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This paper examines the impact of India's Pradhan Mantri Ujjwala Yojana (PMUY), a clean cooking policy that offered free Liquified Petroleum Gas (LPG) connections to women from economically and socially disadvantaged households, on their well-being. Exploiting the targeted introduction of the policy; and using a large nationally representative data in a difference-in-difference framework, we show that the policy has a positive impact on women's health, education and employment, although the effects on education and employment outcomes are relatively modest. Further, we show that the beneficiary women have higher autonomy post-policy. We also document that in districts with initially lower levels of clean energy access, improvements in employment, education, and health outcomes are lower, but improvements in women's agency measures are higher. Our findings suggest that while the effect on women's autonomy is primarily driven by registering connections in their name, improvements in health, education and employment are due to increased usage of LPG as the main cooking fuel. Overall, these findings provide evidence that a gender-responsive policy like PMUY can effectively enhance access to clean cooking fuel and subsequently improve women's socio-economic outcomes through both connections and consumption channels.

Keywords: Clean cooking fuel; energy access; women health; women agency; employment; gender-responsive policy

JEL Code: Q48, I38, H42

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Abstract

This paper examines the impact of India's Pradhan Mantri Ujjwala Yojana (PMUY), a clean cooking policy that offered free Liquified Petroleum Gas (LPG) connections to women from economically and socially disadvantaged households, on their well-being. Exploiting the targeted introduction of the policy; and using a large nationally representative data in a difference-in-difference framework, we show that the policy has a positive impact on women's health, education and employment, although the effects on education and employment outcomes are relatively modest. Further, we show that the beneficiary women have higher autonomy post-policy. We also document that in districts with initially lower levels of clean energy access, improvements in employment, education, and health outcomes are lower, but improvements in women's agency measures are higher. Our findings suggest that while the effect on women's autonomy is primarily driven by registering connections in their name, improvements in health, education and employment are due to increased usage of LPG as the main cooking fuel. Overall, these findings provide evidence that a gender-responsive policy like PMUY can effectively enhance access to clean cooking fuel and subsequently improve women's socio-economic outcomes through both connections and consumption channels.

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1 Introduction

The global access to clean cooking fuels increased significantly from 48% in 2000 to 68% by 2019. Notably, the period from 2010 to 2019 saw a more pronounced growth rate of 2.2%, in contrast to the 1.5% observed between 2000 and 2010 (Sachs et al., 2023). Despite this progress, projections based on current trends indicate that over 20 years will be required to reach 100% access to clean cooking fuels, thereby missing the Sustainable Development Goal (SDG) target. Globally, transitions to clean cooking fuels have been mainly facilitated by large fossil fuel subsidies. However, these are unlikely to continue due to the challenges posed by energy security, and environmental sustainability (Zinecker et al., 2018). Hence, meeting the clean energy access targets requires shifting from universal subsidies to schemes targeting vulnerable populations (WHO, 2022).

The reliance on polluting fuels disproportionately affects women, underscoring the critical role of clean energy access in addressing gender inequality (McCollum et al., 2018). Using cleaner cooking fuels improves indoor air quality and reduces the time women and girls spend collecting firewood, resulting in better health outcomes and greater opportunities for education and economic activities (WHO, 2016). Consequently, countries must develop innovative policy solutions to provide low-carbon, equitable energy access, thereby mitigating the harmful effects of polluting fuels on millions of women.

This study assesses the effects of the Pradhan Mantri Ujjwala Yojana (PMUY), a policy launched in India in 2016 aimed at subsidizing Liquefied Petroleum Gas (LPG) connections for women in economically disadvantaged households on women's health and socio-economic outcomes. By the conclusion of its first phase in 2019, PMUY had distributed eighty million connections to households Below the Poverty Line (BPL)[1]. Given the extensive scale of the program, understanding its implications is crucial.

While limited, the existing evidence on PMUY has primarily focused on studying its

[1]This is a benchmark used by the government to identify deprived households for targeting various programs and policies. The benchmark varies across states and is based on multiple socio-economic indicators including family income, asset ownership among others.

impact on LPG consumption (Kar et al., 2019; Gould et al., 2020; Gill-Wiehl et al., 2022). However, to understand the effectiveness of a large scale clean cooking program like PMUY in a comprehensive way, it is crucial to also examine its impact on socio-economic outcomes including health and education, particularly for women in addition to its impact on use of LPG.

Assessing the impact of a switch to clean cooking fuels on women's outcomes is challenging due to endogeneity concerns. Households that make this transition are likely to be systematically different from the households that continue to use traditional polluting fuels. While the existing studies have tried to address these concerns by controlling for household fixed effects, time varying factors (like change in preferences) could still confound the effect of clean cooking fuel. We address these concerns by studying policy induced switch to LPG for eligible households and provide reduced-form estimates of the impact of PMUY on women's well being.

We use several indicators of women's socio-economic status to capture their well being in a comprehensive way. We construct an index of women's mobility, financial autonomy and decision making power in the household to capture their agency. We also look at education and employment outcomes of women. Additionally, we construct health outcomes as measured by women's likelihood of suffering from heart disease and respiratory ailments.

There are multiple reasons why we expect PMUY to positively affect women's outcomes. One, women spend more time than men in the kitchen and several studies estimate that the time spent by women in cooking and other kitchen work is more than 3 hours in a day (Afridi et al., 2023; Maji et al., 2021). Increased reliance on LPG is associated with reduced cooking time and trips made by women to collect firewood also see a decline (Akter and Pratap, 2022). The time saved can then be spent on education or employment. Two, usage of LPG is likely to reduce their exposure to Indoor Air Pollution (IAP) from use of polluting fuels resulting in improved health outcomes. Third, PMUY was launched to provide connections to females in a household with a goal of targeting women to improve household's access to

LPG. Introduction of a gender-responsive policy that registered connections in the name of the woman is likely to improve their agency in the household.

However, past experiences with clean cooking policies in India have yielded limited success (Khandelwal et al., 2017), underscoring the significance of evaluating the impact of PMUY. While several studies examining PMUY scheme have reported an increase in the likelihood of households adopting LPG as their primary cooking fuel, there are questions about the program's effectiveness and the magnitude of LPG consumption. According to a governmental audit, during the fiscal year 2016-17, the average annual refill consumption among PMUY beneficiaries stood at 3.9 cylinders, contrasting with 7.5 cylinders among non-PMUY beneficiaries. Subsequently, refill rates exhibited a decline for both PMUY and non-PMUY beneficiaries in the fiscal years 2017-18 and 2018-19, albeit the rate of decline was notably higher among PMUY beneficiaries (Comptroller and of India, 2019). It has also been pointed out that beneficiaries have still not completely transitioned to using LPG even after getting the connection suggesting fuel stacking - a commonly observed phenomena in India. Given these concerns, it is not clear if the PMUY scheme will be successful in affecting the well-being of women. We empirically examine this in the paper.

We identify the impact of PMUY in a difference-in-difference framework, wherein we compare clean fuel usage and women's outcomes for BPL[2] households with those of non-BPL households before and after the policy. We make use of two rounds of National Family Health Survey (NFHS) - a large demographic health survey conducted across all districts in the country - to do this analysis. In particular, we use the fourth round of NFHS conducted in 2015-16 for pre-PMUY and the fifth round of NFHS conducted in 2019-20 for post-PMUY information on women's outcomes and usage of LPG as primary cooking fuel.

Our regression results first establish that there is an increase in the likelihood of using LPG as the primary cooking fuel for BPL households post-PMUY as compared to non-

[2]This is a benchmark used by the government to identify deprived households for targeting various programs and policies. The benchmark varies across states and is based on multiple socio-economic indicators including family income, asset ownership among others.

BPL households. We confirm that this increase is not driven by other policies targeted to BPL households before PMUY was launched. Further, we show that women gain from an increase in access to LPG in the house. Women report having increased mobility, financial autonomy and decision making power. Additionally, they have better employment and education outcomes. Since the access to LPG reduces IAP, we also document women having reduced likelihood of suffering from respiratory and heart ailments.

We also show that the impact of the program varies by initial PMUY eligible population. Our results show that increase in LPG usage is lower in districts with initially lower clean energy access. This result is in line with the existing work that has shown peer effects in clean cooking fuel usage. Consequently, our results also suggest that improvement in employment and health outcomes is lower in high-eligibility districts (low initial LPG access). However, an interesting insight that emerges from our heterogeneity analysis is that improvement in women agency measures is higher in districts that have high PMUY eligibility. Using administrative data on PMUY connections disbursed, our results suggest that this improvement could be driven by increased disbursement of connections in high eligibility districts. Our findings point that improvement in women autonomy is driven by registering connections in their name and not necessarily increased usage of LPG as the main cooking fuel.

Our paper proceeds as follows: Section 2 discusses the existing literature, section 3 provides a background to clean cooking policies in India, section 4 explains the data and empirical methodology used, section 5 reports the results and section 6 concludes.

2 Related literature

Our paper contributes to a growing body of work that studies how a transition to clean cooking fuels affects women's welfare. This work has suggested that a complete transition from solid fuels to LPG improves women's outcomes. Using clean cooking fuel bridges the inequality between men and women by reducing the time burden (Su and Azam, 2023; Afridi

et al., 2023). It also reduces the health burden on women by reducing the ill effects of indoor air pollution caused by polluting cooking fuels Azam (2023); Maji et al. (2021). Together, the two effects impact their years of education and employment among other outcomes. Biswas and Das (2022) find a positive impact of clean fuel use on the education of adolescent females, mainly through direct time substitution. Verma and Imelda (2023) show a positive and significant health impact of an LPG conversion program in Indonesia on women compared to the insignificant impact on men. They also report increased work hours for both women and men through women's health channel. Azam (2023) show that the positive impact of switching from polluting fuels to LPG on household members reporting adverse short-term respiratory issues is higher for women. Additionally, they find that shifting from polluting fuel to fuel stacking strategy, however, does not reduce adverse respiratory health issues. In a recent study, Lee et al. (2024) investigate the impact of transitioning to clean cooking fuels on various dimensions of women's empowerment. The study leverages exogenous variation in the number of wet days and estimates positive impact of clean cooking fuel on women's empowerment. While the paper does not explicitly study the impact of PMUY, since the study was conducted in the post PMUY period, their observed effect could partly be driven by the PMUY scheme.

Our paper is also related to the impact evaluation studies of large-scale LPG conversion programs that have been implemented by developing countries, with Indonesia's mega LPG conversion program being one of the most notable (Budya and Arofat, 2011). Researchers have leveraged the staggered implementation of this scheme to investigate the causal impact of clean fuel use on child mortality (Imelda, 2020) and women's health and labor supply (Verma and Imelda, 2023). The literature has also studied the impact of use of clean cooking fuels on health and well-being of household members. However, addressing the issue of endogeneity in studying this relationship is one of the major challenges (Duflo et al., 2008). Several studies have addressed this issue with multiple approaches, the most prominent being the instrument variable approach. A significant portion of this research focuses on child

mortality (Basu et al., 2024; Zhu et al., 2023) and its impact on vulnerable populations (Liu et al., 2020; Wang et al., 2019, 2023). There is also growing research on the impact on child education (Frempong et al., 2021).

Our work also directly contributes to studies examining the impact of PMUY scheme. Three studies have assessed the impact of the PMUY scheme on LPG consumption using the Access to Clean Cooking Energy and Electricity – Survey of States (ACCESS) data. Developed by independent research institutions, this panel dataset encompasses over 9,000 households across six energy-deprived Indian states. Mani et al. (2020) using the rounds conducted in 2015 and 2018 suggest that PMUY has been an important driver in increasing LPG users from 22% to 58%. Using the second round, their findings also suggest that PMUY beneficiaries have lower odds of utilizing LPG as either the primary or exclusive cooking fuel compared to non-beneficiary customers. Gould et al. (2020) extended this inquiry by modelling the quantity of LPG consumption. The study revealed that PMUY beneficiaries are predicted to consume 27 kilograms less LPG than non-beneficiary customers, who typically consume an average of 93 kilograms.

While these studies attempt to study the impact of PMUY on LPG connections and consumption, they are unable to fully account for observable and unobservable differences in PMUY and non-PMUY beneficiaries and therefore suggest correlations, rather than causation, at best. Gill-Wiehl et al. (2022) try to address the endogeneity issue by comparing policy-eligible households with policy-ineligible households with only slightly higher income. Their study demonstrated that while BPL policies enhanced the likelihood of BPL households acquiring an LPG connection, they did not influence the extent of LPG consumption among these households. Kar et al. (2019) analysed refill rates among PMUY and non-PMUY beneficiaries, utilizing multi-year LPG sales data from a single district. The authors found that in the examined district, from 2016 to 2018, monthly refill sales per 1,000 consumers among PMUY beneficiaries fluctuated around 100 cylinders, compared to 400 cylinders observed among non-PMUY rural consumers. These studies thus reveal that while the increase in the

number of connections in PMUY households is greater than in non-PMUY households, the impact of the scheme on LPG consumption is limited.

Using NFHS conducted in 2015–16 and 2019-21, Roy (2024) studied the role of consumer socio-economic characteristics in driving clean fuel adoption. The authors find that, in 2019-20, households identified as BPL and Schedule Caste were more likely to choose clean fuels as a primary fuel for cooking over solid fuels than in 2015–16. The authors also find that the improvements in the odds of choosing clean were lower for regions where a higher number of LPG connections were issued. This regional variation underlines the importance of using a nationally representative survey to analyse the total impact of the PMUY scheme. Our paper adds to this growing literature on PMUY by focusing on how the scheme has affected the welfare of women. To the best of our knowledge, this is one of the first few studies to conduct a rigorous impact evaluation of PMUY on women's socio-economic status.

Our work also contributes to a burgeoning strand of work that has evaluated how infrastructure expansion has affected the welfare of women. Sedai et al. (2021) study the impact of electricity reliability on status of women in India and find that improved electricity reliability increases the likelihood of women being employed and reduces their time allocation to home production. It has also been shown to improve women's agency in the household and reduce mobility restrictions faced by them. Jensen and Oster (2009) show that introduction and expansion of cable television in India results in increase in women autonomy and decrease in fertility. Nandwani and Roychowdhury (2024) evaluate the impact of a rural roads construction program and find that the policy improved a range women's socio-economic outcomes including decision making power, financial autonomy and mobility. Rajkhowa and Qaim (2022) show that improved mobile phones access reduces mobility restrictions faced by women.

3 Clean cooking policies in India

Since gaining independence, India has followed the conventional path of subsidizing clean cooking fuels to promote their adoption, which has continued until recently. Beginning in the late 1960s, the government introduced subsidies for LPG consumption, making LPG cylinders available at a subsidized rate to all domestic households. However, due to concerns regarding the escalating subsidy burden and the diversion of subsidized cylinders to the commercial sector, reforms were undertaken between 2012 and 2014 to revamp the implementation of LPG subsidies. These reforms encompassed measures such as imposing a cap on the consumption of subsidized cylinders and initiating the direct bank transfer of LPG subsidies (DBTL). Subsequently, the DBTL scheme was reintroduced as the Pratyaksh Hanstantrit Labh (PAHAL) scheme in 2014. Under this scheme, cylinders are retailed at market rates, while subsidies are directly transferred to beneficiaries' bank accounts.

In 2016, the Indian government initiated the Pradhan Mantri Ujjwala Yojana (PMUY), a scheme to provide free LPG connections to households below the poverty line. Connections under PMUY are issued in the name of adult females within eligible households. PMUY diverges from the PAHAL scheme in two key respects: it subsidizes connections rather than consumption, and it specifically targets women from below-poverty-line households. Under PMUY, the government extends cash assistance to cover the initial cost of Rs.1600 for an LPG connection. Additionally, oil marketing companies (OMCs) offer new consumers the option of equated monthly instalments (EMIs) to cover the expenses associated with acquiring a cooking stove and the first refill. The average subsidy disbursed under PMUY between 2017 and 2021 amounted to INR 42 billion per year, a notable difference from the average annual subsidy of INR 192 billion under PAHAL (DBTL) during the same period.

As a result of these initiatives, access to clean cooking fuels has increased significantly over the past three decades. Figure 1 illustrates the share of households reporting LPG as the primary cooking fuel based on five rounds of the NFHS. The share has increased in urban and rural India over the past three decades. In urban areas, there is an almost linear trend

in the increase in access. In rural India, access has increased faster since 2005, with a further acceleration after 2015.

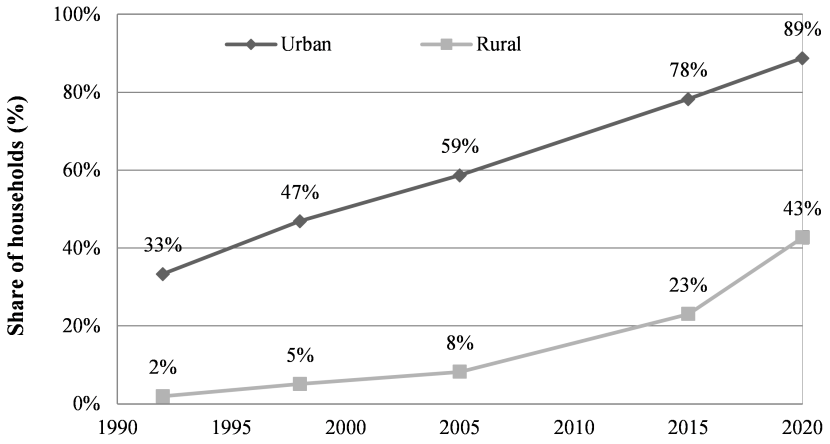

Figure 1: Share of households using LPG as primary cooking fuel in India. Source: NFHS

4 Data and Methodology

4.1 Data

We make use of two rounds of NFHS for information on women's outcomes and usage of LPG as the primary cooking fuel. NFHS is a large demographic health survey that is administered by the Ministry of Health and Family Welfare (MoHFW),[3] Government of India, and is a part of the global Demographic Health Survey (DHS) program. We use the fourth and fifth round of NFHS conducted in the year 2015-16 and 2019-21, respectively. The NFHS administers a separate survey for women aged between 15 and 49 in all the sampled households to collect detailed information on their health, nutrition, marriage, sexual activity, fertility preferences and decision making in the house. We use the women's module to construct our outcome variables.

The first outcome variable, *Mobility* is an index created using the female's response on the following survey questions: a) are you allowed to go to the market alone b) are you

[3]It is conducted by the International Institute for Population Sciences (IIPS).

allowed to go to the health facility alone c) are you allowed to go to places outside this village alone. The mobility index takes a value 1 if the female responds yes to either of the three questions and 0 if she is not allowed to go unaccompanied or at all to all three places. The second outcome is an index of women's financial autonomy which is constructed using the following questions: a) do you have any money of your own that you alone can decide how to use b) do you have a bank or savings account that you yourself use? The index takes a value 1 if the female responds yes to either of the questions and 0 if the response is no to both the questions. The third outcome variable is *Decision* which is also an index constructed using the following questions: a) the person who usually makes decisions regarding respondent's healthcare b) the person who makes decisions regarding large household purchases c) the person who makes decisions regarding respondent's visit to family and relatives d) the person who makes decisions regarding the money that husband earns. The index takes a value 1 if female has full/some say in making these decisions and 0 if the female has no say.

The above three variables are used as indicators of women agency. In addition, we look at women employment outcomes and the number of years of education for young females (aged below 23 years) who may decide to continue education as the house switches to a clean cooking fuel. We also look at health outcomes of women measured as whether the woman has a heart disease or a respiratory ailment. These health outcomes have been chosen as they have been shown to be influenced by a reduction in IAP (Dennis et al., 1996; Gordon et al., 2014; Liu et al., 2007; Ezzati and Kammen, 2001).

The summary statistics, reported in Table 1, show that the likelihood that a female is allowed some mobility at her own will is 61% in 2015-16 which only marginally improves over the sample period. However, there is a significant increase in female's financial autonomy over the sample period with around 85% women reporting some financial autonomy by 2019-21. The likelihood of females having some decision making power is 87% in 2015-16 that marginally improves to 90% in 2019-21. The likelihood of a female being employed in the last 12 months is around 0.31 in our sample. However, the likelihood of them being employed

in paid employment is a meagre 4%. Women in our sample have, on average, seven years of education. Around 1% and 1.5% women report facing heart and respiratory disease, respectively.

NFHS also collects information on a range of household characteristics including primary cooking fuel used in the house as well as whether the household is a BPL household. Table 1 shows that the likelihood of a female reporting that her household uses LPG as the main cooking fuel is 0.35 in 2015-16 and that increases to 0.50 in 2019-20 - a considerable increase in a four year span. This increase could partly be driven by the PMUY program and we empirically test this in the next section.

Another commonly used data source for cooking fuel used by the households is the ACCESS data. Even though ACCESS is a panel data, there are two main reasons we prefer NFHS over ACESS to analyse the impact of the PMUY scheme. Firstly, the survey was conducted in six clean-energy-deprived states. It is likely that the adoption of LPG as a primary fuel depends on its village-level penetration as a cooking fuel. Hence, analysing data from energy-deprived states may underestimate its impact. Secondly, the survey does not collect demographic and socioeconomic data at the individual and household level, limiting its use to analyse the impact on social and economic outcomes. However, we acknowledge that NFHS does not have information on actual LPG consumption or refills of cylinders that ACCESS does. But, it is possible that refills of cylinders or household estimates of LPG consumption may not entirely translate into domestic consumption due to the possibility of diversion for commercial purposes.

4.2 Empirical Methodology

We identify the impact of the policy in a difference-in-difference framework wherein we compare clean fuel usage and women's outcomes for BPL households with non-BPL households before and after the policy. Thus, methodologically, our paper is similar to (Gill-Wiehl et al., 2022) who also make use of a DID methodology to study the impact of PMUY on LPG con-

sumption. However, this paper is unable to disentangle the impact of PMUY from other existing schemes introduced for BPL households during the sample years. Additionally, our paper looks at the impact of PMUY on a range of socio-economic outcomes for women. In particular, we estimate the following regression equation:

$$Y_{i,d,s,t} = \alpha + \beta_d + \delta Post_t + \theta BPL_i + \gamma BPLXPost_{i,d,s,t} + Z_i^{'}\nu + \epsilon_{i,d,s,t} \quad (1)$$

where Y denotes the outcome for woman i residing in district d, state s in NFHS round t. BPL is a dummy variable indicating that the woman belongs to the BPL household. $Post$ takes a value 1 for NFHS round five and partials out the effect of common trend of clean fuel usage across districts and BPL and non-BPL households. The interaction between BPL and $Post$ is the variable of interest and the estimated coefficient γ indicates the difference-in-difference impact of introduction of PMUY on women's outcomes. The specification includes district dummies that partial out the impact of district specific time-invariant factors affecting clean fuel usage and women's outcomes. The specification also controls for a battery of individual level controls including birth-year dummies, caste and religion of the female, years of education, marital status, relationship to the head of the household and whether the woman smokes. We also add a range of household level controls that are expected to impact women's outcomes including household wealth, source of drinking water for the house, whether the household has electricity, number of children below the age of five in the house, number of adult women in the house and gender of the household head. We cluster the standard errors at the district level to allow shocks to clean fuel usage and women's outcomes to be correlated within a district over time.

5 Results

We begin our results by first establishing that PMUY scheme indeed improves the access to LPG for women belonging to BPL households. Results obtained from estimating equation

1 are reported in column 1 of Table 2. The results show that BPL households have a lower likelihood of using LPG than non-BPL households; and that LPG adoption is higher in 2019-20 as compared to 2015-16. Importantly, we find that the coefficient of the interaction is positive and significant. The magnitude of the coefficient suggests that likelihood of BPL women reporting LPG as their primary fuel goes up by 2.2% points in the post policy period. This represents a 17% increase in clean fuel usage when compared with the average likelihood of LPG usage as primary fuel in rural areas in 2015-16 (before the introduction of the policy).

An important identification assumption in the estimation of above specification is that clean fuel consumption in BPL households did not not differentially increase before PMUY was implemented. However, this assumption is likely to be violated if other policies introduced before PMUY affected cooking fuel choice of households. While we have provided a discussion in the earlier section that most of the pre-PMUY policies that subsidised clean cooking fuel were universal in nature and not targeted to BPL households, it is possible that these policies ended up primarily benefiting BPL households. It is also possible that other government programs for BPL households improved their disposable income allowing them to switch to clean energy options. The Indian government launched several schemes aimed at improving the welfare of the poor in the 2016 to 2021 period[4]. In addition, state governments routinely introduce welfare policies for the poor. Since these policies can potentially affect LPG usage among BPL households, we provide suggestive evidence to address this concern.

We re-estimate equation 1 using the third and fourth rounds of NFHS data conducted in 2005-06 and 2015-16, respectively - the pre-PMUY period. While, the period between 2005 and 2015 did not have PMUY, there were many other policies that could have differentially affected clean fuel consumption of BPL households. If these policies, instead of PMUY, are responsible for the observed positive coefficient on the interaction in column 1, we should also see a positive significant coefficient on the interaction for the pre-PMUY period. How-

[4]Most of these schemes were in the sector of education, health, rural development, employment generation and improvement of agriculture productivity etc.

ever, results estimated using the pre-PMUY period (column 2) confirm that there was no differential increase in the use of LPG as primary cooking fuel for the BPL households in the pre-policy period allaying concerns of pre-existing policies driving the observed increase in clean fuel consumption.

We now report the impact of the policy on indicators of women agency. While we acknowledge that gender norms that relate to socio-economic status of women are sticky, we carefully choose indicators of women agency that have earlier been shown to be impacted by government programs and policies in the short run (Rajkhowa and Qaim, 2022; Sedai et al., 2021). The first three columns of Table 3 look at the index of mobility that takes a value 1 if the woman is allowed to move outside her home without any permission. The first column is restricted to only rural households as the policy is expected to have a stronger effect in rural areas where a large proportion of households make use of polluting cooking fuels due to easy access to firewood[5]. The second column estimates a triple DID estimation wherein we test the differential impact of the policy on rural households as compared to the urban households. The third column estimates the second specification and adds the interaction between state dummies and round trend. This partials out the impact of state level variables that change with NFHS round on women outcomes. Column 1 shows that there is increase in women's likelihood of reporting increased mobility by 2 percentage points. Column 2 shows that the impact of PMUY on women mobility is much higher in rural areas (infact the coefficient is insignificant for urban areas). This result remains robust to addition state dummies interacted with round trend, further providing suggestive evidence that other state-level policy changes are unlikely to be driving the impact.

We report the impact of PMUY on financial autonomy of women in columns 4, 5 and 6. There is a 4% point increase in the likelihood of BPL women reporting being financially independent after the policy. This amounts to a 7% increase as compared to the pre-policy average for BPL households. This increased financial autonomy is primarily concentrated

[5]As per the fifth round of NFHS, around 53% of rural households make use of firewood and animal dung as cooking fuel as opposed to 10% in urban areas.

in rural areas (column 5) and robust to addition of state dummies interacted with round trend. The last three columns report the impact on decision making of women regarding her own health, expenses in the house and her visits to her family. Our results show that women report having higher decision making power after the PMUY policy and this effect is primarily concentrated in rural areas. This table thus show that PMUY scheme improved the agency of women belonging to BPL households. Note that the sample size in this table is much smaller as compared to Table 2. This is because of non-reporting on many of the questions related to decision making and mobility.

Next, we report the impact of the policy on education outcomes for young girls (below the age of 23). Access to LPG potentially saves time for young girls from cooking and collecting firewood (Afridi et al., 2023) and they can utilise the saved time in studying. In line with existing work that has pointed that usage of clean fuel leads to improved education outcomes for girls (Biswas and Das, 2022), our results reported in Table 4, show that PMUY policy increases the number of years of education for young girls both in rural and urban areas. However, the effect size is modest - a possible reason for this could be that daily time saved for women from cooking and collecting firewood is close to an hour (Maji et al., 2021) which while may translate into large improvements in learning outcomes as girls can focus more effectively on their studies but may have limited impact on increasing number of years. A limitation of NFHS is that it does not collect data on learning outcomes and therefore we restrict our analysis to number of years of education.

Table 5 reports the impact of PMUY on employment outcomes for women above the age of 23 who are likely to have completed their education. The results suggest that the policy only had a weak positive impact on the likelihood of women being employed in the last 12 months and being in employment that pays (significant coefficient only in columns 3 and 6). While this may seem surprising given that we have documented positive impact of policy on education as well as other indicators of women agency, increasing employment outcomes of women have to proved to be extremely challenging as has been widely discussed in the

work on female labour force participation rate. See (Deshpande and Singh, 2021) for this discussion.

Next, we report the impact of PMUY on women's health outcomes in Table 6. Women who switch from traditional polluting cooking fuels to LPG due to the policy are likely to experience improvement in health outcomes due to a decline the exposure to IAP. As expected, our results show that BPL women in rural areas have a lower likelihood of suffering from heart disease and respiratory ailments after the policy. Quantitatively, our results show a decline in the likelihood of women experiencing heart and respiratory ailments by 7 and 13% as compared to the pre-policy mean for the BPL households. This is an important result as improved health outcomes can allow women to focus their time on other productive activities.

Heath outcomes of women are likely to also be significantly affected by outside air quality. Over the past decade and a half, air pollution in India has significantly increased with PM 2.5 levels increasing by 28 to 79% across different regions in India (Guttikunda and Nishadh, 2022). Deteriorating air quality related health ailments have also shot up (Brunekreef and Holgate, 2002; Glencross et al., 2020). Thus we ensure that our results observed in Table 6 are robust to outside air quality. We do that by adding the interaction between the air quality level (that excludes indoor air quality) and round trend in our regression specification. Our results, reported in Table 6, show that our results on health outcomes of women are robust to controlling for outside air quality.

We get district-level data on the level of PM 2.5[6] from Guttikunda and Nishadh (2022) for the year 2017[7] and use it as an indicator of air quality. The authors have developed the PM 2.5 levels apportioned by source by overlaying PM 2.5 data with fuel consumption and activity patterns. The data for 2017 shows that the share of biomass combustion in households in the total PM 2.5 is in the range of 16-48% in Indian districts. Excluding the

[6]PM 2.5 units is micro-gm per cubic meter.

[7]The reason we use PM 2.5 data for the year 2017 and not a more recent year is because source apportioned data on PM 2.5 is not publicly available for other years.

contribution of biomass combustion is important to control the impact of air quality due to pollution from other sources such as power generation, industrial manufacturing, transport, dust, etc. Note that our paper is one of the first few studies to use data on PM 2.5 to control for the level of outside air pollution when studying the impact of clean fuel usage on health outcomes.

5.1 Variation by initial eligibility

In this section, we examine if the PMUY policy has a larger bite in districts where initial usage of LPG as the main cooking fuel is low. The PMUY policy was introduced for those BPL households who did not have a LPG connection. Based on the information provided in NFHS, we compute the proportion of PMUY eligible population in a district in the pre-policy period using NFHS - IV data and interact it with $BPLXpost$ interaction to study heterogeneous impact of the policy by initial eligibility.

Results, reported in Table 8, present interesting insights. Column 1 shows that the coefficient on the triple interaction is negative and significant suggesting that the increase in the usage of LPG as a major cooking fuel is higher in districts that have high proportion of existing LPG users (or low PMUY eligible population). In particular, the impact on the likelihood of using LPG as a major fuel increases by 11% points when there is one standard deviation increase in proportion of population eligible for the program (0.20). This is lower than the coefficient of the $bplXpost$ which indicates the impact of the program in districts with close to 0 eligible population.

We think that the lower usage of LPG as the main cooking fuel in districts with high eligible population could be driven by either the policy being less effective in high eligibility districts with lower connections disbursement or it could be because of lower usage of LPG as the main cooking fuel in districts where LPG usage was low to begin with. While we do not have direct evidence for the latter, we utilise district wise connections disbursement under PMUY to provide evident against the former. The district wise data on PMUY connections

uptil 2019 is made available by the Ministry of Petroleum and Natural Gas - the nodal ministry responsible for PMUY implementation. We check the correlation between initial district eligibility and connections disbursed under the program. Table 9 shows that the correlation is positive suggesting that high eligibility districts did get higher connections.

Additionally, we provide suggestive evidence that supports the latter explanation. The Government of India, through a National Indicator Framework (NIF), monitors the progress of households using clean cooking fuel using the number of LPG and PNG (piped natural gas) connections. According to the NIF Progress Report 2023, the percentage of households with an LPG or PNG connection in India rose from 63% in 2015-16 to 98% in 2019-20[8]. However, as per NFHS data, the households having access to LPG in 2015 and 2019 were 42% and 58%, respectively. The difference in the estimates could be the high refilling cost of LPG cylinders and the practice of fuel stacking in households, where many may have an LPG connection but do not use it as their primary cooking fuel (Gould and Urpelainen, 2020).

Further, our finding of lower impacts in districts with lower adoption rates also aligns with the technology diffusion curves typically seen with new technologies wherein, in the early stages, the adoption rate is slow, but it increases as penetration grows (Rogers et al., 2014). The existing work has also suggested peer effects in penetration of LPG usage suggesting that the propensity of the population to use LPG as a main cooking fuel is lower in places where usage of LPG is lower in community (Mani et al., 2020). Thus the lower usage of LPG as the main cooking fuel is possibly driving the negative coefficient on the triple interaction in Table 8.

Since high eligibility districts see lower usage of LPG, we also expect lower positive impact on likelihood of being employed as well as health outcomes of women as these outcomes are directly related to consumption of LPG and do not necessarily get impacted by having connection alone. As expected columns 5 to 9 show that the coefficient on triple interaction

[8]These figures are derived from estimates provided by the oil marketing companies responsible for supplying these connections to consumers.

is negative and significant in line with column 1. Unless women, who have a LPG connection, use it for cooking, we do not expect to see increased employment or improved health outcomes.

Columns 2 to 4, however, show that districts with high initial program eligibility observe a higher increase in women's indicators of mobility index, financial autonomy and decision-making. While this may seem surprising, the PMUY policy was explicitly designed to be gender-responsive wherein the LPG connections were issued to women and households with adult women were only eligible to get a new LPG connection under the policy. These differential effects thus suggest that issuing a connection in the name of a woman plays a significant role in improving their socio-economic outcomes even though they may not necessarily be using LPG as their primary fuel for cooking. While these results are in line with Lee et al. (2024), our study additionally reveals that the increase in women's empowerment is primarily facilitated through the connection channel rather than the consumption channel.

5.2 Robustness checks

We identify the impact of the PMUY policy on women's outcomes by comparing BPL households with non-BPL households. However, the non-BPL households is a large category that also includes households which have much higher wealth and income levels as compared to the BPL category. Inclusion of significantly wealthier women in the control group may lead to divergent trend in the outcome across BPL and non-BPL households pre-PMUY. We ensure that this is not confounding our results by excluding wealthy women from our data. In particular, we divide the wealth distribution of women in our sample in five equal quantiles and exclude women who belong to households in the top two quantiles from our analysis. All our results (available on request) remain robust to this exclusion.

As an additional test, we remove controls that are possibly endogenous and keep only exogenous covariates in our specifications. In particular, we remove the wealth level of the household the female belongs to, the education of older women, whether the house has an

electricity connection, the source of drinking water for the house, and whether the woman smokes or not. Our results (available on request) remain robust to considering only exogenous covariates.

6 Discussion and Conclusion

Recent research on the causal impact of using clean cooking fuel shows positive outcomes on women's health (Maji et al., 2021; Azam, 2023) and empowerment (Lee et al., 2024). A positive impact of government-administered clean cooking programs on women's health and labour supply is also documented (Verma and Imelda, 2023). This study contributes to this nascent body of literature by examining the gendered impact of clean energy access due to gender-responsive energy policies. Few countries have implemented large-scale clean cooking policies designed to reduce reliance on imported fossil fuels by reconfiguring universal subsidies to subsidies targeted at women.

In this study, we assess the impact of India's Pradhan Mantri Ujjwala Yojana (PMUY) scheme, which aims to subsidize LPG connections for women from economically and socially disadvantaged households. Since the implementation of the PMUY scheme in 2016, eighty million connections were disbursed by the end of 2019. In the second phase of the scheme, an additional 16 million connections have been disbursed by 2022. Concurrently, India has gradually reduced LPG consumption subsidies under the PAHAL program from Rs 130 billion in 2016-17 to Rs 1.8 billion in 2022-23. Conversely, the average annual subsidies under the PMUY scheme during 2016-2023 amounted to Rs 44 billion. Assessing the scheme's impact is critical, as current evidence shows a positive impact on the number of connections but a limited impact on actual consumption (Kar et al., 2019; Gould et al., 2020; Gill-Wiehl et al., 2022).

In a difference-in-difference framework utilizing nationally representative cross-sectional data collected before and after the implementation of the PMUY scheme, we assess the

impact of LPG use on women's health and empowerment indicators. Our analysis corroborates existing findings in the literature regarding the positive impact of the PMUY scheme on households reporting LPG as the primary cooking fuel. We confirm that this impact is specifically driven by the PMUY scheme and not by other concurrent policies.

We find a positive impact of the PMUY scheme on women's health, employment, and educational outcomes. Additionally, the scheme enhances women's mobility, financial autonomy, and decision-making power. We find a relatively modest impact on employment and education outcomes compared to health and empowerment indicators. Interestingly, women in PMUY households from districts with initially lower clean energy access experience smaller gains in health, employment, and educational outcomes but greater improvements in mobility, financial autonomy, and decision-making power. It is likely that the observed improvements in health, employment, and education are driven by changes in consumption patterns. In contrast, the enhancements in mobility, financial autonomy, and decision-making power are attributed to the LPG connections being registered in women's names. This finding underscores the importance of the scheme's gender-responsive design in promoting women's empowerment through the connection channel.

Research has shown that empowered women are more likely to choose clean cooking fuels (Odo et al., 2021; Ghosh et al., 2024; Choragudi, 2024). While the PMUY scheme may have a limited impact on the consumption of clean cooking fuels in regions with lower initial energy access, its effect on empowerment through connections can facilitate future clean fuel adoption. Furthermore, as clean fuel usage increases in these regions, peer effects may further drive adoption. Few studies have demonstrated social spillover effects in a household's decision to use clean cooking technologies (Srinivasan and Carattini, 2020). Transition to clean cooking fuel changes women's perspectives on the relationship between fuel and well-being (Malakar and Day, 2020).

This study demonstrates the impact of a clean cooking fuel policy in an emerging economy where prior efforts to increase clean cooking access have met with limited success. Khan-

delwal et al. (2017) examined the reasons behind the failure of India's improved cookstove programs. While the research pointed to resistance to improved stoves and obstacles to adoption, the authors argued that addressing the priorities of rural Indian women required either capital-intensive investment or challenging powerful institutions, which the improved cookstoves failed to offer. Our findings offers evidence that a gender-responsive policy like PMUY is effective in improving access to clean cooking fuel and consequently women's socio-economic outcomes both through connections and consumption channels.

7 Tables

Table 1: Summary statistics

Variable	Mean (NFHS - IV)	Mean (NFHS - V)	Mean
LPG	0.349	0.506	0.427
Mobility	0.608	0.633	0.620
Fin auto	0.650	0.851	0.744
Decision	0.870	0.905	0.886
Employed	0.305	0.323	0.313
Paid employed	0.043	0.040	0.041
Education	6.706	7.417	7.066
Heart disease	0.015	0.007	0.011
Respiratory disease	0.016	0.014	0.015
BPL card	0.389	0.499	0.445

Notes: LPG is a dummy variable that takes a value 1 if the household reports using LPG as the main cooking fuel. *Mobiity* is an index that takes a value 1 if the female is allowed some mobility to go to places outside her home at her own will and 0 otherwise. *Finauto* is index of financial autonomy that takes a value 1 if the female has cash in hand to spend or has a bank account; and 0 otherwise. *Decision* is an index that takes a value 1 if the woman has some decision making power and 0 otherwise. *Employed* is a dummy variable that takes a value 1 if the female worked in the past 12 months. *Paidemployed* is a dummy variable that takes a value 1 if the female was paid for the work she did in the last 12 month. *Education* is the years of education for females below the age of 23. *Heartdisease* is a dummy variable that takes a value 1 if the female is suffering from heart disease. *Respiratorydisease* is a dummy variable that takes a value 1 if the female is suffering from respiratory disease. *bplcard* is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household.

Table 2: Impact of PMUY on clean fuel usage

	(1) LPG	(2) LPG
bplXpost	0.022***	-0.003
	(0.005)	(0.018)
post	0.164***	0.148***
	(0.005)	(0.020)
bplcard	-0.012***	-0.009
	(0.003)	(0.017)
Observations	960826	517923
District FE	Yes	No
Birth year FE	Yes	Yes
Controls	Yes	Yes
BPL pre-treat mean	0.13	0.05

Standard errors in parentheses

Notes: LPG is a dummy variable that takes a value 1 if the household reports using LPG as the main cooking fuel. *bplcard* is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household. *post* takes a value 1 for the fifth round of NFHS conducted in 2019-21. *bplXpost* is the interaction between *bplcard* and *post*. Standard errors are clustered at the district level in all specifications.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Impact of PMUY on women agency

	(1) Mobility	(2) Mobility	(3) Mobility	(4) Fin auto	(5) Fin auto	(6) Fin auto	(7) Decision	(8) Decision	(9) Decision
bplXpost	0.021***	-0.005	-0.016*	0.038***	0.008	-0.012*	0.009*	-0.003	-0.001
	(0.007)	(0.009)	(0.009)	(0.006)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)
bplXpostXrural		0.028***	0.024***		0.047***	0.042***		0.011*	0.012**
		(0.009)	(0.009)		(0.007)	(0.006)		(0.006)	(0.006)
post	0.063***	0.060***		0.225***	0.201***		0.037***	0.039***	
	(0.006)	(0.005)		(0.006)	(0.005)		(0.004)	(0.004)	
bplcard	-0.010**	-0.008*	0.001	-0.009*	-0.012***	0.001	-0.003	-0.002	-0.003
	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
rural		-0.050***	-0.049***		-0.013***	-0.013***		-0.004	-0.005
		(0.005)	(0.005)		(0.004)	(0.004)		(0.003)	(0.003)
Observations	153270	210534	210534	153270	210534	210534	109288	147823	147823
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Round trend	No	No	Yes	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BPL pre-treat mean	0.57	0.58	0.58	0.59	0.61	0.61	0.85	0.86	0.86

Standard errors in parentheses

Notes: Mobiity is an index that takes a value 1 if the female is allowed some mobility to go to places outside her home at her own will and 0 otherwise. *Finauto* is index of financial autonomy that takes a value 1 if the female has cash in hand to spend or has a bank account; and 0 otherwise. *Decision* is an index that takes a value 1 if the woman has some decision making power and 0 otherwise. *bplcard* is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household. *post* takes a value 1 for the fifth round of NFHS conducted in 2019-21. *bplXpost* is the interaction between *bplcard* and *post*. *rural* takes a value 1 if the female's household resides in a rural area. *bplXpostXrural* is the interaction between *bplXpost* and *rural*. Standard errors are clustered at the district level in all specifications.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Impact of PMUY on women education

	(1) Education	(2) Education	(3) Education
bplXpost	0.211***	0.087**	0.102**
	(0.032)	(0.043)	(0.042)
bplXpostXrural		0.155***	0.145***
		(0.044)	(0.044)
post	2.061***	2.229***	
	(0.040)	(0.035)	
bplcard	-0.292***	-0.280***	-0.281***
	(0.025)	(0.022)	(0.021)
rural		0.252***	0.251***
		(0.032)	(0.032)
Observations	307739	406527	406527
District FE	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes
State-Round trend	No	No	Yes
Controls	Yes	Yes	Yes
BPL pre-treat mean	7.84	8.1	8.1

Standard errors in parentheses

Notes: Education is the years of education for females below the age of 23. *bplcard* is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household. *post* takes a value 1 for the fifth round of NFHS conducted in 2019-21. *bplXpost* is the interaction between *bplcard* and *post*. *rural* takes a value 1 if the female's household resides in a rural area. *bplXpostXrural* is the interaction between *bplXpost* and *rural*. Standard errors are clustered at the district level in all specifications.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Impact of PMUY on women employment

	(1) Employed	(2) Employed	(3) Employed	(4) Paid employed	(5) Paid employed	(6) Paid employed
bplXpost	0.008	-0.008	-0.019**	-0.002	-0.003*	-0.005***
	(0.007)	(0.009)	(0.009)	(0.001)	(0.002)	(0.002)
bplXpostXrural		0.011	0.015*		0.002	0.003+
		(0.009)	(0.009)		(0.002)	(0.002)
post	0.010+	0.019***		-0.002*	-0.003***	
	(0.007)	(0.006)		(0.001)	(0.001)	
bplcard	0.018***	0.024***	0.027***	0.004***	0.005***	0.005***
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
rural		0.045***	0.044***		-0.002*	-0.002**
		(0.005)	(0.005)		(0.001)	(0.001)
Observations	104495	145254	145254	653199	895478	895478
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-Round trend	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
BPL pre-treat mean	0.37	0.35	0.35	0.05	0.05	0.05

Standard errors in parentheses

Notes: Employed is a dummy variable that takes a value 1 if the female worked in the past 12 months. *Paidemployed* is a dummy variable that takes a value 1 if the female was paid for the work she did in the last 12 month. *bplcard* is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household. *post* takes a value 1 for the fifth round of NFHS conducted in 2019-21. *bplXpost* is the interaction between *bplcard* and *post*. *rural* takes a value 1 if the female's household resides in a rural area. *bplXpostXrural* is the interaction between *bplXpost* and *rural*. Standard errors are clustered at the district level in all specifications.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Impact of PMUY on women health

	(1) Heart disease	(2) Heart disease	(3) Heart disease	(4) Respiratory disease	(5) Respiratory disease	(6) Respiratory disease
bplXpost	0.000	0.001**	0.001*	-0.000	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
bplXpostXrural		-0.002***	-0.001**		-0.003***	-0.003***
		(0.001)	(0.001)		(0.001)	(0.001)
post	-0.006***	-0.006***		-0.001	-0.000	
	(0.001)	(0.001)		(0.001)	(0.001)	
bplcard	-0.000	0.000	0.000	0.000	0.000	0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
rural		0.001**	0.001**		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
Observations	955575	1295137	1295137	956341	1296284	1296284
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-Round trend	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
BPL pre-treat mean	0.015	0.015	0.015	0.016	0.016	0.016

Standard errors in parentheses

Notes: $Heartdisease$ is a dummy variable that takes a value 1 if the female is suffering from heart disease. $Respiratorydisease$ is a dummy variable that takes a value 1 if the female is suffering from respiratory disease. $bplcard$ is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household. $post$ takes a value 1 for the fifth round of NFHS conducted in 2019-21. $bplXpost$ is the interaction between $bplcard$ and $post$. $rural$ takes a value 1 if the female's household resides in a rural area. $bplXpostXrural$ is the interaction between $bplXpost$ and $rural$. Standard errors are clustered at the district level in all specifications.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Impact of PMUY on women health - robustness to air pollution

	(1) Heart disease	(2) Heart disease	(3) Heart disease	(4) Respiratory disease	(5) Respiratory disease	(6) Respiratory disease
bplXpost	-0.000	0.001**	0.001^{+}	-0.000	0.002*	0.001^{+}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
bplXpostXrural		-0.002***	-0.002**		-0.002***	-0.002***
		(0.001)	(0.001)		(0.001)	(0.001)
post	-0.006***	-0.006***		-0.001	-0.002	
	(0.002)	(0.001)		(0.002)	(0.002)	
bplcard	-0.000	0.000	0.000	0.000	0.000	0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Air pollution	0.000	-0.000	0.000	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
rural		0.001**	0.001**		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
Observations	870257	1183546	1183546	870862	1184424	1184424
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-Round trend	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

Notes: $Heartdisease$ is a dummy variable that takes a value 1 if the female is suffering from heart disease. $Respiratorydisease$ is a dummy variable that takes a value 1 if the female is suffering from respiratory disease. $bplcard$ is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household. $post$ takes a value 1 for the fifth round of NFHS conducted in 2019-21. $bplXpost$ is the interaction between $bplcard$ and $post$. $rural$ takes a value 1 if the female's household resides in a rural area. $bplXpostXrural$ is the interaction between $bplXpost$ and $rural$. $Airpollution$ is the average level of PM 2.5 in a district. Standard errors are clustered at the district level in all specifications.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Heterogeneous impact by initial PMUY eligibility

	(1) LPG	(2) Mobility	(3) Fin auto	(4) Decision	(5) Employed	(6) Paid employed	(7) Education	(8) Heart disease	(9) Respiratory disease
bplXpost	0.141***	-0.066***	-0.064***	-0.013	0.095***	0.010**	0.152	0.006**	0.005**
	(0.017)	(0.019)	(0.020)	(0.015)	(0.025)	(0.005)	(0.109)	(0.003)	(0.002)
bplXpostXeligible	-0.154***	0.114***	0.136***	0.028	-0.119***	-0.016***	0.098	-0.008**	-0.007**
	(0.020)	(0.026)	(0.025)	(0.020)	(0.032)	(0.006)	(0.144)	(0.003)	(0.003)
post	0.163***	0.064***	0.222***	0.038***	0.015**	-0.001	2.150***	-0.006***	-0.000
	(0.005)	(0.006)	(0.006)	(0.005)	(0.007)	(0.001)	(0.043)	(0.001)	(0.001)
bplcard	-0.012***	-0.010**	-0.008^{+}	-0.003	0.034***	0.006***	-0.618***	-0.000	0.000
	(0.003)	(0.005)	(0.005)	(0.004)	(0.005)	(0.001)	(0.028)	(0.001)	(0.000)
Observations	863757	140202	140202	100014	95351	592832	281528	869795	870398
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

Notes: LPG is a dummy variable that takes a value 1 if the household reports using LPG as the main cooking fuel. *Mobiity* is an index that takes a value 1 if the female is allowed some mobility to go to places outside her home at her own will and 0 otherwise. *Finauto* is index of financial autonomy that takes a value 1 if the female has cash in hand to spend or has a bank account; and 0 otherwise. *Decision* is an index that takes a value 1 if the woman has some decision making power and 0 otherwise. *bplcard* is a dummy variable that takes a value 1 if the female belongs to the Below Poverty Line (BPL) household. *post* takes a value 1 for the fifth round of NFHS conducted in 2019-21. *bplXpost* is the interaction between *bplcard* and *post*. *bplXpostXeligible* is the interaction between *bplXpost* and the proportion of PMUY eligible population in the district. Standard errors are clustered at the district level in all specifications.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: PMUY connections and eligibility

	(1) PMUY connections (in lakhs)	(2) PMUY connections (in lakhs)
Eligible	1.860***	0.580***
	(0.201)	(0.208)
Observations	575	572
State FE	No	Yes

Standard errors in parentheses

Notes: $PMUY connections(inlakhs)$ is the total number of connections disbursed under the PMUY policy. Eligible is the proportion of PMUY eligible population in a district.

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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