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Beyond cost: Exploring fuel choices and the socio-cultural dynamics of liquefied petroleum gas stove adoption in Peru

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Abstract

Reducing the burden of household air pollution requires that cleaner fuels such as liquefied petroleum gas (LPG) be used nearly exclusively. However, exclusive adoption has been challenging in low- and middle-income countries. Previous studies have found that economic, social, and cultural barriers often impede adoption. We conducted in-depth qualitative interviews

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with 22 participants in a research trial where LPG was provided for free in Puno, Peru. We aimed to determine whether social and cultural barriers to LPG use persisted when monetary costs to the household were removed, and what factors influenced exclusive adoption of LPG in a cost-free context. Facilitators of LPG use included: support from study staff, family support, time savings, previous experience with LPG, stove design, ability to use existing pots, smoke reductions, desire for cleanliness, removal of traditional stoves, and perceptions of luck. Barriers to LPG use included: fears of LPG, problems with LPG brands, delays in obtaining LPG refills, social pressure, perceived incompatibility of traditional dishes, perceived inability to use clay pots, separate kitchens for LPG and traditional stoves, designated pots for use on the traditional stove, and lack of heat. However, these barriers did not prevent participants from using LPG nearly exclusively. Results suggest that social and cultural barriers to exclusive LPG use can be overcome when LPG stoves and fuel are provided for free and supplemented with behavioral support. Governments should evaluate the economic feasibility and sustainability of LPG subsidization, considering the potential benefits of exclusive LPG use.

Keywords

clean cookstoves; qualitative research; behavior change; household energy; household air pollution; Peru

Introduction

Household air pollution (HAP) is the leading environmental cause of premature death and disability in low- and middle-income countries (LMICs) [1]. One of the main contributors to HAP is the indoor burning of solid fuels such as wood, dung, and crop residues in open fires or traditional stoves. In 2017, the Global Burden of Disease study attributed 1.6 million premature deaths and 60 million disability-adjusted life years to HAP exposure [2]. Among women in LMICs, HAP is the fifth leading risk factor for premature death, likely due to the fact that women are responsible for most cooking, which keeps them in closer proximity to HAP for longer periods of time than men [1–3].

Reducing the burden of HAP could be achieved by adoption of cleaner-burning fuels such as liquefied petroleum gas (LPG), electricity, ethanol, and biogas [4]. Estimates indicate that if cleaner fuels such as these are used for the majority of cooking, indoor concentrations of pollutants such as fine particulate matter (PM_{2.5}) and carbon monoxide (CO) can be reduced to levels recommended by the World Health Organization (WHO) [5,6]. Modeling suggests that a biomass stove used for more than one hour per week can produce pollutant levels that exceed the WHO annual concentration interim target of 35 µg/m³ [5]. Thus, households must use cleaner-burning fuels nearly exclusively to meet the target.

Most previous efforts to promote transitions from cooking with solid fuel to clean cooking have been unsuccessful in achieving the near-exclusive use necessary for health improvements [7]. Stove stacking, in which households continue to use a biomass stove for some cooking tasks even after obtaining a clean stove, is observed universally [7,8]. Previously identified reasons for stove stacking include preference for the taste of food cooked on traditional stoves, resistance from key household decision-makers such as

husbands and mothers-in-law, inability of LPG stoves to produce the same level of heat as traditional stoves, fears about the safety of LPG stoves and tanks, and the inability to cook some traditional foods with LPG [8]. One of the biggest barriers to LPG use is cost [8]. LPG adoption is hampered by the cost of purchasing the LPG cooking equipment, as well as the costs of LPG refills and travel required to obtain refills, especially in poorer and remote rural areas [8–10].

Most studies that have investigated LPG adoption have been carried out in contexts where participants had to pay for LPG refills [11–16]. Little is known about whether cultural barriers and negative perceptions of LPG continue to impede LPG adoption when the costs of LPG stove equipment and refills are removed. Our study sought to explore LPG adoption and use through an in-depth qualitative analysis of the factors influencing exclusive LPG use in a research context where both the LPG stove and LPG fuel refills were free. This study aimed to provide a unique understanding of how the commonly reported social and cultural barriers to LPG adoption and use operated when economic barriers were removed.

Methods

Study Setting

This study was carried out in Puno, Peru, which is 3,825 meters above sea level and has year-round low temperatures. Most people speak Aymara as their first language, and Spanish secondarily. The majority of households in rural Puno cook with wood, dung, and crop residues over a traditional stove (*fogón*) (Figure 1). The most common occupations of Puno residents are farming, raising livestock, and selling products such as household goods, agricultural yields, and prepared food or beverages. Cooking is usually done by women, once in the morning and once in the evening, in an indoor kitchen that is separate from the main living area (Figure 2).

The Peruvian government is currently operating a program called the *Fondo de Inclusión Social Energético* (FISE, Energy Social Inclusion Fund), which provides vouchers to poor families to subsidize the cost of LPG [17]. Additionally, a previous program called *Cocinas Peru* (Peru Stoves) provided a free two-burner LPG stove, LPG tank, and accessories to poor families from 2013–2016 [17]. Because of these programs, knowledge and penetration of LPG stoves was widespread in Puno prior to the current study.

Cardiopulmonary outcomes and Household Air Pollution (CHAP) Trial

This study was conducted with a sub-sample of participants from the Cardiopulmonary outcomes and Household Air Pollution (CHAP) trial (NCT02994680) [18]. The details of the CHAP trial are described elsewhere [19]. Briefly, CHAP aimed to test the impact of sustained use of LPG stoves on household air pollution and cardiopulmonary health compared to traditional stove use. The trial enrolled 180 non-pregnant, female primary cooks (aged 25–64 years) who cooked indoors with biomass daily between January 2017 and February 2018 [19].

After completing baseline measurements, approximately 15 women were randomized each month for 12 months, half to intervention and half to control arms. Intervention participants

(n=90) received a free three-burner LPG stove produced locally for the CHAP trial, a 10 kilogram (kg) LPG tank, tank valve, and hose (Figure 3). Before receiving their LPG equipment, all women in the intervention group participated in a cooking demonstration that included a review of the benefits of LPG compared to biomass fuel, training on how to safely operate the LPG stove, and hands-on practice cooking a traditional dish with LPG. Intervention households also received 12 months of free LPG fuel delivered to their household as needed. Three field workers delivered LPG tanks when participants called for refills. The field workers also tracked when deliveries were made and visited households who were likely overdue for a refill. When participants still had a small amount of LPG in their tank, the field workers sometimes left a second tank with the household for them to change themselves. As part of the LPG delivery, field workers removed and installed the tanks, and checked for leaks or problems. Control participants continued with their baseline cooking practices for the first year of the study.

Field workers placed stove use monitors (SUMs; LabJack© Digit-TL temperature sensors [20]) on traditional and LPG stoves in both intervention and control households. We monitored stove use with temperature data from the SUMs continuously over the entire 12-month study period [19]. Field workers informed participants that the SUMs would monitor temperatures in their kitchens, however many participants realized over time that the field workers could use the information on the devices to determine which stoves they used.

Qualitative Component of CHAP

We conducted 22 in-depth, semi-structured qualitative interviews with women from the intervention group of the CHAP trial (Table 1). We chose interviews as opposed to focus groups because women in Puno are shy and hesitant to talk openly in large groups, participants lived far apart, and interviews were tailored based on specific participant characteristics. We arrived at our sample size by recruiting women until we reached thematic saturation, when similar themes were emerging across interviews with little to no new information in subsequent interviews [21]. Women were purposively selected to ensure a mix of exclusive and non-exclusive LPG users based on SUMs data available at the time of the interview, from those who: 1) expressed willingness to participate in an in-depth interview, 2) indicated ability to express thoughts and opinions in detail based on previous interactions with field workers, and 3) represented a wide range of opinions and characteristics based on field worker observations.

The research investigators [KNW and SAH] trained one local field worker who was fluent in Aymara and Spanish to conduct the interviews. Topics included general opinions of the LPG stove, barriers and motivators to LPG use, perceptions of food preparation using LPG, recall and opinions about the behavioral strategies delivered through the study, family reactions to LPG, and the influence of the stove use monitoring devices on cooking behavior. The interview guide is available in Appendix A. The field worker conducted interviews between 3 and 11 months after LPG stove delivery to ensure a range in experience with the LPG stove.

Interviews of approximately 30–90 minutes took place in participant homes or a location preferred by the participant. The field worker conducted interviews in Aymara or Spanish

according to the participant's preference and recorded the interviews using a Sony digital voice recorder. A professional transcriptionist bi-lingual in Spanish and Aymara transcribed the recordings into Spanish. The research investigators bi-lingual in Spanish and English translated the transcripts to English for analysis. One of the research investigators [KNW] observed and took written notes on each interview to document contextual elements and non-verbal cues.

Qualitative Analysis

The first author reviewed all transcriptions and documented important themes arising from each in memos, as described by Birks et al. [22]. She then reviewed the memos with the last author to create a master list of inductively identified themes. Using these themes, the first author coded each transcript in Atlas.ti version 8 [23]. The last author reviewed the coded quotes and confirmed or updated assigned codes. Using the coded quotes, all authors discussed how each theme operated as a barrier and/or motivator to LPG use, and explored relationships within and across themes to understand potential interactions.

Results

Selection of Qualitative Interview Participants

Table 1 shows the characteristics of interview participants. Within the overall CHAP study, SUMs data indicated that 51% of intervention participants (46 of 90) used the LPG stove exclusively and 49% (44 of 90) used LPG for between 86–99% of cooking minutes. We selected 12 of the non-exclusive LPG users and 10 of the exclusive LPG users to participate in qualitative interviews.

Qualitative Findings

The following sections highlight important themes that emerged from qualitative interviews on conditions that motivated occasional use of the traditional stove and factors that promoted near-exclusive LPG use. Themes and illustrative quotes are summarized in Table 2.

Fear—Many women expressed fears about lighting the LPG stove and adjusting the heat, because the stove knobs were sensitive and often caused a burst of flame when turned on too high. Additionally, almost all interviewed women said they were afraid to change the LPG tank because they could improperly connect the hose and cause a gas leak. Others were afraid they could cause a gas leak by opening the LPG tank valve too much or forgetting to close the tank valve or the stove knobs. A few women were afraid because they had been burned by the LPG stove, for example when cleaning the stove before it cooled, when lighting the stove, or by overflowing pots. Many did not want their children to use or be near the LPG stove because of these fears.

“I have a young son [age 13] and I told him you are not going to turn it on... It lights strong, it makes a strong flame when it lights. You are not going to light it I tell him.” (Participant V)

Many people mentioned they heard rumors or stories about LPG tank explosions or fires that happened in other places. Although they never directly observed these accidents, the stories

instilled fear that their LPG tanks could explode or gas leaks could start a fire. Some women reported fears that things in their kitchen could catch on fire; one family asked for a fire extinguisher as a precaution. However, women reported continuing to use their LPG stove despite these rumors because they never directly experienced any severe accidents.

“Many people talk in the city, they say it burns you, for this reason sometimes we had fear. But when we use [the gas stove], it is just normal, just calm.” (Participant B)

In general, fears of LPG did not prevent use of the LPG stove. Both exclusive LPG users and occasional *fogón* users reported some fears about cooking with LPG. Certain fears, such as changing the LPG tank, also persisted even after participants owned the LPG stove for some time.

Brand—The study used several different LPG distributors, who each supplied tanks with distinct colors and markings. Nearly all participants reported negative perceptions of the orange LPG tanks, which were perceived to not last as long, be more prone to gas leaks, and produce flames that were harder to regulate. Perceptions of orange tanks made some participants reluctant or afraid to cook with LPG. Although most women continued to use the LPG stove despite the brand, some women described using their traditional stove when they were experiencing problems with a certain brand.

“Because of that [leak from the orange gas tank], I cooked outside... The kitchen smelled very strong... it scared me... I kept smelling it in the places where I brought my sheep to pasture, and half foolish like a drunk person I was shepherding the sheep.” (Participant D)

Family Support—Women who had supportive family members were able to ask for help from their husbands or children, which facilitated their continued use of LPG even when they were afraid or encountered problems with the LPG stove. Older children often helped women learn how to use the LPG stove, and helped their mothers operate it until they learned to use it on their own. Often women were reluctant to adopt LPG or wanted to go back to their *fogón* when they had problems with their LPG stove, but their children and husbands encouraged them to cook with LPG. However, if women were alone when a problem occurred, some resorted to their traditional stove.

“When my gas runs out, I’m afraid. Only my son changes [the tank], or my husband. If they are not here I don’t change it... I cook outside [with dung].” (Participant V)

Women whose family and friends approved of the LPG stove had fewer challenges using LPG than women whose family and friends were less supportive. Women whose family members were less supportive of LPG were more likely to report using the *fogón* at times.

“[My kids] are already tired [of gas] because in Ilave [a nearby urban town] they cook exclusively with gas... When they come to the countryside... they cook outside on the fogón... They say the food is delicious [on the fogón].” (Participant C)

Support and Education from Field Workers—Many women appreciated that the cooking demonstration helped them learn about the benefits of and feel comfortable using LPG, especially those who had not used an LPG stove before.

“They taught us how to open and close the gas tank... I never knew [gas] is better... It would have been different if they had given us the stove without teaching us, we wouldn't have known how to turn it on or off. It's good they have taught us better. Since that day I learned to cook and care for the stove because they taught us.” (Participant L)

After using the LPG stove in their own homes, women were able to see the benefits of LPG described in the demonstration for themselves. They reported being cleaner, having more free time, and not being bothered by smoke anymore. Although the cooking demonstration was successful in showing women that food cooked with LPG tastes delicious, many said that since they did not know the specific recipes used at the demonstration, they would not be able to prepare the same food themselves.

“We are here we don't leave, we don't know how to prepare other food. Because of that ... we invented quinoa and barley soup. We make up things like that. It would have been nice to have recipes.” (Participant F)

The participants developed relationships with the field workers, who visited several times per month to deliver LPG and address any problems with the stove or tanks. Women appreciated the safety advice they received, such as how to check for gas leaks and handle the tank properly. This support from the field workers reassured the participants and decreased their fears about using LPG.

Social Influences—Women in the study reported a strong desire to please the field workers. When delivering gas, the field workers asked questions of participants to confirm that the LPG was being used only for the family's needs and not shared with people in other households. However, because of this questioning, some women reported feeling that they used the LPG too quickly. Not wanting to displease the field workers, some women tried not to call for an LPG delivery when their LPG ran out more quickly than what was normal for them. If the LPG tank ran out quickly, some women cooked with a traditional stove until they believed it would be acceptable to call.

“[Our gas] seems to run out in 15 days... As we are only two people, if it doesn't last that long, [the field workers] ask why it ran out so quickly. When it runs out [early]... sometimes I cook with my own gas stove, sometimes outside... with dung.” (Participant D)

Additionally, women knew from the field workers that they were not supposed to use the *fogón* and that the SUMs would record if they did. To avoid displeasing the field workers, women sometimes cooked outside on an unmonitored makeshift biomass stove when they were not able to use their LPG stove.

“They told me not to cook [on the fogón]. It's very clear when we cook on the fogón because that device [SUM] that is hung there will capture us... For that I cook outside.” (Participant J)

Because intervention participants met each other at the cooking demonstrations, the research team expected that they would communicate and support each other to use LPG throughout the year. However, most intervention participants said they did not talk to other participants because they wanted to avoid the control participants who they thought would be angry and jealous. Some women who did talk to others reported feeling social pressure to avoid wasting LPG.

“I consume [the gas], for that I have fear. I use two tanks per month, it’s too much. Another woman who was also randomized to gas told me ‘I am making [one tank of gas] last a month.’” (Participant I)

Overall, participants reported leading solitary lives with little social interaction. They said daily chores such as cooking, taking animals to pasture, tending the fields, and collecting fuel are usually done alone.

“I don’t talk with anybody. My neighbors are far away, and that neighbor is in the field. I am alone here... There is no time to find each other.” (Participant C)

Perceptions of Luck—The randomization of households to the LPG or control group was based on a lottery with the 15 participants enrolled each month. Participants selected an envelope from a pile that was approximately half LPG and half control. Because of this lottery process, the participants who chose the LPG group expressed a feeling of luck. This instilled a sense that the LPG stove was a highly coveted item that should be used and valued if received.

“We have been lucky, we have to enjoy it my husband tells me.” (Participant I)

Previous Experience with LPG—Many women who did not have experience with LPG were afraid of the LPG stove at first, while those with experience were able to adopt it more quickly and easily. However, those who had previously owned an LPG stove also mentioned that they had handled the stove and LPG tank in ways that the study advised against.

“Before when I was buying gas... when the gas ran out... I turned the tank upside down... I laid it on its side. I heated it over the fire of the gas stove burner... And there was a little more gas... Now I don’t do that. In the training they said it is dangerous.” (Participant U)

Women who previously owned LPG stoves also reported greater satisfaction with the trial stove. Most of their previous LPG stoves had two burners and a weak flame (“*like a cigarette lighter*,” Participant A), which made the trial stove with three burners and a strong flame appear superior. Some women also said their LPG tanks lasted longer with the trial stove and that the flame was easier to regulate.

Stove Design—Participants noted that the three-burner stove distributed by the study was more practical for their needs because their *fogón* also had three burners. Women reported that they need three burners in the morning when they typically prepare tea, soup for breakfast, lunch to bring with them to the field, and animal food. However, most participants mentioned that even with three burners, the study stove was not sufficient to cook for a party.

“When a lot of people come, we cook outside... We arrange clay bricks [into a stove]... I have to use big pots... they can't fit on the [gas stove], they're too big” (Participant T)

Traditional Dishes—Some women said they are not able to cook certain traditional dishes and staple foods with LPG. For example, women reported that they could not toast grains without burning them on the LPG stove. Others said they could not make *quispiño*, steamed bread made from quinoa flour, with LPG. Some women learned to make *quispiño* with LPG and found that it tasted normal, while others either never tried or thought it would not taste the same.

“You can cook everything on the gas stove... I have made *quispiño*... It is delicious [with gas]... It tastes the same [as with the *fogón*].” (Participant C)

Some participants reported that they used the *fogón* occasionally when they wanted to make a dish that they believed could not be made with LPG. Others either stopped making the dishes that could not be prepared with LPG, transitioned to making those dishes with LPG, or received food prepared with a *fogón* from their neighbors. Most people reported that almost everything could be prepared equally with LPG, but some still believed certain dishes were more delicious when cooked with the *fogón*. However, although some people thought the food cooked with LPG was less delicious, they still used primarily LPG because of the smoke reductions. Other participants reported that they actually preferred the taste of food cooked with LPG.

“[With gas] the smoke doesn't enter the food. Now I am cooking with gas and it's cleaner, it doesn't have the smell of smoke.” (Participant G)

Pot Preference—Participants also explained that certain foods, such as *quispiño*, fava beans, soups, and quinoa, are more delicious when cooked in a clay pot. Clay pots were also reported to stay warmer for longer than aluminum ones. Although clay pots could be used with LPG as shown during the cooking demonstration, women said they did not have access to the flat-bottomed clay pots required for the LPG stove. They also explained that even with proper care and regular greasing, clay pots break more quickly when used with LPG compared to the *fogón*. As a result, some women avoided preparing specific dishes that were believed to come out better in clay pots or used their *fogón* to prepare them. However, several women did use clay pots on the LPG stove to prepare specific dishes.

“The clay pots could break on the gas stove... But in the tin pots the food is different. In my [clay] pots the food is delicious.” (Participant D)

All participants said they had previously used aluminum pots on the *fogón*, and thus transitioned easily to using the same pots with LPG. However, some women did not want to use their stained aluminum pots from the *fogón* on the LPG stove to avoid dirtying their hands, the stove, or the food. These pots were sometimes washed to remove the char, or replaced with new aluminum pots that were only used on the LPG stove. Once clean, participants did not want to use the clean pots on the *fogón* to avoid dirtying them again.

“I had pots of clay... and aluminum. But those I don’t use [on the gas stove] because they are stained... I bought others for the gas stove... The black pots would ruin the gas stove.” (Participant V)

Valuation of LPG—Although women did not pay for their LPG stove or fuel, they showed high appreciation and value for the stove. All participants would keep their LPG stove and tank at the end of the trial, but many were concerned that the field workers would reclaim the LPG equipment. Women said they valued their LPG stove and did not want to go back to the *fogón*.

“If you will take it away, I say I am going to buy one for myself... I have already become accustomed to gas.” (Participant L)

Availability of Traditional Stove—After receiving their LPG stove, some women destroyed their *fogón* completely and others moved their *fogón* intact into storage. People who removed their traditional stove from their kitchen reported less temptation to use biomass. Women whose traditional stoves remained in the kitchen said they were more easily able to use it on occasion.

“You don’t need [the fogón] they say. If I am going to have this fogón I am going to want to cook on it when I run out of gas... I already removed the fogón completely... I broke it.” (Participant G)

Installation Location—Women who had space said they preferred to install their LPG stove in an extra room instead of in the kitchen with the *fogón*, to take advantage of the cleanliness of LPG. However, these women said they maintained a separate kitchen where they could continue cooking with the *fogón* on occasion without spoiling their clean LPG kitchen. Many women who did not have an extra room said they cleaned the ashes from the roof and walls of their *fogón* kitchen after receiving their LPG stove. Some said they installed new aluminum roofs in place of their ash-covered, leaky thatch roofs or old aluminum roofs that had holes from the *fogón* smoke. Although these women reported that they no longer cooked with the *fogón* in their remodeled kitchens to avoid dirtying them, when they needed to cook with biomass they created a makeshift stove outside.

“We cook outside... We don’t cook inside [with the fogón]; it could stain and smoke [the kitchen]. I have cleaned out all of the stain. But if we keep cooking there it would keep smoking and the ashes would continue falling.” (Participant C)

Additionally, many women did not like that the LPG stove had to be installed on a high table above the LPG tank for safety, as they were accustomed to cooking seated on the floor with the *fogón*.

“That table is uncomfortable, but the young man insisted. ‘Can I put it on the ground?’ [I asked him]. It’s that I prefer to be seated, because I get tired standing... I’m used to sitting when I cook with the fogón... I’ve become accustomed little by little [to standing with the gas stove], but I always get tired when I cook a lot.” (Participant V)

Space Heating—Although many women reported that they are colder when cooking with LPG compared to the *fogón*, they prefer LPG because there is less smoke. To compensate, they wear more layers, drink hot tea, and heat water for bathing and washing. Some women said they are actually warmer with LPG because they can close the windows and doors of the kitchen since there is no smoke to ventilate. Also women said the aluminum roofs that can be used with LPG keep the kitchen warmer than thatch roofs or old aluminum roofs with holes. LPG is also more comfortable to use at mid-day when the sun is strong and additional heat from the *fogón* is not desired.

“[With the *fogón*], the door is always open, because it smells like smoke. Now with gas I can close the door and it’s normal... It is not cold.” (Participant I)

Delivery Delays—Difficulty with the timely delivery of LPG was one of the main reasons that women continued to occasionally use the *fogón*. Many participants did not know when their tank was low and thus did not call until they had only a few minutes of fuel remaining.

“I see that the gas is low when the flame gets weak. The flame says, ‘Tin tin tin,’ and then I call for gas. Already there is no more gas. I lift the tank and it is empty... We have to wait.” (Participant G)

Some women called for a refill based on their knowledge of how many days their LPG tanks usually lasted. This strategy worked well when cooking behaviors were normal, but not when cooking was unusual or different. Calling itself was challenging for some women who had poor or non-existent cell service around their house, or lacked access to a cell phone.

Field workers were not able to make deliveries at night because the rural roads were dangerous: muddy, icy, filled with holes, and dark. In these cases, LPG was usually delivered early the next morning, but was not available for the evening meal.

“In the evening, my gas ran out, I was just able to boil some tea... [In the morning], I remained without breakfast. I thought about cooking with my *fogón*, but I waited a little while longer... I waited without eating until the gas delivery staff arrived.” (Participant H)

When an LPG tank ran out in the middle of cooking or was not delivered in time to prepare a meal, some women cooked with their *fogón* or in a makeshift stove constructed outside. Others used their neighbor’s stove. Some women had their own back-up LPG tank that they attached to the trial stove, or used their own LPG stove and tank.

“When the gas runs out... sometimes I cook with my own gas and sometimes I cook outside with dung. Sometimes it runs out when we are in the middle of cooking and things are half cooked – what do we do?” (Participant D)

Discussion

These results highlight the reasons why near-exclusive use of LPG was high when economic barriers were removed, despite the fact that women still reported some negative perceptions and challenges with LPG use. Women were able to overcome other social and cultural barriers to successfully use LPG nearly exclusively when fuel was provided for free and

accompanied by other programmatic strategies such as home delivery and intensive maintenance and usage support. Our findings align with other studies that have found cost to be the biggest barrier to adoption of cleaner fuels and suggest that high LPG adoption can be achieved if costs are removed [9,10,24,25].

Other implementation factors were also important for achieving near-exclusive LPG adoption. Although almost all women reported some fear of LPG, initial and ongoing support from both field workers and family members enabled women to continue using LPG despite their fears. Participants described the initial cooking demonstration as important for helping them learn how to use the LPG stove, but most needed further reinforcement on stove use in their home. Other studies have similarly found that after-sales support is vital to sustained use of clean cooking technologies [26].

Receiving the LPG stove and fuel for free likely contributed to the willingness of women to adjust to LPG over time, including standing to cook, adapting to the flavor of food, and overcoming initial fears. If women had to pay for their own LPG, these initial discomforts may have triggered abandonment of LPG, or prevented purchase of an LPG stove in the first place. Although some have argued that a monetary investment is necessary for people to value and use a product [27], other research has shown that a product too highly valued may not be used out of a desire to preserve it [15]. Thus, the fact that our participants did not pay for the stove, yet felt lucky to receive it, may have actually increased usage.

Additionally, a delicate balance must be struck between preventing families from using more than the minimum amount of LPG needed vs. ensuring they get enough fuel for exclusive use. The provision of free fuel could lead to over-use as observed in India [25]. However, an insufficient subsidy could lead to stacking with traditional stoves in an attempt to ration LPG to reduce costs [9,17,24]. As we observed in our study, social perceptions around the acceptable rate of LPG use may lead some people to continue using their traditional stove to comply with perceived social norms around LPG consumption. More evidence on the quantity of LPG required to support exclusive use and how to strike a balance between removing cost as a barrier and encouraging wasteful LPG use is needed.

Peer-to-peer social interactions did not seem to affect LPG adoption among our study participants. Some participants avoided certain social situations for fear that others would be jealous of their LPG stove, as was also found by Thompson et al. [12]. However, because most households were far apart [19] and women did not describe frequent communication with neighbors, the need to avoid these social interactions was not a major deterrent to LPG adoption in our population. In general, adoption of LPG may have been facilitated by the fact that women in Puno generally reported cooking and collecting fuel alone, thus they were not losing a social opportunity by reducing those practices. This contrasts with a study from Guatemala where participants reported collecting biomass fuel in groups and enjoying this time [15]. Further research on how limited social interactions may impact community diffusion of clean cooking technologies is needed.

Because the trial-provided LPG stove was perceived as noticeably better than previous LPG stoves available in the region, women were likely more satisfied with the stove than if they

had been completely unfamiliar with LPG. This provides evidence that experience with cleaner stoves, even if initial models are problematic, can facilitate transition up the energy ladder (i.e. replacement of current stoves with new and better models as technologies develop) [28]. However, this could be different when households are paying for their own stove. They might not be as willing to pay for a new technology after a bad experience with a previous version.

As frequently reported in other studies, participants in our study also described several traditional dishes and cooking tasks that they said could not be done with LPG [11,24]. However, because some participants were able to adjust to dishes prepared with LPG and many were open to trying new recipes, people could learn to integrate new or slightly different LPG dishes into their daily routine. The trade off in flavor may be acceptable in exchange for other LPG benefits such as reduced smoke, faster cooking, and increased cleanliness. Some even preferred that food did not taste like smoke, as was also found in Ghana [14].

Even if some tasks are never transitioned away from biomass stoves (such as cooking outdoors for parties, or occasionally preparing certain traditional foods), these infrequent tasks could be integrated into a primarily clean cooking routine. As highlighted by Ruiz-Mercado, meeting the full repertoire of cooking needs requires a range of different devices, thus one LPG stove is unlikely to satisfy all cooking needs and we must accept that certain infrequent tasks could continue with biomass [29].

Implications and Application of Findings

Our findings suggest several strategies that could be applied by LPG promotion programs both in Peru and globally to increase exclusive LPG adoption. The importance of family support suggests that all household members, including men, should be involved in trainings and LPG promotion, as also reported elsewhere [12,15]. However, involvement of family should not replace the importance of instilling self-efficacy in primary cooks so they can handle the LPG stove when they are alone.

Additionally, participants' strong desire to please field workers by using LPG exclusively suggests that promoting abandonment of traditional stoves could generate social desirability to comply. Training on how to prepare traditional dishes or complete tasks such as toasting with LPG could also decrease continued traditional stove use. Increasing access to flat-bottomed clay pots that could be sustainably used with LPG could improve people's ability to cook dishes they prefer to make in clay pots with LPG.

As participants frequently mentioned cleanliness as a benefit of LPG, encouraging women to clean or discard their *fogón* pots and install the LPG stove in the same *fogón* kitchen after cleaning it could demotivate continued traditional stove use. Similarly, removing the *fogón* completely could reduce temptation for continued use, as was also found in Guatemala and India [12,25]. Additionally, to increase comfort while using the LPG stove among women who are accustomed to sitting while cooking, stools could be provided with the stove. To compensate for the lack of heat from LPG stoves, which is frequently reported as a barrier to LPG adoption in cold settings [10], promotion efforts could encourage women to use more

layers, close windows and doors (if there is another source of ventilation), or heat water to stay warm.

Given the challenges with monitoring LPG use and making timely deliveries, programs could provide households with weight scales, flow meters, or pressure gauges to help people better predict when they need a refill, as was also suggested in Cameroon [9]. Families could also maintain two LPG tanks, connecting the second tank as soon as the first runs out, thus giving them more time to refill the empty tank. This strategy was seen as valuable in India, where 85% of participants paid to keep a second LPG cylinder after completing a trial [25].

Strengths and Limitations

Basing our qualitative study within a research context in which LPG stoves and fuel were provided for free and fuel was delivered directly to participants allowed us to concentrate more explicitly on the social and cultural influencers of LPG use when economic barriers were removed. Interviewing participants with whom field workers already had an established relationship increased trust between the interviewees and the interviewer, thus increasing the depth and quality of information participants shared in the interviews. Given the semi-structured nature of our qualitative investigation, we were able to adapt interviews to probe more in-depth on important themes and questions arising from early interviews, allowing us to gain a more complete understanding of LPG adoption within our context.

Several limitations should also be noted. Women knew that they were expected to use the LPG stove exclusively as part of the trial, thus were hesitant to admit to ever using traditional stoves in qualitative interviews. This social desirability bias may have limited women's descriptions of reasons for occasional traditional stove use. Additionally, given the intensive behavioral support provided by the trial, we cannot conclude what factors may influence exclusive LPG use when costs are removed without behavioral support. Also, participants in our study already had extensive knowledge and experience with LPG. Social and cultural barriers to LPG adoption may play a larger role in populations with less knowledge and experience with LPG. Lastly, our classification of households as exclusive or non-exclusive LPG users may have been biased by our inability to quantify the extent of cooking on unmonitored outdoor traditional stoves.

Conclusion

This study provides evidence that when economic barriers are removed, other social and cultural barriers previously thought to be major influencers of LPG adoption may no longer significantly inhibit LPG use. Concerns about LPG did not prevent women from transitioning most cooking tasks to LPG stoves. These results suggest that if LPG is provided for free, and accompanied by maintenance and usage support, near exclusive LPG adoption is possible. Further research is needed to determine feasible and effective ways of combining economic and behavioral support for LPG adoption, to ultimately achieve more widespread exclusive LPG use and realize the potential health benefits of this cleaner fuel.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix A.: Semi-Structured Interview Guide for Intervention Participants in the Cardiopulmonary outcomes and Household Air Pollution (CHAP) Trial in Puno, Peru

Date: ____/____/____ Start Time: ____:____ End time: ____:____
 Day Month Year Hour Min Hour Min

Participant Code: _____

Interviewer: _____

Observers: _____

Questions:

1. Tell me about your gas stove. What has happened since you received your gas stove? How are you using it? What has been your experience using it?
2. Do you remember the cooking demonstration? How did it seem to you?
 - What did you think about the demonstration?
 - What surprised you?
 - Was there anything you saw or heard in the demonstration that you doubted?
 - What do you think about those things now?

3. Where was your gas stove installed?
 - What made that the best place to install the stove?
 - Is the stove still there? Where is the gas stove now?
 - If the gas stove is in the kitchen: Did you change anything in your kitchen when you received the gas stove?
 - If yes, what did you change?
 - If the stove is in another room: What would you like to change about your kitchen to be able to use the gas stove there? What would make it better or easier to use the gas stove in your kitchen?
 4. When you received your gas stove, the field staff also gave you a guide and a calendar.
 - How useful has the guide been for you?
 - Tell me about a time when you referred to the guide.
 - What made you decide to look at the guide?
 - What information were you looking for?
 - Where do you keep the guide?
 - What information is missing from the guide?
 - What would you change to make the guide more useful?
 - How useful has the calendar been for you?
 - Tell me about a time when you referred to the calendar.
 - What made you decide to look at the calendar?
 - What information were you looking for?
 - Where do you keep the calendar?
 - What information is missing from the calendar?
 - What would you change to make the calendar more useful?
 5. What did your family say when you decided to enroll in the study?
 - What did they say when you received the gas stove?
 6. When you use the gas stove, how does your family react?
 - What do they think about the food you cook with gas?
 - What do you do if someone in your family does not want you to cook with gas?
- Probe:
- Husband?

- Mother/mother-in-law?
 - Father/father-in-law?
 - Children?
 - Others?
7. When you first received your gas stove, how did you learn how to use it?
- Who helped you learn how to use it?
 - What did they do to help you?
8. When people first obtain something new, it can take time to adapt and learn how to use it. In the beginning, what was the most difficult thing for you to do with the gas stove?
- What did you do to overcome that problem?
 - Is it still hard for you?
 - What do you do differently now to avoid that problem?
 - What is still complicated or problematic with the gas stove?
9. What have you cooked recently with the gas stove?
- Some people say that you can't prepare that dish with gas. What steps do you take to prepare that dish with gas?
 - When you prepare the same dish with the traditional stove, what do you do differently?
10. Tell me about a time when you were not able to prepare something with the gas stove.
- How did you prepare it? What stove did you use?
 - What were the reasons why you could not use the gas stove to prepare it?
 - Now that you have the gas stove, when do you use your traditional stove? What do you still do with the traditional stove?
 - Are there times when you use the traditional stove and the gas stove at the same time? Why do you need two stoves in those moments?
- Probe:
- When you have guests?
 - When there is a party?
 - When someone asks you to cook with the traditional stove?
11. Do you use the gas stove to prepare food for your animals?
- Which animals?

- What do you cook for those animals?
 - How do you cook the food for those animals?
 - Why do you cook for those animals and not other animals?
 - What would happen if you fed the animals raw food?
 - What stove do you prefer to use to cook food for your animals? Why?
- 12.** How does the time of year, season, or weather affect your cooking?
- What types of food do you normally cook during the cold season? What stove do you like to use to prepare those things? Could you also prepare those things with another stove?
 - What types of food do you normally cook during the rainy season? What stove do you like to use to prepare those things? Could you also prepare those things with another stove?
 - What types of food do you normally cook during the windy season? What stove do you like to use to prepare those things? Could you also prepare those things with another stove?
- 13.** How does the system of gas delivery seem to you? Probe: What is good? What could be better?
- Has your gas tank run out before a replacement was delivered? Sometime have you lacked gas?
If yes:
 - What did you do?
 - Did you need to use your traditional stove while you were waiting for the gas delivery?
- 14.** Tell me about a time when you were happy that you had a gas stove.
- In what situations has having gas been the most useful for you?
- 15.** How has the gas stove affected how you spend your time?
- What is your daily routine now?
 - How is your daily routine now different from your daily routine before you received the gas stove?
 - How has the gas stove affected the time when you wake up?
 - How has the gas stove affected the time when you start to cook breakfast? Lunch? Dinner?
- 16.** What changes have you noticed in the amount of time that you spend cooking? How do these changes seem to you? Good or bad?
- 17.** What changes have you noticed in the amount of time that you spend collecting and preparing biomass fuel? How do these changes seem to you? Good or bad?

18. In what situations have you felt the most confident/safe cooking with gas?
19. In what situations have you felt the least confident/safe cooking with gas?
20. I'm going to describe some situations and I would like you to tell me how they affect which stove you use to cook. What do you do when:
- You have guests and have to cook for many people?
 - There is a party?
 - It's very cold? Probe: Does your desire to warm up influence which stove you use?
21. What do you think about the red device that hangs near your stoves?
- How does it affect which stove you use to cook?
22. Do you receive benefits from the FISE program? (discounts on gas tanks)
- If yes:
- Now that you are receiving all your gas for free, what do you do with the FISE vouchers?
- Probe:
- Do you still use the vouchers to obtain gas tanks for another stove?
 - Do you sell them?
 - Do you give them to others as gifts?
23. When you talk about gas with your friends, what do they say?
24. I know there are other women in your village who received a gas stove from our project. Have you spent time with them?
- What do you do together?
 - What do you talk about?
25. We're almost at the end. What more would you like to tell me before we finish?

Thank you for your participation today!

Abbreviations:

CHAP	Cardiopulmonary outcomes and household air pollution trial
CO	Carbon monoxide
FISE	<i>Fondo de Inclusión Social Energético</i> (Energy Social Inclusion Fund)
HAP	Household air pollution
Kg	Kilograms

LMIC	Low- and middle-income country
LPG	Liquefied petroleum gas
PM_{2.5}	Fine particulate matter
SUMs	Stove use monitors
WHO	World Health Organization

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Highlights:

- When LPG was provided for free, support from staff and family, perceived advantages of the trial LPG stove, compatibility of the LPG stove with most cooking practices, and perceptions of being lucky to receive LPG facilitated near-exclusive use of LPG.
- Participants reported they were willing to accept the perceived disadvantages of LPG given the highly valued benefits
- Reducing cost and improving accessibility of LPG in tandem with maintenance and usage support can enable the near-exclusive use necessary to achieve potential health benefits



Figure 1.
Traditional stove (*fogón*) typically used in Puno.



Figure 2.
Adobe kitchen structure with thatch roof common in Puno. Some households have aluminum roofs.



Figure 3.
LPG equipment delivered by the CHAP trial to participants.

Table 1.

Characteristics of qualitative interview participants.

Participant ^a	% LPG Use	Owned LPG stove at Baseline	# Months with LPG ^b	Age	HH Size	Wealth Quintile ^c	Removed <i>Fogón</i> ?
A	Non-Exclusive	Yes	5	42	8	Poorest	No
B	Non-Exclusive	Yes	5	62	2	Poor	No
C	Non-Exclusive	Yes	8	56	2	Poorest	No
D	Non-Exclusive	Yes	5	63	2	Poor	No
E	Non-Exclusive	Yes	8	55	4	Poorest	No
F	Non-Exclusive	Yes	8	41	4	Poor	No
G	Non-Exclusive	Yes	7	33	6	Middle	Month 5
H	Non-Exclusive	Yes	5	53	4	Poor	No
I	Non-Exclusive	Yes	3	58	4	Poorest	No
J	Non-Exclusive	No	8	61	3	Poor	No
K	Non-Exclusive	No	5	62	3	Poorest	No
L	Non-Exclusive	Yes	3	64	4	Poorest	No
M	Exclusive	No	5	62	3	Poor	Month 3
N	Exclusive	Yes	11	48	2	Poor	Month 7
O	Exclusive	Yes	3	54	4	Poorest	No
P	Exclusive	Yes	3	41	4	Poorest	Month 1
Q	Exclusive	Yes	3	38	3	Poor	No
R	Exclusive	No	3	52	4	Poor	Month 0
S	Exclusive	Yes	8	48	6	Poor	Month 0
T	Exclusive	Yes	8	43	3	Poorest	Month 0
U	Exclusive	No	8	39	4	Middle	Month 0
V	Exclusive	Yes	7	46	4	Poorest	Month 0

^aAll participants were female^bNumber of months between installation of the CHAP LPG stove and the qualitative interview^cWealth quintiles are based on asset ownership and nationally-representative cut-offs determined from the Peruvian Demographic and Health Survey [30]

Table 2.

Summary of themes influencing exclusive use of LPG and illustrative quotes from in-depth interviews.

Theme	Illustrative Quotes
Fears about LPG	<p>"When we move [the stove knob], there is a lot of fire, it's strong. For that I'm afraid. The fogón is good because although there's fire, it's normal." (Participant L)</p> <p>"I had full sacks of quinoa here [in the kitchen], but for fear that they would catch on fire [from the gas stove] I moved them to a different location." (Participant D)</p> <p>"Once I cleaned [the gas stove] when it was hot and I burned myself. Now I'm afraid. My daughter burned herself before too. For that we are afraid." (Participant S)</p> <p>"The field workers change the gas tank. They told me I should learn but I'm afraid, very afraid. I might not close the tank well and I could start a fire." (Participant E)</p> <p>"Sometimes I light [the gas stove] and the flame is very low. I want to turn up the flame, but it comes out hissing with too much flame. I try to lower the flame and it turns off.... Now I've become accustomed not to turn the knob too fast and it's good." (Participant J)</p> <p>"I was afraid... the gas tank could explode. It could kill and start a fire. The gas could escape... At first the strong fire scared me. But now I've accustomed to it." (Participant U)</p>
Brand of LPG	<p>"That orange tank, it finishes quickly in seven days. The other blue tank lasted 11 or 12 days. The orange one doesn't last, it finishes quickly." (Participant Q)</p> <p>"Last week they brought an orange tank... I was lighting [the stove] and a huge flame came out. It scared us." (Participant S)</p> <p>"That orange tank... when I turned it on the gas escaped from both sides... We took [the tank] out and in the morning the field worker came and saw that it was leaking and replaced it." (Participant O)</p>
Family Support	<p>"When [the gas tank valve] was loose, it wasn't good. I was afraid... Only my husband would light the stove, I wouldn't light it. Even my children were scared because it stunk, there was a bad odor [of gas]." (Participant D)</p> <p>"[My family] says the gas stove is good... The food comes out delicious... They say it tastes the same as [the fogón]." (Participant O)</p> <p>"My daughter [taught me to use the gas stove]... I was afraid. She said, 'We are going to light it, turn it off.' For that I learned and now I cook normally [with gas]." (Participant S)</p> <p>"My sons told me [the gas stove] is good. My youngest son said, 'Mom, it's really good. Now we will cook with gas. Now you won't have to use the fogón. It's good because the dung is wet and you always cry when you cook [with the fogón]. Now when you cook [with gas] it will be good.'" (Participant J)</p> <p>"My kids come on Saturdays and Sundays, sometimes my aunts and brothers come. They say, 'Where will we cook?' They live far away in Tacna and Lima. When they come to the field, they say, 'We have to cook on the fogón.'" (Participant I)</p>
Support and Education from Field Workers	<p>"[The field workers] always review everything for me. They install the tank and review it. I could get burned, but they always ensure it is well connected." (Participant J)</p> <p>"That day I liked to learn what we have to do. How to light [the gas stove], how to turn it off, how to check for a flaw in the hose... Now [with gas] it is clean and we don't cry... Your hands aren't all black and cracked... Now there is no smoke... I cook fast." (Participant G)</p>
Social Influences	<p>"One day I used the fogón and the field workers told me the device registered it... If I cook on the fogón, it upsets the field workers, it bothers them. They ask me why I have cooked on the fogón... They told me I should not even cook outside on the biomass stove. For that we don't do it anymore." (Participant L)</p> <p>"The others who did not receive gas... they are grumbling, they are angry they told me. For that I don't talk with anyone about anything." (Participant D)</p> <p>"I cooked fava beans two, three, or four days. I toasted them. But now I don't do that anymore. I was scared because it used a lot of gas, and we can't waste the gas. People say we shouldn't waste the gas." (Participant N)</p> <p>"Here we don't run into anybody. We don't encounter anybody. Here I am alone. I do everything alone." (Participant M)</p> <p>"I don't talk with anybody. My neighbors are far away, and that neighbor is in the field. I am alone here... There is no time to find each other." (Participant C)</p> <p>"One day I cooked for a lot of people and my gas ran out in 12 days... Normally it lasts 15 days... The field worker asked me why I ran out so quickly... Now I'm making [the gas tank] last two or three days more." (Participant P)</p>
Perceptions of Luck	<p>"[My husband told me], 'You've been lucky. Now you have to cook with gas.'" (Participant N)</p> <p>"[My sons said], 'You were lucky to get gas, Mom. Now you have to cook there and not on the fogón anymore.'" (Participant A)</p>
Previous Experience with LPG	<p>"The three burners are good because in one round I cook everything. It's not like [my previous stove] with two burners, on that one I was delayed more." (Participant G)</p> <p>"When I lit [my old gas stove], [the flame] had less strength. When I wanted to make tochtuchi [fried bread], it didn't cook. In contrast, here [in the CHAP gas stove], if you want a strong flame, it's strong; if you want a lower flame, it's low." (Participant F)</p> <p>"I always knew how to light the stove with those knobs... I had a gas stove before." (Participant O)</p> <p>"I had never cooked with gas before... I was scared... I missed my fogón a lot in the first days. 'How am I going to light [the gas stove],' I said. The ladies told me how to open [the tank and knobs], but I was doubting that I could light it." (Participant J)</p> <p>"I had never lit a [gas stove], everyone had a turn to light the stove [at the demonstration]. I said that I didn't know how to cook on this type of stove but the same they made us light it, and I lit it. Those that knew [gas] lit it quickly, I had a lot of fear." (Participant D)</p>

Theme	Illustrative Quotes
Stove Design	<p>“Yes it is quicker with the three burners, because on one side I put soup, one side hot water for my tea, the other food for the pig.” (Participant R)</p> <p>“In the fogón we cooked with three burners. And now the gas stove has three burners too. It’s good.” (Participant A)</p>
Traditional Dishes	<p>“I can’t make toast nor toast the quinoa [on the gas stove]. Sometimes I toast grains for the tea [with gas], but it burns quickly and comes out black... The quispino [steamed quinoa bread] also does not come out well [with gas].” (Participant L)</p> <p>“When I cooked with the fogón, the food had a different flavor. When I cook with gas it tastes different. At first I wasn’t accustomed to [the flavor of food cooked with gas], but now I’ve become accustomed. Now it’s normal for me and my children. They eat [food cooked with gas] normally.” (Participant P)</p> <p>“On the fogón, [some food is better]. But there is always smoke. With gas there is no smoke.” (Participant K)</p> <p>“In September I used the fogón... because I wanted to cook quispino... When I cook quispino over the flame of the fogón it has a different flavor. With gas it has less flavor.” (Participant I)</p> <p>“I cook everything with gas. Everything that I decide... everything that I think about, I cook. Only until now I haven’t cooked quispino.” (Participant R)</p>
Pot Preference	<p>“We use clay pots for quispino. It’s also good to cook fava beans... We make them [on the gas stove] normally... with the same clay pots I was using on the fogón... I’ve been searching for a flat one, but they don’t have them here.” (Participant Q)</p> <p>“When we cook barley soup in the clay pot, we can take it off the stove and it finishes cooking, the barley bursts nicely. It is delicious and beautiful. However, in the aluminum pot, it gets cold fast and doesn’t finish cooking.” (Participant J)</p> <p>“[The calendar] shows pretty, flat clay pots for the gas stove. The clay pots for my fogón are round. I haven’t bought those flat ones for the gas stove.” (Participant N)</p> <p>“My aluminum pots from the fogón are all black... I’ve washed some but the stains don’t want to come out... I bought others... because the black ones would make the gas stove dirty.” (Participant T)</p> <p>“Now [with gas] we use only the metal pots. The same pots we used before. We used them to cook on the fogón as well.” (Participant B)</p>
Valuation of LPG	<p>“I haven’t cooked [on the fogón]. I’ve become accustomed to gas... When the free gas ends, what will I do? I’m going to cry... [The gas] has changed our life... Next year I will have to go back to cooking on my fogón... There is not enough money.” (Participant P)</p> <p>“I don’t want to go back [to the fogón]. It smokes, it makes my eyes burn. I’ve become accustomed to gas. I don’t want to cook with the fogón anymore.” (Participant A)</p> <p>“I would like to have gas forever, because I’m accustomed to it... When my year is over, what will I do?... Will they take the gas stove and tank from me?... I’m concerned and sad about that.” (Participant E)</p>
Availability of Traditional Stove	<p>“One day my gas ran out and I said, ‘I’m going to cook on the fogón.’” (Participant E)</p> <p>“I only use gas, because I don’t have a fogón... I broke [the fogón] and threw it away.” (Participant N)</p> <p>“I removed my fogón, I’ve stored it in another room... Why should it be in the kitchen? I have gas. What would I put [to cook] on the fogón?” (Participant M)</p>
Installation Location	<p>“When we cooked on the fogón, the kitchen was always stained and the ashes fell [from the roof]. The fogón kitchen was not clean. The gas stove doesn’t stain anything... I didn’t want to be dirty... For that we have constructed [a new kitchen].” (Participant P)</p> <p>“I changed the aluminum roof [in my kitchen], it was broken... The smoke [from the fogón] had made holes in the aluminum... When it rained, the water entered... When [the project] ends, I’m going to make another kitchen for my fogón. That [remodeled] kitchen will be only for gas.” (Participant U)</p>
Space Heating	<p>“No, no, I don’t heat myself [with the stove]... I go in the sun. I bundle up more. I put on my coat. When I’m like that, with a sweater, the cold passes.” (Participant U)</p> <p>“With the gas stove we feel cold. With the fogón it was warm, but with smoke, it was full of smoke.” (Participant Q)</p> <p>“No, I don’t [cook with the fogón at midday]. Because of the smoke... And during the day it is very hot... [With gas] I cook easily at noon.” (Participant E)</p>
Delivery Delays	<p>“Here in the country there is not always a signal. I am well hidden. For that it is difficult to call [for gas]... Sometimes I have credit and sometimes I don’t.” (Participant Q)</p> <p>“Sometimes the gas runs out and we pass the day without eating because we finished the gas and we don’t have anything to cook with.” (Participant S)</p> <p>“Late at night [the conditions] are not good. Something could happen to the gas delivery staff. They could fall in a ditch.” (Participant L)</p> <p>“Sometimes [the number of days the tank lasts] varies. When in addition my daughter comes and my husband arrives, the gas finishes quickly. When we are only two it lasts longer. The gas delivery staff ask me, so quickly you have finished and sometimes you don’t finish so quickly.” (Participant U)</p> <p>“I was in the middle of cooking and the gas ran out. I had already started. So I put it on the fogón to finish.” (Participant I)</p> <p>“Sometimes the gas runs out in the middle of cooking... I have to go to my neighbor’s house carrying my pot and finish cooking on her fogón.” (Participant E)</p> <p>“They always bring the gas. Sometimes it seems they already know when it’s running out... Sometimes they even deliver the gas in the rain.” (Participant T)</p> <p>“One day I didn’t have gas... They didn’t deliver it quickly... [I cooked] on my own gas stove, because I was afraid to connect my [gas tank] to the [project] stove.” (Participant V)</p>