BMJ Open

But the Vaccine Might Harm Me: Understanding Vaccine Acceptance and Messaging in Indigenous Populations in the Central Highlands of Guatemala

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-067210
Article Type:	Original research
Date Submitted by the Author:	06-Aug-2022
Complete List of Authors:	Skinner, Nadine; Stanford University School of Medicine, Sanders, Kelly; University of California San Francisco, Lopez, Emily; Maya Health Alliance Wuqu' Kawoq Sotz Mux, Magda; Maya Health Alliance Wuqu' Kawoq Abascal Miguel, Lucía; University of California San Francisco Vosburg, Kathryn; University of California San Francisco (UCSF) Johnston, Jamie; Stanford University School of Medicine, Stanford Center for Health Education Diamond-Smith, Nadia; University of California San Francisco, Epidemiology and Biostatistics Kraemer Diaz, Anne; Maya Health Alliance Wuqu' Kawoq
Keywords:	COVID-19, World Wide Web technology < BIOTECHNOLOGY & BIOINFORMATICS, QUALITATIVE RESEARCH, PUBLIC HEALTH

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

But the Vaccine Might Harm Me: Understanding Vaccine Acceptance and Messaging in Indigenous Populations in the Central Highlands of Guatemala

[1] Nadine Ann Skinner, [2] Kelly Sanders, [3] Emily Lopez, [3] Magda Silvia Sotz Mux, [2] Lucia Abascal Miguel, [2] Kathryn Bradford Vosburg, [1] Jamie Johnston, [2] Nadia Diamond-Smith, and [3] Anne Kraemer Diaz

[1] Stanford Center for Health Education, Digital Medic, Stanford University, United States
[2] Institute for Global Health Sciences, University of California, San Francisco, United States
[3] Wuqu´ Kawoq, Maya Health Alliance, Tecpán, Guatemala

*Corresponding author Nadine Ann Skinner, nas2@stanford.edu, Stanford Center for Health Education, Digital Medic, Stanford University, 408 Panama Mall, Stanford, California, 94305, United States

Word Count: 4,909

ABSTRACT

Introduction: As of July 2022, only a little over one third of Guatemalans are fully vaccinated. Non-governmental organizations, activists, and reporters have observed that COVID-19 vaccination rates are especially low among high-risk Indigenous populations. There are numerous potential barriers to COVID-19 vaccination in Indigenous populations in Guatemala, including (1) fears of side effects, (2) language barriers, (3) systemic and historical health inequities, (4) vaccine misinformation and myths, and (5) variable supply and availability. This qualitative study aimed to better delineate why these groups have low COVID-19 vaccine uptake in order to support the development of targeted human-centered designed media campaigns to increase vaccine uptake.

Methods: In November 2021, we conducted eight focus group discussions (FGDs) with 42 Indigenous men and women and 16 in-depth interviews (IDIs) with community health workers, nurses, and physicians conducted in the target departments of Chimaltenango and Sololá in the Central Highlands of Guatemala.

Results: Analysis of the FGDs and IDIs indicates that myths and misinformation about the vaccine are prevalent in Indigenous communities. The lack of information available in local languages and access challenges have increased fear and mistrust in the vaccine and public health systems, making the population especially vulnerable to misinformation that has metastasized through word of mouth and social media. Participants identified a lack of information available in Indigenous languages as a barrier to vaccination for community members, and noted a preference for messages that emphasize how members of the local community have been safely vaccinated.

Conclusion: Increasing vaccine acceptance requires integrating local understanding, cultural contexts, and languages into vaccine messaging.

KEY MESSAGES

What is already known on this topic: Guatemala has the lowest rate of COVID-19 vaccinations in Central America. Indigenous populations in the Central Highlands of Guatemala are a high-risk population with poor health access even prior to the pandemic.

This study determined that there are three major overarching barriers to vaccination: (1) lack of COVID-19 vaccine information available that is easily understandable, linguistically appropriate and culturally sensitive; (2) widespread mis- and dis-information that preys on people's fears of the unknown and mistrust of the medical establishment and government; and (3) vaccine access and supply issues that prevent people from being vaccinated efficiently and quickly.

How this study might affect research, practice or policy: When developing vaccine messages, content should be culturally relevant, appropriate for low literacy populations, and should be in the languages that people prefer to speak. Promotional materials should be in multiple modalities (print, radio, social media) and also have specific Maya cultural references (dress, food, concepts of disease) to ensure messaging connects with intended targets. This study supports the need for more robust research into best practices for communicating about COVID-19 vaccines to marginalized communities, and suggests that policy makers should invest in targeted local solutions to increase vaccine uptake.

STRENGTHS AND LIMITATIONS

Strengths:

- A strength of this study is it is one of the first to describe factors that influence COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala.
- This hard-to-reach population has disproportionate health impacts from a colonial legacy of entrenched racism, exclusion, and antagonism combined with systemic health inequities toward Maya peoples, thus this study supports robust research into best practices for communicating about COVID-19 vaccines to marginalized communities.
- This study strategically partnered within the community to build trust and ensure that the research best serves the communities' interest allowing unparalleled access and trust.

Limitations:

- First, given the sample was restricted to the Central Highlands of Guatemala, results cannot necessarily be generalized to the wider population, or even other Indigenous groups.
- Secondly, given the rapidly evolving nature of the pandemic and risk of in-person interviewing, the study limited FGDs and IDIs to the minimum needed for theme saturation. We recognize that additional focus groups with community members may be helpful for teasing out more nuanced findings.

INTRODUCTION

Guatemala has the lowest rate of COVID-19 vaccinations in Central America, with only 35.16% of the population fully vaccinated against COVID-19 as of July 2022[1, 2]. While previous research has indicated that vaccine acceptance, and acceptance of COVID-19 vaccines in particular, may be high in low- and middle-income countries (LMICs)[3, 4], this may not be the case in Guatemala. Previous international research with Indigenous populations has found

numerous potential barriers to vaccines, including (1) fears of side effects[5, 6], (2) language barriers[7, 8], (3) systemic and historical health inequities[9, 10, 11], (4) vaccine misinformation and myths[5, 10, 12, 13, 14], and (5) variable supply and availability[15]. However, there is limited research describing vaccine acceptance, especially for the COVID-19 vaccine, in Indigenous communities in Guatemala[16].

Guatemala is culturally diverse, with 43.7% of the population self-identifying as Indigenous from the Maya (41.7%), Garífuna (0.1%), and Xinca (1.8%) peoples[17, 18]. Indigenous populations speak over twenty non-Spanish languages; 27.1% of the Guatemalan population speaks K'iche' and 17.2% reports speaking Kaqchikel[18]. Indigenous populations have experienced systemic violence and historical health inequities,[9, 10] contributing to high levels of government distrust[19, 20]. The United Nations supported Commission for Historical Clarification (CEH) concluded that Guatemala's 36-year armed conflict, which officially ended in 1996, was part of a colonial legacy of entrenched racism, exclusion, and antagonism towards the Maya peoples[21]. State-sponsored violence against the Indigenous population has historically impacted public health practices. Guatemala's colonial legacy of medical humanitarianism has reinforced racial/ethnic hierarchies using violence and coercion to enforce compliance with state-directed public health campaigns[9]. Today, the underfunded public health system infrastructure disproportionately impacts Indigenous Guatemalans, leaving many Indigenous peoples without healthcare coverage or with high out-of-pocket medical expenses[22, 23, 24, 25]. Within the healthcare system, they face linguistic and cultural barriers, discrimination, and widespread mistreatment[22, 25, 26].

The historical legacies and systemic health inequities have engendered distrust in the government and health systems by the Indigenous Maya populations[20, 27]. Distrust in the

government has been shown to influence public behavior in the context of major health threats [27, 28]. One study of trust in the COVID-19 vaccine in six countries in Latin America found that two of the most common contributors of vaccine hesitancy were distrust of the government and mistrust of the vaccine development process[5]. Mistrust in public health campaigns can lead to higher susceptibility to vaccine misinformation and myths[12, 15, 28, 30]. Additional research on the spread of COVID-19 misinformation on social media suggests that people in LMICs are especially exposed to significant amounts of misinformation and may be more susceptible to this misinformation when exposed[12].

Given a general lack of information and research on how misinformation impacts Indigenous Maya populations, this study aimed to (1) understand how the COVID-19 vaccine is perceived by the Indigenous Maya population in the Central Highlands of Guatemala; (2) determine which myths/misinformation exist within the communities; (3) identify trusted sources of health messaging for Indigenous community members, and (4) understand how members of Indigenous communities prefer to receive health information.

MATERIALS AND METHODS

Study Design

This study used a community-based participatory research approach to identify vaccine access barriers, myths/fears around immunization, sources of accurate vaccine information or misinformation, and how messages are shared among social networks with the aim of designing targeted health messages. Local researcher team members conducted eight focus group discussions (FGDs) with 42 Indigenous men and women and 16 in-depth interviews (IDIs) with four hospital-based nurses, 11 community nurses, and one physician in the departments of Chimaltenango and Sololá in the Central Highlands of Guatemala in November 2021.

Patient and public involvement

Community nurses, hospital nurses, and physicians were selected to participate in the IDIs by staff members of Wuqu' Kawoq | Maya Health Alliance, an NGO that focuses on improving the health of Indigenous Maya populations. Development of this research project was grounded in Wuqu' Kawoq's 15 years of experience as a community organization of Indigenous healthcare providers for Indigenous peoples. Wuqu' Kawoq staff members selected adult (over 18 years) participants who identified as Indigenous Maya for FGDs using a snowball sampling technique, identifying participants through community connections. K'iche' is the most common Mayan language in the Sololá department where 96.4% of the population identifies as Indigenous Maya. In Sololá, 33% of the population is under 14 years and 61.9% are 15- 64 years, with 61.6% of the population residing in urban municipalities[18, 31]. Kaqchikel is the most common Mayan language in the Chimaltenango department, where 66.5% of the population identifies as Indigenous Maya, with 34% of the population under 14 years and 61% of the population 15-64 years of age. In Chimaltenango, 54.1% of the population resides in urban municipalities[18, 31].

FGDs explored community vaccine hesitancy and uptake, as well as perspectives on messages from social media and other sources related to COVID-19 vaccines. FGDs and IDIs followed a semi-structured discussion protocol. FGDs were facilitated by an Indigenous Maya interviewer to ensure trust, safety, and inclusion were built into the research process. The FGDs and IDIs were conducted by Wuqu' Kawoq staff trained in qualitative research methods. FGDs and IDIs were conducted in Spanish or Kaqchikel, depending on the preference of those being interviewed. In light of cultural gender norms, men and women participated in separate FGDs of

3-6 people, which lasted between sixty and ninety minutes. IDIs ranged between thirty and sixty minutes.

In addition to the Wuqu' Kawoq team members, the research team also included international researchers trained in community-based participatory research methods. To ensure that questions, analysis, and findings were relevant, consistently addressed equity, and ethically engaged with Indigenous communities in sample communities, the entire study team met weekly. Wuqu' Kawoq team members shared results and social media content based on the results with study participants to ensure that findings and materials were relevant to their priorities, and matched with their experience and preferences.

Analysis

IDIs and FGDs were transcribed in Kaqchikel and then translated into Spanish. Transcripts and field notes were shared with the U.S. researchers in Spanish; members of the research team translated them into English. Researchers then conducted a rapid analysis using a priori codes from the literature. Next, researchers used constant comparative methods to systematically code data and identify the initial key themes emerging from interview data. The team then revised the coding data again to include both inductive and deductive codes.

After the revision, each interview transcript was analyzed again and independently coded by two members of the research team. During this process, researchers met multiple times to confer and calibrate coding interpretation and to further refine and recalibrate coding schemes. Once researchers identified the final key themes from the data, members of the team translated the key themes into Spanish. The key themes were then reviewed for reliability by the interviewers.

RESULTS

Community members and healthcare workers identified what they perceived were potential barriers to vaccination for local Indigenous populations, which included: a lack of information, mistrust in government and health systems, misinformation, fear, access and supply issues, and apathy. They also provided potential ideas on how the healthcare system might improve COVID-19 vaccine uptake for these populations, including ensuring trusted local healthcare workers and leaders provide culturally relevant information in Mayan languages.

Community Perceptions of Vaccine Barriers

Lack of information in local languages

Indigenous community members and healthcare workers identified a lack of COVID-19 health and vaccine information available in Indigenous languages. They suggested that lack of information was a major contributing factor to why members of the Indigenous communities were not seeking vaccination:

> "The health information disseminated about vaccination and COVID in general is not helpful for our communities… I have rarely heard some announcements on national radio and television… Also, in social networks all the information is in Spanish, not in Mayan languages... If you search the internet for information about COVID in Kaqchikel there is nothing… people do not have information and do not want to get vaccinated. They have reason to be afraid because fear arises from the unknown, from the lack of information." (IDI 6).

They identified social media as being specifically devoid of information in Indigenous languages:

> "There are people who don't understand Spanish, right? Well, I understand that on that side it has fallen very short... Because, maybe they do have media, like Facebook and others. But they don't speak Spanish. Let's not say that we can't handle technology… Because there are native languages that should be promoted, so that the message also reaches them" (IDI 16).

Healthcare workers also identified the lack of health information, including confusion over vaccine dosing schedules, eligibility for vaccines, and vaccination dates, as a problem for the communities they served. In particular, they connected the lack of credible information with the spread of misinformation: "It is not so easy for someone from the community to have reliable information" (IDI 9).

Distrust in the Government and Health Institutions

Community members mentioned their distrust of the Guatemalan government regarding COVID-19 vaccines, as well as general mistrust of the governments of other countries, particularly wealthy and powerful countries. For example, one community member said "That [the vaccine is] a racket they say, between presidents, between countries, they've made these agreements between themselves. To raise money, to get money, they say" (FGD 8). A healthcare worker shared that they heard from community members that "[the vaccine is] to make money. From the other countries, that's why this vaccine was created, so that the other countries become richer and we become poorer" (IDI 10).

Healthcare workers also highlighted that Indigenous communities distrusted the government. Healthcare workers often attributed this distrust to the armed conflict and government's ongoing neglect of Indigenous populations. One healthcare worker stated:

> "They question if it is a government plan to reduce the population. For the Indigenous people… it is because of the history of the armed conflict that there are still after-effects of this. Because the distrust that the population has towards the government… Because of everything that is happening, corruption, violence, and all that, they are afraid" (IDI 1).

Healthcare workers and community members argued that distrust in the government contributed to susceptibility to myths and fears about the vaccine.

Myths

There are four common myths about the vaccine that are reported to be prevalent throughout the communities. These myths are that (1) the vaccines are designed to kill, (2) vaccines cause infertility, (3) vaccines are against the will of God or will cause you to be marked by the Devil, and (4) vaccines implant tracking microchips.

One highly prevalent myth is that the vaccine is designed to kill all or segments of the population, including the elderly, the Indigenous populations, or Guatemalans: "they say the vaccine is to eliminate all the elderly, they want to kill us, they want to eliminate us" (FGD 2). While many fear deadly side effects of vaccination, the myth that the vaccine kills is specifically predicated on the belief that the vaccine was intentionally created to eliminate certain populations. This is illustrated by a community member who states "those who run the world want everyone to get vaccinated… because what they want is a smaller population… they want to empty the planet a little bit" (IDI 14). Some who believe in this myth state that the vaccine contains diseases, especially cancers, designed to harm the population. This is demonstrated by this quote "instead of a vaccine, it is a virus that in the future is going to make all of us sick" (IDI 7).

Related to myths about population control, another prevalent myth is that the vaccine causes infertility. One vaccinated woman shared that others told her the vaccine would make her infertile. She stated "They say that for us women, if we get injected when we're 30 to 35 years old, they say that we won't have the good fortune of having children" (FGD 8). Related were concerns that if pregnant women were vaccinated, the vaccine would hurt or kill the baby, or cause birth defects.

Other prevalent vaccine myths were regarding religious beliefs. There were concerns that vaccination was going against the will of God. A core aspect of this myth is that the vaccine is the mark of the Devil or the Antichrist. One healthcare worker shared:

> "What I've heard a lot is that the vaccine is the seal of the beast, the 666. That those who have the vaccine are not going to go to heaven… those who are getting vaccinated don't have faith in God, because if the disease exists, your God is going to protect you, and if you believe in your God you don't have to be afraid of that disease. As if vaccination is a sign or proof that you don't have faith" (IDI 6).

Many community members and healthcare workers also stated they had heard that the vaccine contains a micro-chip. However, healthcare workers frequently stated that community members sometimes created these myths, perhaps out of fear, but were less clear on whether community members were choosing not to vaccinate because of them. Other less common myths included that the vaccine is made of animal blood or would turn those who were vaccinated into an animal, and that the vaccine will make those who are immunized magnetic. In addition to less common myths, some community members questioned whether the vaccine they were receiving was real, or if it was just water.

Fears of Side Effects

While myths were prevalent in the communities and provoked fears about the vaccines, community members were also afraid of potential vaccine reactions or side effects. For example, one participant noted:

> "My in-laws… were not convinced, because they had doubts about how it was going to be. So, my husband and I sat down with them to talk about their concerns about the effects that the vaccine was going to have on them. And, we talked to them and finally they both got vaccinated" (IDI 7).

Access and Supply Challenges

Healthcare workers and community members identified vaccine access and supply challenges as potential limitations to vaccination. Access challenges were considered to be a bigger concern in

remote and rural areas, and traveling to vaccination sites could be difficult. One healthcare worker illustrated this point, saying:

> "There are people who have to take the only bus that is in their community every day and only at certain times. They have to travel two hours to get to the head of the community and get the vaccine. In the end the people had to invest time and money that they don't have and go very far, besides the fear of traveling by bus" (IDI 6).

Healthcare workers and community members remarked that lines for the vaccine were very long early in the vaccine campaign, which created challenges for those who had to work or were unable to stand for long periods:

> "It was like we were waiting in line because they called some people from there, others from there, and it got messy because there were a lot of people. And I got very desperate, seeing the long lines, and the big mess that was there, and since I had other commitments to do in the afternoon, it was better for me to go back. I left" (FGD 5).

Supply problems were also identified as a potential barrier. Some healthcare workers noted that initially they did not have enough vaccines available to meet the demand. One healthcare worker stated:

> "Sometimes they tell us that there are no vaccines, and we call people and they get upset with us. And because of the internet signal, there is no good internet signal, we don't have computer equipment and we use our personal computers. The ministry didn't think directly, they just gave us work orders and let us see how it goes" (IDI 2).

While supply problems were identified as a problem early in the vaccination campaign, it should be noted that multiple participants remarked that the issue seemed to be improving over time.

Apathy

Healthcare workers and community members also identified that there was a general sense of apathy amongst some who chose not to be vaccinated. The apathy that some community members, especially the elderly, held towards the vaccine were linked to beliefs that the vaccine

was not necessary as death was inevitable. One example from a focus group with several elderly community members is:

> "That's what one person said to me… 'I'm ready to die so what's the point in getting the vaccine', that's how they think… my mum says it too. What's happening is that the old people need to be taken care of, but they don't want to be" (FGD 4).

Community Perceptions of How to Increase Vaccine Acceptance

Social Influence

Indigenous community members and healthcare workers identified vaccinated individuals as influential in building confidence in vaccine safety. Many of those interviewed argued that seeing and talking to vaccinated community members about their experiences was the most influential method to increase vaccine uptake in the community. One healthcare worker shared:

> "My aunts on my mom's side did not want to get vaccinated… when my mom got vaccinated… they started to worry. My mom told them that she was fine. One aunt saw that it was true... And, within a matter of two weeks all my aunts were vaccinated. They were very scared, but seeing someone very close to them, that helped a lot." (IDI 6).

Healthcare workers and community members indicated that they believed leveraging the stories of vaccinated community members would help to encourage higher vaccine uptake.

Fear of COVID-19 and Trust in Vaccine Safety and Efficacy

Healthcare workers and community members emphasized that their communities had faced ongoing health and economic difficulties during the COVID-19 pandemic. Many of them shared that they and others in the community were tired of dealing with the effects of the pandemic and viewed the vaccine as a solution. One community member shared "these vaccines are the best defense that we have been given, when we didn't have them, the disease got worse here in our community" (FGD 7). Another healthcare worker expressed:

> "People were previously afraid because of so much death caused by the pandemic... maybe one person was the one who started in the family to get vaccinated, and the others saw that nothing happened to him. So little by little people began to be encouraged to get vaccinated, and they saw that the vaccine is good" (FGD 5).

Religious Faith

While religious concerns led some Indigenous community members to believe that being vaccinated was going against the will of God, others indicated that their faith and trust in religious leaders who supported the vaccine encouraged them to be vaccinated. One community member shared:

> "For me the vaccine is essential, because even the Pope, the holy father of the Catholic Church recommends it, and I don't distrust or doubt him because he is an honorable person, to say such and such a thing, right?" (FGD 8).

Another person indicated that their faith led them to trust the vaccine, by stating "I'm sure that God cures and does miracles, but also God has given wisdom to doctors, their study, everything. So, you have to also believe in medicine" (FGD 2).

Trusted Sources of Health Messaging for Indigenous Community Members

Healthcare Workers

Community members identified that they trusted health information from their local health center workers, including the nurses, midwives, and community health workers. One community member stated "I have more confidence in the information given by the nurses at the health center" (FGD 5). Healthcare workers recognized that community members relied on them to provide health messages. One healthcare worker stated:

> "...but a lot of people trust us too much sometimes. These are things we have to keep in mind. I think that this career that we've chosen, our profession, requires a lot of human responsibility, a lot of empathy." (IDI 5).

Community members and healthcare workers also indicated a high level of trust in health messages from local community leaders and non-governmental organizations (NGOs). This trust is illustrated by one healthcare worker who stated:

> "It is information that has been worked on by non-governmental institutions, that focuses on the population itself, in their own language. I think that is more reliable.... Also, the role that some community leaders have played, and the midwives… I think their experience helped women, because I think that they are people who have been given a lot of trust. So, when they mentioned that they had been vaccinated, they convinced other people to do it" (IDI 1).

The expressed trust in local healthcare workers and community leaders co-exist with distrust of the government. Although healthcare workers and local leaders may provide messages based on central Ministry of Health guidelines, these messages may only be highly trusted when delivered by locally-embedded healthcare workers embedded. This may indicate that local healthcare workers have been able to successfully translate messages to make them more culturally acceptable and relevant for the Indigenous community members.

How Community Members Prefer to Receive Health Information

Social Media

Many Indigenous community members in the departments of Chimaltenango and Sololá rely on social media for information, especially younger generations. One participant stated "Social media is important. It's a key part of it, because now you can see that children already have phones now" (IDI 5). Many people indicated that information from social media is often transmitted from younger people to older people: "There are people who don't have phones, but their children have phones and social networks, so they are the ones who give the information to their parents" (IDI 3). However, some healthcare workers noted social media is not universally

accessible, which can be a barrier to accessing vaccine information, including locations of government vaccine clinics that tend to be posted on Facebook:

> "In Facebook they see it, we put the information and the calls start, to ask which vaccines are available. There are many questions… also… by WhatsApp. It works for about 50 percent, it is only for people who have access" (IDI 2).

Local Communication Campaigns

Local community radio is considered to be a popular source of public health information, especially for older generations, given its one of the few sources of information in Mayan languages. One healthcare worker remarked:

> "I think that there are some older adults, sometimes they do not have a phone to see it on social networks... So, I think that with the community radios that most of the population that works in the field, they normally listen to the radio stations of the town" (IDI 15).

Much of the current information about sites and dates of vaccine availability came from healthcare workers driving health center vehicles and making announcements in Mayan languages.

Make Information Available in the Mayan Languages

Healthcare workers and community members emphasized the importance of providing health information, especially audio, in Mayan languages. The need for information in Mayan languages was considered especially significant for older populations, who were less likely to speak Spanish. One community member explained this, stating:

> "It is necessary in our language, I don't know a lot of Spanish words. I don't understand it. I don't know what to say, but in our language, I do… in Spanish, maybe I can only answer one or two things, but I cannot keep the conversation, the words don't get to my mind. It's hard not to know Spanish" (FGD 4).

Not only is providing information in Mayan languages critical for understanding, but it also helps community members emotionally and culturally connect with messages. One healthcare worker expressed:

> " 'Unless they say something in Kaqchikel, they say that it belongs to the ladinos' [a term for the socio-ethnic category of Mestizo or Hispanicized peoples], so to speak, 'that it is not ours'... how to reach the people… is someone… an Indigenous person is the one who tells them or that it is contextualized to the area around and basically it is very important that it is in the language" (IDI 6).

Yet, even though healthcare workers and community members repeatedly emphasized the necessity of providing information in Mayan languages, they expressed that very little information on COVID-19 and the vaccines in Mayan languages exists. A community member shared:

> "Here there are a lot of people who still don't understand Spanish. A lot of people. [Vaccine information] should be disseminated more in our languages, right? In this case, Kaqchikel… This has fallen very short. The ministries that are in charge of disseminating this information, they need to see other ways" (FGD 6).

Make Messages Appealing for Those with Low or No Literacy

While healthcare workers and community members emphasized the need for health and vaccine information in the Mayan languages, they also recognized the low literacy rates in the community, especially among elderly monolingual Mayan language speakers. Many respondents suggested information may need to be provided in audio or visual formats. One healthcare worker illustrated this, stating:

> "There are many of us who know how to speak, but we don't even know how to read it. I am one of them who can speak Kaqchikel but if they put me to read it, or write it, I think I am at zero. So rather than maybe reading it, or writing it on posters, I think it would be better to speak it" (IDI 13).

Additionally, some participants indicated information should be relayed through concise and engaging messages. This would help with both literacy challenges and benefit those with limited technology access or bandwidth.

Ensure that Messages are Culturally Relevant

Healthcare workers and community members emphasized that health and vaccine messages should reflect Indigenous peoples' experiences. One healthcare worker said messages should contain "images that are adapted, for example, to their industry… the phrases in Kaqchikel... The most concrete, with information that is not boring… but above all that it is culturally relevant" (IDI 1). Another healthcare worker states:

> "How to reach the people and convince them is that someone from their family tells them… or an Indigenous person is the one who tells them, contextualized to the area around here, and basically and it is very important that it is in their language. It is useless to have contextualized images or drawings if the audio is not in the language of the people who are listening" (IDI 6).

DISCUSSION

This study is one of the first to describe factors that influence COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala. Although findings have many similarities with those described in other countries[13], they are highly contextualized in economic, cultural, political, and social factors specific to Maya populations in Guatemala. Highlighting the challenges faced by this population is critical given a long history of marginalization; it is paramount for public health officials to identify how to effectively support the most marginalized and highest risk populations during health crises.

Study findings delineate common barriers to vaccination within this at-risk population. These can be roughly grouped into three major overarching themes: (1) lack of COVID-19

vaccine information available that is easily understandable, linguistically appropriate, and culturally sensitive; (2) widespread mis- and dis-information that preys on people's fears and mistrust of the medical establishment and government; and (3) vaccine access and supply issues that prevent people from being vaccinated efficiently and quickly. Several participants noted that the fear and resistance to vaccines is not surprising given the widespread government distrust and dearth of well-designed culturally relevant information, especially in Mayan languages. The negative health impacts related to distrust in the government has been noted in previous studies [31], but this study adds to the literature by focusing on the Maya of the Central Highlands of Guatemala.

Participants had recommendations for how to navigate the challenges faced by the Indigenous populations. First, study results highlight the power of social influence to encourage vaccine acceptance in Indigenous communities. Specifically, participants noted that messages highlighting how community members have been safely vaccinated, and messages that come directly from local healthcare workers, community leaders, and council members, may be the most trusted by those who are still unvaccinated. This is consistent with other research conducted in Latin American countries that has found that providing information about others' vaccinations successfully increased both vaccine willingness, as well as the willingness of respondents to encourage others to be vaccinated[5].

This research also highlights that messages should be culturally relevant, appropriate for low literacy populations, and should be in the languages that people speak. Several participants noted that health promotional material should have specific Maya cultural references (dress, food, concepts of disease) to ensure messaging connects with intended targets. Additionally, multiple modalities should also be used to reach a large population. While a large proportion of

young people use social media and the internet, many older people rely on radio and vehicles with loudspeakers traveling through local villages to get their information. Ensuring health promotion campaigns use multiple different modalities will be critical to optimizing impact.

Further research is needed to determine the most effective ways to develop relevant educational and promotional materials and how to best target information to this population in order to increase uptake of COVID-19 vaccines. Careful attention should be paid to different Indigenous constructs of health and disease, as well as the cultural and political context within which the population accesses and understands information. Ongoing follow-up research from this study includes development of social media educational content that is currently being evaluated through social media polling and analytics and in-person surveys.

AUTHORS' CONTRIBUTIONS

NS, KS, JJ, NDS, and AKD led the conceptualization and design of the study. EL, MSM, and AKD led participant outreach and recruitment. NS, KS, EL, and AKD led the development of the interview and focus group protocols. MSM conducted the qualitative interviews and focus group discussions, transcribed data, and translated materials. NS, KS, EL, NDS, and JJ conducted the qualitative data analysis and interpretation. NS and KS led the data analysis, the interpretation of findings, and writing all drafts. NS, KS, EL, LAM, KBV, JJ, NDS, AKD contributed to the design of the study, interpretation of findings, and revising all drafts. All authors have read and approved the final manuscript.

ACKNOWLEDGMENTS

We would like to thank the community members who participated in focus groups for their generous contributions to this project by sharing their lived-experiences and personal opinions. We would also like to thank the entire Wuqu' Kawoq staff, including their participation in interviews and connections to both local healthcare workers and community members. We would also like to extend our gratitude to Anil Vora, Katherine Sziraczky, Katie Gleason, Aarti Porwal, and Charles Prober.

ETHICS STATEMENT

Verbal informed consent was obtained from the study participants. All participants were read the consent document in private to ensure that regardless of literacy they were fully informed about their right to refuse participation and to ensure they were clear on the purposes of the research project. The study received approval by Institutional Review Boards at the University of California, San Francisco (Study # 21-35160) and Stanford University (Protocol # 63193), and a private IRB through Wuqu' Kawoq (Protocol # WK 2021 005).

COMPETING INTERESTS STATEMENT

No members of the research team have financial interests in the development of COVID-19 vaccines or in promoting vaccination.

FUNDING STATEMENT

Funding for the study was provided by the Vaccine Confidence Fund grant number (VCF-001).

DATA AVAILABILITY STATEMENT

No additional data available.

REFERENCES

1. Understanding Vaccination Progress by Country [Internet]. Johns Hopkins Coronavirus Resource Center. [cited 2022 July 13]. Available from: https://coronavirus.jhu.edu/vaccines/international
2. COVID-19 vaccination rate by country Latin America 2022 [Internet]. *Statista*. [cited 2022 Apr 19]. Available from: https://www.statista.com/statistics/1194813/latin-america-covid-19-vaccination-rate-country/
3. Bhopal S, Nielsen M. Vaccine hesitancy in low- and middle-income countries: potential implications for the COVID-19 response. *Archives of Disease in Childhood* [Internet]. 2021 Feb 1 [cited 2021 Nov 2];106(2):113–4. Available from: https://adc.bmj.com/content/106/2/113
4. Kozlov M. COVID vaccines have higher approval in less-affluent countries. *Nature* [Internet]. 2021 Jul 22 [cited 2021 Nov 2]; Available from: https://www.nature.com/articles/d41586-021-01987-9
5. Argote P, Barham E, Daly S, Gerez J, Marshall J, Pocasangre O. Messages That Increase COVID-19 Vaccine Willingness: Evidence From Online Experiments in Six Latin American Countries [Internet]. Rochester, NY: *Social Science Research Network*; 2021 Jun [cited 2022 Apr 19]. Report No.: ID 3812023. Available from: https://papers.ssrn.com/abstract=3812023
6. Bono SA, Faria de Moura Villela E, Siau CS, Chen WS, Pengpid S, Hasan MT, et al. Factors Affecting COVID-19 Vaccine Acceptance: An International Survey among Low- and Middle-Income Countries. *Vaccines* (Basel). 2021 May 17;9(5):515.
7. Cassady D, Castaneda X, Ruelas MR, Vostrejs MM, Andrews T, Osorio L. Pandemics and Vaccines: Perceptions, Reactions, and Lessons Learned from Hard-to-Reach Latinos and the H1N1 Campaign. *Journal of Health Care for the Poor and Underserved* [Internet]. 2012 [cited 2022 Apr 19];23(3):1106–22. Available from: https://muse.jhu.edu/article/481736
8. Flood D, Rohloff P. Indigenous languages and global health. *The Lancet Global Health* [Internet]. 2018 Feb 1 [cited 2022 Apr 13];6(2):e134–5. Available from: https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(17)30493-X/fulltext

9. Few M. Epidemics, indigenous communities, and public health in the COVID-19 era: views from smallpox inoculation campaigns in colonial Guatemala. *Journal of Global History* [Internet]. 2020 Nov [cited 2021 Oct 18];15(3):380–93. Available from: https://www.cambridge.org/core/journals/journal-of-global-history/article/epidemics-indigenous-communities-and-public-health-in-the-covid19-era-views-from-smallpox-inoculation-campaigns-in-colonial-guatemala/E03AB2F33D7CA7B110A3C0AB03A72E9C
10. Meneses-Navarro S, Freyermuth-Enciso MG, Pelcastre-Villafuerte BE, Campos-Navarro R, Meléndez-Navarro DM, Gómez-Flores-Ramos L. The challenges facing indigenous communities in Latin America as they confront the COVID-19 pandemic. *Int J Equity Health* [Internet]. 2020 [cited 2021 Oct 20];19(1):63. Available from: https://equityhealthj.biomedcentral.com/articles/10.1186/s12939-020-01178-4
11. Poirier B, Sethi S, Garvey G, Hedges J, Canfell K, Smith M, et al. HPV vaccine: uptake and understanding among global Indigenous communities - a qualitative systematic review. *BMC Public Health.* 2021 Nov 10;21(1):2062.
12. Singh K, Lima G, Cha M, Cha C, Kulshrestha J, Ahn Y-Y, et al. Misinformation, believability, and vaccine acceptance over 40 countries: Takeaways from the initial phase of the COVID-19 infodemic. *PLOS ONE* [Internet]. 2022 Feb 9 [cited 2022 Feb 18];17(2):e0263381. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0263381
13. Dash S, Parray AA, Freitas LD, et al. Combating the COVID-19 infodemic: a three-level approach for low and middle-income countries. *BMJ Global Health*. 2021;6(1):e004671. doi:10.1136/bmjgh-2020-004671
14. Maffioli EM, Gonzalez R. Are socio-demographic and economic characteristics good predictors of misinformation during an epidemic? *PLOS Global Public Health* [Internet]. 2022 Mar 16 [cited 2022 Apr 28];2(3):e0000279. Available from: https://journals.plos.org/globalpublichealth/article?id=10.1371/journal.pgph.0000279
15. Chen Z, Zheng W, Wu Q, Chen X, Peng C, Tian Y, et al. Global diversity of policy, coverage, and demand of COVID-19 vaccines: a descriptive study. *BMC Med* [Internet]. 2022 Apr 4 [cited 2022 Apr 28];20(1):130. Available from: https://doi.org/10.1186/s12916-022-02333-0
16. Guzman-Holst A, DeAntonio R, Prado-Cohrs D, Juliao P. Barriers to vaccination in Latin America: A systematic literature review. *Vaccine*. 2020 Jan 16;38(3):470–81.
17. IWGIA - International Work Group for Indigenous Affairs. Indigenous World 2020: Guatemala - *IWGIA - International Work Group for Indigenous Affairs* [Internet]. 2020

[cited 2022 Mar 3]. Available from: https://www.iwgia.org/en/guatemala/3622-iw-2020-guatemala.html

18. Principales Resultados Censo 2018: Septiembre 2019 [Internet]. 2019. [cited 2022 Mar 3]. Available from: https://www.censopoblacion.gt/dondeestamos
19. Sanford V. From Genocide to Feminicide: Impunity and Human Rights in Twenty-First Century Guatemala. *Journal of Human Rights* [Internet]. 2008 Jun 17 [cited 2022 Apr 19];7(2):104–22. Available from: https://doi.org/10.1080/14754830802070192
20. Beck E. The Uneven Impacts of Violence against Women Reform in Guatemala: Intersecting Inequalities and the Patchwork State. *Latin American Research Review*. 2021;56(1):20-35. doi:10.25222/larr.636
21. Guatemala — Memory of Silence: Report of the Commission for Historical Clarification: Conclusions and Recommendations (February 1999). (1999). Die Friedens-Warte, 74(4), 511–547. [cited 2022 Mar 4]. Available from: http://www.jstor.org/stable/23778631
22. Chary A, Flood D, Austad K, et al. Accompanying indigenous Maya patients with complex medical needs: A patient navigation system in rural Guatemala. *Healthcare*. 2018;6(2):144-149. doi:10.1016/j.hjdsi.2017.08.006
23. Seitz K, Cohen J, Deliens L, et al. Place of death and associated factors in 12 Latin American countries: A total population study using death certificate data. *J Glob Health*. 2022;12:04031. doi:10.7189/jogh.12.04031
24. Flood D, Chary A, Austad K, Coj M, Lopez W, Rohloff P. Patient Navigation and Access to Cancer Care in Guatemala. *JGO*. 2018;(4):1-3. doi:10.1200/JGO.18.00027
25. Hernandez A, Hurtig AK, Sebastian MS, Jerez F, Flores W. 'History obligates us to do it': political capabilities of Indigenous grassroots leaders of health accountability initiatives in rural Guatemala. *BMJ Global Health*. 2022;7(5):e008530. doi:10.1136/bmjgh-2022-008530
26. Perry MF, Coyote EI, Austad K, Rohloff P. Why women choose to seek facility-level obstetrical care in rural Guatemala: A qualitative study. *Midwifery*. 2021;103:103097. doi:10.1016/j.midw.2021.103097
27. Karin Dyrstad, Kristin M. Bakke & Helga M. Binningsbø (2021) Perceptions of Peace Agreements and Political Trust in Post-War Guatemala, Nepal, and Northern Ireland, *International Peacekeeping,* 28:4, 606-631, DOI: 10.1080/13533312.2020.1869541
28. Lazarus JV, Ratzan S, Palayew A, et al. COVID-SCORE: A global survey to assess public perceptions of government responses to COVID-19 (COVID-SCORE-10). Hotchkiss D, ed. *PLoS ONE*. 2020;15(10):e0240011. doi:10.1371/journal.pone.0240011

29. Blair RA, Morse BS, Tsai LL. Public health and public trust: Survey evidence from the Ebola Virus Disease epidemic in Liberia. *Social Science & Medicine*. 2017; 172: 89-97. doi:10.1016/j.socscimed.2016.11.016

30. Bessi A, Coletto M, Davidescu GA, Scala A, Caldarelli G, Quattrociocchi W. Science vs Conspiracy: Collective Narratives in the Age of Misinformation. *PLoS One* [Internet]. 2015 Feb 23 [cited 2022 Mar 4];10(2):e0118093. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4338055/

31. Instituto Nacional de Estadística Guatemala. Compendio Estadístico de Pueblos. [cited 2022 Mar 3]. 2021. Available from: https://www.ine.gob.gt/sistema/uploads/2021/12/30/20211230192119ITIf0Taxw7mbshQNenoLw9A9K5cR4pMt.pdf

BMJ Open

But the Vaccine Might Harm Me: A Participatory Qualitative Study on the Barriers to COVID-19 Vaccine Acceptance to Improve Messages for Vaccine Uptake in Indigenous Populations in the Central Highlands of Guatemala

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-067210.R1
Article Type:	Original research
Date Submitted by the Author:	17-Nov-2022
Complete List of Authors:	Skinner, Nadine; Stanford University School of Medicine, Sanders, Kelly; University of California San Francisco, Lopez, Emily; Maya Health Alliance Wuqu' Kawoq Sotz Mux, Magda; Maya Health Alliance Wuqu' Kawoq Abascal Miguel, Lucía; University of California San Francisco Vosburg, Kathryn; University of California San Francisco (UCSF) Johnston, Jamie; Stanford University School of Medicine, Stanford Center for Health Education Diamond-Smith, Nadia; University of California San Francisco, Epidemiology and Biostatistics Kraemer Diaz, Anne; Maya Health Alliance Wuqu' Kawoq
Primary Subject Heading:	Communication
Secondary Subject Heading:	Health policy, Infectious diseases, Public health, Qualitative research
Keywords:	COVID-19, QUALITATIVE RESEARCH, PUBLIC HEALTH, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PREVENTIVE MEDICINE

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

But the Vaccine Might Harm Me: A Participatory Qualitative Study on the Barriers to COVID-19 Vaccine Acceptance to Improve Messages for Vaccine Uptake in Indigenous Populations in the Central Highlands of Guatemala

[1] Nadine Ann Skinner, [2] Kelly Sanders, [3] Emily Lopez, [3] Magda Silvia Sotz Mux, [2] Lucia Abascal Miguel, [2] Kathryn Bradford Vosburg, [1] Jamie Johnston, [2] Nadia Diamond-Smith, and [3]Anne Kraemer Diaz

[1] Stanford Center for Health Education, Digital Medic, Stanford University, United States
[2] Institute for Global Health Sciences, University of California, San Francisco, United States
[3] Wuqu´ Kawoq, Maya Health Alliance, Tecpán, Guatemala

*Corresponding author Nadine Ann Skinner, nas2@stanford.edu, Stanford Center for Health Education, Digital Medic, Stanford University, 408 Panama Mall, Stanford, California, 94305, United States

Word Count: 5,332

ABSTRACT

Introduction: As of July 2022, a little over one third of Guatemalans were fully vaccinated. While COVID-19 vaccination rates are not officially reported nationally by racial/ethnic groups, non-governmental organizations and reporters have observed that COVID-19 vaccination rates are especially low among high-risk Indigenous populations. We conducted one of the first studies on COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala, which aimed to better understand the barriers to COVID-19 vaccine uptake and how to improve vaccine promotional campaigns.

Methods: In November 2021, we conducted eight focus group discussions (FGDs) with 42 Indigenous men and women and 16 in-depth interviews (IDIs) with community health workers, nurses, and physicians conducted in Chimaltenango and Sololá. Using a participatory design approach, our qualitative analysis used constant comparative methods to understand the inductive and deductive themes from the FGD and IDI transcripts.

Results: We found three major overarching barriers to vaccination within the sampled population: (1) a lack of available easily understandable, linguistically appropriate and culturally sensitive COVID-19 vaccine information, (2) vaccine access and supply issues that prevented people from being vaccinated efficiently and quickly, and (3) widespread mis- and dis-information that preys on people's fears of the unknown and mistrust of the medical establishment and government.

Conclusion: When developing COVID-19 vaccine messages, content should be culturally relevant, appropriate for low literacy populations, and should be in the languages that people prefer to speak. Promotional materials should be in multiple modalities (print, radio, social media) and also have specific Maya cultural references (dress, food, concepts of disease) to ensure messaging connects with intended targets. This study supports the need for more robust research into best practices for communicating about COVID-19 vaccines to marginalized communities globally, and suggests that policy makers should invest in targeted local solutions to increase vaccine uptake.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- A strength of this study is it is one of the first studies on COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala, a population that has faced systemic health inequities.
- Another strength of this study is it is grounded in a community-based participatory design approach to work collaboratively with the Indigenous Maya population to ensure that the study and the findings have cultural and linguistic relevance.

- One limitation of this study is that because the sample was restricted to the Central Highlands of Guatemala, results cannot be generalized to the wider population in Guatemala, or even to other Indigenous groups.
- Another limitation is that the study limited FGDs and IDIs to the minimum needed for theme saturation due to the rapidly evolving nature of the pandemic and risk of in-person interviewing. Additional focus groups with community members may be helpful for teasing out more nuanced findings.

INTRODUCTION

Guatemala has the lowest rate of COVID-19 vaccinations in Central America, with only 35.16% of the population fully vaccinated against COVID-19 as of July 2022[1, 2]. There has been extensive research on the COVID-19 vaccine acceptance and hesitancy globally[3-11]. However, there is limited research describing vaccine acceptance, especially for the COVID-19 vaccine, in Indigenous communities in Guatemala[10-11]. While previous research has indicated that vaccine acceptance, and acceptance of COVID-19 vaccines in particular, may be high in low- and middle-income countries (LMICs)[12-14], this may not be the case in Guatemala. Previous international research with Indigenous populations has found numerous potential barriers to vaccines, including (1) fears of side effects[15,16], (2) language barriers[17, 18], (3) systemic and historical health inequities[19-22], (4) vaccine misinformation and myths[14, 20, 23-25], and (5) variable supply and availability[26].

Guatemala is culturally diverse, with 43.7% of the population self-identifying as Indigenous from the Maya (41.7%), Garífuna (0.1%), and Xinca (1.8%) peoples[27, 28]. Indigenous populations speak over twenty non-Spanish languages; 27.1% of the Guatemalan population speaks K'iche' and 17.2% reports speaking Kaqchikel[28]. Indigenous populations have experienced systemic violence and historical health inequities[19, 20] contributing to high levels of government distrust[29, 30]. The United Nations supported Commission for Historical Clarification (CEH) concluded that Guatemala's 36-year armed conflict, which officially ended

in 1996, was part of a colonial legacy of entrenched racism, exclusion, and antagonism towards the Maya peoples[31]. State-sponsored violence against the Indigenous population has historically impacted public health practices. Guatemala's colonial legacy of medical humanitarianism has reinforced racial/ethnic hierarchies using violence and coercion to enforce compliance with state-directed public health campaigns[19]. Today, the underfunded public health system infrastructure disproportionately impacts Indigenous Guatemalans, leaving many Indigenous peoples without healthcare coverage or with high out-of-pocket medical expenses[32-35]. Within the healthcare system, they face linguistic and cultural barriers, discrimination, and widespread mistreatment[32, 35, 36].

The historical legacies and systemic health inequities have engendered distrust in the government and health systems by the Indigenous Maya populations[30, 37]. Distrust in the government has been shown to influence public behavior in the context of major health threats [37, 38]. Studies of trust in the COVID-19 vaccine in Latin America found that two of the most common contributors of vaccine hesitancy were distrust of the government and mistrust of the vaccine development process[10, 11, 16, 39]. Mistrust in public health campaigns can lead to higher susceptibility to vaccine misinformation and myths[23, 26, 38, 41, 42]. Additional research on the spread of COVID-19 misinformation on social media suggests that people in LMICs[23] are especially exposed to significant amounts of misinformation and may be more susceptible to this misinformation when exposed[23].

Given a general lack of information and research on how misinformation impacts Indigenous Maya populations, this study aimed to (1) understand how the COVID-19 vaccine is perceived by the Indigenous Maya population in the Central Highlands of Guatemala; (2) determine which myths/misinformation exist within the communities; (3) identify trusted sources

of health messaging for Indigenous community members, and (4) understand how members of Indigenous communities prefer to receive health information.

MATERIALS AND METHODS

Study Design

This study used a community-based participatory design approach to identify vaccine access barriers, myths/fears around immunization, sources of accurate vaccine information or misinformation, and how messages are shared among social networks with the aim of designing targeted health messages[36, 43, 44]. Local researcher team members conducted eight focus group discussions (FGDs) with 42 Indigenous men and women and 16 in-depth interviews (IDIs) with four hospital-based nurses, 11 community nurses, and one physician in the two departments of Chimaltenango and Sololá, which are located in the Central Highlands of Guatemala, in November 2021.

Patient and public involvement

Development of this research project was grounded in Wuqu' Kawoq | Maya Health Alliance's 15 years of experience as a community organization of Indigenous healthcare providers for Indigenous peoples. Indigenous Maya staff members reviewed, revised, and translated the IDI and FGD protocols to ensure cultural and linguistic relevance. The IDIs and FGDs were then facilitated by an Indigenous Maya interviewer to ensure trust, safety, and inclusion were built into the research process.

In addition to the Wuqu' Kawoq team members, the research team also included international researchers trained in community-based participatory research methods. To ensure that questions, analysis, and findings were relevant, consistently addressed equity, and ethically

engaged with Indigenous communities in sample communities, the entire study team met weekly. Wuqu' Kawoq team members shared results and social media content based on the results with study participants to ensure that findings and materials were relevant to their priorities, and matched with their experience and preferences.

Study Population

Wuqu' Kawoq staff members selected adult (over 18 years) participants who identified as Indigenous Maya for in person FGDs using a snowball sampling technique, identifying participants through community connections. This sampling methodology was chosen based on Wuqu' Kawoq's extensive experience conducting qualitative studies in this population, with a particular focus on minimizing harms and optimizing access given barriers presented by ongoing COVID-19 outbreaks in the area during the study period. K'iche' is the most common Mayan language in the Sololá department where 96.4% of the approximately 421,583 population identifies as Indigenous Maya. In Sololá, 33% of the population is under 14 years and 61.9% are 15- 64 years, with 61.6% of the population residing in urban municipalities[28, 45]. Kaqchikel is the most common Mayan language in the Chimaltenango department, where 66.5% of the approximately 615,776 population identifies as Indigenous Maya, with 34% of the population under 14 years and 61% of the population 15-64 years of age. In Chimaltenango, 54.1% of the population resides in urban municipalities[28, 45]. The study specifically sampled participants from these specific groups to minimize the likelihood of study results reflecting inappropriate generalizations between different Maya populations, which are highly diverse and therefore may have very different needs.

FGDs explored community vaccine hesitancy and uptake, as well as perspectives on messages from social media and other sources related to COVID-19 vaccines. FGDs and IDIs

followed a semi-structured discussion protocol. The FGDs and IDIs were conducted by Wuqu' Kawoq staff trained in qualitative research methods. FGDs and IDIs were conducted in Spanish or Kaqchikel, depending on the preference of those being interviewed. In light of cultural gender norms, men and women participated in separate FGDs of 3-6 people, which lasted between sixty and ninety minutes. The demographic characteristics of FGD participants can be found in Table 1. IDIs ranged between thirty and sixty minutes. The demographic characteristics of IDI participants can be found in Table 2.

[Tables 1 & 2 about here]

Analysis

IDIs and FGDs were transcribed in Kaqchikel and then translated into Spanish. Transcripts and field notes were shared with the U.S. researchers in Spanish; members of the research team translated them into English. Researchers then conducted a rapid analysis using a priori codes from the literature. Next, researchers used constant comparative methods to systematically code data and identify the initial key themes emerging from interview data using Dedoose software. The team then revised the coding data again to include both inductive and deductive codes.

After the revision, each interview transcript was analyzed again and independently coded by two members of the research team. During this process, researchers met multiple times to confer and calibrate coding interpretation and to further refine and recalibrate coding schemes. Once researchers identified the final key themes from the data, members of the team translated the key themes into Spanish. The key themes were then reviewed for reliability by the Indigenous Maya interviewers.

RESULTS

Community members and healthcare workers identified three overarching barriers to vaccination, which included (1) a lack of COVID-19 vaccine information available that is easily understandable, linguistically appropriate and culturally sensitive, (2) widespread mis- and dis-information that preys on people's fears of the unknown and mistrust of the medical establishment and government, and (3) vaccine access and supply issues that prevented people from being vaccinated efficiently and quickly. . They also provided ideas on how the healthcare system might improve COVID-19 vaccine uptake for these populations, including developing messages that (1) encourage social acceptance, (2) focus on vaccine efficacy, (3) use appropriate religious and cultural contexts, (4) are culturally relevant, and (5) are available in Mayan languages, (6) and are appropriate for low-literacy audiences. Finally, the community members and healthcare workers identified multiple appropriate modalities for disseminating culturally and linguistically relevant COVID-19 vaccine information including (1) trusted local healthcare workers and local leaders, (2) community radio, and (3) social media.

Community Perceptions of Vaccine Barriers

Barrier One: Lack of information in local languages

Indigenous community members and healthcare workers identified a lack of COVID-19 health and vaccine information available in Indigenous languages. They suggested that lack of information was a major contributing factor to why members of the Indigenous communities were not seeking vaccination:

> "The health information disseminated about vaccination and COVID in general is not helpful for our communities… I have rarely heard some announcements on national radio and television… Also, in social networks all the information is in Spanish, not in Mayan languages... If you search the internet for information about COVID in Kaqchikel there is nothing… people do not have information and do not want to get vaccinated. They have reason to be afraid because fear arises from the unknown, from the lack of information." (IDI 6).

They identified social media as being specifically devoid of information in Indigenous languages:

> "There are people who don't understand Spanish, right? Well, I understand that…it has fallen very short... Because, maybe they do have media, like Facebook and others. But they don't speak Spanish. Let's not say that we can't handle technology… Because there are native languages that should be promoted, so that the message also reaches them" (IDI 16).

Healthcare workers also identified the lack of health information, including confusion over vaccine dosing schedules, eligibility for vaccines, and vaccination dates, as a problem for the communities they served. In particular, they connected the lack of credible information with the spread of misinformation: "It is not so easy for someone from the community to have reliable information" (IDI 9).

Barrier Two: Myths, Misinformation, Mistrust, and Fear

Myths and misinformation are prevalent throughout the region. There are four common myths about the COVID-19 vaccine that are reported to be prevalent throughout the communities. These myths are that (1) the vaccines are designed to kill, (2) vaccines cause infertility, (3) vaccines are against the will of God or will cause you to be marked by the Devil, and (4) vaccines implant tracking microchips.

One highly prevalent myth is that the vaccine is designed to kill all or segments of the population, including the elderly, the Indigenous populations, or Guatemalans: "they say the vaccine is to eliminate all the elderly, they want to kill us, they want to eliminate us" (FGD 2). While many fear deadly side effects of vaccination, the myth that the vaccine kills is specifically predicated on the belief that the vaccine was intentionally created to eliminate certain populations. This is illustrated by a community member who states "those who run the world want everyone to get vaccinated… because what they want is a smaller population… they want

to empty the planet a little bit" (IDI 14). Some who believe in this myth state that the vaccine contains diseases, especially cancers, designed to harm the population. This is demonstrated by this quote "instead of a vaccine, it is a virus that in the future is going to make all of us sick" (IDI 7).

Related to myths about population control, another prevalent myth is that the vaccine causes infertility. One vaccinated woman shared that others told her the vaccine would make her infertile. She stated "They say that for us women, if we get injected when we're 30 to 35 years old, they say that we won't have the good fortune of having children" (FGD 8). Related were concerns that if pregnant women were vaccinated, the vaccine would hurt or kill the baby, or cause birth defects.

Other prevalent vaccine myths were regarding religious beliefs. There were concerns that vaccination was going against the will of God. A core aspect of this myth is that the vaccine is the mark of the Devil or the Antichrist. One healthcare worker shared:

> "What I've heard a lot is that the vaccine is the seal of the beast, the 666. That those who have the vaccine are not going to go to heaven… those who are getting vaccinated don't have faith in God, because if the disease exists, your God is going to protect you, and if you believe in your God you don't have to be afraid of that disease. As if vaccination is a sign or proof that you don't have faith" (IDI 6).

Many community members and healthcare workers also stated they had heard that the vaccine contains a microchip. However, healthcare workers frequently stated that community members sometimes created these myths, perhaps out of fear, but were less clear on whether community members were choosing not to vaccinate because of them. Other less common myths included that the vaccine is made of animal blood or would turn those who were vaccinated into an animal, and that the vaccine will make those who are immunized magnetic. In addition to less

common myths, some community members questioned whether the vaccine they were receiving was real, or if it was just water.

Connected with myths and misinformation was the distrust that community members had for the Guatemalan government regarding COVID-19 vaccines, as well as general mistrust of the governments of other countries, particularly wealthy and powerful countries. For example, one community member said "That [the vaccine is] a racket they say, between presidents, between countries, they've made these agreements between themselves. To raise money, to get money, they say" (FGD 8). A healthcare worker shared that they heard from community members that "[the vaccine is] to make money. From the other countries, that's why this vaccine was created, so that the other countries become richer and we become poorer" (IDI 10).

Healthcare workers also highlighted that Indigenous communities distrusted the government. Healthcare workers often attributed this distrust to the armed conflict and government's ongoing neglect of Indigenous populations. One healthcare worker stated:

> "They question if it is a government plan to reduce the population. For the Indigenous people… it is because of the history of the armed conflict that there are still after-effects of this. Because the distrust that the population has towards the government… Because of everything that is happening, corruption, violence, and all that, they are afraid" (IDI 1).

Healthcare workers and community members argued that distrust in the government contributed to susceptibility to myths and fears about the vaccine.

While myths were prevalent in the communities and provoked fears about the vaccines, community members were also afraid of potential vaccine reactions or side effects. For example, one participant noted:

> "My in-laws… were not convinced, because they had doubts about how it was going to be. So, my husband and I sat down with them to talk about their concerns about the effects that the vaccine was going to have on them. And, we talked to them and finally they both got vaccinated" (IDI 7).

Barrier Three: Access and Supply Challenges

Healthcare workers and community members identified vaccine access and supply challenges as potential limitations to vaccination. Access challenges were considered to be a bigger concern in remote and rural areas, and traveling to vaccination sites could be difficult. One healthcare worker illustrated this point, saying:

> "There are people who have to take the only bus that is in their community every day and only at certain times. They have to travel two hours to get to the head of the community and get the vaccine. In the end the people had to invest time and money that they don't have and go very far, besides the fear of traveling by bus" (IDI 6).

Healthcare workers and community members remarked that lines for the vaccine were very long early in the vaccine campaign, which created challenges for those who had to work or were unable to stand for long periods:

> "It was like we were waiting in line because they called some people from there, others from there, and it got messy because there were a lot of people. And I got very desperate, seeing the long lines, and the big mess that was there, and since I had other commitments to do in the afternoon, it was better for me to go back. I left" (FGD 5).

Supply problems were also identified as a potential barrier. Some healthcare workers noted that initially they did not have enough vaccines available to meet the demand. One healthcare worker stated:

> "Sometimes they tell us that there are no vaccines, and we call people and they get upset with us. And because of the internet signal, there is no good internet signal, we don't have computer equipment and we use our personal computers. The ministry didn't think directly, they just gave us work orders and let us see how it goes" (IDI 2).

While supply problems were identified as a problem early in the vaccination campaign, it should be noted that multiple participants remarked that the issue seemed to be improving over time.

Community Perceptions of How to Increase Vaccine Acceptance

Improving Uptake with Social Influence Messages

Indigenous community members and healthcare workers identified vaccinated individuals as influential in building confidence in vaccine safety. Many of those interviewed argued that seeing and talking to vaccinated community members about their experiences was the most influential method to increase vaccine uptake in the community. One healthcare worker shared:

> "My aunts on my mom's side did not want to get vaccinated… when my mom got vaccinated… they started to worry. My mom told them that she was fine. One aunt saw that it was true... And, within a matter of two weeks all my aunts were vaccinated. They were very scared, but seeing someone very close to them, that helped a lot." (IDI 6).

Healthcare workers and community members indicated that they believed leveraging the stories of vaccinated community members would help to encourage higher vaccine uptake.

Improving Uptake with Vaccine Safety and Efficacy Messages

Healthcare workers and community members emphasized that their communities had faced ongoing health and economic difficulties during the COVID-19 pandemic. Many of them shared that they and others in the community were tired of dealing with the effects of the pandemic and viewed the vaccine as a solution. One community member shared "these vaccines are the best defense that we have been given, when we didn't have them, the disease got worse here in our community" (FGD 7). Another healthcare worker expressed:

> "People were previously afraid because of so much death caused by the pandemic... maybe one person was the one who started in the family to get vaccinated, and the others saw that nothing happened to him. So little by little people began to be encouraged to get vaccinated, and they saw that the vaccine is good" (FGD 5).

Improving Vaccine Uptake with Appropriate Religious and Cultural Messages

While religious concerns led some Indigenous community members to believe that being vaccinated was going against the will of God, others indicated that their faith and trust in

religious leaders who supported the vaccine encouraged them to be vaccinated. One community member shared:

> "For me the vaccine is essential, because even the Pope, the holy father of the Catholic Church recommends it, and I don't distrust or doubt him because he is an honorable person, to say such and such a thing, right?" (FGD 8).

Another person indicated that their faith led them to trust the vaccine, by stating "I'm sure that God cures and does miracles, but also God has given wisdom to doctors, their study, everything. So, you have to also believe in medicine" (FGD 2).

Improving Uptake by Ensuring that Messages are Culturally Relevant

Healthcare workers and community members emphasized that health and vaccine messages should reflect Indigenous peoples' experiences. One healthcare worker said messages should contain "images that are adapted, for example, to their industry… the phrases in Kaqchikel... The most concrete, with information that is not boring… but above all that it is culturally relevant" (IDI 1). Another healthcare worker states:

> "How to reach the people and convince them is that someone from their family tells them… or an Indigenous person is the one who tells them, contextualized to the area around here, and basically and it is very important that it is in their language. It is useless to have contextualized images or drawings if the audio is not in the language of the people who are listening" (IDI 6).

Improving Uptake by Making Information Available in the Mayan Languages

Healthcare workers and community members emphasized the importance of providing health information, especially audio, in Mayan languages. The need for information in Mayan languages was considered especially significant for older populations, who were less likely to speak Spanish. One community member explained this, stating:

> "It is necessary in our language, I don't know a lot of Spanish words. I don't understand it. I don't know what to say, but in our language, I do… in Spanish, maybe I can only

answer one or two things, but I cannot keep the conversation, the words don't get to my mind. It's hard not to know Spanish" (FGD 4).

Not only is providing information in Mayan languages critical for understanding, but it also helps community members emotionally and culturally connect with messages. One healthcare worker expressed:

> " 'Unless they say something in Kaqchikel, they say that it belongs to the ladinos' [a term for the socio-ethnic category of Mestizo or Hispanicized peoples], so to speak, 'that it is not ours'... how to reach the people… is someone… an Indigenous person is the one who tells them or that it is contextualized to the area around and basically it is very important that it is in the language" (IDI 6).

Yet, even though healthcare workers and community members repeatedly emphasized the necessity of providing information in Mayan languages, they expressed that very little information on COVID-19 and the vaccines in Mayan languages exists. A community member shared:

> "Here there are a lot of people who still don't understand Spanish. A lot of people. [Vaccine information] should be disseminated more in our languages, right? In this case, Kaqchikel… This has fallen very short. The ministries that are in charge of disseminating this information, they need to see other ways" (FGD 6).

Improving Uptake by Making Messages Appealing for Those with Low or No Literacy

While healthcare workers and community members emphasized the need for health and vaccine information in the Mayan languages, they also recognized the low literacy rates in the community, especially among elderly monolingual Mayan language speakers. Many respondents suggested information may need to be provided in audio or visual formats. One healthcare worker illustrated this, stating:

> "There are many of us who know how to speak, but we don't even know how to read it. I am one of them who can speak Kaqchikel but if they put me to read it, or write it, I think I am at zero. So rather than maybe reading it, or writing it on posters, I think it would be better to speak it" (IDI 13).

Additionally, some participants indicated information should be relayed through concise and engaging messages. This would help with both literacy challenges and benefit those with limited technology access or bandwidth.

Trusted Sources of Health Messaging for Indigenous Community Members

Healthcare Workers and Local Leaders

Community members identified that they trusted health information from their local health center workers, including the nurses, midwives, and community health workers. One community member stated "I have more confidence in the information given by the nurses at the health center" (FGD 5). Healthcare workers recognized that community members relied on them to provide health messages. One healthcare worker stated:

> "...but a lot of people trust us too much sometimes. These are things we have to keep in mind. I think that this career that we've chosen, our profession, requires a lot of human responsibility, a lot of empathy." (IDI 5).

Community members and healthcare workers also indicated a high level of trust in health messages from local community leaders and non-governmental organizations (NGOs). This trust is illustrated by one healthcare worker who stated:

> "It is information that has been worked on by non-governmental institutions, that focuses on the population itself, in their own language. I think that is more reliable.... Also, the role that some community leaders have played, and the midwives… I think their experience helped women, because I think that they are people who have been given a lot of trust. So, when they mentioned that they had been vaccinated, they convinced other people to do it" (IDI 1).

The expressed trust in local healthcare workers and community leaders co-exist with distrust of the government. Although healthcare workers and local leaders may provide messages

based on central Ministry of Health guidelines, these messages may only be highly trusted when delivered by locally-embedded healthcare workers embedded. This may indicate that local healthcare workers have been able to successfully translate messages to make them more culturally acceptable and relevant for the Indigenous community members.

Local Communication Campaigns

Local community radio is considered to be a popular source of public health information, especially for older generations, given its one of the few sources of information in Mayan languages. One healthcare worker remarked:

> "I think that there are some older adults, sometimes they do not have a phone to see it on social networks... So, I think that with the community radios that most of the population that works in the field, they normally listen to the radio stations of the town" (IDI 15).

Much of the current information about sites and dates of vaccine availability came from healthcare workers driving health center vehicles and making announcements in Mayan languages.

Social Media

Many Indigenous community members in the departments of Chimaltenango and Sololá rely on social media for information, especially younger generations. One participant stated "Social media is important. It's a key part of it, because now you can see that children already have phones now" (IDI 5). Many people indicated that information from social media is often transmitted from younger people to older people: "There are people who don't have phones, but their children have phones and social networks, so they are the ones who give the information to their parents" (IDI 3). However, some healthcare workers noted social media is not universally accessible, which can be a barrier to accessing vaccine information, including locations of government vaccine clinics that tend to be posted on Facebook:

> "In Facebook they see it, we put the information and the calls start, to ask which vaccines are available. There are many questions… also… by WhatsApp. It works for about 50 percent, it is only for people who have access" (IDI 2).

DISCUSSION

This study is one of the first to describe factors that influence COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala. Although findings have many similarities with those described in other countries[24, 46, 47], they are highly contextualized in economic, cultural, political, and social factors specific to Maya populations in Guatemala. The research has indicated that acceptance of myths and misinformation about COVID-19 vaccines are related to a lower intention to be vaccinated[42, 48, 49]. However, understanding cultural differences in these beliefs is critical for combating this misinformation[42]. Highlighting the challenges faced by the Maya population is critical given a long history of marginalization; it is paramount for public health officials to identify how to effectively support the most marginalized and highest risk populations during health crises.

Study findings delineate common barriers to vaccination within this at-risk population. These can be roughly grouped into three major overarching themes: (1) lack of COVID-19 vaccine information available that is easily understandable, linguistically appropriate, and culturally sensitive; (2) widespread mis- and dis-information that preys on people's fears and mistrust of the medical establishment and government; and (3) vaccine access and supply issues that prevent people from being vaccinated efficiently and quickly. Several participants noted that the fear and resistance to COVID-19 vaccines is not surprising given the widespread government distrust and dearth of well-designed culturally relevant information, especially in Mayan languages. The negative health impacts related to distrust in the government has been noted in previous studies[32, 33, 36, 40, 41, 44, 50], but this study adds to the literature by focusing on

the uptake of COVID-19 vaccine by the Maya population of the Central Highlands of Guatemala. Additionally, religion and the opinions of religious leaders was noted have the potential to be both a facilitating factor or a barrier to vaccination, depending on the context. More research is required to better understand the nuances of this issue and to find effective ways to work with faith leaders to encourage vaccination.

Participants had recommendations for how to navigate the challenges faced by the Indigenous populations. First, study results highlight the power of social influence to encourage vaccine acceptance in Indigenous communities. Specifically, participants noted that messages highlighting how community members have been safely vaccinated, and messages that come directly from local healthcare workers, community leaders, and council members, may be the most trusted by those who are still unvaccinated. This is consistent with other research conducted in Latin American countries that has found that providing information about others' vaccinations successfully increased both vaccine willingness, as well as the willingness of respondents to encourage others to be vaccinated[14, 39].

This research also highlights that messages should be culturally relevant, appropriate for low literacy populations, and should be in the languages that people speak. Several participants noted that health promotional material should have specific Maya cultural references (dress, food, concepts of disease) to ensure messaging connects with intended targets. Additionally, multiple modalities should also be used to reach a large population. While a large proportion of young people use social media and the internet, many older people rely on radio and vehicles with loudspeakers traveling through local villages to get their information. Ensuring health promotion campaigns use multiple different modalities will be critical to optimizing impact.

CONCLUSION

This study indicated a lack of available COVID-19 health materials in Indigenous Maya languages. The Indigenous Maya populations in Guatemala are at high risk for vaccine myths and misinformation due to their historical and current context. Vaccine education that integrates local understanding and cultural contexts and in Indigenous languages should be disseminated through a variety of modalities, including social media may improve social acceptance of the vaccine, perceived safety, and increase vaccine uptake. Given the complexity of developing efficacious content for diverse populations with potentially varying needs, policy makers should focus on collaborating with and integrating local knowledge from community leaders, non-governmental organizations and healthcare providers that work directly with the Maya communities to leverage their respective expertise in incentivizing health behaviors.

There are several limitations of this study. First, given the sample was restricted to the Central Highlands of Guatemala, results cannot necessarily be generalized to the wider population, or even other Indigenous groups. Secondly, given the rapidly evolving nature of the pandemic and risk of in-person interviewing, the study limited FGDs and IDIs to the minimum needed for theme saturation. We recognize that additional focus groups with community members may be helpful for teasing out more nuanced findings.

Further research is needed to determine the most effective ways to develop relevant educational and promotional materials and how to best target information to this population in order to increase uptake of COVID-19 vaccines. Careful attention should be paid to different Indigenous constructs of health and disease, as well as the cultural and political context within which the population accesses and understands information. Ongoing follow-up research from this study includes development of social media educational content that is currently being evaluated through social media polling and analytics and in-person surveys.

AUTHORS' CONTRIBUTIONS

NS, KS, JJ, NDS, and AKD led the conceptualization and design of the study. EL, MSM, and AKD led participant outreach and recruitment. NS, KS, EL, and AKD led the development of the interview and focus group protocols. MSM conducted the qualitative interviews and focus group discussions, transcribed data, and translated materials. NS, KS, EL, NDS, and JJ conducted the qualitative data analysis and interpretation. NS and KS led the data analysis, the interpretation of findings, and writing all drafts. NS, KS, EL, LAM, KBV, JJ, NDS, AKD contributed to the design of the study, interpretation of findings, and revising all drafts. All authors have read and approved the final manuscript.

ACKNOWLEDGMENTS

We would like to thank the community members who participated in focus groups for their generous contributions to this project by sharing their lived-experiences and personal opinions. We would also like to thank the entire Wuqu' Kawoq staff, including their participation in interviews and connections to both local healthcare workers and community members. We would also like to extend our gratitude to Anil Vora, Katherine Sziraczky, Katie Gleason, Aarti Porwal, and Charles Prober.

ETHICS STATEMENT

Verbal informed consent was obtained from the study participants. All participants were read the consent document in private to ensure that regardless of literacy they were fully informed about their right to refuse participation and to ensure they were clear on the purposes of the research project. The study received approval by Institutional Review Boards at the University of California, San Francisco (Study # 21-35160) and Stanford University (Protocol # 63193), and a private IRB through Wuqu' Kawoq (Protocol # WK 2021 005).

COMPETING INTERESTS STATEMENT

No members of the research team have financial interests in the development of COVID-19 vaccines or in promoting vaccination.

FUNDING STATEMENT

Funding for the study was provided by the Vaccine Confidence Fund grant number (VCF-001).

DATA AVAILABILITY STATEMENT

No data are available.

REFERENCES

1. Understanding vaccination progress by country [Internet]. Johns Hopkins Coronavirus Resource Center. [cited 2022 July 13]. Available from: https://coronavirus.jhu.edu/vaccines/international
2. COVID-19 vaccination rate by country Latin America 2022 [Internet]. *Statista*. [cited 2022 Apr 19]. Available from: https://www.statista.com/statistics/1194813/latin-america-covid-19-vaccination-rate-country/
3. Biswas MR, Alzubaidi MS, Shah U, Abd-Alrazaq AA, Shah Z. A scoping review to find out worldwide COVID-19 vaccine hesitancy and its underlying determinants. *Vaccines (Basel)*. 2021 Oct 25;9(11):1243.
4. Joshi A, Kaur M, Kaur R, Grover A, Nash D, El-Mohandes A. Predictors of COVID-19 vaccine acceptance, intention, and hesitancy: A scoping review. *Front Public Health*. 2021;9:698111.
5. Ochieng C, Anand S, Mutwiri G, Szafron M, Alphonsus K. Factors associated with COVID-19 vaccine hesitancy among visible minority groups from a global context: A scoping review. *Vaccines (Basel)*. 2021 Dec 7;9(12):1445.
6. Sallam M. COVID-19 Vaccine hesitancy worldwide: A concise systematic review of vaccine acceptance rates. *Vaccines (Basel)*. 2021 Feb 16;9(2):160.
7. Wang Q, Hu S, Du F, Zang S, Xing Y, Qu Z, et al. Mapping global acceptance and uptake of COVID-19 vaccination: A systematic review and meta-analysis. *Commun Med.* 2022 Sep 12;2(1):1–10.
8. Majid U, Ahmad M, Zain S, Akande A, Ikhlaq F. COVID-19 vaccine hesitancy and acceptance: a comprehensive scoping review of global literature. *Health Promot Int.* 2022 Jun 1;37(3):daac078.
9. Norhayati MN, Che Yusof R, Azman YM. Systematic review and meta-analysis of COVID-19 vaccination acceptance. *Frontiers in Medicine.* 2022;8.
10. Guzman-Holst A, DeAntonio R, Prado-Cohrs D, Juliao P. Barriers to vaccination in Latin America: A systematic literature review. *Vaccine*. 2020 Jan 16;38(3):470–81.
11. Alarcón-Braga EA, Hernandez-Bustamante EA, Salazar-Valdivia FE, Valdez-Cornejo VA, Mosquera-Rojas MD, Ulloque-Badaracco JR, et al. Acceptance towards COVID-19

vaccination in Latin America and the Caribbean: A systematic review and meta-analysis. *Travel Med Infect Dis*. 2022 Oct;49:102369.

12. Bhopal S, Nielsen M. Vaccine hesitancy in low- and middle-income countries: potential implications for the COVID-19 response. *Archives of Disease in Childhood*. 2021 Feb 1 [cited 2021 Nov 2];106(2):113–4.
13. Kozlov M. COVID vaccines have higher approval in less-affluent countries. *Nature*. 2021 Jul 22.
14. Solís Arce JS, Warren SS, Meriggi NF, Scacco A, McMurry N, Voors M, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med.* 2021;27(8):1385–94.
15. Bono SA, Faria de Moura Villela E, Siau CS, Chen WS, Pengpid S, Hasan MT, et al. Factors affecting COVID-19 vaccine acceptance: An international survey among low- and middle-income countries. *Vaccines* (Basel). 2021 May 17;9(5):515.
16. Argote P, Barham E, Daly S, Gerez J, Marshall J, Pocasangre O. Messages that increase COVID-19 vaccine willingness: Evidence from online experiments in six Latin American countries. Rochester, NY: *Social Science Research Network*; 2021 Jun. Report No.: ID 3812023. Available from: https://papers.ssrn.com/abstract=3812023
17. Cassady D, Castaneda X, Ruelas MR, Vostrejs MM, Andrews T, Osorio L. Pandemics and vaccines: Perceptions, reactions, and lessons learned from hard-to-reach Latinos and the H1N1 campaign. *Journal of Health Care for the Poor and Underserved*. 2012;23(3):1106–22.
18. Flood D, Rohloff P. Indigenous languages and global health. *The Lancet Global Health*. 2018 Feb;6(2):e134–5.
19. Few M. Epidemics, indigenous communities, and public health in the COVID-19 era: views from smallpox inoculation campaigns in colonial Guatemala. *Journal of Global History*. 2020 Nov;15(3):380–93.
20. Meneses-Navarro S, Freyermuth-Enciso MG, Pelcastre-Villafuerte BE, Campos-Navarro R, Meléndez-Navarro DM, Gómez-Flores-Ramos L. The challenges facing Indigenous communities in Latin America as they confront the COVID-19 pandemic. *Int J Equity Health*. 2020;19(1):63.
21. Poirier B, Sethi S, Garvey G, Hedges J, Canfell K, Smith M, et al. HPV vaccine: uptake and understanding among global Indigenous communities - a qualitative systematic review. *BMC Public Health.* 2021 Nov 10;21(1):2062.
22. Mosby I, Swidrovich J. Medical experimentation and the roots of COVID-19 vaccine hesitancy among Indigenous Peoples in Canada. *CMAJ.* 2021 Mar 15;193(11):E381–3.

23. Singh K, Lima G, Cha M, Cha C, Kulshrestha J, Ahn Y-Y, et al. Misinformation, believability, and vaccine acceptance over 40 countries: Takeaways from the initial phase of the COVID-19 infodemic. *PLOS ONE*. 2022 Feb 9;17(2):e0263381.
24. Dash S, Parray AA, Freitas LD, et al. Combating the COVID-19 infodemic: a three-level approach for low and middle-income countries. *BMJ Global Health*. 2021;6(1):e004671. doi:10.1136/bmjgh-2020-004671
25. Maffioli EM, Gonzalez R. Are socio-demographic and economic characteristics good predictors of misinformation during an epidemic? *PLOS Global Public Health*. 2022 Mar 16;2(3):e0000279.
26. Chen Z, Zheng W, Wu Q, Chen X, Peng C, Tian Y, et al. Global diversity of policy, coverage, and demand of COVID-19 vaccines: a descriptive study. *BMC Med*. 2022 Apr 4;20(1):130.
27. IWGIA - International Work Group for Indigenous Affairs. Indigenous World 2020: Guatemala - *IWGIA - International Work Group for Indigenous Affairs* [Internet]. 2020 [cited 2022 Mar 3]. Available from: https://www.iwgia.org/en/guatemala/3622-iw-2020-guatemala.html
28. Principales Resultados Censo 2018: Septiembre 2019 [Internet]. 2019. [cited 2022 Mar 3]. Available from: https://www.censopoblacion.gt/dondeestamos
29. Sanford V. From genocide to femicide: Impunity and human rights in twenty-first century Guatemala. *Journal of Human Rights*. 2008 Jun 17;7(2):104–22.
30. Beck E. The uneven impacts of violence against women reform in Guatemala: Intersecting inequalities and the patchwork state. *Latin American Research Review*. 2021;56(1):20-35. doi:10.25222/larr.636
31. Guatemala — Memory of silence: Report of the Commission for Historical Clarification: Conclusions and recommendations (February 1999). (1999). Die Friedens-Warte, 74(4), 511–547.
32. Chary A, Flood D, Austad K, et al. Accompanying Indigenous Maya patients with complex medical needs: A patient navigation system in rural Guatemala. *Healthcare*. 2018;6(2):144-149. doi:10.1016/j.hjdsi.2017.08.006
33. Seitz K, Cohen J, Deliens L, et al. Place of death and associated factors in 12 Latin American countries: A total population study using death certificate data. *J Glob Health*. 2022;12:04031. doi:10.7189/jogh.12.04031
34. Flood D, Chary A, Austad K, Coj M, Lopez W, Rohloff P. Patient navigation and access to cancer care in Guatemala. *JGO*. 2018;(4):1-3. doi:10.1200/JGO.18.00027

35. Hernandez A, Hurtig AK, Sebastian MS, Jerez F, Flores W. 'History obligates us to do it': political capabilities of Indigenous grassroots leaders of health accountability initiatives in rural Guatemala. *BMJ Global Health*. 2022;7(5):e008530. doi:10.1136/bmjgh-2022-008530
36. Perry MF, Coyote EI, Austad K, Rohloff P. Why women choose to seek facility-level obstetrical care in rural Guatemala: A qualitative study. *Midwifery*. 2021;103:103097. doi:10.1016/j.midw.2021.103097
37. Dyrstad, K, Bakke, KM, & Binningsbø HM. Perceptions of peace agreements and political trust in post-war Guatemala, Nepal, and Northern Ireland, *International Peacekeeping,* 2021; 28:4, 606-631, DOI: 10.1080/13533312.2020.1869541
38. Lazarus JV, Ratzan S, Palayew A, et al. COVID-SCORE: A global survey to assess public perceptions of government responses to COVID-19 (COVID-SCORE-10). Hotchkiss D, ed. *PLoS ONE*. 2020;15(10):e0240011. doi:10.1371/journal.pone.0240011
39. Argote P, Barham E, Daly SZ, Gerez JE, Marshall J, Pocasangre O. The shot, the message, and the messenger: COVID-19 vaccine acceptance in Latin America. NPJ *Vaccines.* 2021 Sep 30;6(1):118.
40. Blair RA, Morse BS, Tsai LL. Public health and public trust: Survey evidence from the Ebola Virus Disease epidemic in Liberia. *Social Science & Medicine*. 2017; 172: 89-97. doi:10.1016/j.socscimed.2016.11.016
41. Bessi A, Coletto M, Davidescu GA, Scala A, Caldarelli G, Quattrociocchi W. Science vs conspiracy: Collective narratives in the age of misinformation. *PLoS One*. 2015 Feb 23;10(2):e0118093.
42. Caycho-Rodríguez T, Valencia PD, Ventura-León J, Vilca LW, Carbajal-León C, Reyes-Bossio M, et al. Design and cross-cultural invariance of the COVID-19 vaccine conspiracy beliefs scale (COVID-VCBS) in 13 Latin American countries. *Front Public Health.* 2022;10:908720.
43. Poirier B, Sethi S, Garvey G, Hedges J, Canfell K, Smith M, et al. HPV vaccine: uptake and understanding among global Indigenous communities - a qualitative systematic review. *BMC Public Health.* 2021 Nov 10;21(1):2062.
44. Burghouts J, Del Nogal B, Uriepero A, Hermans PWM, de Waard JH, Verhagen LM. Childhood vaccine acceptance and refusal among Warao Amerindian caregivers in Venezuela; A qualitative approach. *PLoS One.* 2017;12(1):e0170227.
45. Instituto Nacional de Estadística Guatemala. Compendio Estadístico de Pueblos. [cited 2022 Mar 3]. 2021. Available from:

https://www.ine.gob.gt/sistema/uploads/2021/12/30/20211230192119ITIf0Taxw7mbshQNenoLw9A9K5cR4pMt.pdf

46. Mose A. Willingness to receive COVID-19 vaccine and its determinant factors among lactating mothers in Ethiopia: A cross-sectional study. *Infection and Drug Resistance.* 2021 Mar 30;14:4249–59.
47. Hossain E, Rana J, Islam S, Khan A, Chakrobortty S, Ema NS, et al. COVID-19 vaccine-taking hesitancy among Bangladeshi people: knowledge, perceptions and attitude perspective. *Human Vaccines & Immunotherapeutics*. 2021 Nov 2;17(11):4028–37.
48. Islam MS, Kamal AHM, Kabir A, Southern DL, Khan SH, Hasan SMM, et al. COVID-19 vaccine rumors and conspiracy theories: The need for cognitive inoculation against misinformation to improve vaccine adherence. *PLOS ONE*. 2021 May 12;16(5):e0251605.
49. Zheng Y, Xi L, Hepeng J. Is it all a conspiracy? Conspiracy theories and people's attitude to COVID-19 vaccination. *Vaccines*. 2021 Sep 22;9(10).
50. Cox GR, Anastario M, FireMoon P, Ricker A, Rink E. Narrative frames as choice over structure of American Indian sexual and reproductive health consequences of historical trauma. *Sociology Health & Illness*. 2021;43(8):1774–88.

Table 1. Focus Group Discussion Population Characteristics

Characteristics		N (%)
Primary Language	Spanish Kaqchikel K'iche' Other	15% 85% 0% 0%
Gender	Female Male Non-binary Not specified	80% 20% 0% 0%
Age	18-24 25-64 65+	10% 85% 5%
Region	Urban Rural	25% 75%

Table 2. In Depth Interview Population Characteristics

Characteristics		N (%)
Primary Language	Spanish Kaqchikel K'iche' Other	19% 66% 25%
Gender	Female Male Non-binary Not specified	81% 19% 0% 0%
Age	18-24 25-64 65+	6% 88% 6%
Profession	Doctor Hospital-based Nurse Community Health Worker (Nurse)	6% 25% 69%

Standards for Reporting Qualitative Research (SRQR)*

Title and abstract	**Page no(s).**
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Title page
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	P. 1

Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	P. 1-3
Purpose or research question - Purpose of the study and specific objectives or questions	P. 3

Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale	P. 3

Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	P. 4
Context - Setting/site and salient contextual factors; rationale	P. 4 & 5, Table 1 & 2
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	P. 4 & 5
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Ethics Statement P. 20
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale	P. 4, 5, & 6
Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	P. 5 & 6
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Tables 1 & 2
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	P. 5 & 6

Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale	P. 6, Author Contribution Statement P. 20
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale	P. 6

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	P. 6 & 7
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	P. 7-16

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	P. 16-18
Limitations - Trustworthiness and limitations of findings	P. 19

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	P. 20
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	P. 20

BMJ Open

A Participatory Qualitative Study on the Barriers to COVID-19 Vaccine Acceptance to Improve Messages for Vaccine Uptake in Indigenous Populations in the Central Highlands of Guatemala

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-067210.R2
Article Type:	Original research
Date Submitted by the Author:	13-Jan-2023
Complete List of Authors:	Skinner, Nadine; Stanford University School of Medicine, Sanders, Kelly; University of California San Francisco, Lopez, Emily; Maya Health Alliance Wuqu' Kawoq Sotz Mux, Magda; Maya Health Alliance Wuqu' Kawoq Abascal Miguel, Lucía; University of California San Francisco Vosburg, Kathryn; University of California San Francisco (UCSF) Johnston, Jamie; Stanford University School of Medicine, Stanford Center for Health Education Diamond-Smith, Nadia; University of California San Francisco, Epidemiology and Biostatistics Kraemer Diaz, Anne; Maya Health Alliance Wuqu' Kawoq
Primary Subject Heading:	Communication
Secondary Subject Heading:	Health policy, Infectious diseases, Public health, Qualitative research
Keywords:	COVID-19, QUALITATIVE RESEARCH, PUBLIC HEALTH, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PREVENTIVE MEDICINE

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

A Participatory Qualitative Study on the Barriers to COVID-19 Vaccine Acceptance to Improve Messages for Vaccine Uptake in Indigenous Populations in the Central Highlands of Guatemala

[1] Nadine Ann Skinner, [2] Kelly Sanders, [3] Emily Lopez, [3] Magda Silvia Sotz Mux, [2] Lucia Abascal Miguel, [2] Kathryn Bradford Vosburg, [1] Jamie Johnston, [2] Nadia Diamond-Smith, and [3]Anne Kraemer Diaz

[1] Stanford Center for Health Education, Digital Medic, Stanford University, United States
[2] Institute for Global Health Sciences, University of California, San Francisco, United States
[3] Wuqu´ Kawoq, Maya Health Alliance, Tecpán, Guatemala

*Corresponding author Nadine Ann Skinner, nas2@stanford.edu, Stanford Center for Health Education, Digital Medic, Stanford University, 408 Panama Mall, Stanford, California, 94305, United States

Word Count: 5,232

ABSTRACT

Introduction: As of July 2022, a little over one third of Guatemalans were fully vaccinated. While COVID-19 vaccination rates are not officially reported nationally by racial/ethnic groups, non-governmental organizations and reporters have observed that COVID-19 vaccination rates are especially low among high-risk Indigenous populations. We conducted one of the first studies on COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala, which aimed to better understand the barriers to COVID-19 vaccine uptake and how to improve vaccine promotional campaigns.

Methods: In November 2021, we conducted eight focus group discussions (FGDs) with 42 Indigenous men and women and 16 in-depth interviews (IDIs) with community health workers, nurses, and physicians in Chimaltenango and Sololá. Using a participatory design approach, our qualitative analysis used constant comparative methods to understand the inductive and deductive themes from the FGD and IDI transcripts.

Results: We found three major overarching barriers to vaccination within the sampled population: (1) a lack of available easily understandable, linguistically appropriate and culturally sensitive COVID-19 vaccine information, (2) vaccine access and supply issues that prevented people from being vaccinated efficiently and quickly, and (3) widespread mis- and dis-information that preys on people's fears of the unknown and mistrust of the medical establishment and government.

Conclusion: When developing COVID-19 vaccine messages, content should be culturally relevant, appropriate for low literacy populations, and should be in the languages that people prefer to speak. Promotional materials should be in multiple modalities (print, radio, social media) and also have specific Maya cultural references (dress, food, concepts of disease) to ensure messaging connects with intended targets. This study supports the need for more robust research into best practices for communicating about COVID-19 vaccines to marginalized communities globally, and suggests that policy makers should invest in targeted local solutions to increase vaccine uptake.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is one of the first studies on COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala, a population that has faced systemic health inequities.
- This study is grounded in a community-based participatory design approach to work collaboratively with the Indigenous Maya population to ensure that the study and the findings have cultural and linguistic relevance.

- One limitation is that because the sample was restricted to the Central Highlands of Guatemala, results cannot be generalized to the wider population in Guatemala, or even to other Indigenous groups.
- The study limited FGDs and IDIs to the minimum needed for theme saturation due to the rapidly evolving nature of the pandemic and risk of in-person interviewing. Additional focus groups with community members may be helpful for teasing out more nuanced findings.

INTRODUCTION

Guatemala has the lowest rate of COVID-19 vaccinations in Central America, with only 35.16% of the population fully vaccinated against COVID-19 as of July 2022[1, 2]. There has been extensive research on the COVID-19 vaccine acceptance and hesitancy globally[3-11]. However, there is limited research describing vaccine acceptance, especially for the COVID-19 vaccine, in Indigenous communities in Guatemala[10-11]. While previous research has indicated that vaccine acceptance, and acceptance of COVID-19 vaccines in particular, may be high in low- and middle-income countries (LMICs)[12-14], this may not be the case in Guatemala. Previous international research with Indigenous populations has found numerous potential barriers to vaccines, including (1) fears of side effects[15,16], (2) language barriers[17, 18], (3) systemic and historical health inequities[19-22], (4) vaccine misinformation and myths[14, 20, 23-25], and (5) variable supply and availability[26].

Guatemala is culturally diverse, with 43.7% of the population self-identifying as Indigenous from the Maya (41.7%), Garífuna (0.1%), and Xinca (1.8%) peoples[27, 28]. Indigenous populations speak over twenty non-Spanish languages; 27.1% of the Guatemalan population speaks K'iche' and 17.2% reports speaking Kaqchikel[28]. Indigenous populations have experienced systemic violence and historical health inequities[19, 20] contributing to high levels of government distrust[29, 30]. The United Nations supported Commission for Historical

Clarification (CEH) concluded that Guatemala's 36-year armed conflict, which officially ended in 1996, was part of a colonial legacy of entrenched racism, exclusion, and antagonism towards the Maya peoples[31]. State-sponsored violence against the Indigenous population has historically impacted public health practices. Guatemala's colonial legacy of medical humanitarianism has reinforced racial/ethnic hierarchies using violence and coercion to enforce compliance with state-directed public health campaigns[19]. Today, the underfunded public health system infrastructure disproportionately impacts Indigenous Guatemalans, leaving many Indigenous peoples without healthcare coverage or with high out-of-pocket medical expenses[32-35]. Within the healthcare system, they face linguistic and cultural barriers, discrimination, and widespread mistreatment[32, 35, 36].

The historical legacies and systemic health inequities have engendered distrust in the government and health systems by the Indigenous Maya populations[30, 37]. Distrust in the government has been shown to influence public behavior in the context of major health threats [37, 38, 39]. Studies of trust in the COVID-19 vaccine in Latin America found that two of the most common contributors to vaccine hesitancy were distrust of the government and mistrust in the vaccine development process[10, 11, 16, 40]. Mistrust in public health campaigns can lead to higher susceptibility to vaccine misinformation and myths[23, 26, 38, 41, 42]. Additional research on the spread of COVID-19 misinformation on social media suggests that people in LMICs[23] are especially exposed to significant amounts of misinformation and may be more susceptible to this misinformation when exposed[23].

Given a general lack of information and research on how misinformation impacts Indigenous Maya populations, this study aimed to (1) understand how the COVID-19 vaccine is perceived by the Indigenous Maya population in the Central Highlands of Guatemala; (2)

determine which myths/misinformation exist within the communities; (3) identify trusted sources of health messaging for Indigenous community members, and (4) understand how members of Indigenous communities prefer to receive health information.

MATERIALS AND METHODS

Study Design

This study used a community-based participatory design approach to identify vaccine access barriers, myths/fears around immunization, sources of accurate vaccine information or misinformation, and how messages are shared among social networks with the aim of designing targeted health messages[36, 43, 44]. Local research team members conducted eight focus group discussions (FGDs) with 42 Indigenous men and women and 16 in-depth interviews (IDIs) with four hospital-based nurses, 11 community nurses, and one physician in the two departments of Chimaltenango and Sololá, which are located in the Central Highlands of Guatemala, in November 2021.

Patient and public involvement

Development of this research project was grounded in Wuqu' Kawoq | Maya Health Alliance's 15 years of experience as a community organization of Indigenous healthcare providers for Indigenous peoples. Indigenous Maya staff members reviewed, revised, and translated the IDI and FGD protocols to ensure cultural and linguistic relevance. The IDIs and FGDs were then facilitated by an Indigenous Maya interviewer to ensure trust, safety, and inclusion were built into the research process.

In addition to the Wuqu' Kawoq team members, the research team also included international researchers trained in community-based participatory research methods. To ensure that questions, analysis, and findings were relevant, consistently addressed equity, and ethically engaged with the Indigenous communities, the entire study team met weekly. Wuqu' Kawoq team members shared results and social media content based on the results with study participants to ensure that findings and materials were relevant to their priorities, and matched with their experiences and preferences.

Study Population

Wuqu' Kawoq staff members selected adult (over 18 years) participants who identified as Indigenous Maya for in person FGDs using a snowball sampling technique, identifying participants through community connections. This sampling methodology was chosen based on Wuqu' Kawoq's extensive experience conducting qualitative studies in this population, with a particular focus on minimizing harms and optimizing access given barriers presented by ongoing COVID-19 outbreaks in the area during the study period. K'iche' is the most common Mayan language in the Sololá department where 96.4% of the approximately 421,583 population identifies as Indigenous Maya. In Sololá, 33% of the population is under 14 years and 61.9% are 15- 64 years, with 61.6% of the population residing in urban municipalities[28, 45]. Kaqchikel is the most common Mayan language in the Chimaltenango department, where 66.5% of the approximately 615,776 population identifies as Indigenous Maya, with 34% of the population under 14 years and 61% of the population 15-64 years of age. In Chimaltenango, 54.1% of the population resides in urban municipalities[28, 45]. The study specifically sampled participants from these specific groups to minimize the likelihood of study results reflecting inappropriate

generalizations between different Maya populations, which are highly diverse and therefore may have very different needs.

FGDs explored community vaccine hesitancy and uptake, as well as perspectives on messages from social media and other sources related to COVID-19 vaccines. FGDs and IDIs followed a semi-structured discussion protocol. The FGDs and IDIs were conducted by Wuqu' Kawoq staff trained in qualitative research methods. FGDs and IDIs were conducted in Spanish or Kaqchikel, depending on the preference of those being interviewed. In light of cultural gender norms, men and women participated in separate FGDs of 3-6 people, which lasted between sixty and ninety minutes. The demographic characteristics of FGD participants can be found in Table 1. IDIs ranged between thirty and sixty minutes. The demographic characteristics of IDI participants can be found in Table 2.

[Tables 1 & 2 about here]

Analysis

IDIs and FGDs were transcribed in Kaqchikel and then translated into Spanish. Transcripts and field notes were shared with the U.S. researchers in Spanish; members of the research team translated them into English. Researchers then conducted a rapid analysis using a priori codes from the literature. Next, researchers used constant comparative methods to systematically code data and identify the initial key themes emerging from interview data using Dedoose software. The team then revised the coding data again to include both inductive and deductive codes.

After the revision, each interview transcript was analyzed again and independently coded by two members of the research team. During this process, researchers met multiple times to confer and calibrate coding interpretation and to further refine and recalibrate coding schemes.

Once researchers identified the final key themes from the data, members of the team translated the key themes into Spanish. The key themes were then reviewed for reliability by the Indigenous Maya interviewers.

RESULTS

Community members and healthcare workers identified three overarching barriers to vaccination, which included (1) a lack of available COVID-19 vaccine information that is easily understandable, linguistically appropriate, and culturally sensitive, (2) widespread mis- and dis-information that preys on people's fears of the unknown and mistrust of the medical establishment and government, and (3) vaccine access and supply issues that prevented people from being vaccinated efficiently and quickly. They also provided ideas on how the healthcare system might improve COVID-19 vaccine uptake for these populations, including developing messages that (1) encourage social acceptance, (2) focus on vaccine efficacy, (3) use appropriate religious and cultural contexts, (4) are culturally relevant, (5) are available in Mayan languages, (6) and are appropriate for low-literacy audiences. Finally, the community members and healthcare workers identified multiple appropriate modalities for disseminating culturally and linguistically relevant COVID-19 vaccine information including (1) trusted local healthcare workers and local leaders, (2) community radio, and (3) social media.

Community Perceptions of Vaccine Barriers

Barrier One: Lack of information in local languages

Indigenous community members and healthcare workers identified a lack of COVID-19 health and vaccine information available in Indigenous languages. They suggested that lack of

information was a major contributing factor to why members of the Indigenous communities were not seeking vaccination:

> "The health information disseminated about vaccination and COVID in general is not helpful for our communities… I have rarely heard announcements on national radio and television… Also, in social networks all the information is in Spanish, not in Mayan languages... If you search the internet for information about COVID in Kaqchikel there is nothing… people do not have information and do not want to get vaccinated. They have reason to be afraid because fear arises from the unknown, from the lack of information." (IDI 6).

They identified social media as being specifically devoid of information in Indigenous languages:

> "There are people who don't understand Spanish, right?... Because, maybe they have media, like Facebook and others. But they don't speak Spanish. Let's not say that we can't handle technology… there are native languages that should be promoted, so that the message also reaches them" (IDI 16).

Healthcare workers also identified the lack of health information, including confusion over vaccine dosing schedules, eligibility for vaccines, and vaccination dates, as a problem for the communities they served. In particular, they connected a lack of credible information with the spread of misinformation: "it is not so easy for someone from the community to have reliable information" (IDI 9).

Barrier Two: Myths, Misinformation, Mistrust, and Fear

Myths and misinformation are prevalent throughout the region. There are four common myths about the COVID-19 vaccine that are reported to be prevalent throughout the communities. These myths are that (1) the vaccines are designed to kill, (2) vaccines cause infertility, (3) vaccines are against the will of God or will cause you to be marked by the Devil, and (4) vaccines implant tracking microchips.

One highly prevalent myth is that the vaccine is designed to kill all or segments of the population, including the elderly, the Indigenous populations, or Guatemalans: "they say the vaccine is to eliminate all the elderly, they want to kill us, they want to eliminate us" (FGD 2). While many fear deadly side effects of vaccination, the myth that 'the vaccine kills' is specifically predicated on the belief that the vaccine was intentionally created to eliminate certain populations. This idea is illustrated by a community member who states "those who run the world want everyone to get vaccinated… because what they want is a smaller population… they want to empty the planet a little bit" (IDI 14). Some who believe in this myth state that the vaccine contains diseases, especially cancers, designed to harm the population. This idea is demonstrated by this quote "instead of a vaccine, it is a virus that in the future is going to make all of us sick" (IDI 7).

Related to myths about population control, another prevalent myth is that the vaccine causes infertility. One vaccinated woman shared that others told her the vaccine would make her infertile. She stated "They say that for us women, if we get injected when we're 30 to 35 years old, they say we won't have the good fortune of having children" (FGD 8). Related were concerns that if pregnant women were vaccinated, the vaccine would hurt or kill the baby, or cause birth defects.

Other prevalent vaccine myths were regarding religious beliefs. There were concerns that vaccination was going against the will of God. A core aspect of this myth is that the vaccine is the mark of the Devil or the Antichrist. One healthcare worker shared:

> "What I've heard a lot is that the vaccine is the seal of the beast, the 666. That those who have the vaccine are not going to go to heaven… those who are getting vaccinated don't have faith in God, because if the disease exists, your God is going to protect you, and if you believe in your God you don't have to be afraid of that disease. As if vaccination is a sign or proof that you don't have faith" (IDI 6).

Many community members and healthcare workers also stated they had heard that the vaccine contains a microchip. However, healthcare workers frequently stated that community members sometimes created these myths, perhaps out of fear, but were less clear on whether community members were choosing not to vaccinate because of them. Other less common myths included that the vaccine is made of animal blood or would turn those who were vaccinated into an animal, and that the vaccine will make those who are immunized magnetic. In addition to less common myths, some community members questioned whether the vaccine they were receiving was real, or if it was just water.

Connected with myths and misinformation was the distrust that community members had for the Guatemalan government regarding COVID-19 vaccines, as well as general mistrust of the governments of other countries, particularly wealthy and powerful countries. For example, one community member said "[the vaccine is] a racket they say, between presidents, between countries, they've made these agreements between themselves. To raise money, to get money" (FGD 8). A healthcare worker shared that they heard from community members that "[the vaccine is] to make money. From the other countries, that's why this vaccine was created, so that the other countries become richer and we become poorer" (IDI 10).

Healthcare workers also highlighted that Indigenous communities distrusted the government. Healthcare workers often attributed this distrust to the armed conflict and the government's ongoing neglect of Indigenous populations. One healthcare worker stated:

> "They question if it is a government plan to reduce the population. For the Indigenous people… it is because of the history of the armed conflict that there are still after-effects of this. Because the distrust that the population has towards the government… Because of everything that is happening, corruption, violence, and all that, they are afraid" (IDI 1).

Healthcare workers and community members argued that distrust in the government contributed to susceptibility to myths and fears about the vaccine.

While myths were prevalent in the communities and provoked fears about the vaccines, community members were also afraid of potential vaccine reactions or side effects. For example, one participant noted:

> "My in-laws… were not convinced, because they had doubts about how it was going to be. So, my husband and I sat down with them to talk about their concerns, about the effects that the vaccine was going to have on them. We talked to them. Finally they both got vaccinated" (IDI 7).

Barrier Three: Access and Supply Challenges

Healthcare workers and community members identified vaccine access and supply challenges as potential limitations to vaccination. Access challenges were considered to be a bigger concern in remote and rural areas, and traveling to vaccination sites could be difficult. One healthcare worker illustrated this point, saying:

> "There are people who have to take the only bus that is in their community every day and only at certain times. They have to travel two hours to get to the [administrative center] and get the vaccine. In the end the people had to invest time and money that they don't have and go very far, besides the fear of traveling by bus" (IDI 6).

Healthcare workers and community members remarked that lines for the vaccine were very long early in the vaccine campaign, which created challenges for those who had to work or were unable to stand for long periods:

> "It was like we were waiting in line because they called some people from there, others from there, and it got messy because there were a lot of people. And I got very desperate, seeing the long lines, and the big mess that was there, and since I had other commitments to do in the afternoon, it was better for me to go back. I left" (FGD 5).

Supply problems were also identified as a potential barrier. Some healthcare workers noted that initially they did not have enough vaccines available to meet the demand. One healthcare worker stated:

> "Sometimes they tell us that there are no vaccines, and we call people and they get upset with us. And because of the internet signal, there is no good internet signal, we don't have computer equipment and we use our personal computers. The ministry didn't think directly, they just gave us work orders and let us see how it goes" (IDI 2).

While supply problems were identified as a problem early in the vaccination campaign, it should be noted that multiple participants remarked that the issue seemed to be improving over time.

Community Perceptions of How to Increase Vaccine Acceptance

Improving Uptake with Social Influence Messages

Indigenous community members and healthcare workers identified vaccinated individuals as influential in building confidence in vaccine safety. Many of those interviewed argued that seeing and talking to vaccinated community members about their experiences was the most influential method to increase vaccine uptake in the community. One healthcare worker shared:

> "My aunts on my mom's side did not want to get vaccinated… when my mom got vaccinated… they started to worry. My mom told them that she was fine. One aunt saw that it was true... And, within a matter of two weeks all my aunts were vaccinated. They were very scared, but seeing someone very close to them, that helped a lot" (IDI 6).

Healthcare workers and community members indicated that they believed leveraging the stories of vaccinated community members would help to encourage higher vaccine uptake.

Improving Uptake with Vaccine Safety and Efficacy Messages

Healthcare workers and community members emphasized that their communities had faced ongoing health and economic difficulties during the COVID-19 pandemic. Many of them shared that they and others in the community were tired of dealing with the effects of the pandemic and viewed the vaccine as a solution. One community member shared "these vaccines are the best defense that we have been given, when we didn't have them, the disease got worse here in our community" (FGD 7). Another healthcare worker expressed:

> "People were previously afraid because of so much death caused by the pandemic... maybe one person was the one who started in the family to get vaccinated, and the others saw that nothing happened to him. So little by little people began to be encouraged to get vaccinated, and they saw that the vaccine is good" (FGD 5).

Improving Vaccine Uptake with Appropriate Religious and Cultural Messages

While religious concerns led some Indigenous community members to believe that being vaccinated was going against the will of God, others indicated that their faith and trust in religious leaders who supported the vaccine encouraged them to be vaccinated. One community member shared:

> "For me the vaccine is essential, because even the Pope, the holy father of the Catholic Church recommends it, and I don't distrust or doubt him because he is an honorable person, to say such and such a thing, right?" (FGD 8).

Another person indicated that their faith led them to trust the vaccine, by stating "I'm sure that God cures and does miracles, but also God has given wisdom to doctors, their study, everything. So, you have to also believe in medicine" (FGD 2).

Improving Uptake by Ensuring that Messages are Linguistically and Culturally Relevant

Healthcare workers and community members emphasized that health and vaccine messages should reflect Indigenous peoples' experiences. One healthcare worker said messages should contain "images that are adapted, for example, to their industry… the phrases in Kaqchikel... The most concrete, with information that is not boring… but above all that it is culturally relevant" (IDI 1).

Healthcare workers and community members also emphasized the importance of providing health information, especially audio, in Mayan languages. The need for information in Mayan languages was considered especially significant for older populations, who were less likely to speak Spanish. One community member explained this, stating:

> "It is necessary in our language, I don't know a lot of Spanish words. I don't understand it. I don't know what to say, but in our language, I do… in Spanish, maybe I can only answer one or two things, but I cannot keep the conversation, the words don't get to my mind. It's hard not to know Spanish" (FGD 4).

Not only is providing information in Mayan languages critical for understanding, but it also helps community members emotionally and culturally connect with messages. One healthcare worker expressed:

> "Unless they say something in Kaqchikel, they say that it belongs to the ladinos [a term for the socio-ethnic category of Mestizo or Hispanicized peoples], so to speak, 'that it is not ours'... how to reach the people… is someone… an Indigenous person is the one who tells them or that it is contextualized to the area around… it is very important that it is in the language" (IDI 6).

Yet, even though healthcare workers and community members repeatedly emphasized the necessity of providing information in Mayan languages, they expressed that very little information on COVID-19 and the vaccines in the Mayan languages exists. A community member shared:

> "Here there are a lot of people who still don't understand Spanish. A lot of people. [Vaccine information] should be disseminated more in our languages, right? In this case, Kaqchikel… This has fallen very short. The ministries that are in charge of disseminating this information, they need to see other ways" (FGD 6).

Improving Uptake by Making Messages Appealing for Those with Low or No Literacy

While healthcare workers and community members emphasized the need for health and vaccine information in the Mayan languages, they also recognized the low literacy rates in the community, especially among elderly monolingual Mayan language speakers. Many respondents suggested information may need to be provided in audio or visual formats. One healthcare worker illustrated this, stating:

> "There are many of us who know how to speak, but we don't even know how to read it. I am one of them who can speak Kaqchikel but if they put me to read it, or write it, I think

> I am at zero. So rather than maybe reading it, or writing it on posters, I think it would be better to speak it" (IDI 13).

Additionally, some participants indicated information should be relayed through concise and engaging messages. This would help with both literacy challenges and benefit those with limited technology access or bandwidth.

Trusted Sources of Health Messaging for Indigenous Community Members

Healthcare Workers and Local Leaders

Community members identified that they trusted health information from their local health center workers, including the nurses, midwives, and community health workers. One community member stated "I have more confidence in the information given by the nurses at the health center" (FGD 5). Healthcare workers recognized that community members relied on them to provide health messages. One healthcare worker stated:

> "...but a lot of people trust us too much sometimes. These are things we have to keep in mind. I think that this career that we've chosen, our profession, requires a lot of human responsibility, a lot of empathy" (IDI 5).

Community members and healthcare workers also indicated a high level of trust in health messages from local community leaders and non-governmental organizations (NGOs). This trust is illustrated by one healthcare worker who stated:

> "It is information that has been worked on by non-governmental institutions that focuses on the population itself, in their own language. I think that is more reliable.... Also, the role that some community leaders have played, and the midwives… I think their experience helped women, because I think that they are people who have been given a lot of trust. So, when they mentioned that they had been vaccinated, they convinced other people to do it" (IDI 1).

The trust in local healthcare workers and community leaders co-exist with distrust of the government. Although healthcare workers and local leaders may provide messages based on central Ministry of Health guidelines, these messages may only be highly trusted when delivered by locally-embedded healthcare workers. This may indicate that local healthcare workers have been able to successfully translate messages to make them more culturally acceptable and relevant for the Indigenous community members.

Local Communication Campaigns

Local community radio is considered to be a popular source of public health information, especially for older generations, given it's one of the few sources of information in Mayan languages. One healthcare worker remarked:

> "I think that there are some older adults, sometimes they do not have a phone to see it on social networks... So, I think that with the community radios that most of the population that works in the field, they normally listen to the radio stations of the town" (IDI 15).

Much of the current information about sites and dates of vaccine availability came from healthcare workers driving health center vehicles and making announcements in Mayan languages.

Social Media

Many Indigenous community members in the departments of Chimaltenango and Sololá rely on social media for information, especially younger generations. One participant stated "Social media is important. It's a key part of it, because now you can see that children already have phones now" (IDI 5). Many people indicated that information from social media is often transmitted from younger people to older people: "There are people who don't have phones, but their children have phones and social networks, so they are the ones who give the information to their parents" (IDI 3). However, some healthcare workers noted social media is not universally

accessible, which can be a barrier to accessing vaccine information, including the locations of government vaccine clinics that tend to be posted on Facebook:

> "In Facebook they see it, we put the information and the calls start, to ask which vaccines are available. There are many questions… also… by WhatsApp. It works for about 50 percent, it is only for people who have access" (IDI 2).

DISCUSSION

This study is one of the first to describe factors that influence COVID-19 vaccine acceptance in Indigenous populations in the Central Highlands of Guatemala. Although findings have many similarities with those described in other countries[24, 46, 47], they are highly contextualized in economic, cultural, political, and social factors specific to Maya populations in Guatemala. The research has indicated that acceptance of myths and misinformation about COVID-19 vaccines are related to a lower intention to be vaccinated[42, 48, 49]. However, understanding cultural differences in these beliefs is critical for combating this misinformation[42]. Highlighting the challenges faced by the Maya population is crucial given a long history of marginalization; it is paramount for public health officials to identify how to effectively support the most marginalized and highest risk populations during health crises.

Study findings delineate common barriers to vaccination within this at-risk population. These can be roughly grouped into three major overarching themes: (1) lack of available COVID-19 vaccine information that is easily understandable, linguistically appropriate, and culturally sensitive; (2) widespread mis- and dis-information that preys on people's fears and mistrust of the medical establishment and government; and (3) vaccine access and supply issues that prevent people from being vaccinated efficiently and quickly. Several participants noted that the fear and resistance to COVID-19 vaccines is not surprising given the widespread government distrust and dearth of well-designed culturally relevant information, especially in Mayan

languages. The negative health impacts related to distrust in the government has been noted in previous studies[32, 33, 36, 39, 41, 44, 50], but this study adds to the literature by focusing on the uptake of the COVID-19 vaccine by the Maya populations in the Central Highlands of Guatemala. Additionally, religion and the opinions of religious leaders were noted to have the potential to be both a facilitating factor or a barrier to vaccination, depending on the context. More research is required to better understand the nuances of this issue and to find effective ways to work with faith leaders to encourage vaccination.

Participants had recommendations for how to navigate the challenges faced by the Indigenous populations. First, study results highlight the power of social influence to encourage vaccine acceptance in Indigenous communities. Specifically, participants noted that messages highlighting how community members have been safely vaccinated, and messages that come directly from local healthcare workers, community leaders, and council members may be the most trusted by those who are still unvaccinated. This is consistent with other research conducted in Latin American countries that has found that providing information about others' vaccinations successfully increased both vaccine willingness, as well as the willingness of respondents to encourage others to be vaccinated[14, 40].

This research also highlights that messages should be culturally relevant, appropriate for low literacy populations, and should be in the languages that people speak. Several participants noted that health promotional material should have specific Maya cultural references (dress, food, concepts of disease) to ensure messaging connects with intended targets. Additionally, multiple modalities should also be used to reach a large population. While a large proportion of young people use social media and the internet, many older people rely on radio and vehicles

with loudspeakers traveling through local villages to get their information. Ensuring health promotion campaigns use multiple modalities will be critical to optimizing impact.

There are several limitations of this study. First, given the sample was restricted to the Central Highlands of Guatemala, results cannot necessarily be generalized to the wider population, or even other Indigenous groups. Second, given the rapidly evolving nature of the pandemic and risk of in-person interviewing, the study limited FGDs and IDIs to the minimum needed for theme saturation. We recognize that additional focus groups with community members may be helpful for teasing out more nuanced findings.

Further research is needed to determine the most effective ways to develop relevant educational and promotional materials and how to best target information to this population in order to increase uptake of COVID-19 vaccines. Careful attention should be paid to different Indigenous constructs of health and disease, as well as the cultural and political context within which the population accesses and understands information. Ongoing follow-up research from this study includes the development of social media educational content that has been evaluated through social media polling and analytics and in-person surveys.

CONCLUSION

This study indicated a lack of available COVID-19 health materials in Indigenous Mayan languages. The Indigenous Maya populations in Guatemala are at high risk for vaccine myths and misinformation due to their historical and current contexts. Vaccine education that integrates local understanding and cultural contexts and in Indigenous languages disseminated through a variety of modalities, including social media, may improve social acceptance of the vaccine, perceived safety, and increase vaccine uptake. Given the complexity of developing efficacious

content for diverse populations with potentially varying needs, policy makers should focus on collaborating with and integrating local knowledge from community leaders, non-governmental organizations and healthcare providers that work directly with the Maya communities to leverage their respective expertise in incentivizing health behaviors.

AUTHORS' CONTRIBUTIONS

NS, KS, JJ, NDS, and AKD led the conceptualization and design of the study. EL, MSM, and AKD led participant outreach and recruitment. NS, KS, EL, and AKD led the development of the interview and focus group protocols. MSM conducted the qualitative interviews and focus group discussions, transcribed data, and translated materials. NS, KS, EL, NDS, and JJ conducted the qualitative data analysis and interpretation. NS and KS led the data analysis, the interpretation of findings, and writing all drafts. NS, KS, EL, LAM, KBV, JJ, NDS, and AKD contributed to the design of the study, the interpretation of findings, and revising all drafts. All authors have read and approved the final manuscript.

ACKNOWLEDGMENTS

We would like to thank the community members who participated in focus groups for their generous contributions to this project by sharing their lived-experiences and personal opinions. We would also like to thank the entire Wuqu' Kawoq staff, including their participation in interviews and connections to both local healthcare workers and community members. We would also like to extend our gratitude to Anil Vora, Katherine Sziraczky, Katie Gleason, Aarti Porwal, and Charles Prober.

ETHICS STATEMENT

Verbal informed consent was obtained from the study participants. All participants were read the consent document in private to ensure that regardless of literacy they were fully informed about their right to refuse participation and to ensure they were clear on the purposes of the research project. The study received approval by Institutional Review Boards at the University of California, San Francisco (Study # 21-35160) and Stanford University (Protocol # 63193), and a private IRB through Wuqu' Kawoq (Protocol # WK 2021 005).

COMPETING INTERESTS STATEMENT

No members of the research team have financial interests in the development of COVID-19 vaccines or in promoting vaccination.

FUNDING STATEMENT

Funding for the study was provided by the Vaccine Confidence Fund grant number (VCF-001).

DATA AVAILABILITY STATEMENT

No data are available.

REFERENCES

1. Understanding vaccination progress by country [Internet]. Johns Hopkins Coronavirus Resource Center. [cited 2022 July 13]. Available from: https://coronavirus.jhu.edu/vaccines/international
2. COVID-19 vaccination rate by country Latin America 2022 [Internet]. *Statista*. [cited 2022 Apr 19]. Available from: https://www.statista.com/statistics/1194813/latin-america-covid-19-vaccination-rate-country/
3. Biswas MR, Alzubaidi MS, Shah U, Abd-Alrazaq AA, Shah Z. A scoping review to find out worldwide COVID-19 vaccine hesitancy and its underlying determinants. *Vaccines (Basel)*. 2021 Oct 25;9(11):1243.
4. Joshi A, Kaur M, Kaur R, Grover A, Nash D, El-Mohandes A. Predictors of COVID-19 vaccine acceptance, intention, and hesitancy: A scoping review. *Front Public Health*. 2021;9:698111.
5. Ochieng C, Anand S, Mutwiri G, Szafron M, Alphonsus K. Factors associated with COVID-19 vaccine hesitancy among visible minority groups from a global context: A scoping review. *Vaccines (Basel)*. 2021 Dec 7;9(12):1445.
6. Sallam M. COVID-19 Vaccine hesitancy worldwide: A concise systematic review of vaccine acceptance rates. *Vaccines (Basel)*. 2021 Feb 16;9(2):160.
7. Wang Q, Hu S, Du F, Zang S, Xing Y, Qu Z, et al. Mapping global acceptance and uptake of COVID-19 vaccination: A systematic review and meta-analysis. *Commun Med.* 2022 Sep 12;2(1):1–10.
8. Majid U, Ahmad M, Zain S, Akande A, Ikhlaq F. COVID-19 vaccine hesitancy and acceptance: a comprehensive scoping review of global literature. *Health Promot Int.* 2022 Jun 1;37(3):daac078.
9. Norhayati MN, Che Yusof R, Azman YM. Systematic review and meta-analysis of COVID-19 vaccination acceptance. *Frontiers in Medicine.* 2022;8.
10. Guzman-Holst A, DeAntonio R, Prado-Cohrs D, Juliao P. Barriers to vaccination in Latin America: A systematic literature review. *Vaccine*. 2020 Jan 16;38(3):470–81.
11. Alarcón-Braga EA, Hernandez-Bustamante EA, Salazar-Valdivia FE, Valdez-Cornejo VA, Mosquera-Rojas MD, Ulloque-Badaracco JR, et al. Acceptance towards COVID-19

vaccination in Latin America and the Caribbean: A systematic review and meta-analysis. *Travel Med Infect Dis*. 2022 Oct;49:102369.

12. Bhopal S, Nielsen M. Vaccine hesitancy in low- and middle-income countries: potential implications for the COVID-19 response. *Archives of Disease in Childhood*. 2021 Feb 1 [cited 2021 Nov 2];106(2):113–4.
13. Kozlov M. COVID vaccines have higher approval in less-affluent countries. *Nature*. 2021 Jul 22.
14. Solís Arce JS, Warren SS, Meriggi NF, Scacco A, McMurry N, Voors M, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med.* 2021;27(8):1385–94.
15. Bono SA, Faria de Moura Villela E, Siau CS, Chen WS, Pengpid S, Hasan MT, et al. Factors affecting COVID-19 vaccine acceptance: An international survey among low- and middle-income countries. *Vaccines* (Basel). 2021 May 17;9(5):515.
16. Argote P, Barham E, Daly S, Gerez J, Marshall J, Pocasangre O. Messages that increase COVID-19 vaccine willingness: Evidence from online experiments in six Latin American countries. Rochester, NY: *Social Science Research Network*; 2021 Jun. Report No.: ID 3812023. Available from: https://papers.ssrn.com/abstract=3812023
17. Cassady D, Castaneda X, Ruelas MR, Vostrejs MM, Andrews T, Osorio L. Pandemics and vaccines: Perceptions, reactions, and lessons learned from hard-to-reach Latinos and the H1N1 campaign. *Journal of Health Care for the Poor and Underserved*. 2012;23(3):1106–22.
18. Flood D, Rohloff P. Indigenous languages and global health. *The Lancet Global Health*. 2018 Feb;6(2):e134–5.
19. Few M. Epidemics, indigenous communities, and public health in the COVID-19 era: views from smallpox inoculation campaigns in colonial Guatemala. *Journal of Global History*. 2020 Nov;15(3):380–93.
20. Meneses-Navarro S, Freyermuth-Enciso MG, Pelcastre-Villafuerte BE, Campos-Navarro R, Meléndez-Navarro DM, Gómez-Flores-Ramos L. The challenges facing Indigenous communities in Latin America as they confront the COVID-19 pandemic. *Int J Equity Health*. 2020;19(1):63.
21. Poirier B, Sethi S, Garvey G, Hedges J, Canfell K, Smith M, et al. HPV vaccine: uptake and understanding among global Indigenous communities - a qualitative systematic review. *BMC Public Health.* 2021 Nov 10;21(1):2062.
22. Mosby I, Swidrovich J. Medical experimentation and the roots of COVID-19 vaccine hesitancy among Indigenous Peoples in Canada. *CMAJ.* 2021 Mar 15;193(11):E381–3.

23. Singh K, Lima G, Cha M, Cha C, Kulshrestha J, Ahn Y-Y, et al. Misinformation, believability, and vaccine acceptance over 40 countries: Takeaways from the initial phase of the COVID-19 infodemic. *PLOS ONE*. 2022 Feb 9;17(2):e0263381.
24. Dash S, Parray AA, Freitas LD, et al. Combating the COVID-19 infodemic: a three-level approach for low and middle-income countries. *BMJ Global Health*. 2021;6(1):e004671. doi:10.1136/bmjgh-2020-004671
25. Maffioli EM, Gonzalez R. Are socio-demographic and economic characteristics good predictors of misinformation during an epidemic? *PLOS Global Public Health*. 2022 Mar 16;2(3):e0000279.
26. Chen Z, Zheng W, Wu Q, Chen X, Peng C, Tian Y, et al. Global diversity of policy, coverage, and demand of COVID-19 vaccines: a descriptive study. *BMC Med*. 2022 Apr 4;20(1):130.
27. IWGIA - International Work Group for Indigenous Affairs. Indigenous World 2020: Guatemala - *IWGIA - International Work Group for Indigenous Affairs* [Internet]. 2020 [cited 2022 Mar 3]. Available from: https://www.iwgia.org/en/guatemala/3622-iw-2020-guatemala.html
28. Principales Resultados Censo 2018: Septiembre 2019 [Internet]. 2019. [cited 2022 Mar 3]. Available from: https://www.censopoblacion.gt/dondeestamos
29. Sanford V. From genocide to femicide: Impunity and human rights in twenty-first century Guatemala. *Journal of Human Rights*. 2008 Jun 17;7(2):104–22.
30. Beck E. The uneven impacts of violence against women reform in Guatemala: Intersecting inequalities and the patchwork state. *Latin American Research Review*. 2021;56(1):20-35. doi:10.25222/larr.636
31. Guatemala — Memory of silence: Report of the Commission for Historical Clarification: Conclusions and recommendations (February 1999). (1999). Die Friedens-Warte, 74(4), 511–547.
32. Chary A, Flood D, Austad K, et al. Accompanying Indigenous Maya patients with complex medical needs: A patient navigation system in rural Guatemala. *Healthcare*. 2018;6(2):144-149. doi:10.1016/j.hjdsi.2017.08.006
33. Seitz K, Cohen J, Deliens L, et al. Place of death and associated factors in 12 Latin American countries: A total population study using death certificate data. *J Glob Health*. 2022;12:04031. doi:10.7189/jogh.12.04031
34. Flood D, Chary A, Austad K, Coj M, Lopez W, Rohloff P. Patient navigation and access to cancer care in Guatemala. *JGO*. 2018;(4):1-3. doi:10.1200/JGO.18.00027

35. Hernandez A, Hurtig AK, Sebastian MS, Jerez F, Flores W. 'History obligates us to do it': political capabilities of Indigenous grassroots leaders of health accountability initiatives in rural Guatemala. *BMJ Global Health*. 2022;7(5):e008530. doi:10.1136/bmjgh-2022-008530
36. Perry MF, Coyote EI, Austad K, Rohloff P. Why women choose to seek facility-level obstetrical care in rural Guatemala: A qualitative study. *Midwifery*. 2021;103:103097. doi:10.1016/j.midw.2021.103097
37. Dyrstad, K, Bakke, KM, & Binningsbø HM. Perceptions of peace agreements and political trust in post-war Guatemala, Nepal, and Northern Ireland, *International Peacekeeping,* 2021; 28:4, 606-631, DOI: 10.1080/13533312.2020.1869541
38. Lazarus JV, Ratzan S, Palayew A, et al. COVID-SCORE: A global survey to assess public perceptions of government responses to COVID-19 (COVID-SCORE-10). Hotchkiss D, ed. *PLoS ONE*. 2020;15(10):e0240011. doi:10.1371/journal.pone.0240011
39. Blair RA, Morse BS, Tsai LL. Public health and public trust: Survey evidence from the Ebola Virus Disease epidemic in Liberia. *Social Science & Medicine*. 2017; 172: 89-97. doi:10.1016/j.socscimed.2016.11.016
40. Argote P, Barham E, Daly SZ, Gerez JE, Marshall J, Pocasangre O. The shot, the message, and the messenger: COVID-19 vaccine acceptance in Latin America. NPJ *Vaccines.* 2021 Sep 30;6(1):118.
41. Bessi A, Coletto M, Davidescu GA, Scala A, Caldarelli G, Quattrociocchi W. Science vs conspiracy: Collective narratives in the age of misinformation. *PLoS One*. 2015 Feb 23;10(2):e0118093.
42. Caycho-Rodríguez T, Valencia PD, Ventura-León J, Vilca LW, Carbajal-León C, Reyes-Bossio M, et al. Design and cross-cultural invariance of the COVID-19 vaccine conspiracy beliefs scale (COVID-VCBS) in 13 Latin American countries. *Front Public Health.* 2022;10:908720.
43. Poirier B, Sethi S, Garvey G, Hedges J, Canfell K, Smith M, et al. HPV vaccine: uptake and understanding among global Indigenous communities - a qualitative systematic review. *BMC Public Health.* 2021 Nov 10;21(1):2062.
44. Burghouts J, Del Nogal B, Uriepero A, Hermans PWM, de Waard JH, Verhagen LM. Childhood vaccine acceptance and refusal among Warao Amerindian caregivers in Venezuela; A qualitative approach. *PLoS One.* 2017;12(1):e0170227.
45. Instituto Nacional de Estadística Guatemala. Compendio Estadístico de Pueblos. [cited 2022 Mar 3]. 2021. Available from:

https://www.ine.gob.gt/sistema/uploads/2021/12/30/20211230192119ITIf0Taxw7mbshQNenoLw9A9K5cR4pMt.pdf

46. Mose A. Willingness to receive COVID-19 vaccine and its determinant factors among lactating mothers in Ethiopia: A cross-sectional study. *Infection and Drug Resistance.* 2021 Mar 30;14:4249–59.
47. Hossain E, Rana J, Islam S, Khan A, Chakrobortty S, Ema NS, et al. COVID-19 vaccine-taking hesitancy among Bangladeshi people: knowledge, perceptions and attitude perspective. *Human Vaccines & Immunotherapeutics*. 2021 Nov 2;17(11):4028–37.
48. Islam MS, Kamal AHM, Kabir A, Southern DL, Khan SH, Hasan SMM, et al. COVID-19 vaccine rumors and conspiracy theories: The need for cognitive inoculation against misinformation to improve vaccine adherence. *PLOS ONE*. 2021 May 12;16(5):e0251605.
49. Zheng Y, Xi L, Hepeng J. Is it all a conspiracy? Conspiracy theories and people's attitude to COVID-19 vaccination. *Vaccines*. 2021 Sep 22;9(10).
50. Cox GR, Anastario M, FireMoon P, Ricker A, Rink E. Narrative frames as choice over structure of American Indian sexual and reproductive health consequences of historical trauma. *Sociology Health & Illness*. 2021;43(8):1774–88.

Table 1. Focus Group Discussion Population Characteristics

Characteristics		N (%)
Primary Language	Spanish Kaqchikel K'iche' Other	15% 85% 0% 0%
Gender	Female Male Non-binary Not specified	80% 20% 0% 0%
Age	18-24 25-64 65+	10% 85% 5%
Region	Urban Rural	25% 75%

Table 2. In Depth Interview Population Characteristics

Characteristics		N (%)
Primary Language	Spanish Kaqchikel K'iche' Other	19% 66% 25%
Gender	Female Male Non-binary Not specified	81% 19% 0% 0%
Age	18-24 25-64 65+	6% 88% 6%
Profession	Doctor Hospital-based Nurse Community Health Worker (Nurse)	6% 25% 69%

Standards for Reporting Qualitative Research (SRQR)*

Title and abstract	**Page no(s).**
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Title page
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	P. 1

Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	P. 1-3
Purpose or research question - Purpose of the study and specific objectives or questions	P. 3

Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale	P. 3

Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	P. 4
Context - Setting/site and salient contextual factors; rationale	P. 4 & 5, Table 1 & 2
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	P. 4 & 5
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Ethics Statement P. 20
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale	P. 4, 5, & 6
Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	P. 5 & 6
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Tables 1 & 2
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	P. 5 & 6

Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale	P. 6, Author Contribution Statement P. 20
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale	P. 6

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	P. 6 & 7
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	P. 7-16

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	P. 16-18
Limitations - Trustworthiness and limitations of findings	P. 19

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	P. 20
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	P. 20