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Children first: women's perspectives on evacuation at Fuego volcano and implications for disaster risk reduction

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As major drivers of behavior during crisis, cultural norms influence how disasters differentially affect people of different genders. Cultural gender norms also impact how authorities and at-risk populations approach disaster risk reduction strategies. At Fuego volcano, Guatemala, we applied qualitative methods to investigate women's experiences of the evacuation process after a paroxysmal eruption on 7–8 March 2022. While participants' experiences and decisions varied, we identified how gender influences evacuation dynamics within communities at Fuego volcano, including who evacuates and who decides at the community and household levels. We find that communities prioritized women for evacuation with the children and elderly in their care, yet prioritized men in the evacuation decision-making; that despite this hierarchy, a woman may override a male partner's decision in order to prioritize the safety and well-being of her children; and that even if she overcomes social barriers to leaving, she may be unable to evacuate in a timely manner because of lack of transportation—a barrier impacting all residents, but especially women since they are the ones leading their households in evacuation. This gendered evacuation strategy disproportionately leaves men exposed to the threat, since most do not evacuate, and places the burden of evacuation on the women, who leave their homes and likely face the challenges of evacuation with multiple children in their care. This study contributes an example of how gendered norms impact disaster risk reduction strategy at an active volcano and how understanding gendered experiences of evacuation can inform future disaster risk reduction efforts.

KEYWORDS

evacuation, volcano, hazards, gender, women, culture, risk reduction, decision-making

1 Introduction

Researchers have recognized over the past several decades that cultural gender expectations impact vulnerability and resilience to disaster, most commonly negatively impacting women and gender minorities compared with men (Enarson, 1998; Enarson et al., 2018). However, gender is rarely considered in strategies to reduce risk despite an international call to action via both the 2005 Hyogo Framework for Action and the 2015 Sendai Framework for Disaster Risk Reduction (Seager, 2014; Fatouros and Capetola, 2021). Research on gendered experiences in disaster risk reduction (DRR) yields information that may be used to improve preparedness, risk communication, and response capabilities in DRR strategies. Currently, much evacuation research is focused

TABLE 1 Participant distribution.

Village	Population ^a	Evacuated ^b		Session type(s)		Evacuated		Total participants
				Single-person interview	Group interview or listening session	Yes	No	
Panimaché I	389	209	54%	4	1 (3pp)	6	1	7
Panimaché II	172	57	33%	1	2 (3pp, 4pp)	3	4	7
Morelia	1994	256	13%	1	2 (~15 pp each, 5 speaking in each)	11	0	11
Total	2,555	522	20%		11 interviews	20	5	25

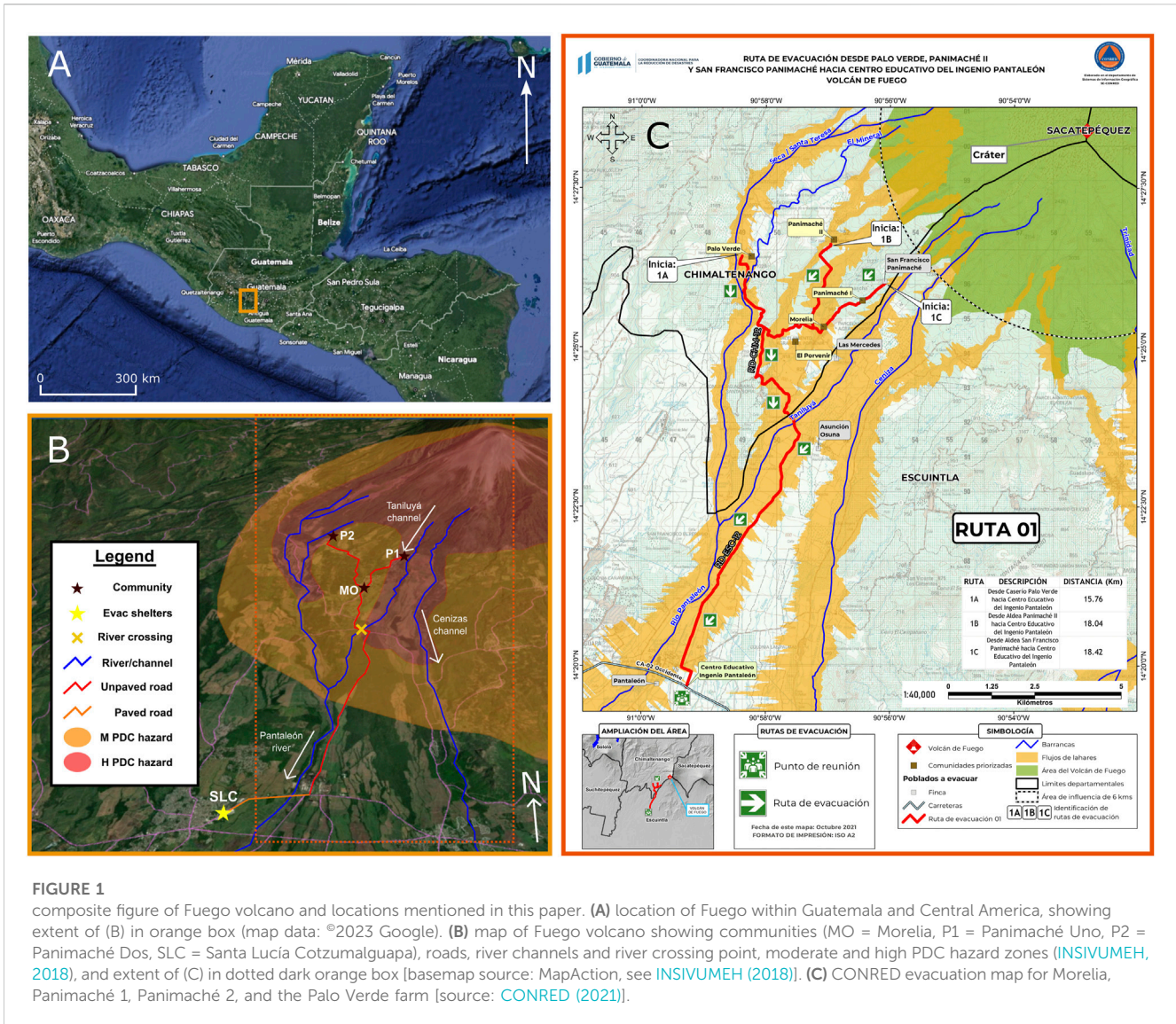
^aFrom 2018 census numbers (INE, 2018), populations likely increased between 2018 and 2022, which would imply a lower percentage of evacuation participation than what we calculate here.

^bFrom CONRED.

on affluent countries where many residents have access to their own transportation, in particular the United States, and on evacuation from extreme weather (see studies represented in Thompson et al., 2017). Here we focus on the experiences of women faced with short-term evacuation from their homes in small, rural communities on the slopes of Fuego volcano, Guatemala. We hope this research not only informs evacuation strategies at Fuego volcano but contributes meaningfully to the body of research on gender in DRR in various cultural and socioeconomic contexts. We also hope to open more dialogue into gendered experiences of living with active volcanoes.

Evacuation is a necessary risk reduction measure at Fuego volcano. Approximately 63,000 people from more than 30 communities live in areas that have been mapped as potentially exposed to pyroclastic density currents (PDCs), deadly and rapid flows of hot volcanic gasses and debris. While Fuego is one of Central America’s most frequently active volcanoes, with daily explosions and frequent short lava flows, PDCs occur only—but not always—during “paroxysms,” or larger, explosive eruptive episodes (Naismith et al., 2019). Fuego has entered into multiple paroxysms a year since reawakening in 1999. Most paroxysms last no longer than 48 h (Naismith et al., 2019), but within that time period can be deadly. PDCs flowing more than 11 km from the volcano’s summit reached populated areas on 3 June 2018, resulting in hundreds of deaths and many more casualties. Temporary evacuation from areas potentially subject to PDCs is the only reliable way to reduce risk to this hazard without invoking permanent relocation. However, evacuation numbers remain low despite the recent tragedy of 2018.

Evacuations around Fuego are recommended by authorities during some but not all paroxysms, and for some but not all communities within the mapped hazard zones in each case. Generally, each community then decides whether to evacuate in order to organize and mobilize external resources, but ultimately evacuation decisions are up to each individual or household. The dynamics of the broader evacuation system are complex and outside the scope of this study; we here focus on the experiences of women within that system. A partial evacuation of three communities on the southwestern flank of Fuego on 7 March 2022 in response to a PDC-generating paroxysm yielded an opportunity to investigate women’s experiences while the event was still fresh in residents’ memories. Only ~20% of the three communities’ combined population, or 522 of ~2,555 residents total, evacuated (Table 1). Guatemala’s national scientific monitoring agency (*Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología*, INSIVUMEH) issued bulletins reporting on the evolution of the eruption, while Guatemala’s national civil protection agency (*Coordinadora Nacional para la Reducción de Desastres*, CONRED) coordinated buses to transport evacuees to evacuation centers where they were provided with food and shelter for 3 days (two nights). In this study, we address three primary research questions: 1) How do gendered norms in these three communities impact evacuation dynamics? 2) What do women in these communities perceive as influencing their decisions to evacuate? 3) What barriers do women face to evacuation? We then discuss how we might use this understanding to inform risk reduction practices.



2 Methods

While we were in Guatemala collecting data for broader research projects on risk reduction, an increase in activity at Fuego volcano on 7 March 2022 spurred government-supported evacuations in three communities (Morelia, Panimaché 1, and Panimaché 2) on the southwest flank of the volcano (Figure 1). We responded by interviewing residents in these three communities in the week and then month after the evacuation. When our existing contacts directed us primarily to women to interview about the evacuation, we realized this was because it was primarily women who had evacuated; we recognized the opportunity to focus on women’s experiences and how gender expectations manifest in evacuation dynamics. We had multiple conversations during this fieldwork on both the informal evacuation strategy at Fuego, where women are prioritized for evacuation with the elderly and children, and how a community decides whether to evacuate or not. We added questions about agency into our interview guide to better understand how women navigate decision-making to meet their needs in what scholars have described as a highly patriarchal culture

(e.g., Batthyány, 2011; Ortega Ponce, 2012). This study focuses on an analysis of those interviews and listening sessions. We chose a qualitative design for this study because it allowed us to explore personal aspects of individual women’s experiences (e.g., emotion and memory) that would be impossible to capture with quantitative methods such as a survey. Choosing qualitative methods allows us to retain the richness and subtlety of the stories women shared with us. Risk itself is a social construct affected by qualitative factors such as willingness (Jenkin, 2006), so a qualitative design for this study is appropriate. All interviews and observations were conducted under and in accordance with Institutional Review Board (IRB) approval 1,760,726–2 from Michigan Technological University.

2.1 Data collection

We spoke with and listened to the stories of women in a variety of settings: single-participant semi-structured interviews, organized group interviews, and an impromptu listening session. In all, we

collected data from approximately 25 women in the three target communities through a total of 11 sessions (interviews and listening sessions, collectively). Because we were already in-country, we were able to respond quickly to conduct these sessions on two different visits to the Fuego Volcano Observatory (*Observatorio Volcán de Fuego*, OVFGO), operated by INSIVUMEH and located in San Francisco Panimaché, or Panimaché 1, [Figure 1](#)), one from 12–13 March 2022, just days after the evacuees returned, and the second from 6–8 April 2022, 1 month after the evacuation. Our goal in these interviews was to document and understand what factors residents consider when making decisions about evacuation during eruptive crises at Fuego volcano, and who makes those decisions at the household level.

2.1.1 Approach

We began with single-participant interviews to build a detailed picture of how individuals responded to the evacuation process and then moved toward group interviews to use our own and participants' time efficiently, increase the perspectives represented, and enable participants to discuss details like the timing of the evacuation with each other to triangulate information in real-time. We conducted three interviews together, four interviews independently, and two sets of interviews/listening sessions in parallel:

- Panimaché 1: Four one-on-one interviews at the houses of participants (author B. A. Bartel, BAB) and one three-person interview at the Fuego Volcano Observatory (BAB and author A. K. Naismith, AKN)
- Panimaché 2: One single-participant interview at a home (BAB and AKN) and two group interviews conducted in parallel at the same home, one with three participants who evacuated (AKN) and one with four participants who did not (BAB)
- Morelia: One single-participant interview at a public park (BAB and AKM) and two impromptu informal listening sessions conducted in parallel in the street, each of ~15 people with ~5 in each who actively participated while others listened (one AKN, one BAB)

In all sessions, we explained the project and received verbal consent to record audio and use data with names removed from all participants. All sessions were conducted in Spanish and recorded on digital audio recorders for later transcription. Sessions lasted from 20 to 90 min. We conducted the interviews and listening sessions a like prioritizing open-ended questions, including “big, expansive questions” ([Jacob and Furgerson, 2015](#), p. 4) that allowed the participant to discuss what they found most relevant, starting most interviews with “Tell me/us about that day. What was it like?” We then asked probing questions considering guidance provided by [Lareau \(2021\)](#) to focus interviewees on factors influencing evacuation decision-making. After an early interviewee shared that she went against her husband's will by evacuating, we modified our interview guide to include a question about who made evacuation decisions within their households. Our interview guide is provided in [Supplementary Material](#).

2.1.2 Participants

We selected participants through convenience sampling in each village, relying on existing contacts to gain access to participants in their communities. In Panimaché 1, we were

connected with participants through staff at the Fuego Volcano Observatory. In Panimaché 2, we interviewed a previous contact who then organized a meeting with fellow members of a directive created to liaise with a non-governmental organization on a development project for women in their community. In Morelia, our connections were through a colleague in the local civil defense group (known as the *Coordinadora Local para la Reducción de Desastres*, or COLRED). The listening sessions arose when we met her at her house where she had convened women to provide post-evacuation information required by the government; we invited anyone willing to stay and share their experiences, which most did. This is why the groups in Morelia were so large (two groups of ~15 women each) and why our total number of interviewees is approximate rather than exact. While we consider all ~30 women to be participants, it would be misleading to count them as a total number of interviewees, as many listened and talked amongst themselves, perhaps agreeing with others on points made but not sharing out their personal stories. Instead of counting 30, we count 10, the approximate number of women who did share their stories (~5 in each group).

Based on information shared in the interviews, participants ranged in age from mid-20s to mid-70s; most but not all are mothers and many are grandmothers; most grew up in one of these three communities, while some are more recent arrivals; many belong to one of several Evangelical Christian churches, while others stated they believe in God but do not belong to a specific church. We did not systematically collect demographic information. Most participants did evacuate ($n=20$), while five did not. [Table 1](#) shows the distribution of participants by community, interview type, and evacuation decision.

2.2 Analysis

We transcribed all interviews using a transcription software (Sonix.ai) to automatically generate preliminary transcripts that we then reviewed for accuracy and corrected, maintaining the original language (Spanish). We then coded all transcripts for pre-determined and emergent themes using a qualitative data analysis software (ATLAS.ti). We wanted a pragmatic coding approach: how to “practically go about analyzing large-scale interview data”? ([Deterding and Waters, 2021](#)). We chose the flexible coding approach as described by [Deterding and Waters \(2021\)](#), and followed this three-step process to flexible coding and analysis: first, we identified code groups (e.g., “Social Networks”) and subcodes (e.g., “Young children”) based on our research questions and our interview notes. Second, we added further codes as themes emerged during coding of the interview data. Finally, we performed a simple review to consolidate similar codes and re-code quotes for codes that may have been missed in earlier coding sessions. Our approach was therefore neither wholly inductive nor deductive, instead best described as “abductive,” or “a continuous process of conjecturing about the world that is shaped by the solutions a researcher has ready-to-hand” ([Timmermans and Tavory, 2012](#)). Research colleagues at Michigan Technological University checked portions of transcripts and coding to provide external

TABLE 2 Example code groups and codes for data analysis.

Code group: Social networks	Code group: Structural
Code: Young children	Code: Transportation
Code: Older	Code: Official presence
Code: Spouse or partner	Code: Opportunity to leave
Code: Community	Code: Place to go
Code: Other	Code: Timeliness of outside aid

validation (see acknowledgements). All quotes here were translated by the authors after coding.

Based on participant descriptions of their experiences leading up to and, where relevant, during evacuation, we designated six broad code groups with multiple subcodes beneath each (Table 2). The coded groups are Social Networks, Homes and Livelihoods, Information Sources, Structural (government-related processes and resources), Wellbeing, and Evacuation. There is some overlap between all code groups. Codes are provided in [Supplementary Material](#).

2.3 Supplementary data sources

Because of our previous and continued data collection on Fuego volcano, we have considered data sources outside these interviews and listening sessions to frame the information provided in this rich yet limited data set. We note where our discussions are directly informed by additional sources.

This study is informed by participant observation during these interviews and others conducted from 2018 to present as well as meetings or workshops such as the accreditation of local civil protection groups (COLREDS) by the national-level civil protection staff (SE-CONRED Department for Prevention on Volcanoes). Participant observations provide insights into the day-to-day lives of participants and others within these communities; messaging from civil protection groups; and communication during volcanic crises. We recorded these participant observations in written field notes; voice memos recorded either individually or together, in conversation; and in photographs taken while in the field.

We also consider data from government census documents, government evacuation statistics, and news media reports.

2.4 Limitations

This study is not intended to be generalizable to all populations around Fuego volcano or even throughout the three communities sampled. We note especially that we spoke with few women who did not evacuate, and in only two of the three villages. Also, because our primary contacts were the Fuego Volcano Observatory staff in Panimaché 1 (INSIVUMEH observers) and local civil protection volunteers (COLRED members) in all three villages, our sample is likely skewed toward residents with high levels of civic engagement.

Regardless of how soon after the event we spoke with participants, our data may reflect participants' justifications for their evacuation decisions rather than the factors that influenced their decision-making process at the time. On the night of the evacuation, for example, one participant shared with us via text that she was not evacuating because she needed to make cheese. This initially struck us as a bizarre priority. As we suspected, the reality was more complicated, as she described in our interviews with her the following month when we were able to speak in person.

We also acknowledge our positionality as clear outsiders: we are both white women from affluent countries with advanced educational degrees, speaking Spanish as a second language (Both our degrees focus on case studies in Central America, so we do have relevant experience in the region.) While we spent time in each community on repeated trips, beyond the two reported on here, our time and exposure to village dynamics were limited. Each conversation and observation broadens and deepens our understanding of how people live with Fuego's frequent eruptive activity and we surely would have gained a more nuanced view with more time. Still, despite the limitations, we believe the results we present here are meaningful and reflect both a shared experience of life for women in these rural areas and the diversity in their experiences as individuals faced with the decision to evacuate from their homes on Fuego's slopes.

3 Results

We here present the results of our analysis in sections organized by our three primary research questions with the addition of a fourth section that highlights how complex and interdependent people's evacuation decisions are at Fuego, shown here in italics: 1. Impact of gendered norms on evacuation dynamics, 2. *Social influences on decision making processes*, 3. Influences on evacuation decisions, and 4. Barriers to evacuation. We use these same categories in the Discussion, incorporating discussion of the additional topic 2) into the first research question 1).

3.1 Impact of gendered norms on evacuation dynamics

3.1.1 Most likely to be home during a crisis

Participants described, and we observed, strong gender norms for distribution of labor within the target communities. In these communities, as elsewhere in Guatemala, women are primarily responsible for household labor while men work in paid labor outside the home. Women's responsibilities include taking care of a family's basic needs, such as clothing and meals; often they also tend to small, home-based livestock such as chickens, geese, ducks, and rabbits and supplement household income with paid labor or products, e.g., making cheese to sell locally, that are also often based out of the home. By contrast, men typically work outside the community, traveling daily to family land or to coffee or

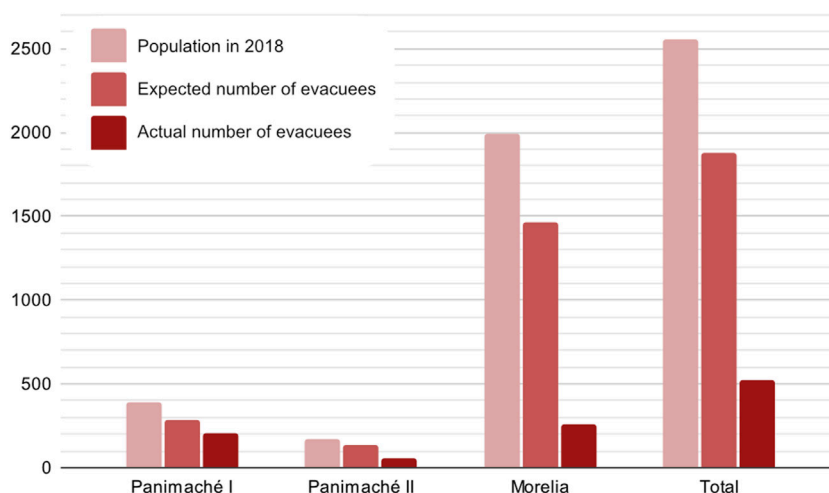


FIGURE 2

Actual vs. expected evacuation numbers in Panimaché 1, Panimaché 2, and Morelia. Population from 2018 census numbers (INE, 2018); populations likely increased between 2018 and 2022, which would imply an even lower percentage of evacuation participation than what we calculate here. Expected number of evacuees estimated by summing all children aged 0–14, all adults aged 60+, and half of adults aged 15–59 (i.e., women); census data showed approximately 50% female and 50% male populations in each location, not disaggregated by age. Actual number of evacuees from CONRED.

sugar plantations, or to cities for up to several weeks at a time because paid work is scarce locally.

This distribution of household labor and livelihood opportunities has significant implications for evacuations. As shared by participants in Panimaché 2, women are more likely to be home during a volcanic crisis than men in their community:

First woman: There are very few men here because there are no jobs here.

Second woman: It's almost only the old men that are here, the [retired] fathers of the young men.

(...)

BAB: Since the eruption was on a Monday, a working day, how...?

First woman: Mostly, it was only us women here.

A video posted by media outlet Prensa Libre during an evacuation process in the town of Ceilán on a Monday in November 2018 shows this holds true for other communities on Fuego as well: the vast majority of the crowd gathered to discuss evacuation are women (Prensa Libre, 2018).

3.1.2 Prioritized for evacuation with children and the elderly

Even if men are present, communities prioritize women for evacuation with children and the elderly while men stay behind to take care of property. The reason both male and female residents gave for the gendered evacuation strategy was that women with children move slowly, while men, unencumbered, can run from danger. The implication is that women are responsible for the caretaking of children. Men stay behind to deter looting, feed livestock, and manage ashfall on roofs to prevent collapse. As

described by a woman in Morelia, even teenage boys may stay behind with fathers:

My husband told me to leave because the ash was falling as if it were water, and it stank, so my husband said, 'Go, because we have a lot of kids'. . . I have five that are still young. The [17-year-old] boy stayed with his father here in Morelia. I took the four little ones. Since they are all small, I left. My husband said, 'Leave, because if it gets worse, how are we going to grab them all since there are so many?'

Like this participant, many households have many children [~22% of women in Yepocapa municipality had five or more living children in 2018 (INE, 2018)], and participants described evacuating not only with children but also with extended family members. Families commonly share land plots, with grown children building houses next to their parents' as they start nuclear families of their own. As one participant in Panimaché 2 said, "there are not small families here, almost all are big. Where the mom is, the son is too, the daughter-in-law, the grandkids." This results in multi-generational groups evacuating with one or more middle-aged woman at the hub, as described by a woman in Morelia:

Since we had to sign up, how many from each family was going, I signed myself up, I signed up my children, I signed up my mom, my dad, my nephew, and I said, 'Okay Mom, I signed you up, let's go.' My husband can flee. He says that if anything happens he can leave running. But me with my children, what am I going to do?

While some shared that men follow later or that only a delegation chosen by local governance stays behind, interviewees in multiple

TABLE 3 Expected evacuation numbers if only and all men stayed behind.

Village	Population ^a	Evacuated ^b	Estimated expected evacuating population ^c	Discrepancy between expected and actual evacuated population
Panimaché I	389	209	283	74
Panimaché II	172	57	132	75
Morelia	1994	256	1,466	1,210
Total	2,555	522	1,881	1,359

^aFrom 2018 census numbers (INE, 2018), populations likely increased between 2018 and 2022, which would imply an even lower percentage of evacuation participation than what we calculate here.

^bFrom CONRED.

^cExpected evacuating population estimated by summing all children aged 0–14, all adults aged 60+, and half of adults aged 15–59 (i.e., women); census data showed approximately 50% female and 50% male populations in each location, not disaggregated by age.

communities expressed that only women, children, and elderly evacuated on 7–8 March, with few exceptions. However, this does not mean that all women, children, and elderly persons evacuated. We estimated the expected number of evacuees from each village if all women, children, and elderly persons left, based on the most recent census data, and compared these estimates to the actual numbers of evacuees provided by CONRED (Table 3; Figure 2). Our estimates show we should expect around 74% of the total population in any of the three communities to evacuate. However, even in Panimaché 1, where residents said ‘everyone’ evacuated (e.g., “Everyone left. Only the authorities and the men stayed.”), CONRED’s numbers indicate that only 54% left, or 19% less of the population than expected.

It is possible that the evacuation numbers represent only people served by the buses and in the shelters and not those who evacuated to the homes of family away from the volcano, which we know to be non-zero. However, this is not enough to explain the large discrepancies observed in Panimaché 2 and Morelia, where we should expect 43% and 61% more evacuees, respectively. Therefore, while the reported norm may be that women evacuate with children and the elderly, numbers indicate that many did not during this most recent evacuation.

3.1.3 Maintaining caretaker responsibilities throughout the evacuation process

Gendered distribution of labor means that women are responsible for multiple aspects of family life throughout the evacuation process, even if men are present. Women we spoke with described preparing their family by gathering important items like documentation, clothing, and diapers, and organizing family members. Thus, the readiness of the family depends primarily on the women in the household. Some women described this responsibility as a burden in a resource-scarce environment; one mother who evacuated from Panimaché 2 explained her feeling of helplessness at maintaining and preparing the “72-h backpack,” a readiness kit promoted by CONRED:

You throw in important papers for the children. And something that you can give them to eat or . . . whatever you think is the most important, you bring. Because they have taught us about these things. But as I said to my friend, the backpack did not cover the hours that it needed to, because the things were used up. Then you say, ‘What can I do?’

Women described taking care of the physical and emotional health of others before and throughout the evacuation process. In Panimaché 1, several participants described sheltering at home to protect themselves and children from ashfall while the men in their family went up to the volcano observatory to get information and discuss evacuation. While several participants described going to the observatory to get information as well, they appear from photos from observatory staff to be the minority. This distribution of labor during a crisis may result in women missing out on opportunities to receive information first-hand and to advocate for themselves and their dependents in negotiating evacuation resources with community leadership and civil defense staff.

Women also described taking on emotional labor and regulating their own feelings in order to manage the feelings of others. For example, this woman in Panimaché 2 shared how she hid her fear

while awaiting evacuation decisions to protect the emotional wellbeing of her children:

Because sometimes, well, we have a knot in our throats, as if, ‘This is it.’ We wanted to cry and we were already crying with fear. But as mothers, we cannot cry because then our children get more scared. So then we endure this knot in our throats.

In evacuation centers, women continued to enact their caretaking responsibilities; they consoled family members, shared resources with others, and problem-solved to keep their children comfortable and clean. A participant from Morelia shared how she found a secluded spot to help her children bathe using containers of drinking water provided in the evacuation center. At night, she concerned herself with her family’s safety:

They were sleeping and I was sitting on the edge of the bed, of the beds they gave us. I looked at my children. And one of them came, a policeman, and told me, ‘Go to sleep, daughter, because we are taking care of you here. We are taking care of you and your children and all the families that are here.’

The same woman reflected other participants’ concerns about leaving their homes and their other responsibilities, especially in regards to preparing food for their male family members who stayed behind:

Because like I said, it is hard to leave our belongings, leave our animals, our spouses without meals. It is painful.

Most women we spoke to said they were well-provided for in the evacuation centers, though many had stories of concerns they had addressed for their family or community members: participants described giving medicine to the elderly, consoling young mothers with newborn babies, and borrowing cell phones from other women for calls to check in on family members.

A participant in Panimaché 1’s civil protection group who evacuated with her community members advocated for them in the shelters, for instance asking if there would be breakfast coming for restless children when none was provided at a normal mealtime. She and the other two women in Panimaché 1’s civil protection group (all three evacuated, and the seven men in the group all stayed back) also kept order among their community members, for which she proudly said they were congratulated—even though they were women.’

They congratulated us. They told us that ‘Even though you are women, you had your people in good order. All calm.’

This caveat (‘even though’) indicates both her and the speaker’s unfortunately low expectations for women’s abilities in civic life.

In summary, gendered divisions of labor mean women are more likely to be home during a crisis, shoulder the burden of preparing households for evacuation, evacuate without their spouses with children in their care, manage and take care of children’s physical and emotional health throughout the crisis, and continue much of their caretaking work at the evacuation center even if basic needs are provided for.

3.2 Social influences on decision-making processes

3.2.1 Prioritizing men for decision-making

Participants shared a variety of responses when asked who makes the decision to evacuate in their household, though most indicated a clear expectation that men should or do. In Panimaché 2, one woman said, “The husband makes it. If he says to go, they go. Based on how he sees the danger.” She and her interview group agreed that in men’s absence, they would have to make decisions if they see there is great danger, but that there are always at least some older, retired men in the village. They described how their decision-making is consistent with their caretaking responsibilities: to prepare their families while awaiting the decision to evacuate.

First woman: We cannot make the decision, the men do.

Second woman: We did make the decision, but to have things ready, telling the children, “Look, we’re ready” . . . because “Let’s see what your dad says.” Or see what the authority says.

Men who are absent from the home may still weigh in, as described by a participant in Panimaché 2 whose husband who is gone each week for work elsewhere:

I was going to go. I was ready to go. Then I talked with him by phone and he told me to only go to Morelia [where my in-laws live] and if it gets worse then you can leave more easily from there.

Relying on men’s judgment may significantly hinder both community-wide and household decision-making if men are not accessible. We can see this play out in the same video of November 2018 evacuation dynamics described in [section 3.1.1](#), when authorities ask a group of mostly women gathered in the street if they will evacuate; one woman responds, “Well, we cannot decide anything, ma’am, because our husbands are working in the sugar cane. So maybe when they come we will meet to see what they say” (Prensa Libre, 2018, 00:09:20). In Panimaché 2, interviewees complained that the male head of both their local governance and civil protection groups was away at work on 7 March at a sugar cane plantation and inaccessible until 5 p.m.

3.2.2 Influencing decisions within and beyond their households

Women’s stories revealed their expectation to rely on men for decision-making but also how they exercise agency in a variety of ways. One participant in Panimaché 1 said she told her husband and eldest son not to go tend to their farmland higher on the mountain on the morning of 7 March because of the heightened volcanic activity; they stayed home. Women faced with evacuation also swayed people’s decisions in other, nearby communities. One participant in Panimaché 2 who did not evacuate described her influence over her adult daughter in Morelia:

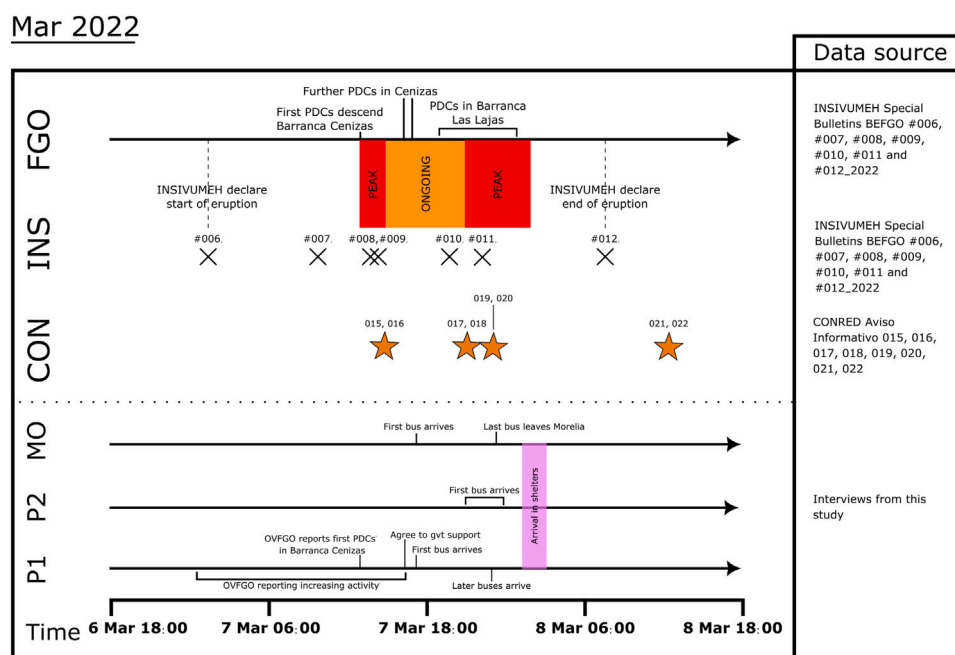


FIGURE 3 Timeline of events for the 7 March 2022 eruption. (Top - bottom) FGO = activity of Fuego, including timings of pyroclastic density current (PDC) descent; INS = INSIVUMEH Special Bulletins (ID and release time); CON = CONRED Aviso Informativo (they release one for community and one for authorities simultaneously); P1-P2-MO = evacuation timeline for each of the three target communities (Panimaché 1, Panimaché 2, Morelia). Information sources are listed on the right.

I told her if I go I'm going to bring you with me. Okay, she said, I'm going to get ready and if you go I'll go too. But since we did not leave, she did not leave either.

Participants frequently described decision-making as collaborative between family members in other households, such as a widow in Morelia who told how she discussed whether to evacuate with her adult children:

So, I do not have a husband anymore, he died. But my children ... there is a daughter of mine who lives near where I live, and she has a daughter, and they were very worried. So we decided between us to leave. We made the decision between my children and I, and we left.

Making the decision to evacuate can be a source of great stress, especially given the large, tightly connected family groups. A participant in Panimaché 2 described how the decision of whether to evacuate affects not only large nuclear families but an extended family network:

I would have left with seven children and two daughters-in-law, yes. And the grandchildren. It is a large group and even one of my sisters and my mother met there at our house to decide and they said, 'Well, if you leave, so will we.' So I could not figure out what to do, because it was not just my life that was in danger, it was my whole family. So it is quite difficult to make the decision that 'I'm staying today.'

3.2.3 Influencing others through civic engagement and example

While women are almost exclusively responsible for housework, they do also participate in civic life within their communities. At least four of our participants were members of their local civil protection groups (COLREDs) during the 7–8 March 2022 evacuation, one in Panimaché 1 and three in Panimaché 2 (not all of which evacuated). Participants in Panimaché 1 explained that a COCODE (*Consejo Comunitario de Desarrollo*, a community's development council) gathers the community to make a decision about evacuation and the COLRED then supports evacuation if called for, although this may vary between communities. Participation in the COLREDs is encouraged by national-level civil protection agency staff with the recognition that women are more likely than men to be present in a community during a crisis.

As part of the COLRED, women share information about evacuation and may motivate others in their community to evacuate, as described by a COLRED member in Panimaché 1:

Here they said 'Well, we're not leaving.' But I said 'Well, that's why we're here and bringing information, we have to get out, let's go! Let's leave now when you can.' Because they're going to want to leave when they cannot. 'Right now there's a bus, let's go!'—cheering the people, people who did listen to us and liked what we told them. That's how people left.

In summary, women described prioritizing men, especially their husbands, in the decision-making process, but that the process can be very collaborative between them and their

partner, within extended families, and within communities. They also described having influence on other family members and in turn their families—which can be positive but also a burden. In local civil protection groups, they may encourage others to evacuate following official guidance from their community.

3.3 Influences on evacuation decisions

We asked our study participants how they decided to evacuate or, in the case of the five who stayed, why they did not.

3.3.1 Considering official warnings as guidance

Participants described receiving information from officials about the volcano's activity, alerts to prepare for possible evacuation, and guidance or an order (described differently by different participants) on whether to leave. We heard that these official recommendations can be important but also heard that in some communities (i.e., Panimaché 2) it never arrived, or that there was a large gap in guidance. Some, like this woman in Morelia, expressed that they follow the authorities' guidance as an order:

I am willing to follow the rules and if they say that we have to go, we have to go.

Others, however, described the decision as up to each household or individual, and most described guidance from authorities as informing, not determining, their decision, as with this woman in Panimaché 2:

We get together to see what the authorities are going to do. To make the best decision.

As we can see from other descriptions below, while participants may have considered official guidance, most deciding factors revolved around protecting children—and the availability of transportation.

3.3.2 Motivated by children's fear

As indications that they should evacuate, women described volcanological phenomena including heavy ashfall, dark skies, the occurrence of pyroclastic flows (the most dangerous type of pyroclastic density current), the smell of sulfur, loud and continuous explosions, and ground shaking. However, alongside these descriptions of volcanic phenomena, participants, like this woman in Morelia, almost always also described the fear Fuego caused them and their children:

My girls were very scared. From when it got dark. From then, they did not want to eat, they cried. The same for me, my blood pressure rose, I did not have lunch, I did not have dinner, and that's how I left because I get really bad too. And the truth is that I'm afraid of [the volcano]. It does scare me. I'm afraid and my girls . . . crying that we were not going and my husband did not want us to leave and I told him if he wanted he could stay, but I would go with them because they tormented me and I was the same, well, I was too scared because the thunder from the volcano was very loud and it would not calm down.

Another woman in Morelia forewent describing volcanic phenomena and indicated her main motivators to evacuate were her children's fear and the pressure of the last available transportation:

My kids did not go to sleep at that time, they could not sleep. They cried. And it was the last bus that was going to leave. So, yes [I had] the decision of either I go or I stay. And in the end my heart could not bear to see my kids, the fear of my kids, and I said well, we'd better go. That's how we made the decision to leave, then.

Several women in Panimaché 1 expressed that they were not concerned for their own lives and only evacuated because of the children:

First woman: We did leave voluntarily, always out of fear, for the children. Like I said, we're grown up, we've already lived, but children are what we feel.

Second woman: They have to go first. They get scared.

First woman: The kids get scared.

These women in Morelia shared that they were similarly not concerned about the volcano's activity for themselves, but evacuated out of concern for their children's emotional wellbeing:

Well, I say nothing is going to happen. As in, this happens normally . . . But they just get scared.

What happens is that at that moment the children come to cry. To cry and that—they say they are afraid to die. And all that. And many times that encourages you to go too, you go, because—out of fear for the children. That they can get sick from so much fright.

These stories imply that there are no set criteria or thresholds for evacuations; instead, much of women's evacuation decisions are driven by how uncomfortable they and/or their children are.

We note that families do not have much control over when to evacuate, instead deciding on whether to evacuate given the timing of available transportation. We address this issue in [Section 3.4: Barriers to evacuation](#).

3.3.3 Prioritizing children over competing factors

Participants indicated that protecting or calming their children was more important than other factors influencing their evacuation decisions, describing how they overcame economic and social pressures to address children's needs. For a participant in Morelia, the desire to appease her children outweighed the inconvenience of evacuation as well as the potential livelihood losses.

It is hard because you think first of the children. In my case, I have three. Hauling them around, right? There's the fear of staying, also, because of them. Because in my case, I did not really want to leave, right? Because of my animals and everything, it pained me to leave. But at the same time, my son was crying and saying, 'Mom, let's go, Mom, let's go!'

Despite saying they prioritized men's word in decision-making ([section 3.2.1](#)), multiple women told stories of deciding to evacuate with their children even when their husbands said they should stay.

As shared by a woman in Morelia, this unilateral decision-making may cause tension in relationships and be seen as disobedience:

And I told him, ‘Forgive me my love, because what you put on is white, I turned it black. Because I left with my children and you said no, and I said yes.’ ‘But thank God, now you’re all back,’ he told me, ‘You’re all here without any problems.’ And everything was like nothing happened.

These women emphasized their responsibilities as mothers to overcome gendered expectations of obedience. We note that it is quite possible that many women did not evacuate because of deferring to their husbands’ wishes, given our small sample of non-evacuees; two of the five who stayed back clearly expressed the influence of their husbands in staying.

Two different participants also countered religious arguments to stay home and leave the outcome in the hands of God, arguing like this participant in Panimaché 1 that having faith in God was not contrary to evacuating with their children:

BAB: Why did not the people at the church evacuate? Because they say they have faith in God. Of course, we all believe in God and that He exists—but not in leaving the burden only to God. We also have to do our part to leave. So, they said they did not evacuate because they trusted in God and that nothing was going to happen. And I know that God is great because nothing worse happened. But we did it out of concern for our families and to keep them safe.

3.3.4 Avoiding regret

One woman in Panimaché 2 described fear not related directly to the volcano’s activity but to the potential to regret not taking action. As with many other mothers interviewed, her concerns were tied to the lives of her children:

I think that we have to be on alert before we have something else to regret. Yes, because sometimes after a tragedy happens, someone will lament, “Why did not I go, why did not I get out?” And then more when people have small children, the children do what the mother and father say. And if someone as a parent does not think that the life of a child is worth much? And what we think sometimes is that . . . the children go where the mother goes, and if we have this opportunity to leave in time, it is much better.

In summary, many participants indicated they took the official guidance to evacuate as a consideration rather than an obligation and described the wellbeing of their children—both their lives and emotional health—as a primary motivating factor in their decision to evacuate that could outweigh concerns for their livelihoods, obedience to husbands, and arguments that religious faith deems protective action unnecessary.

3.4 Barriers to evacuation

Whether women want to evacuate or not, their ability to do so is challenged by competing factors, including those mentioned above:

leaving their homes, leaving their animals, preparing large family groups, and disagreeing on the importance of evacuation with spouses. In previous work and informal interviews, we also heard about concerns that conditions in evacuation centers would be poor or that their families would not be well provided for in them. Some barriers are more surmountable than others; as described above, many of these factors were overcome by the desire to protect children. However, participants also described multiple facets of a single barrier that proved particularly important in their decision to and ability to evacuate: transportation.

3.4.1 Availability of vehicles and drivers

Both Panimaché 1 and Panimaché 2 evacuate through Morelia. All three communities evacuate to temporary evacuation shelters such as schools in the small city of Santa Lucía Cotzumalguapa (Figure 1). The evacuation route is mostly on unpaved dirt roads; residents of Panimaché 2 must travel 18.04 km on such roads until they meet the paved highway (RN-14) at the Education Centre of Ingenio Pantaleón (Figure 1C), and a further 2.8 km on the RN-14 to the beginning of Santa Lucía (20.84 km total). Residents of Panimaché 1 travel ~17.4 km on the dirt road (~20.2 km to Santa Lucía), and residents of Morelia ~16.0 km on the dirt road (~18.8 km to Santa Lucía). According to Guatemala’s 2018 census, only 20.2% of households in the municipality of San Pedro Yepocapa had a motorcycle, while fewer—8.8%—had a car or truck (INE, 2018). These percentages are likely lower for these three rural communities, as numbers are skewed by urban centers.

Limited vehicle access severely restricts evacuation options for all residents, even after authorities recommend an evacuation. Women in Panimaché 1 and Panimaché 2 shared that authorities expected them to walk to Morelia or further, a task made particularly challenging with small children in tow:

And they told us to leave. To evacuate. But by foot! By foot from here to, to the main road (Panimaché 1).

First woman: They’ve told us that we have to walk. But [the children] do not let us walk.

AKN: How much time does it take to walk to Morelia from here? First woman: Walking? With children, almost an hour.

Second woman: Doing this, the eruption will catch us halfway between here in Panimaché and Morelia! So it is almost better that we stay at home. (Panimaché 2).

Even for the few vehicles available in a community, women have less transportation autonomy than men. According to one interviewee in Panimaché 2, “there is a vehicle here but only men drive.” She shares that several women in the community, “maybe 4,” can drive a motorcycle. This lack of autonomy is reflected in conversations where participants described taking buses or, in the few cases where a household vehicle was described, riding on their sons’ motorcycles for non-evacuative transportation. This limitation may be particularly important for people with special needs: a participant in Panimaché 1 shared how she and other family members waited for her father, who owns a truck, to drive them to a safe location because her sister had recently undergone surgery. He was too busy with his duties as COCODE president to do so; they ended up not evacuating.

3.4.2 Timeliness, safety, and comfort of vehicles and route

INSIVUMEH issued a first Special Bulletin (BEFGO #006–2022) on the paroxysm at 00:50 on 7 March, and their observer and others noted the first big pyroclastic flows at 12:58 p.m. (BEFGO #008–2022). The eruption had two peaks in seismic energy and PDCs, one from around 1:00 p.m. to 3:00 p.m. with PDCs in the Cenizas channel (BEFGO #010–2022) and a second one from around 7:00 p.m. to 1:00 a.m. with greater seismic energy and PDCs in the Cenizas and Las Lajas channels (BEFGO #012–2022). Seismic energy and observed activity remained elevated between the two eruptive peaks. According to interviews, Panimaché 1 began to agree to evacuation support at 4 p.m. and the first government-coordinated buses arrived at 5 p.m., provided by nearby plantations (Azúcar de Guatemala, 2022; Germán Alfaro (ICC), pers. comm.). Therefore, transportation options were available from 5 p.m., but only in Panimaché 1 and Morelia. Panimaché 2's first transportation support arrived sometime around or after 9 p.m., a volunteer firefighter flatbed truck that made two trips to shuttle interested residents to Morelia. The last bus left from Morelia with these evacuees plus others from Morelia at 11:20 p.m. Military and police support arrived to Panimaché 1 around the same time and Panimaché 1 residents we spoke with described this additional, late-night support as the reason 'all of Panimaché 1 evacuated (Table 1). The last transport arrived at evacuation centers well after midnight and possibly as late as 3 a.m. on 8 March. Figure 3 is a timeline of the eruption including INSIVUMEH and CONRED bulletins and approximate timings for the arrival of evacuation vehicles at each of the three target communities.

Participants, in particular in Panimaché 1 and Panimaché 2, shared their concern with the timing of transportation. A participant in Panimaché 1 complained that transportation was provided at the height of the eruption, rather than beforehand. The evacuation route requires fording channels prone to lahars, violent mudflows of rainfall and volcanic sediment; because there is no bridge, the route becomes impassable in poor conditions:

It is scary. Because the worst is when [a flow] starts to come down, in all the rivers, you cannot pass. You get stuck. You cannot get out. So the buses are afraid to come up here. This should be coordinated ahead of time to evacuate people. But no, when [they] hear that the turmoil is here, then they send the buses. And it should not be like that. I do not think it should be like that. Because it should be beforehand, right?

A participant in Panimaché 2 complained that the transportation came after she perceived the main threat to have passed:

[CONRED and the firefighters] arrived at 11 at night. But the worst had already passed, which were the rumbles. And it was dark because there was lots of ash. All this had already happened, and the sound [from the volcano] was slower. So then - it is very late and there was no vehicle to take us, transport us downhill. Only the firefighters.

The same women said she did not evacuate because of the timing of transportation but also because the transportation provided was insufficient for the number of people evacuating and thus unsafe:

[My husband] saw the danger, that it is very dangerous for me to go hanging onto the truck with everyone all packed in, with suitcases, with children. No. That would have had to be during the day, because at night it is very dangerous. It goes into a ditch, the truck turns over, there's nothing to hold on to. Maybe nothing will happen to me because of the volcano, but something will happen to me because we're all going together, heaped on top of each other.

BAB: What if there was more transportation?

If there had been more transportation? One bus, everyone comfortable? Let's go! That would not be dangerous.

A woman in Morelia described her misery and that of the children on the last bus to leave:

It was hard because the children were going to vomit. Not only because of the heat that gripped them . . . it is that it was super packed . . . a taxi. We went in the last bus . . . it was full of ash. Our skin and hair were white from the ash. I left with a stomach ache, with nausea. And everything was bad. . . . It took around 2 hours. We waited for it to fill, then it drove down very badly, we were barely moving.

In summary, women recalled the arduous process of evacuation on 7 March. The rugged and river-woven landscape of Fuego's flanks makes transit to and from these remote communities very difficult even in good conditions; exacerbated by darkness, ash, and heavy loads, evacuating by bus during eruption is a miserable and dangerous experience. Women may still take on this hardship when motivated to by their children's fear. However, we also learned that transportation did not arrive to some communities until after interviewees perceived the eruption as lessened. Despite women's agency and motivations to leave, transportation is a structural barrier to evacuation that they cannot overcome themselves.

4 Discussion

4.1 Impact of gendered norms on evacuation dynamics

Rural Guatemala has rigid gender norms for women and men (Ortega Ponce, 2012). As in much of Latin America, these norms dictate that women dedicate a majority of their time and effort to domestic labor and childcare, while men dedicate time and effort towards public life and paid labor (Batthyány, 2011). In 2009, men accounted for 73% of the daily hours worked for paid labor while women accounted for 74% of unpaid labor (Batthyány, 2011). Statistics from 2,000 show that women with children in the household spent almost three times as much time on domestic

labor per week than men with children. These societal norms imply that women in Guatemala are, as in many cultures worldwide, likely to be responsible for taking care of children during a crisis and more vulnerable than men to economic hardship after a disaster. Consistent with this expectation, we see cultural gender norms impacting behavior before and during evacuation in the three communities represented in this research. We find that gender is a major determinant for who is likely to be in the village during a crisis, who has authority in making decisions about whether to evacuate, and distribution of labor throughout the evacuation process. The results described above have significant implications for risk reduction strategies at Fuego and in other high-risk environments throughout Guatemala.

Women's caretaking responsibilities are the primary drivers for the gendered evacuation dynamics at Fuego volcano, though other patriarchal norms also influence evacuation outcomes. Retrospectives around the world that disaggregate data by gender document a disparity in female vs. male deaths in disasters, most commonly with the deaths of women and girls outnumbering those of men and boys (e.g., Seager, 2014). These disparities are attributed to gender norms such as norms of perceived femininity that dissuade women and girls from learning to swim, norms of virtue that prevent women from leaving a building without a male escort, and norms of labor that place women with vulnerable populations such as children in their care (e.g., Fatouros and Capetola, 2021). Oxfam International. (2005) reported that women accounted for up to 77% of deaths resulting from the 2004 Indian Ocean tsunami in some communities and that many women died because they stayed behind to look for their children and other relatives. Women are also often less likely than men to have access to warning information in many locations because of lower levels of literacy, less access to technology such as cell phones, and less access to public spaces (Seager, 2014). These are examples of how gender norms, in the absence of a comprehensive evacuation strategy, can negatively impact specific demographics during a crisis.

The approach to evacuation at Fuego volcano—albeit informal and undocumented—is to prioritize evacuation of women, children, and the elderly, moving vulnerable populations and those who care for them to safety before a rapid escape is necessary. Other places implementing tiered evacuation strategies include Japan (Japan Meteorological Agency, 2022) and Canada (Scharbach and Waldram, 2016), both of which prioritize more vulnerable populations such as those with limited mobility to evacuate first, with the rest of the population to follow at a higher level of warning. However, at Fuego there is no documented strategy for evacuating the remaining population. Instead, men, or a delegation of men, stay behind to protect property from looting and ash accumulation and to tend to livestock, common concerns for evacuees in rural volcanic settings elsewhere in the world as well (Barclay et al., 2019). This gendered division of labor significantly impacts evacuation experiences and has important implications for both short- and long-term outcomes should a disaster occur.

The strategy to leave a delegation behind leaves a significant portion of the population, and specifically the population's workforce, exposed to the threat of PDCs at Fuego volcano. Residents' claim that men will be able to escape if needed likely underestimates the reality of the environment in which they will have to run from PDCs; the flows chart unpredictable pathways at

speeds too fast to outrun or outdrive, especially on the poorly maintained roads. At night or in dark conditions it may be difficult to see PDCs, which are mostly silent, coming. Therefore, in the short term, a PDC reaching a village could mean immediate loss of many of the men within the community. The tragedy of this potential loss of lives should not be understated. In addition to this human loss, surviving adult household members in evacuation centers—women—are already the most economically disadvantaged within Guatemalan society, relying on a husband's paid labor. In the long-term, economic recovery may be hampered by scarcity of livelihoods in the high-hazard zone or, conversely, disruption of livelihoods and social networks if relocating (Bowman and Henquinet, 2015), and the new double demand of finding paid labor and undertaking the reproductive labor that women primarily shoulder (Moreno-Walton and Koenig, 2016).

While this strategy of partial evacuation at Fuego may entice people to evacuate who would not otherwise out of concern for their property, it separates family members. In a study of mothers' evacuation behavior during a 2017 hurricane in southern Florida, Brodar et al. (2020) found that keeping their family together was one of respondents' top priorities when deciding whether to evacuate. Mothers in the Florida study were less likely to evacuate if their partners were not evacuating, for instance if the partner was in an emergency response role for which they needed to stay onsite. In Saskatchewan, Canada, the tiered evacuation strategy mentioned above created hardship for already vulnerable family members who were evacuated separately from the rest of their families (Scharbach and Waldram, 2016). Women at Fuego who evacuated indicated that they worried about their male family members left behind, both because of the danger and because they, as their wives and mothers, were not there to prepare meals for them. We also heard from participants that they worked to keep their extended family groups together whether evacuating or sheltering in place. It is possible that more families at Fuego would have evacuated if the norm was for the whole family to leave, including the men.

This gendered evacuation strategy also places the burden of evacuation squarely on the shoulders of women, especially mothers. In Broder et al. (2020) study, at least one respondent acknowledged that she did not evacuate because she did not want to have to navigate the chaos of an evacuation with a child and two dogs "alone with them." In our study's three target communities, shouldering the labor of evacuation starts for women before the evacuation does. Women described gendered distribution of pre-evacuation activities, even where both men and women were available. They are primarily responsible for preparing their families for evacuation, including unnecessary work such as preparing a "72-h backpack" promoted by civil protection while they should have their needs provided for in the evacuation centers. They also take on the emotional labor of maintaining calm within a frightened household and take on the stress of their children who, like them, may be too anxious to eat. Finally, they and possibly their husbands as well concern themselves with the health of their children, though they are more likely to do so from their home while their husband and older sons may be out gathering information and advocating for their family members. By distributing labor, women may wait with their children; however, they may also be deprived of first-hand information on which to make their own assessments and their opportunity to advocate for

themselves and their families, since they are the ones who will evacuate.

Finally, in this pre-evacuation phase, gendered norms give men more authority in decision making, even as women enact those decisions. In an environment where evacuations already lag behind the timeline of the paroxysm, in part due to inefficient decision-making processes (Naismith et al., in prep), decisions (and therefore evacuation) may be further delayed where men responsible for household- and even community-level decisions are out of communication. In 2018, only 54% of the population aged 7 and older in San Pedro Yepocapa were using cell phones, compared with 83% in Guatemala City (INE, 2018). Because of the gendered labor distribution, with men likely to be engaged in paid work outside the community while women are at home with children, this is a likely scenario and one we have seen play out at Fuego already, as described in Section 3.1.

This norm of men making household- and community-level evacuation decisions is also problematic if men's risk perception is lower and/or tolerance is higher than that of the women in their community, for example, because they are not there and do not have the situational awareness or because they are confident in their abilities to take appropriate action to decrease their risk. Multiple studies point to women as more likely than men to choose to evacuate in other contexts around the world, indirectly implying a higher risk perception or lower risk tolerance. In a literature review of studies on evacuations in multiple natural hazard contexts, Thompson et al. (2017) found that risk perception was a consistent positive predictor of evacuation; in case studies on risk perception, gender is a common differentiator, with women more commonly found to have lower perceptions of preparedness and higher perceptions of risk than men. In regards to volcanic hazards, specifically, researchers have found higher risk perception in women than men in communities in Mexico (Ponce-Pacheco et al., 2021), Ecuador (Jones et al., 2013), and Italy (Barberi et al., 2008). Flynn et al. (1994) suggest sociopolitical factors such as power explain why white men sampled in the U.S. have much lower risk perceptions than white women and all other non-white participants. This may well also be the case in rural Guatemala, a highly patriarchal society (Batthyány, 2011; Ortega Ponce, 2012) where men, as we can see from the decision-making norm, are afforded more power than women. If men do have lower risk perceptions or higher risk tolerances than women around Fuego, this would imply that some women would exceed their threshold for tolerable risk while having to wait for approval from male family members and outside aid.

Still, women around Fuego are not powerless. Despite prioritization of male voices, women described large spheres of influence. They exercise agency by preparing their families and encouraging members of their extended family, neighbors, and broader community to evacuate, through dialogue and through example, including through formal roles in local civil protection groups. In Broder et al. (2020) study of mothers in Florida, 80% of evacuees reported that feeling pressure from family and friends impacted their decision to evacuate. They found only about a third of non-evacuees reported this social influence on their decision to stay. At Fuego, we know women were influenced by and influenced others in decisions both to stay and go, though it is possible that this social influence is particularly important in motivating others to evacuate. Because of tight family structures (Gibbons et al., 2021), it

is important to enable extended families and ideally communities to stay together throughout evacuation, for example, by designating an evacuation center for a single community. The influence a woman can have within a social network can be leveraged, for example, by working closely with the women in the local civil protection groups. Also, and importantly, women overcome gendered household power dynamics—or possibly leverage them—to evacuate for the sake of their children's safety. Women may prioritize their caretaking role over the norm of submissiveness to their husbands to evacuate with their children regardless of their husband's advice.

Other studies on evacuation show how women in shelters assume extra burdens while shouldering more stress (Delica, 1998). Evacuation, if not properly managed, can heavily increase women's responsibilities and isolate them precisely when they may most need their social networks (Tobin and Whiteford, 2002). Evacuation can also require women to assume more responsibility in providing financially for their families (Delica, 1998). Our findings align with this previous research, showing that women in the rural Guatemalan context take their caretaking responsibilities with them throughout the evacuation process. These include looking after the elderly (e.g., giving them medicine) and caring for children (hygiene, health, entertainment). They also take on the emotional labor of addressing their children's fear, concerns, and discomfort both before evacuation and in shelters, while managing their own, in an unfamiliar setting.

4.2 Influences on evacuation decisions

Because women are the most likely adults in their household to evacuate, exercise some agency in decision making, and have influence over other households' decisions, it is particularly important to understand what women perceive as motivating their decisions to evacuate or shelter in place. Our interviewees overwhelmingly described children as their primary motivators to evacuate, citing their children's or grandchildren's safety, health, and wellbeing as their reasons to leave. Multiple interviewees described their children's behavior, e.g., crying, as a signal to evacuate, along with or instead of the volcanic activity. Women prioritizing children's needs at Fuego makes sense culturally. Guatemala is a highly collectivist culture, which tends to value family: "Prioritizing family and child wellbeing [is] ... characteristic of Guatemalan culture, labeled as one of the most collectivist societies of the world" (Gibbons et al., 2021). Guatemalan women similarly reported prioritizing their children's development and health through the COVID-19 lockdown, and finding agency in doing so: ".women, despite living in a patriarchal culture, may feel empowered through their ability to care for and protect their children and families" (Gibbons et al., 2021). However, this prioritization of children is not unique to Guatemala and aligns with other research on evacuation decisions worldwide: Thompson et al. (2017) found in their literature review that households with children were more likely to evacuate than those without, and Brodar et al. (2020) found that, in particular, mothers with children under 7 years of age were more likely to evacuate than those with older children. As with the latter study, we found mothers evacuated not only to move their kids to safety but also to reduce their children's stress even if they felt their lives were not in danger.

Despite many of our participants' strong motivation to protect their children, evacuation numbers for the three target communities were low (Section 3.1.2). Lack of permission from male authority figures in households may be one factor influencing low evacuation numbers, though there are other factors that would compel women to stay home as well. Because women's livelihoods are more likely to be associated with their home, and their home is their domain, evacuation implies a lot at stake for them to leave. Large families with many small children are common in these communities yet difficult to mobilize; Brodar et al. (2020) found families with many children were less likely to evacuate than families with fewer children in her study of mothers in Florida. At Fuego, women with many children face the additional challenge of lack of transportation (see section 4.3, below). Finally, while some participants who evacuated opined that everyone should leave when the authorities say to, many treated the official word as optional and used it to inform, rather than to dictate, their decisions. All five participants who did not evacuate as well as many who did shared a common complaint: that the authorities failed to provide adequate and timely transportation.

4.3 Barriers to evacuation

Research participants overwhelmingly described inadequate transportation as a common barrier to evacuation. The turmoil the women experienced echoes the conflict of evacuation described at other volcanoes (Tobin and Whiteford, 2002; Goto et al., 2006), and transportation is recognized as a structural barrier to timely evacuation globally (Lazo et al., 2015; Barclay et al., 2019). At Fuego, previous work that surveyed residents¹ about future evacuation behavior found lack of transportation to be a major concern (Escobar Wolf, 2013). As described in section 3.4.1, few households in these three communities have their own vehicles. Private vehicles are most commonly motorcycles, not trucks, and access requires four-wheel drive. In future eruptions of Fuego, people at risk will continue to require outside transportation to evacuate.

Factors affecting interviewees' perceived safety of transportation for the evacuation on 7–8 March included daytime vs. nighttime travel, drivers who know the area, and uncrowded vehicles. Some interviewees shared that they were motivated to evacuate on the last bus because they knew it was their last opportunity to leave; they also discussed the discomfort of the overcrowded trip. Despite the hardships of evacuating, for many women this was not the first time they evacuated, and many said they would evacuate again. This speaks to the strength of desire to leave for those who evacuated (e.g., for the sake of their children, Section 4.2) but also points to the importance of considering needs of safety and comfort for future evacuations. Women we talked with about the March 2022 evacuation compared their experience with shelter conditions in previous evacuations, on the whole speaking much more favorably about the more recent conditions. Other

people we talked with outside this set of interviews conveyed that negative past experiences with evacuation deters them from future evacuations. This concern for evacuation conditions is a common concern for evacuees relying on government shelters (e.g., Barclay et al., 2019). More families may evacuate if they know shelter experiences will be safe, comfortable, and provide for at least their basic needs.

Outside transportation was slow to arrive on 7 March, arriving after some residents perceived that Fuego had quietened (e.g., Panimaché 2, section 3.4.2). Effective emergency response plans must include the time needed to execute the plan so that evacuees have left a high-hazard zone before eruptive hazards arrive (Marrero et al., 2013). This is particularly pertinent at Fuego: "An evacuation plan should . . . take into account . . . the population lacking the means of self-transport and living in areas of difficult access for the evacuation vehicles. The effect of this group on the evacuation time is significant. To minimize the evacuation time, this population must be evacuated in advance of the rest, or at least re-located as early as possible to more accessible areas" (Marrero et al., 2013 (pg. 976)). The women we spoke to are aware of this (section 3.4.2). However, evacuations on 7 March happened after one of two eruptive climaxes. This could mean that in future eruptions, evacuation might be undertaken at climax when lahars are already descending channels, with the consequence that evacuees either undertake enormous risk in attempting a crossing or have to turn back (Naismith et al., in prep; this paper, section 3.4.2). The consequences of transportation arriving late in future eruptions of Fuego is that women may be disinclined to evacuate for several reasons: the increased risk from crossing channels, or the belief that an eruption is declining. Pyroclastic flows can descend late in a paroxysm, so the risk of staying at home remains high. Timely arrival of transportation would avoid the "between a rock and a hard place" difficulty that women face in choosing whether to stay or go.

Women's experiences of transportation on 7 March show the hard choices they face between conflicting responsibilities during a crisis. Responsibilities related to local civic groups may conflict with family responsibilities. In Panimaché 1, a family relying on the father to drive them to safety was not able to evacuate because of his role in local governance. Because of a medical issue, they were not able to leave by bus; however, when he came home to drive them he was called back up to lead. This one case highlights multiple issues: That residents are taxed by multiple and sometimes conflicting responsibilities in crisis; families evacuate together, often as all or none; special needs such as medical issues may not be addressed in current evacuation plans; transportation is important and scarce; and that even when private transportation is available, women do not know how to drive the vehicles. These issues impact primarily women and the dependents who evacuate with them.

5 Implications

Our findings have critical implications for risk reduction practices at Fuego volcano and for other environments

¹ 155 residents, both men and women, surveyed in 8 communities around Fuego in 2011.

requiring evacuation. Women's responsibility for reproductive labor drives evacuation strategies and determines women's experiences in evacuation, as they act out their caretaking role throughout the evacuation process. The women we talked with prepare their families for evacuation, have networks of influence despite limited agency in evacuation decision-making, are highly driven by the need to protect their children, and look out for their families in evacuation shelters. Communication and evacuation strategies addressing women's concerns and leveraging their strengths can impact up to $\frac{3}{4}$ of a community's populations, since women evacuate with the children and elderly in their family networks while men, for the most part, stay behind to protect property.

Because women are more likely than men to be present in a community during the onset of a crisis, information must be assured to reach them through direct channels. We hope the prominent themes identified through this study, most notably concern for the health (e.g., respiratory) and wellbeing (e.g., basic needs and emotional wellbeing) of young children as a primary motivator of women's actions, can serve to inform future messaging about risk reduction. Information about the timing and condition of transportation and evacuation centers is also critical to inform evacuation decisions. We ask: whether more of the population would evacuate if women had more autonomy and agency in decision-making processes at both the community and household levels; had adequate and timely transportation; were assured they would be in the same evacuation center as the rest of their community; and knew the government would address their family's needs in the evacuation shelters. Decision-making may be facilitated by encouraging families to discuss how they will decide whether to evacuate if male partners are gone, so that women may enact these decisions on behalf of both parents without threatening household and community dynamics.

We suggest that women's concerns should be prioritized in the development of any early warning system or other evacuation strategies, including any criteria on which evacuation will be based, to assure that the members of these communities most likely to be affected by evacuations and with the most responsibility for others have their needs addressed. Involving women more closely in risk reduction strategy, development, and implementation is an important step toward improving DRR at Fuego and in line with commitments agreed to in the Hyogo and Sendai frameworks. However, this involvement must be approached carefully so as not to impinge on their family responsibilities during a crisis; the same applies for men. [Clissold et al. \(2020\)](#) recommend that DRR efforts that resource women's strengths must also include efforts to improve women's wellbeing, agency, livelihoods, and prospects.

Finally, we note that the norm that men stay behind to protect property and the assumption that they will be able to escape the danger of pyroclastic density currents on foot leaves the male population exposed to a threat that is fast and unpredictable, in turn leaving their evacuated families exposed to long-term hardships as survivors. Future efforts to strengthen DRR at Fuego could challenge any norms deterring men from evacuating and recognize more explicitly the dual value of life

and livelihood by including strategies that more explicitly address livelihood concerns without requiring residents' presence. Examples of this might be emergency personnel that stay throughout the entirety of evacuation, or a local evacuation shelter for each community that can sustain only a small number of residents. Addressing these challenges will require working with a diverse representation of residents to agree on strategies that address their concerns, that they are motivated to enact, and that enable safe evacuations of as much of the population as possible.

Data availability statement

The datasets presented in this article are not readily available because per our IRB approval for human subjects research, we cannot provide a full dataset to researchers outside the approved research team as interviews, even with names removed, may contain identifiable information. Requests to access the datasets should be directed to bbartel@mtu.edu.

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board (IRB) approval 1760726-2 from Michigan Technological University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

BB led the research process but both BB and AN fully contributed to each component, including collecting the interview data as described above, revising and coding transcripts, interpreting results, and writing and revising this manuscript. AN produced [Figures 1 and 3](#). All authors contributed to the article and approved the submitted version.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feart.2023.1172867/full#supplementary-material>

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