






BMJ Open Barriers to COVID-19 vaccine acceptance to improve messages for vaccine uptake in indigenous populations in the central highlands of Guatemala: a participatory qualitative study

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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 organisations 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 misinformation and disinformation that prey 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 in the languages that people prefer to speak. Promotional materials should be in multiple modalities (print, radio and social media) and also have specific Maya cultural references (dress, food and 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 marginalised communities globally and suggests that

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 generalised to the wider population in Guatemala, or even to other Indigenous groups.
- ⇒ The study limited focus group discussions and in-depth interviews 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.

policy makers should invest in targeted local solutions to increase vaccine uptake.

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-income 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 20 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 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 behaviour in the context of major health threats.^{37–39} 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 LMICs²³ 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 immunisation, sources of accurate vaccine information or misinformation and how messages are shared among social networks with the aim of designing targeted health messages.^{21 36 43} 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 organisation 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 minimising harms and optimising 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% is 15–64 years, with 61.6% of the population residing in urban municipalities.^{28 44} Kaqchikel is

Table 1 Focus group discussion population characteristics

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

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 44} The study specifically sampled participants from these groups to minimise the likelihood of study results reflecting inappropriate generalisations 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 semistructured 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 three to six people, which lasted between 60 min and 90 min. The demographic characteristics of FGD participants can be found in [table 1](#). IDIs ranged between 30 min and 60 min. The demographic characteristics of IDI participants can be found in [table 2](#).

Analysis

IDIs and FGDs were transcribed in Spanish or Kaqchikel and then translated into Spanish. Transcripts and field notes were shared with the US 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 analysed again and independently coded by two members of the research team. During this process, researchers met

Table 2 In-depth interview population characteristics

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

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 misinformation and disinformation 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 1: 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 2: 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 immunised 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 3: 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 travelling 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 travelling by bus. (IDI 6)

Healthcare workers and community members remarked that lines for the vaccine were very long early in the vaccination 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 2 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 emphasised 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 defence 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 emphasised 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 emphasised 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 emphasised 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 emphasised the need for health and vaccine information in the Mayan languages, they also recognised 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 centre 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 centre' (FGD 5). Healthcare workers recognised 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 organisations. 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 coexist 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 is 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 centre 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 45 46} they are highly contextualised 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 47 48} 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 marginalisation; it is paramount for public health officials to identify how to effectively support the most marginalised 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 misinformation and disinformation 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 43 49} 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 and 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 in the languages that people speak. Several participants noted that health promotional material should have specific Maya cultural references (dress, food and 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 travelling through local villages to get their information. Ensuring health promotion campaigns use multiple modalities will be critical to optimising impact.

There are several limitations of this study. First, given the sample was restricted to the Central Highlands of Guatemala, results cannot necessarily be generalised 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 recognise 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 of 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 and 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 organisations and healthcare providers that work directly with the Maya communities to leverage their respective expertise in incentivising health behaviours.

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REFERENCES

- 1 Johns Hopkins coronavirus resource center. 2022. Available: <https://coronavirus.jhu.edu/vaccines/international>
- 2 COVID-19 vaccination rate by country Latin America 2022. *Statista*. 2022. Available: <https://www.statista.com/statistics/1194813/latin-america-covid-19-vaccination-rate-country/>
- 3 Biswas MR, Alzubaidi MS, Shah U, *et al*. A scoping review to find out worldwide COVID-19 vaccine hesitancy and its underlying determinants. *Vaccines (Basel)* 2021;9:1243.
- 4 Joshi A, Kaur M, Kaur R, *et al*. 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, *et al*. Factors associated with COVID-19 vaccine hesitancy among visible minority groups from a global context: a scoping review. *Vaccines (Basel)* 2021;9:1445.
- 6 Sallam M. COVID-19 vaccine hesitancy worldwide: a Concise systematic review of vaccine acceptance rates. *Vaccines (Basel)* 2021;9:160.
- 7 Wang Q, Hu S, Du F, *et al*. Mapping global acceptance and uptake of COVID-19 vaccination: a systematic review and meta-analysis. *Commun Med (Lond)* 2022;2:113.

- 8 Majid U, Ahmad M, Zain S, *et al.* COVID-19 vaccine hesitancy and acceptance: a comprehensive scoping review of global literature. *Health Promot Int* 2022;37:daac078.
- 9 Norhayati MN, Che Yusof R, Azman YM. Systematic review and meta-analysis of COVID-19 vaccination acceptance. *Front Med (Lausanne)* 2021;8:783982.
- 10 Guzman-Holst A, DeAntonio R, Prado-Cohrs D, *et al.* Barriers to vaccination in latin america: a systematic literature review. *Vaccine* 2020;38:470–81.
- 11 Alarcón-Braga EA, Hernandez-Bustamante EA, Salazar-Valdivia FE, *et al.* Acceptance towards COVID-19 vaccination in latin america and the caribbean: a systematic review and meta-analysis. *Travel Med Infect Dis* 2022;49:102369.
- 12 Bhopal S, Nielsen M. Vaccine hesitancy in low- and middle-income countries: potential implications for the COVID-19 response. *Arch Dis Child* 2021;106:113–4.
- 13 Kozlov M. COVID vaccines have higher approval in less-affluent countries. *Nature* 22, 2021.
- 14 Solís Arce JS, Warren SS, Meriggi NF, *et al.* COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med* 2021;27:1385–94.
- 15 Bono SA, Faria de Moura Villela E, Siau CS, *et al.* Factors affecting COVID-19 vaccine acceptance: an international survey among low- and middle-income countries. *Vaccines (Basel)* 2021;9:515.
- 16 Argote P, Barham E, Daly S, *et al.* Messages that increase COVID-19 vaccine willingness: evidence from online experiments in six Latin American countries. *SSRN Journal* 2021. 10.2139/ssrn.3812023 Available: <https://papers.ssrn.com/abstract=3812023>
- 17 Cassady D, Castaneda X, Ruelas MR, *et al.* Pandemics and vaccines: perceptions, reactions, and lessons learned from hard-to-reach Latinos and the H1N1 campaign. *J Health Care Poor Underserved* 2012;23:1106–22.
- 18 Flood D, Rohloff P. Indigenous languages and global health. *Lancet Glob Health* 2018;6: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;15:380–93.
- 20 Meneses-Navarro S, Freyermuth-Enciso MG, Pelcastre-Villafuerte BE, *et al.* The challenges facing Indigenous communities in Latin America as they confront the COVID-19 pandemic. *Int J Equity Health* 2020;19:63.
- 21 Poirier B, Sethi S, Garvey G, *et al.* Hpv vaccine: uptake and understanding among global Indigenous communities—a qualitative systematic review. *BMC Public Health* 2021;21:2062.
- 22 Mosby I, Swidrovich J. Medical experimentation and the roots of COVID-19 vaccine hesitancy among Indigenous peoples in Canada. *CMAJ* 2021;193:E381–3.
- 23 Singh K, Lima G, Cha M, *et al.* Misinformation, believability, and vaccine acceptance over 40 countries: takeaways from the initial phase of the COVID-19 infodemic. *PLOS ONE* 2022;17:e0263381.
- 24 Dash S, Parray AA, De Freitas L, *et al.* Combating the COVID-19 infodemic: a three-level approach for low and middle-income countries. *BMJ Glob Health* 2021;6:e004671.
- 25 Maffioli EM, Gonzalez R, James PB. Are socio-demographic and economic characteristics good predictors of misinformation during an epidemic? *PLOS Glob Public Health* 2022;2:e0000279.
- 26 Chen Z, Zheng W, Wu Q, *et al.* Global diversity of policy, coverage, and demand of COVID-19 vaccines: a descriptive study. *BMC Med* 2022;20:130.
- 27 IWGIA - IWGIA - international work group for indigenous affairs. 2020. Available: <https://www.iwgia.org/en/guatemala/3622-iw-2020-guatemala.html>
- 28 Principales resultados censo 2018: septiembre 2019. 2019. Available: <https://www.censopoblacion.gt/dondeestamos>
- 29 Sanford V. From genocide to feminicide: impunity and human rights in twenty-first century Guatemala. *Journal of Human Rights* 2008;7:104–22.
- 30 Beck E. The uneven impacts of violence against women reform in Guatemala: intersecting inequalities and the patchwork state. *Lat American Res Rev* 2021;56:20–35.
- 31 Guatemala — memory of silence: report of the commission for historical clarification: conclusions and recommendations(february1999). *Die Friedens-Warte* 1999;74:511–47.
- 32 Chary A, Flood D, Austad K, *et al.* Accompanying indigenous maya patients with complex medical needs: a patient navigation system in rural guatemala. *Healthc (Amst)* 2018;6:144–9.
- 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.
- 34 Flood D, Chary A, Austad K, *et al.* Patient navigation and access to cancer care in Guatemala. *J Glob Oncol* 2018;4:JGO.18.00027:1–3..
- 35 Hernandez A, Hurtig A-K, San Sebastian M, *et al.* “ history obligates us to do it ”: political capabilities of Indigenous grassroots leaders of health accountability initiatives in rural Guatemala. *BMJ Glob Health* 2022;7:e008530.
- 36 Perry MF, Coyote EI, Austad K, *et al.* Why women choose to seek facility-level obstetrical care in rural guatemala: a qualitative study. *Midwifery* 2021;103.
- 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;28:606–31.
- 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). *PLoS ONE* 2020;15:e0240011e0240011.
- 39 Blair RA, Morse BS, Tsai LL. Public health and public trust: survey evidence from the Ebola virus disease epidemic in Liberia. *Soc Sci Med* 2017;172:S0277-9536(16)30625-6:89–97..
- 40 Argote P, Barham E, Daly SZ, *et al.* The shot, the message, and the messenger: COVID-19 vaccine acceptance in Latin America. *NPJ Vaccines* 2021;6:118.
- 41 Bessi A, Coletto M, Davidescu GA, *et al.* Science vs conspiracy: collective narratives in the age of misinformation. *PLoS One* 2015;10:e0118093.
- 42 Caycho-Rodríguez T, Valencia PD, Ventura-León J, *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;10:908720:908720..
- 43 Burghouts J, Del Nogal B, Uriepero A, *et al.* Childhood vaccine acceptance and refusal among warao Amerindian caregivers in Venezuela; a qualitative approach. *PLoS One* 2017;12:e0170227.
- 44 Instituto nacional de estadística guatemala. compendio estadístico de pueblos. 2021. Available: <https://www.ine.gov.gt/sistema/uploads/2021/12/30/202112301921191Tf0Taxw7mbshQNenoLw9A9K5cR4pMt.pdf>
- 45 Mose A. Willingness to receive COVID-19 vaccine and its determinant factors among lactating mothers in Ethiopia: a cross-sectional study. *Infect Drug Resist* 2021;14:4249–59.
- 46 Hossain E, Rana J, Islam S, *et al.* COVID-19 vaccine-taking hesitancy among Bangladeshi people: knowledge, perceptions and attitude perspective. *Hum Vaccin Immunother* 2021;17:4028–37.
- 47 Islam MS, Kamal A-HM, Kabir A, *et al.* COVID-19 vaccine rumors and conspiracy theories: the need for cognitive inoculation against misinformation to improve vaccine adherence. *PLOS ONE* 2021;16:e0251605.
- 48 Yang Z, Luo X, Jia H. Is it all a conspiracy? conspiracy theories and people’s attitude to COVID-19 vaccination. *Vaccines (Basel)* 2021;9:1051.
- 49 Cox GR, Anastario M, FireMoon P, *et al.* Narrative frames as choice over structure of American Indian sexual and reproductive health consequences of historical trauma. *Sociol Health Illn* 2021;43:1774–88.