and low perceived severity and susceptibility of COVID-19, specifically, that FBOs may be best positioned to address. Through extensive FBO networks like the Christian Health Associations affiliated with ACHAP, COVID-related misinformation and disinformation might be addressed efficiently by faith leaders who have the respect and trust of faith communities. Access and trust are invaluable assets in building support for, and confidence in, the COVID-19 vaccines.

The current study adds to the literature on COVID-19 attitudes related to vaccine acceptance. In particular, this study utilizes in-person data collection from a large study sample in two countries. However, results should be considered in light of several limitations. First, this study employs the HBM as a framework for sorting and understanding various findings but was not designed with the HBM in mind and does not address all HBM constructs. Second, this study relies on the self-report of respondents in the presence of data collection personnel which may have influenced responses due to perceived social desirability and social norms. In-person data collection can be a study strength when this methodology allows for clarification of responses or follow-up questions, but the current study did not employ this approach. Third, it is also important to note that this study was conducted at a point in the COVID-19 pandemic when effective vaccines had already been available for many months, and much of the population in each country had personal experience with exposure to vaccination and COVID-19 illness. Fourth, this study was part of a funded project operating on a limited budget preventing the inclusion of additional countries which could have allowed for further analyses and comparisons within and between countries/regions. Fifth, recruitment via email notification and convenience sampling in each study community make it impossible to accurately calculate the survey response rate. Finally, despite the current study's large sample size, results are not generalizable to all of Sierra Leone or Zimbabwe due to selection bias and should be interpreted with care.

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Appendix A. Questionnaire on COVID-19 vaccine hesitancy and confidence in communities

Country:	District: Ward:
Respondent ID:	Age range of respondent (years): 10 – 19 Years 20 – 24 Years 25 – 49 years 50 Years and above
Gender:	Profession:
Respondent category: Faith leader Health care worker Community leader Journalist Community member Other	
Educational level:	

1. Do you have any of the following conditions? [select all that apply]

Cancer	Obesity
Immunocompromised state due to therapy or disease	Diabetes (type 1 or 2)
Cardiovascular disease	Pulmonary disease
Other underlying condition	

2. To your knowledge, have you had COVID-19 before)? Circle:
   - ☐ Yes
   - ☐ No
   - ☐ I don't know

3. IF "Yes in (2) above," describe the status of condition you had, or are receiving:
   - ☐ I had suspected symptoms, but I didn't verify with a doctor and/or specific exams
   - ☐ No
   - ☐ Yes, with no symptoms
   - ☐ Yes, with mild symptoms
   - ☐ Yes, with severe symptoms

4. IF "Yes in (2) above," describe the level of care you received, or are receiving:
   - ☐ Did not seek medical care
   - ☐ Received medical care but was not hospitalized
   - ☐ Was hospitalized

5. If you have refused a vaccine in the past that was recommended to you by a healthcare worker – what was/were the reason(s)? [check all reasons that applied to that situation]

I never refused a vaccine recommended by a healthcare worker	
Did not think it was needed	
Did not have enough information on the vaccine	
Did not think the vaccine was effective	
Did not think the vaccine was safe	
I was concerned about side effects	
I had a bad experience with a previous vaccination	
Did not know where to get vaccination	
Other logistic problems	

6. How concerned are you of:

	Not at all	A little	Somewhat	Very
Contracting COVID-19 at work? (For example: office and other work settings that are not your home)				
Contracting COVID-19 outside of work? (For example: at the grocery store, when you are using transportation, or in other aspects of your daily life)				
Infecting your family or friends with COVID-19?				

7. Do you personally know anyone in your family, group of friends, or community networks who became seriously ill or died because of COVID-19?
   - ☐ Yes
   - ☐ No

8. Have you received a COVID-19 vaccine?
   - ☐ Yes
   - ☐ No

9. What is your perceived risk of the covid-19 vaccine?
   - ☐ Less risky
   - ☐ Somewhat risky
   - ☐ Extremely risky
   - ☐ I don't Know

10. Did you receive a vaccine product that requires only one dose or two doses?
   - ☐ One dose
   - ☐ Two doses
   - ☐ I don’t know

11. During what month/year did you receive the first dose of COVID-19 vaccine?

*Year ___	*Month _	Not sure

12. During what month/year did you receive the second dose of COVID-19 vaccine*?

*Year ___	*Month _	Not sure

13. Many COVID-19 vaccines have already been approved. If you were offered to get the vaccine - at no cost for you- how likely are you to take it?

Very likely	
Somewhat likely	
I am not sure	
Somewhat unlikely	
Very unlikely	
I would not take it within the near future, but I might reconsider it in the future with time	

14. How likely are you to recommend getting the COVID-19 vaccine to others?

Not at all likely	
Somewhat likely	
Extremely likely	

15. How easy do you think it will be to get a COVID-19 vaccine for yourself? Would you say…

Very easy	
Somewhat easy	
Somewhat difficult	
Very difficult	
Not sure	

16. What makes it difficult for you to get a COVID-19 vaccine? (Select all that apply)

I can't go on my own	
I have a physical limitation.	
It's too far away.	
I don't know where to go to get vaccinated.	
I'm not eligible to get a COVID-19 vaccine.	
I have a medical reason that makes me ineligible to get vaccinated (e.g., I have had a severe allergy to vaccines in the past).	
I don't have transportation.	
The hours of operation are inconvenient.	
The waiting time is too long.	
It is difficult to find or make an appointment.	
I am too busy to get vaccinated.	
It was difficult to arrange for childcare.	
I don't have time off work	
Not sure	

17. How safe do you think the COVID-19 vaccine will be for you? Would you say…

Not at all safe	
A little safe	
Moderately safe	
Very safe	

18. What would be important for you to know to make you more confident in the COVID-19 vaccine? (select up to three options)

The fast production of the vaccine did not compromise its safety	
Agencies approving the vaccines are following strict rules	
My risk of getting sick with COVID-19 is bigger than the risk of side effects from the vaccine	
The vaccine cannot cause any immediate or long-term injury	
It is impossible to get COVID-19 or any other disease from the vaccine itself or its components	
The vaccine works in protecting me from COVID-19	
The vaccine works in stopping the transmission of COVID-19 from one person to another	
Health agencies and WHO recommend the vaccine and agree it is safe	
I do not need any other information	
Other - please specify_____	

19. What would be important for you to know to make you more likely to take the COVID-19 vaccine? (select up to three options)

Once vaccinated I will be able to live my life with no restrictions	
Those with concerns about the vaccine have opportunities to share their opinions with the public	
Pharmaceutical companies will not make large profits from the vaccine	
Everybody will have equal access to the vaccine regardless of income or race	
I will be free to choose if I get the vaccine or not with no consequences	
There are no other reasons why so many people are sick (i.e. 5G technology or other unknown reasons)	

20. What would motivate you to get vaccinated or complete your vaccination schedule? (select all that apply)

Protect my health	
Protect health of family/friends	
Protect health of co-workers	
Protect health of community	
To get back to work/school	
To resume social activities	
To resume travel	
Because others encouraged me to get vaccinated	
Other/Not sure	

21. What is your most trusted source of information about COVID-19 vaccines?

Ministry of Health	
Employer	
Family and friends	
Hospital system websites	
Local health officials	
News sources (e.g., television, internet, and radio)	
Health care workers	
Professional organization(s)	
Religious leader(s)	
Online publishers of medical information (such as WebMD or Mayo Clinic)	
Social media (such as Facebook, Twitter, Instagram, WhatsApp, LinkedIn, or Tik- Tok)	
Union leader(s)	
Other	

22. Have you seen or heard any information about COVID-19 vaccines (e.g., on the news, on social media, or from friends and family) that you could not determine were true or false?
    - ☐ Yes
    - ☐ No
    - ☐ Not sure

23. How do you feel about the amount of information on COVID-19 vaccines that you are getting?
    - ☐ I'm not getting enough information
    - ☐ I'm getting enough information
    - ☐ I'm getting too much information

24. Do you know where to get accurate, timely information about COVID-19 vaccines?
    - ☐ Yes
    - ☐ No
    - ☐ Not sure

25. In your views, what can be done to increase COVID-19 vaccine demand and uptake in your community?

26. List down the most outstanding sources of COVID-19 vaccine misinformation and disinformation?

27. What can be done by the following categories to increase vaccine demand and uptake in communities?
    a. Health care workers
    b. Faith leaders
    c. Media personnel
    d. Local community leaders/gate keepers

Thank you for participating

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