

Nudging Households to Increase the Usage of Clean Fuel

Executive summary

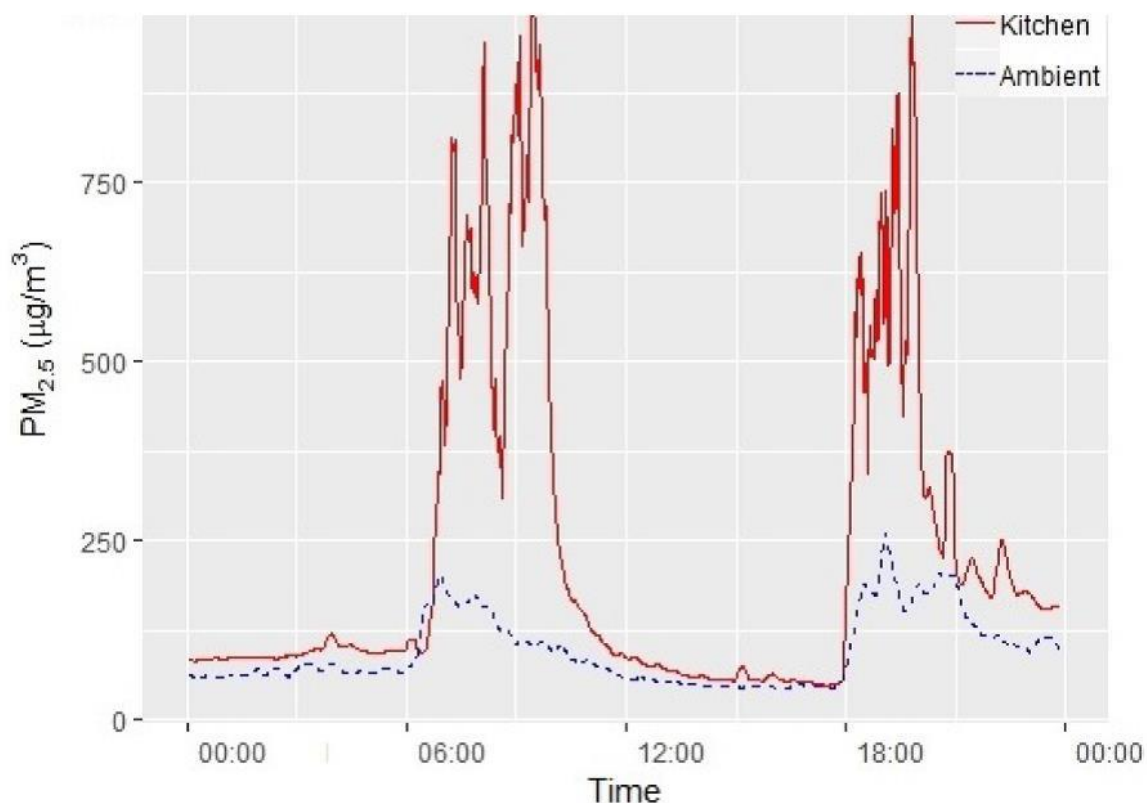
Air pollution is a grave public health concern, and indoor sources are major contributors. Cooking with solid fuels has disproportionately more adverse impact on women vis-à-vis men. In this project, in Madhya Pradesh, villages are randomly assigned to a campaign by public-health workers to either raise awareness about health effects of solid fuels and mitigation measures, or health awareness with information on LPG subsidy programme, or a 'control' group in which neither information is provided. Analysing oil marketing companies' data shows that the combined intervention leads to 6% increase in LPG refills purchase annually, 14% rise in monthly refill consumption, and 320% increase in self-reported induction stove usage. In the 'health only' intervention, although there was no change in refill consumption or stove usage, households became more likely to have smoke outlet or separate cooking room. Hence, financial constraints, and design of public subsidy schemes are salient in inducing regular clean fuel usage.

Introduction – context and rationale

Air pollution levels in households that cook with solid fuels are high and skyrocket during meal preparations. Figure 1 below shows a high correlation between ambient and kitchen PM_{2.5}¹ levels during a typical day in a rural household in northern India. While the World Health Organization's guideline for 24-hour average exposure to this pollution is 25µg/m³, it rises with solid fuel use during meal preparations in these households – to 40 times greater than the safe limit. Not surprisingly, air pollution is one of the gravest public health concerns, not only in developing countries but across the world (Cohen *et al.* 2017). Household sources, however, are the single largest contributor in much of the developing world (Liu *et al.* 2016, GBD-MAPS, 2018).

¹ PM_{2.5} refers to atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometers. Major components of PM are sulphates, nitrates, ammonia, sodium chloride, black carbon, mineral dust, and water. PM_{2.5} can enter the blood system and contribute to the risk of developing respiratory diseases, including lung cancer, besides cardiovascular diseases.

Figure 1. Indoor and outdoor PM_{2.5} concentrations in a North-Indian village



Notes: The solid line plots 15-minute moving averages of PM_{2.5} concentrations over a day (10 February 2019) measured in the kitchen of a household that cooks with solid fuels in a North-Indian village. (ii) The dashed line shows data from an outdoor sensor in the same village and date. (iii) Both measures of PM_{2.5} are at one-minute resolution.

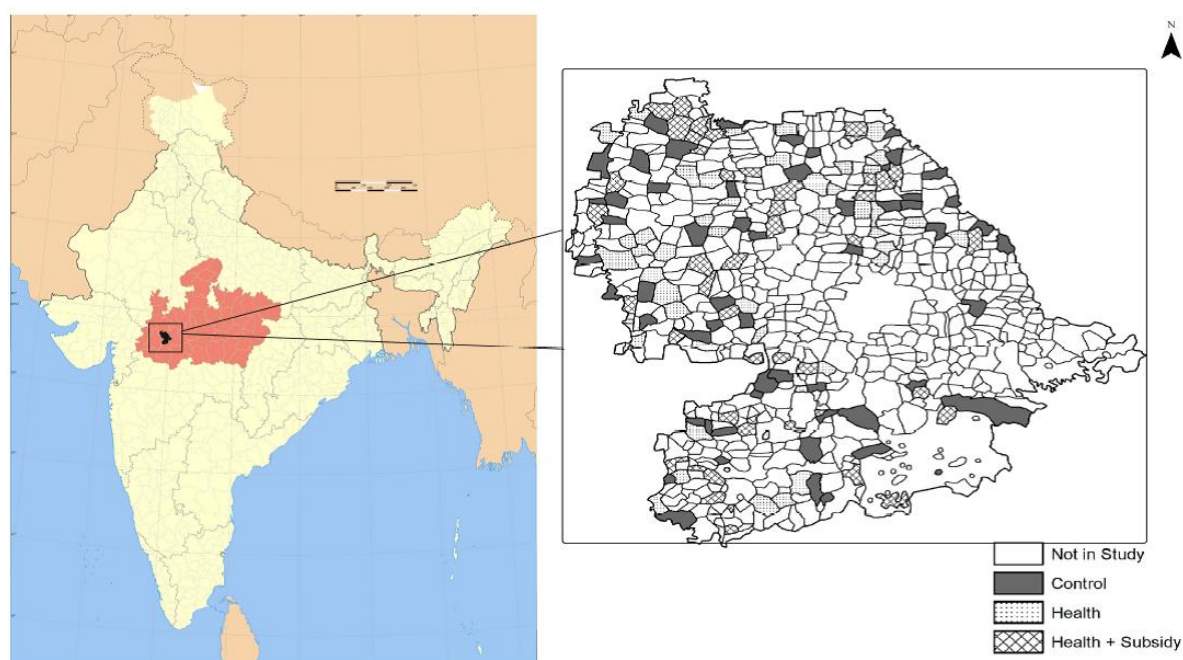
Source: Somanathan et al. (2019).

This project involves a 'cluster-RCT' (randomised controlled trial) in rural Madhya Pradesh, with the aim to induce households to switch to a clean cooking fuel. The study builds on a novel programme launched by the Government of India in 2016 to provide subsidised access to bottled LPG (liquid petroleum gas) to disadvantaged households. While the programme has been an enormous success, with more than 80 million households gaining access by September 2019, average annual usage of LPG by the existing and newly connected rural households remains less than half of what is thought to be needed to eliminate solid fuel use. One reason for this is that despite the subsidy, the cost can be considerable for poor households. Most rural households are either unaware of the government's cash-back scheme on LPG purchases or do not understand the extent of the subsidy they receive on refills. In addition, and irrespective of income, there is low awareness of the long-term health hazards of solid fuel combustion.

Brief description of the study

The cluster-RCT was conducted in 150 villages in the Indore district of Madhya Pradesh during 2018-2019. It aimed at increasing awareness about the health hazards of cooking with solid fuels and the universal financial subsidy scheme for LPG. The intervention had two ‘treatment’ arms: one in which awareness about the adverse health effects of cooking with solid fuels was provided to households, and a second which, in addition to health awareness, explained the existing cash-back payment deposited directly to consumers’ bank accounts after they purchase an LPG refill at market price. No awareness campaign was conducted in the third group of villages – the ‘control’ group.

Figure 2. Map of the study area by ‘treatment’ status of villages



Notes: Indore block and the urban areas of the district (viz. the city of Indore, in the middle of the district) were not part of the study. The southern part of the district has few habitats due to significant forest cover.

To buy subsidised LPG, consumers have to obtain a ‘connection’ – register with one of the three state-owned oil marketing companies (OMCs) that are the only suppliers of LPG. A consumer has to pay a connection charge, a deposit for a cylinder (standard

14.2 kg capacity) and pressure regulator, and purchase a rubber pipe at any OMC's local distributor or 'dealer'. This is an upfront cost of about Rs. 3,200, which could easily be two weeks' worth of household income in rural areas.

Since 2013, all residential LPG consumers in India, irrespective of income, receive a 'direct benefit transfer' (DBT) for up to 12 cylinder refills in a year. This means that when a consumer with an LPG connection buys a cylinder of LPG, s/he pays the market price to the dealer and receives a transfer to his/her bank account for the amount of the subsidy to which s/he is entitled, within the next 2-3 days. The market price of a cylinder varied between Rs. 654 and Rs. 879, during November 2017-October 2018, in tandem with the price of imported liquefied natural gas. The government has kept the subsidised price very stable at around Rs. 500 so that the corresponding subsidy delivered by DBT varied between Rs. 159 and Rs. 376 during this period.

To expand access to LPG, the Government of India launched the *Pradhan Mantri Ujjwala Yojana* (PMUY) in April 2016. PMUY is the most extensive programme on access to clean fuel in the world. The programme mandates that a woman in a rural, socioeconomically disadvantaged household, obtaining an LPG connection (giving a right to buy subsidised gas) bears no upfront cost. The security deposit, along with administrative charges for a connection, are covered by the government. The beneficiary also receives an interest-free loan from the OMC for the purchase of the stove and the first LPG cylinder. The programme has positioned itself as an initiative that empowers rural women, and therefore, does not emphasise health (or financial subsidy) awareness. While it has been successful in significantly improving rural households' access to LPG for cooking, increase in actual usage of LPG is limited.

Nationwide, an estimated 79% of households had an LPG connection in 2018 (PPAC Report, 2018). This study focuses on rural India since LPG use is much lower than in urban areas, with the former having an average annual consumption of about 4 cylinders and the latter about 8.² There are several factors – besides income – that are important in explaining the low demand for LPG in rural India. In forested areas, easy access to firewood reduces demand for LPG. Habit, familiarity, and custom can

² Since LPG sales data are not available publicly, these figures are based on the researchers' estimates from data shared by OMCs for the study area, and media reports.

lead to a preference for traditional fuels even in the areas that do not have freely available firewood (Aklin *et al.* 2015) and LPG costs less than buying firewood from the market (for example, monthly firewood purchase for a family of 4-5 members is approximately Rs. 500-800).

Furthermore, many rural households are unaware of the subsidy on LPG because it is deposited in a bank account that they may not monitor often. Text messages to registered phones intimating customers about the transfer to their bank account are in English and not the local language (for example, Hindi in North India). Physical or remote access to account information on fund availability is limited, particularly for women. Both features of the subsidy scheme – variation in subsidy amount and cash-back – suggest that uneducated and liquidity-constrained consumers may not be able to either comprehend or take advantage of the subsidy. Finally, lack of awareness of the health consequences may cause rural households to continue using solid fuels even if they can afford LPG.

A baseline survey of the 150 villages was conducted during November-December 2018. In each village, 20 households were randomly chosen to be a part of the study. These households were asked whether or not they currently have an LPG connection. If they did, details of the connection, including unique consumer ID, and number of refills in the past year were recorded from their consumer booklets. The LPG consumption data were matched with sales data from the OMCs for validation. Detailed information on household composition, fuel use and collection, health awareness, primary cook's time use and wellbeing, were gathered for all households irrespective of LPG connection status.

Following the baseline, in January 2019, the intervention to increase adoption and regular usage of LPG was initiated for nine months, until September 2019. The 150 villages were randomly assigned to one of three treatment arms with 50 villages each: (i) Health awareness (ii) Health and financial subsidy awareness (iii) no awareness campaign (control group). The intervention leveraged the existing public health system by engaging Accredited Social Health Activists (ASHA) to provide information to households in a door-to-door campaign.³

³ ASHAs were trained by an NGO, along with the research team. ASHAs were made aware of the adverse health impacts of solid fuels, including a list of diseases, their symptoms, and consequences.

Following the completion of the intervention, the endline survey was conducted between late October and December 2019, during which the households surveyed in the baseline were revisited.

Major findings

- By comparing annual and seasonal LPG consumption by households in the study sample before and after the intervention and relative to the control group, it is found that *providing information on both the health hazards of using solid fuels and the existing LPG subsidy led to a 6% increase in annual LPG refill consumption.*
- The *increase in LPG refill consumption took place in the summer*, when LPG consumption is typically low due to the greater availability of solid fuels relative to the wet season.
- The *effects on LPG refill consumption appear to be concentrated among the less educated, and poorer households.* Households with a head who has completed less than primary schooling, increased refill consumption significantly, compared to those whose head was primary educated (or more) – precisely the type of households that need to be informed about both the health hazards of indoor air pollution and the implication of the financial subsidy on out-of-pocket expenditures on LPG refills.
- Running the analysis by month (rather than annually), and taking into account the observed variation in the market price of LPG refill across months, which is determined by the international prices, it is found that there is a *9.3% increase in monthly refill consumption due to the overall intervention.* The result is driven by a 13.6% rise in monthly refill consumption in the combined intervention. The fact that the estimated impact of the intervention is significantly larger on monthly, rather than annual, refill consumption, indicates that *households make monthly LPG consumption decisions.*

For the second treatment arm, details of the subsidy and its cash-back design were also explained. They were then provided hand-held tablets that contained videos, and a campaign manual, and detailed written scripts to follow for up to six household visits.

- Further, in the combined health and subsidy awareness intervention, the usage of induction stoves for cooking increased significantly by 270%.
- *Although the health intervention alone did not increase consumption of LPG refills, it led to significant behavioural changes that can reduce the inhalation of indoor smoke – households were 6 percentage points more likely to have an outlet for smoke from traditional stoves and/or use a separate room as a kitchen, as compared to the control group that did not receive any information. The probability that households used only traditional cooking stoves to prepare the last meal decreased by 5 percentage points in the health information-only intervention.*
- Households are discouraged by the higher cost of transporting LPG cylinders home that they would have to bear when their dealer is located farther away. Reducing their supply-side constraint can have a significant effect on clean fuel take-up. The estimates suggest that *lowering the distance to the nearest dealer can raise LPG refill consumption by 20% when combined with information on health and subsidy.*
- *Temporal variation in the market price of LPG also affects refill consumption, particularly since the study sample of poor households are likely to be both credit and liquidity constrained.*

Policy recommendations

- The results highlight the *complementarity between health awareness and loosening financial constraints*. Poor households may not be able to transition to regular usage of clean fuels even if they are made aware of the long-term damage caused to their health by indoor air pollution.
- More specifically, the findings underline the *importance of the design of public subsidy for clean fuels, both in terms of comprehension and timing*. Households that were able to comprehend the cash-back nature of the LPG subsidy internalised the information that their out-of-pocket expenditure is lower than the market price they pay upfront, by increasing LPG refill purchases and electric induction stoves. Thus, intimation of subsidy deposits through text messages in local languages is relevant.

- However, more importantly, since the government absorbs the variation in market price through the cash-back subsidy, *depositing the subsidy amount upfront into the accounts of beneficiary households* could substantively reduce the financial burden on liquidity- and credit-constrained households, and increase LPG take-up further.
- The *Pradhan Mantri Garib Kalyan Yojana*, launched during the Covid-19 pandemic, deposits refill credit upfront to *Ujjwala* beneficiaries for three months and, according to media reports, has shown a record 13% increase in annual LPG consumption. However, this temporary and limited change in the subsidy scheme has seen only 50% success in the take-up of free cylinders. The research suggests a multipronged approach to induce households to use LPG regularly – combining measures that raise health and subsidy awareness along with a redesigned subsidy scheme.

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Within the initiative, four projects are being led by Prof. Farzana Afridi at the Indian Statistical Institute. This research has been conducted under one of the projects.