Hear my voice: understanding how community health workers in the Peruvian Amazon expanded their roles to mitigate the impact of the COVID-19 pandemic through community-based participatory research

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INTRODUCTION

Peru reported its first case of COVID-19 (SARS-CoV-2) in March 2020. The government issued a nationwide lockdown 10 days after the first case of COVID was reported.3 Despite the initial lockdown, systemic and social factors such as an underfunded and fragmented health system, water and electricity shortages, and multigenerational housing made containing the virus a challenge for the government.3,4 By 2021, Peru had proportionally the world’s highest COVID-19 death toll in the world at 5551 COVID-19 deaths per million.5

Globally, indigenous populations have been disproportionately affected by the COVID-19 pandemic as measured by economic, cultural...
or mortality indicators.\textsuperscript{6,7} In Latin America, mistrust of authorities, COVID-19 misinformation, lack of clean water and unemployment created additional barriers for indigenous populations combating the pandemic.\textsuperscript{3} Loreto, an Amazonian region in northeast Peru with the highest number of registered indigenous communities in the country, closed early in the pandemic because of a lack of personnel protective equipment (PPE) and training to manage the health crisis.\textsuperscript{9,11} Despite the disruption to the health system, two-thirds of community health workers (CHWs) registered with Manta del Rio (MDR), a maternal and infant health programme based at Universidad Peruana Cayetano Heredia (UPCH), continued to promote the health of their communities during the pandemic.\textsuperscript{9} CHWs are legally recognised as ‘those people chosen or recognised by their community, who carry out voluntary actions for health promotion and disease prevention, in coordination with health personnel and other institutions’.\textsuperscript{10} CHWs were globally recognised as a crucial component of primary healthcare delivery by the 1978 Declaration of Alma Ata.\textsuperscript{11} The current CHW system in Peru is fragmented, with CHWs receiving training from the Ministry of Health (MINSAs), religious congregations and non-governmental organisations. Typically, CHWs receive irregular training in one specific health topic, such as infectious disease, maternal health or anaemia prevention. Each community elects one CHW to represent them for an unspecified period. There are no limitations to the age or gender of CHWs; however, most CHWs are men that have served for at least one generation.

Given how CHWs from indigenous communities in the Peruvian Amazon continued to provide care despite the disruption of health services, we aimed to understand how the pandemic affected their responsibilities. Photovoice, a visual research methodology within community-based participatory research (CBPR), was used to investigate how CHWs expanded their roles and mitigated the effects of the pandemic.\textsuperscript{12,13} Photovoice empowered CHWs to identify gaps in the health system through photography and to present their solutions to policy-makers, who in turn can better support indigenous health in future disasters.

**METHODS**

**Study design**

Photovoice was used to understand how CHWs in the Peruvian Amazon adapt to and mitigate the health and social effects of the COVID-19 pandemic in their communities. Photovoice transcends qualitative research by generating empowerment and social change among participants through photography, group discussion and reflection.\textsuperscript{14} The three main goals of photovoice are (1) to enable people to record and reflect on their community’s strengths and concerns, (2) to promote critical dialogue about important issues through group discussion of photographs and (3) to reach policy-makers.\textsuperscript{15,16} Photovoice has been used with marginalised communities around the world, including immigrants and refugees experiencing social challenges such as living with HIV, mental illness or homelessness.\textsuperscript{14} After participants identify community strengths and challenges through photos and discussion, they are given the opportunity to share their work with policy leaders. Thus, the researcher plays a passive role in the development of themes and solutions as the participants take ownership of the project.

Photovoice was considered an appropriate methodology for the study because it allowed CHWs from vulnerable communities to share their experiences during the pandemic, to develop solutions to the challenges they face as CHWs and to present their message to policy-makers from the health sector who could address those challenges. Participants were divided into two groups and asked to explore: ‘How did the COVID-19 pandemic affect my life and work as a CHW?’

**Study setting**

This study took place over a 5-month period from February to June 2022. Focus group discussion occurred as communities emerged from the second wave of the pandemic. Thus, it was a period of COVID-19 quiescence, although the pandemic was described as ongoing. Given the quiescence, there were little to no interruptions in study procedures secondary to the pandemic, and no stages of the project were modified. The study was conducted among two independent groups of CHWs in the districts of Nauta and Parinari. These districts are 2 of the 53 districts in the Loreto Region (figure 1).\textsuperscript{17-21} Loreto is one of the poorest regions in the country, with a poverty rate between 36.7% and 40.9%.\textsuperscript{22} More than one-third of its population lives in rural settlements connected by the river system with little to no land access.\textsuperscript{23}

**Study context**

This study was conducted in partnership with MDR with support from the Regional Health Agency (GERESA) of Loreto, previously known as Regional Health Directorate of Loreto. MDR is a community-based, maternal and neonatal health programme through UPCH.\textsuperscript{9,24-28} MDR trains CHWs from rural communities in Loreto to conduct home visits and promote essential newborn care and healthcare seeking behaviour among women from pregnancy to their postpartum period. MDR held one training session on COVID-19 prevention and vaccination for their CHWs.

**Study participants**

A total of 20 CHWs were contacted to participate in the study. We aimed to recruit 10 participants from Nauta and 10 participants from Parinari based on sample sizes from previous Photovoice studies.\textsuperscript{29} Participants were recruited from MDR through purposive sampling to reduce bias. Key sampling features included gender, length of time-serving as a CHW and time of travel to the study location. Inclusion criteria included having served...
as a CHW through the COVID-19 pandemic and lived in the districts of Nauta or Parinari. All participants were required to attend the initial training session to remain in the project. All participants identified as belonging to the Kukuma-Kukamiria ethnic group. Their main activities include fishing and agriculture based on their close relationship with the rivers.30–32

Patient and public involvement
This study was designed and implemented in partnership with MDR, UPCH, GERESA-Loreto, the MINSA, the Pan American Health Organization and indigenous communities. All partners were involved in protocol development and project delivery. Partners served as key stakeholders and contributed to outcome measures. Community consultation and permission were acquired from CHWs, community authorities and health centre providers. Participants played a key role in defining the research question and approving all research conclusions. Project findings were disseminated to communities via photo albums that contained all project content and acknowledged participants for their contributions.

Author reflexivity
Authors TS, a female student researcher from the USA, and ARFP, a female anthropologist from Peru, served as the primary field team conducting focus groups. MMB, founder of MDR from Peru, provided project mentorship and community access. She was involved in fieldwork and gallery presentations in Lima and Loreto. Authors established relationships with participants prior to study commencement. Author backgrounds, personal goals and biases were disclosed and discussed over multiple meetings. All authors acknowledge their position of privilege in conducting research in indigenous communities. See online supplemental data 2 for the full author reflexivity statement.

Procedures
The procedure was developed based on a typical nine step photovoice approach as highlighted in table 1.15 16 The study was split between districts because of the burden of travel, to keep discussion groups intimate and to obtain a geographically diverse sample. Procedures were identical for the two groups. The study sites lay 134 km apart (5–10 hours by boat, depending on river conditions) along the Marañón River. Figure 1 illustrates participating communities and their relation to the primary study sites. The fieldwork team was composed of two primary researchers: TS (principal investigator) and ARFP (anthropologist), and a logistics coordinator. Researchers commuted between study groups once a week by boat.

The target audience of policymakers was identified at the start of the project so they could serve as project stakeholders. Meetings were held with stakeholders over the course of the project to ensure their participation in the final gallery.

During the 2-day orientation, participants were trained in photovoice methodology and field safety. Demographic data were collected in the form of a 14-question survey. Researchers presented both groups with the primary question: how did the COVID-19 pandemic impact your life and work as a CHW? This was a broad question so it could be contextualised by participants.

SHOWED, a mnemonic in which participants create a concise story explaining their photos, was used during discussion sessions.15 Questions include: What do you See here? What really is Happening here? How does this...
Table 1 Steps outlining the typical approach to a photovoice project as applicable to this study

| Step 1 | Select a target audience of policy-makers | The target audience of policy-makers included elected persons responsible for community-based health from the regional health agency of Loreto previously known as the Regional Health Directorate of Loreto, the Regional Government of Loreto, the Peruvian Ministry of Health, and the Pan American Health Organization.
| Step 2 | Recruit participants | 20 CHWs from the districts of Nauta and parinari were recruited by a coordinator from MDR through purposive sampling. A total of 14 CHWs participated in the project.
| Step 3 | Train participants | Participants were trained in photovoice methodology, study objectives, photography and ethics during a 2-day orientation in each district. Ethics training included field safety and the importance of obtaining informed consent from the people they chose to photograph.
| Step 4 | Obtain informed consent | CHWs were consented to participate in the project before the training session. Participants were provided with consent forms to obtain from individuals whom they planned to photograph in the community on a weekly basis.
| Step 5 | Pose a theme for pictures | Researchers presented CHWs from both districts with the predefined question: how did the COVID-19 pandemic impact my life and work as a CHW?
| Step 6 | Distribute materials for picture taking | CHWs used electronic tablets provided by MDR to take photos. They were given an orientation handbook, pens, photo logs, informed consents/media release forms and SHOwED worksheets to facilitate photo taking and discussion.
| Step 7 | Allow time for photo taking | Participants were given between 5 and 7 days to take photos in their communities depending on how far away they lived from the primary study site.
| Step 8 | Meet to discuss photos and form a call to action | Discussions were held once per week in each district. Steps 5–8 were repeated until data saturation was met and a call to action was developed. A total of four discussion sessions (two in each district) were held. See table 2 for further breakdown of meeting objectives and discussion.
| Step 9 | Share photos and call to action with policy-makers in the form of an exhibition | The photos and call to action were shared with the target audience in two separate galleries in Iquitos and Lima.

CHW, community health worker; MDR, Mamás del Río.

relate to Our lives? Why does this situation, concern or strength Exist? What can we Do about it? Participants shared two to three photos during weekly discussions. WhatsApp, an end-to-end encrypted messaging application, was used to share and transmit photos between participants and researchers.

After the first session, researchers posed framing questions to CHWs during discussions. This empowered participants to take ownership of the project as they developed subsequent research questions and relevant themes. Notably, both groups chose to ask questions that further explored the responsibility of the CHWs during the pandemic (table 2). The groups voted on one photo from each participant to include in the final gallery during each session.

All sessions were led by TS and ARFP in Spanish. All discussions were recorded and transcribed verbatim into Spanish by university anthropology students. Data saturation was met when participants from both districts independently voted that they no longer need photo taking sessions to complete their gallery for policy-makers. Thus, researchers did not play a role in determining saturation, or completeness of photo taking.14 33

All English translations were first done by ARFP and then edited independently by TS. Any conflicts were jointly discussed until resolution. Translations were made without overt corrections to grammar or sentence structure to maintain the voice of participants and richness of text.

Consent

Written consents and photographic releases were obtained from each participant. Participation was voluntary. All participants were compensated S/15 (US$4.02) for each meeting session they attended. Participants received reimbursement for all travel expenses, overnight lodging and three meals per day. Participants were made aware of study goals and objectives. No pseudonyms were used during meeting sessions. Participants were required to obtain written consent of any human subjects they chose to photograph over the course of the study. The photovoice methodology resulted in the empowerment of CHWs. CHWs expressed empowerment by creating a federation to advocate for CHW rights independent of this study.

Data analysis and thematic development

Transcripts were uploaded into Atlas.ti, an online software, for data analysis. Thematic analysis was used to generate codes and define final themes from raw
data. Thirty-three photo units, consisting of the photo title, the photo(s) and the SHOwED text, were analysed in conjunction with transcripts. While photo units were the product of only one participant, transcripts were the product of group discussion. Thus, by analysing the two in tandem, visual data could be better contextualised and generalised to the CHW experience.

The themes identified in the field by participants were broken down into codes with their respective photo units and then linked back into categories and final themes by researchers. The data from each district were analysed separately and then combined to form conclusions. Codes were maintained in a shared code-book within Atlas.ti, and transcripts were independently coded by TS and ARFP. Two hundred and three codes were grouped into 33 categories based on overlapping concepts through cluster mapping. Themes were created by grouping similar categories within the context of the research question. Authors collectively agreed on final themes after multiple rounds of reading and rereading texts.

The final meeting, named the call to action; meeting, took place in April 2022. Researchers combined themes from both groups into a single photo gallery because of overlap. The combined gallery and final themes were approved by all participants for publishing in the exhibition. Authors chose the images for this publication based on quality, proper consent, relevance to research question, and representation of theme. Bolded narrative highlights poignant text that was used as codes.

**RESULTS**

Fourteen out of 20 CHWs participated in the study, with seven participants belonging to the Nauta group and seven belonging to the Parinari group. Seven CHWs were unable to attend the initial training session, which disqualified them from participating in the remainder of the study. Online supplemental data 1 includes participant demographics.

Three core themes emerged: (1) the collapse of health infrastructure, (2) the use of medicinal plants vs pharmaceuticals and (3) community adaptation strategies and struggles. The leadership of CHWs spanned across these themes to highlight how CHWs took on new COVID-19-related responsibilities without government support.

### The collapse of health infrastructure

One participant photographed an abandoned health post and explained how the closure of the health posts placed greater responsibility on the CHW to provide basic healthcare in the communities.

The **health post** is closed because there was no medical care for COVID-19 in the communities. When the pandemic came, everything totally changed: they did not have medicines, nor did they have a full professional staff. We were afraid. **Who remained when the post was understaffed or out of stock? That was the task of the community health worker...** If we are an ally of the health establishment... they need to consider us, because where there are no posts in the communities, the community health worker [works] (CHW11, Parinari).
CHWs did not have the training to work at health posts, although they were providing healthcare. The perspective of the photo from outside the building mirrors how CHWs felt outside the formal health infrastructure. Despite their leadership in health delivery, they were not recognised as frontline health workers, making them feel isolated from the health system. As one participant described, CHWs were also responsible for transporting sick patients to the health posts that remained open:

It is our everyday mobility that helps us in any emergency: it allows us to save the lives of ourselves or neighbors. During the pandemic, we transported our patients to the nearest health center. In an emergency you can mobilize quickly [with a boat], and when you cannot, you have to look for a neighbor or someone else [with a boat], because there is no ambulance in our community. This boat is very useful for everything in our daily lives. Without it, we do nothing, we can die. We wish that the community has a speedboat or small canoe dedicated for the transport of patients in emergencies and to carry out procedures (CHW8, Parinari).

The primary form of transportation in this region is personal canoes known as peque peques. Lockdowns mandated early in the pandemic prevented residents from leaving or entering the communities. CHWs identified the need for an ambulance boat that could be readily accessible to transport patients to health posts during emergencies. Despite feeling outside of the formal system as visualised in figure 2, CHWs acknowledged the important role they could play upstream in coordinating care with health posts. By positioning their role within the foundation of health infrastructure, CHWs viewed themselves as healthcare leaders whose role could be supported to better deliver coordinated care.

The use of medicinal plants versus pharmaceuticals

The collapse of supply chains prevented communities in the Amazon from accessing pharmaceutical drugs during the pandemic. One participant photographed an empty ‘community medicine cabinet’, which should contain essential medicines:

This little box is a community medicine cabinet. In the community, it is the responsibility of the health promoter, and it is mainly for the benefit of the community. As a CHW, I feel worried because it is empty. It is like a soldier who goes to war without weapons. You are left with great despair at not being able to provide support. The disease comes and we do not make it alive. Our role is not only to treat the patient, but also to support him so that he can reach the health post. Therefore, we must promote communal medicine cabinets with higher authorities. We want training on medicine administration so that we can be prepared for an emergency in our community (CHW6, Nauta).

The emptiness of figure 3 reflects the hopelessness CHWs felt in protecting their communities from COVID. CHWs felt the burden of temporising COVID-19 patients as they were transported to health posts, while at the same time, they lacked the ability to manage and distribute pharmaceutical drugs.

A major emphasis was placed on the use of medicinal plants to cure patients of COVID-19. The knowledge of plant remedies was revered by all participants, and participants used the focus groups to exchange different plant recipes. Participants agreed that community members should each have their own plot to grow medicinal plants for emergencies. As one CHW explained,

Since the pandemic is not over, we must continue to prepare those life-saving vegetables and eat them to protect ourselves. We should all have a well-organized garden with plants to take care of our health (CHW2, Nauta).

Participants considered basic knowledge of medicinal plants an unofficial part of the CHWs’ responsibility as community members looked to them to cure disease. Their knowledge and use of medicinal plants served as a foundation for trust in their communities though the pandemic. This trust enshrined them as important leaders as they could liaise between the formal health system and indigenous health practices. CHWs felt the need to distribute medicine and cure patients, even though this responsibility laid outside of their health promoter role. CHWs filled in the emptiness of the medicine cabinet from figure 3 with medicinal plants. They led communities through the pandemic without relying on the distribution of pharmaceuticals by the government.
Community adaptation strategies and struggles

The transition from a culture of togetherness to one of social distancing and isolation in accordance with COVID-19 protocols was difficult for many community members. As one participant from Parinari shared,

We were not used to living locked up. We were used to living free (CHW10, Parinari).

Families adapted to keeping their distance from sick relatives. One participant described the fear of leaving their family members alone at the health centre.

A pregnant woman in her bed is accompanied by her daughter. The pregnant woman is sick...The State said that the sick patient with COVID has to go to places alone; but our custom says that the person cannot be alone. When you are accompanied, you feel safer, protected. Care is the responsibility of the family. Several families had relatives arrive at the hospital, if they cured them, they would come out alive, otherwise, you would never see them. We have to organize ourselves in the community to manage a medical post with medications and trained professional nurses for emergency response and to prevent a pregnant woman or newborn from dying at any time (CHW9, Parinari).

Figure 4 captures the importance of family in caring for sick relatives, as a pregnant mom with COVID is being cared for by her young daughter. Visitors were not allowed to accompany their loved ones to the health posts because of COVID-19 restrictions. These restrictions made community members hesitant to take sick family members to the health post for fear of them dying alone. Thus, many sick patients opted to stay home and rely on family or community care rather than institutional healthcare. This new practice placed a greater responsibility on CHWs to take care of sick patients. As people died from COVID-19, communities felt sadness, indifference and vulnerability. One CHW described how communities were underprepared for these emotional struggles,

Many of us have lost our family members: our father, our mother, our partner, children, grandfathers, grandmothers, neighbors. We have been unprepared and distrustful, thinking that nothing is going to happen. We have to help each other so that our families do not die from these diseases (CHW9, Parinari).

CHWs felt pressure to help community members in receiving care. Thus, the deaths of community members devastated CHWs who felt it was their duty to provide healthcare. At the same time, the communities’ reliance on familial care was viewed as an overall strength by CHWs. Rather than succumb to isolation, participants generally remained hopeful they would overcome the pandemic by working together.

The leadership of the CHW

The leadership of CHWs was embedded within the health infrastructure, medicinal and adaptational challenges that communities faced during the pandemic. CHWs provided leadership for these downstream effects of COVID-19; however, their self-recognition as leaders, despite the lack of government acknowledgement, is crucial in understanding how they transformed their roles during the pandemic. Figures 2–4 show how the leadership of CHWs emerged as a cross-cutting theme.
during the study. Figure 5 shows one participant, dressed in PPE, outside the home of a COVID-19 patient.

A community health worker is visiting a community member with COVID-19 in the middle of the pandemic. At first, I was afraid, but at that time, I would always check on [the patients] to see how they were, if they were getting better [or] if they were getting worse—that was my job. My will is great. I don’t earn a penny; you don’t earn any incentive, but I work for my community. There was a danger that some community members would die from COVID-19. Since I had protection, I would [make visits]. I was no longer afraid of death. (CHW2, Nauta).

Not only did most CHWs remain committed to their established role during the pandemic, but some CHWs went beyond this role to take on new pandemic-related responsibilities, such as caring for COVID-19 patients, for which they had received little to no training or compensation. The collapse of formal health system forced CHWs to become the primary health providers as demonstrated by figure 5. CHWs understood that community members would follow their examples in adhering to COVID protocols like vaccination, despite vaccine hesitancy secondary to rumours. These rumours included that the vaccine was a government microchip or that the vaccine was the ‘seal of the beast’, or the 666 seal from the Bible. As one participant described:

As community health workers, we must promote vaccination. We have an obligation so that other people can follow our example in the first, second and third doses. We hear that “the vaccine is the seal of the beast; it has a chip.” We are key to showing why the vaccine is important, and that the first vaccine injected in the shoulder is the best vaccine. We can continue teaching and informing that getting vaccinated is best for everyone.” (CHW14, Parinari)

Not only did CHWs lead vaccine adoption, but they also helped organise the logistics of vaccine delivery with health posts and the Apu, or community chief. Figure 5 captures the breadth of CHW leadership during the pandemic. This leadership was recognised within the boundaries of the community, but was not formally used, acknowledged or supported by formal health authorities. This created a barrier to health delivery in indigenous communities as there was no standardisation of the CHW role during the pandemic. The degree of CHW leadership varied between communities based on the personality of the CHW, but overall, CHWs took more leadership roles during the pandemic.

Call to action and photo galleries
The call to action allowed participants to have a unified voice in asking for changes to improve healthcare delivery in the Amazon. The call to action linked all photos, texts and themes to highlight the importance of CHWs during pandemic. It asked policy-makers for the formal integration of CHWs into the healthy system by:

1. Providing each CHW with an accreditation that certifies their role as part of the formal health system with remuneration.
2. Expanding and standardising the role of CHWs by formally training them in first aid and other relevant health topics such as mental health and family planning.
3. Strengthening the community medicine cabinet in each community by sending essential medicines at least quarterly and training CHWs in the administration of pharmaceutical drugs.

Two photo exhibitions were held during the first week of June 2022, celebrating the ‘Day of the CHW’, which is recognised by the MINSA. The first photo exhibition was in Iquitos with local policy-makers and CHWs. The second photo exhibition was held at MINSA in Lima with national government officials and broadcast online. All photos with respective texts were included and organised into subthemes approved by to better orient the call to action and gaps in the CHW system CHWs (beyond the scope of this paper).

DISCUSSION
Over the 4-month period of photo taking, focus group discussion and observation, participants shared how the COVID-19 pandemic affected their responsibilities as CHWs. Despite the lack of infrastructure, compensation or equipment to take on the challenges of the pandemic, CHWs exceeded their expected level of commitment by expanding their responsibilities to mitigate the shortcomings of the health system.

Three key themes emerged during this photovoice project: (1) the collapse of health infrastructure, (2) the use of medicinal plants versus pharmaceuticals and (3) community adaptation strategies and struggles. The leadership of the CHW spanned across these themes to highlight their importance in community health access, delivery and promotion.
CHWs were not required to fill the vacuum of health-care delivery and promotion during the pandemic left by the government. Most CHWs expanded their roles because of their self-recognition as leaders within indigenous communities, which the government did not recognise. An opportunity exists for the health system to properly equip CHWs to help address the primary care and public health challenges beyond the pandemic.

CHWs in other low-income and middle-income countries (LMICs) have been facing similar structural challenges to healthcare delivery during the pandemic.\textsuperscript{39–43} The role of CHWs in LMICs, like Peru, needs to be refined to account for the pandemic setting. Globally, there was little clarity in training and supervision of CHWs during the pandemic.\textsuperscript{14} In countries with well-established CHW programmes, such as Nigeria and Vietnam, the role of CHWs transformed to support community engagement, awareness and contact tracing in the pandemic setting.\textsuperscript{44} In India, the formal training, mobilisation and compensation of CHWs in the COVID-19 setting eased the pressure on the formal health system and augmented pandemic preparedness.\textsuperscript{45} CHWs have been recognised to be an effective and committed health force in LMICs; however, they are undervalued, under-resourced and undertrained on a global scale.\textsuperscript{46, 47} When health systems protect CHWs, they can leverage their roles to interrupt virus transmission, maintain healthcare worker capacity, and shield the most vulnerable in society from the downstream socioeconomic effects of pandemics.\textsuperscript{48} CHWs can also provide psychosocial support to their communities to increase mental health services.\textsuperscript{49} The integration of CHWs into formal health systems is imperative to effective health planning, coordination and partnerships in vulnerable communities around the world.\textsuperscript{50}

Our study shows that CHWs in rural settings have the potential and desire to serve as front-line providers with the proper recognition, training, supervision and tools. They also serve as a key cultural liaison between indigenous communities and the formal health system, which fosters trust between the state and community members.\textsuperscript{51–53} The role of CHWs as a bridge between the health system and vulnerable groups has been recognised and leveraged in Brazil, a South American country with an established CHW network.\textsuperscript{42} This role should be expanded on and leveraged in other contexts where CHWs can strengthen health system resilience and protect the health of vulnerable populations.

The major study limitation is that researchers were non-independent from the organisation, therefore, results could be influenced by researcher bias. Challenges faced during this study included unreliable and dangerous transportation between communities along the Amazon River. Limited access to internet made communication with participants sparse in between meetings.

The strength of photovoice in this setting is that it allows participants to share their experiences directly with policy-makers. All participants experienced some level of increased empowerment at the end of the project, and many attributed their likening of photovoice to the opportunity to share their voices with policy-makers. After the conclusion of this study, CHWs expressed their empowerment by creating the first association of indigenous CHWs in Loreto called Asociación de agentes comunitarios de salud intercultural de Loreto with the objective to advocate for the recognition and inclusion of CHWs in the Peruvian health system. It was also a feasible modality in a rural setting with limited access to the internet or advanced technology. Further research is needed to explore how the role of the community healthcare worker can be standardised through training and remuneration in Peru. Future research is also needed to better understand how CHWs bridge the gap to healthcare access and delivery in vulnerable communities around the globe.

CONCLUSION

To our knowledge, this is the first study that explores the effects of the COVID-19 pandemic on the life and work of CHWs in the Peruvian Amazon through Photovoice, a form of CBPR. Our findings add to the growing body of literature on the importance of training CHWs to address health gaps and emergencies in LMICs. This study highlights the structural and logistical challenges faced by indigenous communities combating the COVID-19 pandemic, in addition to the leadership of CHWs in mitigating the health crisis. Global investment in CHW programmes has the potential to increase healthcare access and delivery in pandemic and non-pandemic settings. Further research should explore how CHWs strengthen primary healthcare and increase health system resilience in LMICs.

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Contributors TS was responsible for study design, planning and facilitation of the intervention, data collection, analysis, interpretation and write-up. PM was responsible for research mentorship, facilitation and execution of study. ARFP was responsible for project planning, facilitation of intervention, anthropological consideration, data collection, analysis, interpretation and translation. EMM was responsible for project design and methodology. OM was responsible for field coordination and community access. SR was responsible for project proposal, design and write-up. MMN was responsible for mentorship, community access, project planning, intervention and gallery design. TS, PM and MMB coordinated efforts for ethics approval through the university. All authors reviewed the final manuscript for publication. TS serves as active guarantor.

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REFERENCES
Data Supplement 1
Participant Demographic Characteristics

<table>
<thead>
<tr>
<th>Participant characteristics</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 14)</td>
</tr>
<tr>
<td>District</td>
<td></td>
</tr>
<tr>
<td>Nauta</td>
<td>7 (50%)</td>
</tr>
<tr>
<td>Parinari</td>
<td>7 (50%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5 (36%)</td>
</tr>
<tr>
<td>Male</td>
<td>9 (64%)</td>
</tr>
<tr>
<td>Age (in years)</td>
<td></td>
</tr>
<tr>
<td>20-29</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>30-39</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>40-49</td>
<td>7 (50%)</td>
</tr>
<tr>
<td>50-59</td>
<td>6 (43%)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Kukama kukamiria</td>
<td>14 (100%)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Primary incomplete</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Primary completed</td>
<td>5 (36%)</td>
</tr>
<tr>
<td>Secondary incomplete</td>
<td>5 (36%)</td>
</tr>
<tr>
<td>Secondary completed</td>
<td>2 (14%)</td>
</tr>
<tr>
<td>Technical incomplete</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Technical completed</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Bachelor's incomplete</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Category</td>
<td>Count (Percentage)</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Bachelor's completed</td>
<td>0 (0%)</td>
</tr>
<tr>
<td><strong>Time as a CHW</strong></td>
<td></td>
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<tr>
<td>Less than 1 year</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Between 1 and 2 years</td>
<td>0 (0%)</td>
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<tr>
<td>More than 2 years</td>
<td>14 (100%)</td>
</tr>
<tr>
<td><strong>History of COVID-19 infection</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11 (79%)</td>
</tr>
<tr>
<td>No</td>
<td>3 (21%)</td>
</tr>
<tr>
<td><strong>Confirmation of COVID-19 infection by Test</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5 (33%)</td>
</tr>
<tr>
<td>No</td>
<td>9 (67%)</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>0 (0)</td>
</tr>
<tr>
<td><strong>History of COVID-19 Vaccine</strong></td>
<td></td>
</tr>
<tr>
<td>Vaccinated</td>
<td>12 (93%)</td>
</tr>
<tr>
<td>Not vaccinated</td>
<td>1 (7%)</td>
</tr>
<tr>
<td><strong>COVID-19 perceived as a threat</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13 (93%)</td>
</tr>
<tr>
<td>No</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Don’t know</td>
<td>1 (7%)</td>
</tr>
</tbody>
</table>

* Suspected infection by COVID-19 including those not confirmed by molecular or antigen test
** Antigen or molecular test
*** At least two doses
Author Reflexivity Statement

1. How does this study address local research and policy priorities?

This original research was designed to specifically address gaps in healthcare for indigenous community members in the Peruvian Amazon. The work utilizes Photovoice, a visual research methodology, where participants defined the research question. Thus, the research team facilitated discussion and led the analysis, but participants defined the research objective and priorities. Furthermore, participants identified and presented policy concerns directly to local and national policymakers as a part of the project methodology.

2. How were local researchers involved in study design?

The knowledge and involvement of local researchers have been crucial to the development of this project. MB serves as the last author of the paper. She is a physician-researcher based in Peru, who has devoted her career to indigenous health in the Peruvian Amazon. GM serves as a physician-policy maker based in Loreto, Peru. She provided policy support and access to communities. Both MB and GM have extensive research experience. AR is a trained anthropologist in Peru and guided all anthropological considerations of the project. PM, EM, TS, and SR have diverse cultural backgrounds; however, they represent high-income country researchers in the work. They acknowledge their privileged positions in research and aim to promote equitable research for international colleagues.

3. How has funding been used to support the local research team?

This project received $10,000 USD from the US National Institutes of Health Global Health Equity Scholars Program and an additional $5,000 USD from the Pan American Health Organization. Funding has been used with the local research team to purchase qualitative analytical software, graphic design software, and pay fair wages to research assistants. Funding was also used to pay for all travel expenses of the local research team and to give this team the opportunity to travel and present the work to continue career growth.

4. How are research staff who conducted data collection acknowledged?

All research staff who engaged in data collection are acknowledged as authors. Specific roles of authors are outlined in the acknowledgments.

5. Do all members of the research partnership have access to study data?

All team members have access to study data.

6. How was data used to develop analytical skills within the partnership?

Junior-level researchers were required to complete the literature review and data analysis for the project. Additionally, all researchers were invited to attend a 2-day Photovoice workshop to learn more about the methodology and analyze this data set. Qualitative data analysis through
synthesis and data coding were key analytical skills prioritized by the research team. Lastly, the research team developed their language skills as transcripts and concepts were translated from Spanish to English.

7. How have research partners collaborated in interpreting study data?

Multiple virtual meetings were held with all research partners and local stakeholders during data interpretation. Key themes were identified through multiple rounds of meetings. All partners agreed on data interpretation in the context of respecting and promoting indigenous health.

8. How were research partners supported to develop writing skills?

Early career researchers (TS and AR) were supported by senior researchers through multiple revisions of the manuscript and all related writing throughout the project.

9. How will research products be shared to address local needs?

We wish to publish this work as open access. Additionally, all participants have received photo albums that contain the final photos, themes, text, and policy statements arising from the data analysis of this project. Participants have their own copies of their photos and all project deliverables to take back to their communities. The project was shared with policymakers at two galleries in Peru. Policymakers received copies of project deliverables to help their decision-making in addressing local needs.

10. How is the leadership, contribution and ownership of this work by LMIC researchers recognised within the authorship?

MB (Peru) serves as the last author of the paper. She was the project mentor and was primarily responsible for the leadership of the project. AR (Peru) and GM (Peru) serve as a middle author and have been recognized in the acknowledgements for their contributions to the writing of this work and the overall project. Overall, this work has 7 authors. Three authors are from Peru and four authors are from high-income countries. Although there are more authors from high-income countries, local researchers and partners have been crucial to this work and recognized for their contributions to this project.

11. How have early career researchers across the partnership been included within the authorship team?

Early career researchers (TS and AR) have been heavily included in the development, analysis, fieldwork, and writing of this work. TS is a pre-doctoral MD student and served as the first author. AR is a young career anthropologist who served as a research assistant. She was heavily involved in fieldwork, data analysis, translation, and writing. Young career researchers attended methodology workshops and had the opportunity to attend all meetings with local and national policy makers.
12. How has gender balance been addressed within the authorship?

Six authors are female (TS, MB, PM, AR, EM, and GM) and one author is male (SR).

13. How has the project contributed to training of LMIC researchers?

Three authors (MB, GM, and AR) are LMIC researchers. MB and GM are senior level researchers. MB is the founder of Mamás del Río – the primary local partner. GM currently holds a tenured position for the Regional Health Government of Loreto. AR is a junior researcher. She was employed by project funding for the duration of the project. She took all anthropological leadership of the project and presented the work at the Ministry of Health and at national conferences.

14. How has the project contributed to improvements in local infrastructure?

After the project, participants were empowered to create the first federation of organized community health workers in the Peruvian Amazon. Their purpose is to continue advocating for appropriate integration, training, and support of community health workers in the Amazon by the Peruvian government. MB continues to work at the policy level through Mamás del Río to integrate community health into the formal health system. The objective of this project was to identify gaps in the community health worker system of Peru to address those gaps and improve health infrastructure.

15. What safeguarding procedures were used to protect local study participants and researchers?

During fieldwork, participants provided written consent to participate in the project. Additionally, all persons that were subjects of photos had to provide written consent for their photos to be taken. COVID-19 safety measures including social distancing, hand sanitization, and masking, were taken during fieldwork. Participants who had photos included in the manuscript also consented via the BMJ consent forms. All names and other data have been de-identified.

References
**Introducción:** La pandemia de la COVID-19 provocó el colapso del sistema de salud peruano. El objetivo de este estudio fue comprender cómo esta pandemia transformó las responsabilidades de los Agentes Comunitarios de Salud (ACS) de comunidades indígenas en la Amazonía peruana para que los formuladores de políticas puedan apoyar los esfuerzos indígenas de salud.

**Métodos:** Catorce ACS de Loreto, Perú, participaron en un proyecto de Investigación de Acción Participativa basado en la comunidad utilizando Fotovoz. Los participantes fueron reclutados a través de Mamás del Río usando un muestreo intencional. Se les solicitó que fotografiaran cómo la pandemia afectó sus vidas y su trabajo. Ellos se reunieron cuatro veces durante cinco meses para compartir fotografías y desarrollar planes de acción. Los datos se organizaron en temas claves utilizando un método inductivo. Las fotografías finales y los planes de acción se compartieron con los formuladores de políticas en galerías fotográficas en Iquitos y Lima.

**Resultados:** Los ACS tomaron un total de 36 fotos en las que surgieron cuatro temas centrales: (1) el colapso de la infraestructura social, (2) el uso de plantas medicinales versus productos farmacéuticos, (3) las adaptaciones y luchas de la comunidad, y (4) la importancia de los ACS. Los ACS ampliaron sus responsabilidades y aprovecharon su liderazgo para apoyar a los pacientes con COVID-19, la vacunación y los mandatos del gobierno sin capacitación ni recursos. Ellos solicitaron a los formuladores de políticas una integración formal en el sistema de salud, la estandarización de la capacitación de los ACS y una mejor gestión de las farmacias comunitarias.
**Conclusión**: Los ACS asumieron funciones adicionales durante la pandemia con poca o ninguna capacitación por parte del gobierno. Ellos demostraron cómo el gobierno puede apoyar mejor sus funciones para mejorar respuestas a futuras catástrofes de salud en la Amazonía peruana.