Does reliable electricity reduce domestic violence? Evidence from India*

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Abstract

The positive effect of reliable electricity on household welfare is well-documented in the literature. However, little is known about any plausible impact of the reliability of electricity on domestic violence. Using nationally representative panel data from India, the exogenous variation of average hours of electricity excluding the home district of the respondent in an instrumental variable probit regression approach is adopted to explore any causal impact of the reliability of electricity on domestic violence. Results suggest that additional hours of electricity in a day significantly reduce the likelihood of domestic violence experienced by the female members of the household. We conjecture that the reliability of electricity improves female labour force participation, household economic standing, and shift in attitudes towards gender roles. Which in turn improves women's health and her bargaining power in the household and overall improvement in living standards. Our findings are robust to alternative identification strategies, including plausibly exogenous instrumental variable, Lewbel instrumental variable, and propensity score matching. Policymakers may follow progressive pricing mechanisms with targeted subsidies to ensure uninterrupted household electricity to reduce domestic violence, with broader social impacts.

Keywords: Electricity; domestic violence; gender; welfare

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1 Introduction

"Eliminating all forms of violence against all women and girls", is a part of the United Nation's Sustainable Development Goals[1] as such violence significantly impacts their physical and mental health (Ellsberg et al., 2008; Adam et al., 2010; Devries, Mak, Bacchus, et al., 2013) with increasing the obstetrics risk (Sardinha et al., 2022). Studies (Devries, Mak, Garcia-Moreno, et al., 2013; Stöckl et al., 2013) show that over 30% of women globally experience domestic violence. Existing literature (Farmer & Tiefenthaler, 1997; Kim et al., 2007; Bandiera et al., 2012; Duflo, 2012; Devries, Mak, Garcia-Moreno, et al., 2013; Ellsberg et al., 2015; Buller et al., 2018; Peterman et al., 2022) has highlighted the significance of interventions such as large-scale campaigns, edutainment programs, skills-building and economic empowerment initiatives, and participatory training, with an aim to change attitudes and norms, empower women and girls, and promote non-violent, gender-equitable behaviours. Additionally, infrastructure improvements like specialised police stations (Jubb et al., 2008), one-stop centres for gender-based violence (Keesbury et al., 2012), and enhanced street lighting and public transport safety are also essential to reduce opportunities for violence (Michau et al., 2015). Literature also suggests that access to information through electronic media, i.e., cable television, radio, and mobile phones, reduces the acceptance of DV among vulnerable women (IEG, 2008; Jensen & Oster, 2009; Lenz, Munyehirwe, Peters, & Sievert, 2017).

The success of many such initiatives to address the issue of domestic violence targeted towards women's empowerment and protect women from abuse is likely to be bound by reliable electricity. Furthermore, stable electrification could ensure the uninterrupted use of electrical devices, lighting appliances, and other home appliances such as refrigerators and coolers (Sedai, Nepal, & Jamasb, 2021), potentially reducing household stress that may shift attitudes towards domestic violence. Moreover, the time required for household activities decreases due to the use of these appliances, enabling women to pursue other economic activities as well (Dinkelman, 2011; Fletcher et al., 2017; Rathi & Vermaak, 2018; Ferrant

[1] https://sdgs.un.org/goals

& Thim, 2019; Klasen, 2019), thus, improving intra-household bargaining power through economic empowerment and making the women resistance to domestic violence.

While literature extensively documents the impact of electrification on women's empowerment and modernises gender roles (Kohlin et al., 2012; Wilhite, 2017), household welfare (Parikh, 2011; Rao, 2013; Chakravorty et al., 2014; S. R. Khandker et al., 2014; Aklin et al., 2016; Dang & La, 2019; Churchill et al., 2020; Sedai, Nepal, & Jamasb, 2021) and women's well-being including improvements in life expectancy, literacy, and economic participation (Cecelski, 2005; Kanagawa & Nakata, 2008; Dinkelman, 2011; Winther et al., 2017; Samad & Zhang, 2019; Sedai, Vasudevan, et al., 2021), limited attention has been paid on the role of reliable electricity on domestic violence. The noted exception includes Sievert (2015), who, using the linear probability model and propensity score matching, more descriptively explored the effect of access to electricity on intimate partner violence in rural sub-Saharan Africa. To the best of our knowledge, none of the studies conducted to date have attempted to establish a causal link between reliable electricity and domestic violence.

In this paper, we study the impact of increased electricity hours on the domestic violence faced by women in India. While the issue of gender equality is a primary concern worldwide, it is specifically salient in the Indian context. Sen (1992) argued that India had 41 million "missing women"—girls and women who prematurely succumbed to the mistreatment from the male-dominated society. The preference for boys over girls in India has become stronger over decades (Kugler & Kumar, 2017). More predominately, girls and women in India are discriminated against in education, health care, and nutrition (Borooah, 2004; Osters, 2009; Kumar et al., 2020). The recent round of the Family Health Survey (IIPS & ICF, 2021) suggests that, in India, approximately 32% of married women report experiencing domestic violence, physical abuse being the most common (28%), followed by emotional (14%) and sexual abuse (6%). This is exacerbated by its low-income and patriarchal society (Harris, 2000; Kalokhe et al., 2017; Mahapatro & Kumar, 2021). While the government of India introduced The Protection of Women from Domestic Violence (DV) Act, 2005[2] to provide

[2] https://www.tnsocialwelfare.tn.gov.in/en/social-legislations/protection-of-womens-from-domestic-violence-act

legal relief to women subjected to DV, the voices of abused women are often silenced within their homes (Rahman, 2020; Kaburi & Kaburi, 2023). Exposing households to reliable electricity might lead to women's economic empowerment, change in bargaining power, and reduce household tension by using electric appliances. It is this possibility that this paper is exploring.

The crucial feature of our paper is we examine the impact of reliable electricity on domestic violence originating from six different reasons - leaving without permission, having an extra-marital affair, lack of dowry, neglecting household duties, not being respectful, and lastly, cooking inadequacy. We also created three indices from these six primary variables of violence. The granular details enable us to understand if domestic violence as a phenomenon can be mitigated through reliable electrification or if the underlying causes for violence can introduce some heterogeneity. We used both rounds (2004-2005 and 2011-2012) of the Indian Human Development Survey (Desai et al., 2008) jointly conducted by the Maryland University and the National Council of Applied Economic Research, India. In this paper, we heavily rely on the 'Eligible Women' data of IHDS, which provides granular details of the incidence of domestic violence against women and the several reasons associated with violence. The women have been extensively interviewed about domestic violence, fertility preferences, health issues, pre-natal and ante-natal consumption, household dynamics and other related variables. We obtained a sample size of 73,511 eligible women using household and individual data.

On the methodological front, we employ a linear instrumental variable (IV) model, along with instrumental variable probit design, to assess the effect of hours of electricity on domestic violence. Following Bai et al. (2019); Dang and La (2019); Sedai, Vasudevan, et al. (2021), we create a geographical leave-one-out instrument, a mean of electricity hours in the state except for the home district of the individual. We have also adopted plausibly exogenous IV of T. G. Conley et al. (2012), Lewbel instrumental variable approach, and propensity score matching as robustness checks.

The findings suggest that for most reasons (except showing disrespect and ignoring house-

hold duties), the likelihood of violence significantly decreases with increased electricity hours. We find that an additional hour of household electricity reduces the likelihood of domestic violence due to leaving without permission, extramarital affairs, lack of dowry, and cooking inadequacy by 1.4, 1.4, 2.5, and 1.4 percentage points, respectively. These results are statistically significant, except for neglecting household duties and disrespect, which are also indicative of a reduction in violence but are imprecisely estimated. This suggests that while increased electricity reduces domestic violence for most reasons, the most significant reductions are for lack of dowry, followed by leaving without permission, cooking inadequacy, and extramarital affairs. To understand why some reasons for violence show a greater reduction than others, we examine how electrification reduces domestic violence. Increased electricity hours can enhance a household's economic status, women's economic security, productivity, living conditions, and bargaining power. This explains the greater reduction in domestic violence for reasons like dowry, leaving the house without permission, or cooking inadequacy, compared to reasons like disrespect. Therefore, we suggest that differences in the reduction of domestic violence are due to the pathways through which improved household electricity reliability affects its prevalence, for which we propose a detailed 'theory of change'. We also examined if the overall vulnerability of women decreases by evaluating the proportion of violence-related questions for which they have been physically abused. We find that the likelihood of physical abuse is reduced by one percentage point with an increase in one hour of electricity consumption in the household. The absolute number of "Yes" and the proportion of "Yes" also goes down with increased access to electricity hours. Essentially, not only is the threat of domestic violence reduced but also the severity of violence goes down with improved electricity access.

This study contributes to two strands of literature. First, we contribute to the literature on violence against women. While there is a rich extant literature on domestic violence, we provide novel evidence of reduced DV due to reliable electrification. Second, we add to the growing literature on the effects of and reliability of electrification. Policymakers may find reliable electrification as a potent channel to address the issue of violence against women.

Further, the channels explored in this study also highlight the importance of exposure to information and increased employment opportunities for women as significant factors in reducing DV.

The rest of the paper is arranged as follows. The next section elaborates on the background of domestic violence in India and the penetration of stable electrification in India and discusses the plausible links evolved in the existing literature on how reliable electricity impacts domestic violence. Section III describes the IHDS data. In Section IV, we explain the empirical strategy. Section V outlays the results on the impact of reliable electricity on domestic violence. Section VI offers some mechanisms behind the outcome. Section VII concludes.

2 Background and motivation

2.1 Domestic violence in India

Domestic violence is defined as the physical, emotional, sexual or economic abuse of women at the hands of the spouse or a family member. Globally, one in four women have faced domestic violence in one form or another, with the prevalence in South Asia averaging around 35% (Sardinha et al., 2018). Women in developing countries are at a higher risk of facing violence than women in developed nations (WHO, 2013). Such difference in the incidence of domestic violence stems from several reasons, such as the deep-rooted patriarchy and societal and cultural norms which undermine the value of women and restrict their autonomy. In patriarchal societies, limited value is conferred to women and their well-being. There exists a clear son preference within families with expecting mothers; such preference often leads to disregard for female child, girl-child abandonment or worse, sex-selective abortion. Female children are given less importance within households; their nutrition and well-being are secondary to that of a male child. This pattern persists till adulthood, when young girls are married at a tender age. Therefore, women are further disempowered due to low levels of education and, therefore, economic dependence on their partners. In their reproductive ages,

women only having girl children are susceptible to violence and abuse at the hands of family members or partner. Domestic violence is not unique to India, and neither is it a recent development. However, the inertia in taking action as a society to eliminate the prevalence of domestic violence is unusual in India. Domestic violence in India is not seen as a "crime against women"; instead, it is viewed as a "domestic issue". This leads to domestic violence and a lack of recognition of domestic violence as a serious societal issue.

Given the pervasive presence of domestic violence, several studies focus on potential channels to reduce violence against women. Several studies have shown that an increase in job market participation and an active source of income reduces the risk of violence against women. Earning women tend to have greater bargaining power and financial independence. Increased income also reduces the financial constraints within the household, reducing stress and conflict-related violence. The improved financial condition also improves the emotional well-being of individuals in the household, therefore decreasing abusive behaviour. The increased participation in the labour market also increases the women's decision-making power within the household, which makes them less vulnerable to abuse. Another mechanism which decreases domestic violence is the increased interaction with health facilities; through improved health outcomes, women become more resilient against any abuse towards them. This increased strength reduces the intensity and incidence of violence at home. Furthermore, increased participation in social and community interactions enhances the social status of women and increases the social cost of violence for their abuser.

2.2 Electrification in India

In the past few years, the government has been increasingly focused on increased electrification in India. Significant resources have been allocated to achieve the United Nation's Sustainable Development Goal-7, i.e. "ensure access to affordable, reliable, sustainable and modern energy for all". However, several roadblocks are present in the provision of universal electricity access in India. The lack of quality infrastructure and complementary policy initiatives (Sedai, Nepal, & Jamasb, 2021; Aklin et al., 2016), unaffordable electricity prices

and lack of robust financial structure of distribution companies are some of the major deterrents of universal electrification in India (Joseph, 2010; Allcott et al., 2016; Burgess et al., 2020). However, introducing the Electricity Act in 2003 revamped the electricity production industry significantly. The Act was implemented to consolidate the laws related to electricity generation, distribution and transmission. It was aimed to create a more conducive environment for the development of the electricity industry, encouraging competition, improving energy supply to all areas and prioritising the consumer interest. The act also aimed to improve transparency related to subsidised electricity access and rationalising electricity tariffs. The primary objective of the Act was to increase the accessibility of electricity by providing free electricity connections to below-poverty-line households and increasing the electrification in rural areas and habitations, which have a population of over 100 individuals. This initiative was also coupled with other public programs focused on electrification, such as the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) introduced in 2005 by the Government of India. The main objective of RGGVY was to provide electrification in all un-electrified villages across the country. RGGVY was a success and increased the village electrification rates from 59% in 2000 to 74% in 2010 (Rathi & Vermaak, 2018). Besides RGGVY, several other schemes have also been introduced to improve electricity accessibility. Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY), Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) and other such initiatives of state governments are supplementing the central government's efforts to ensure universal electricity access in India. Despite significant efforts and funds being invested to achieve universal electrification, the reliability of electricity is still low (Aklin et al., 2016; Kennedy et al., 2019; Klasen, 2019; Sedai, Nepal, & Jamasb, 2021). The major reason for regular electricity outages is the lack of commercial viability in the electricity distribution business (Pargal & Banerjee, 2014). Electricity is mainly managed by the government, who view the public as voters and not as consumers; this dichotomy leads to the under-pricing of electricity. The under-pricing of electricity acts as a means of garnering voters, leading to under-recovery of the cost of electricity. This is further exacerbated by electricity theft and losses during transmission and distribution. While

several studies have focused on the effects of electrification on various aspects of well-being (Dinkelman, 2011; Winther et al., 2017; Rathi & Vermaak, 2018; Samad & Zhang, 2019; Sedai, Nepal, & Jamasb, 2021), there is a lack of understanding of the effect of electrification on violence against women in Indian households.

2.3 Anticipated Effects from Existing Literature

Increased electrification can potentially bring about changes within households and enterprises that may shift attitudes towards domestic violence. Due to electrification, households tend to acquire electrical devices, lighting appliances, and other home appliances such as refrigerators and coolers (Sedai, Nepal, & Jamasb, 2021). Such appliances bring a certain comfort to everyday life, reducing intra-household stress. Furthermore, the time required for household activities decreases due to the use of these appliances, enabling women to pursue other economic activities as well (Dinkelman, 2011; Fletcher et al., 2017; Rathi & Vermaak, 2018; Ferrant & Thim, 2019; Klasen, 2019). Electrification also improves access to information through TV, radio, and mobile phones, which can influence attitudes towards domestic violence (IEG, 2008; Jensen & Oster, 2009; Lenz et al., 2017). The cumulative effect of increased leisure time, the convenience provided by appliances, and exposure to information through TV and radio enhance women's overall well-being and status in households by reducing stress, increasing work participation, and promoting progressive gender beliefs. This results in improved attitudes towards women and reduces domestic violence.

On the other hand, enterprises experience a hike in productivity due to electrification, which increases the demand for labour. This spike in productivity also increases individuals' earnings as the enterprise becomes more profitable (Van de Walle et al., 2017; Rathi & Vermaak, 2018; Sedai, Vasudevan, et al., 2021). Electrification also enables new businesses and factories to emerge in the region, further contributing to the demand for labour. A notable improvement in female labour participation following electrification has been prominently shown by Rathi and Vermaak (2018); Sedai, Vasudevan, et al. (2021) in India, Dinkelman (2011) in South Africa, Dasso and Fernandez (2015) in Peru, and Chhay and Yamazaki

(2021) in Cambodia, Grogan and Sadanand (2013) in Nicaragua. With increased employment opportunities, not only can female labour participation increase, but the economic well-being of the entire employed population also improves, and overall unemployment decreases. Therefore, the overall economic well-being of households is likely to improve with electrification in the region. All these factors eventually reduce financial stress within households. Literature suggests that financial stress leads to intra-household conflicts (Fox et al., 2002; Anderson & Baland, 2002; Anderson & Eswaran, 2009; Duflo, 2012; Winther et al., 2017; Buller et al., 2018; Peterman et al., 2022). So, the reduction in financial stress due to economic gains from electrification can lead to fewer intra-household conflicts, which reduces the incidence of violence against women. Aizer (2010); Heath (2012) also demonstrate that a rise in wages for females decreases domestic violence against them.

The increase in labour force participation increases women's contribution to household income and, therefore, shifts the power dynamics within the household in favour of women (Goode, 1971; Jewkes, 2002; Anderson & Baland, 2002; Anderson & Eswaran, 2009). The shifts in attitude towards women and their increased financial independence enable women to have a greater say within the household. From household decisions to fertility preferences and financial decisions, women's input becomes more relevant with the increased assertion that comes through financial independence.

Additionally, the increased household income and a favourable shift in attitude towards women lead to improved reproductive health, investment in nutrition, and better living conditions, resulting in an overall improvement in her health (Duflo, 2012). Improved health outcomes also mitigate the risk of domestic violence against women (Buller et al., 2018; Peterman et al., 2022). The cumulative influence of increased bargaining power, social status, improved health, financial security, and participation in household decision-making acts as a shield against domestic violence.

While the effect of electrification on domestic violence is nuanced, based on the literature discussed above, we propose a plausible "theory of change" in Figure 1.

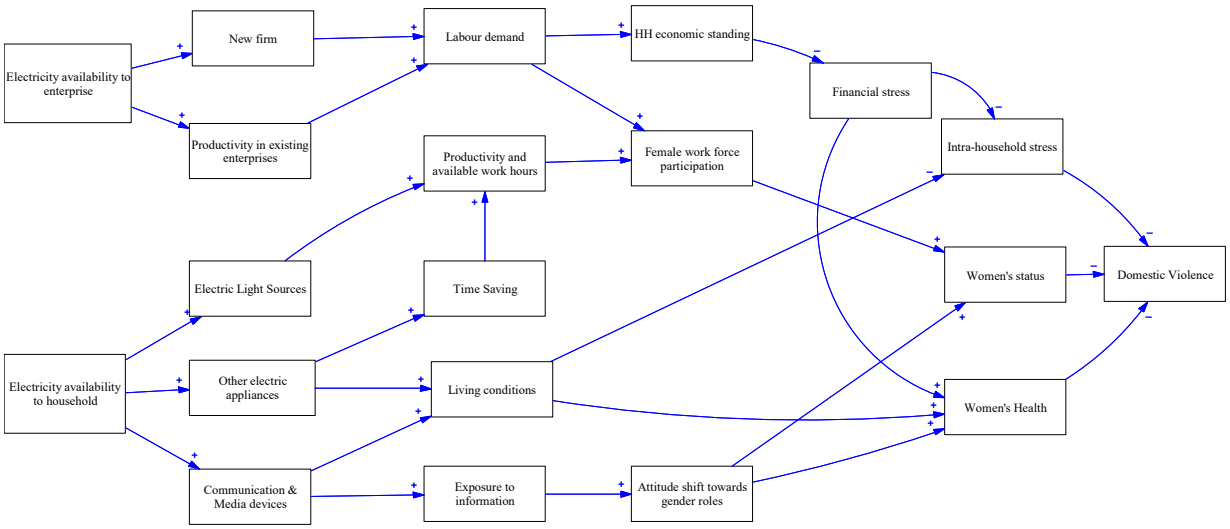


Figure 1: ***Theory of change***

Source: Own illustration

3 Data

The primary objective of this study is to estimate the effect of electricity access on the incidence of domestic violence against women in India. Therefore, we have used the Indian Human Development Survey (IHDS) Panel data (2004-2005, 2011-2012). The IHDS is the largest representative data, spanning 41,554 households in 1503 villages and 971 urban neighbourhoods across India. The IHDS data is collected through the joint efforts of NCAER and Maryland University. IHDS has a wide-ranging survey at the individual, household, and village levels, which has demographic and socio-economic variables. IHDS conducts a multi-topic survey having questions across health, education, income, socio-economic status, marital status, employment, agricultural and many other modules of data. This richness of the data enables us to control for several confounding variables, strengthening our analysis. In this paper, we heavily rely on the 'Eligible Women' data, which provides granular details of the incidence of domestic violence against women and the several reasons associated with violence. The women have been extensively interviewed about domestic violence, fertility preferences, health issues, pre-natal and ante-natal consumption, household dynamics and

other related variables. We obtained a sample size of 73,511 eligible women using household and individual data. The sample is focused on women who have ever been married and are aged between 15-78 years. Since our independent variable is hours of electricity available to a household, we also exclude households which do not have electricity access. We also conducted a secondary analysis using alternate empirical methods and performed several robustness checks using the data.

The dependent variable in this study is drawn from the women's survey of the IHDS dataset. Women aged 15-78, who have ever been married are a part of the population surveyed for this module. The module includes questions regarding the health outcomes of women, participation in the labour force, education and time use details, as well as violence and security-related questions. Even though domestic violence includes physical, emotional, sexual and economic abuse, in this study, we focus on the physical form of violence alone. The primary focus of this paper is on the domestic violence module. There are six questions, each focusing on whether the woman is subjected to physical violence for a particular reason. The reasons for the perpetration of physical violence are as follows- (1) leaving without permission, (2) having an extra-marital affair, (3) being beaten for lack of dowry, (4) neglecting household duties, (5) not being respectful, and lastly (6) beaten for cooking inadequacy. We study the effect of reliable electrification on each of these variables. The granular details enable us to understand if domestic violence as a phenomenon can be mitigated through reliable electrification or if the underlying causes for violence can introduce some heterogeneity. We also create three indices from these six primary variables of violence. The first index is a binary variable which takes value one if the woman is 'ever beaten' for any of the six reasons. Essentially, if a woman answers 'Yes' for any of the granular violence-related questions, 'ever beaten' takes value 1. This variable enables us to assess the effect of electricity hours on domestic violence as a phenomenon. It would highlight if women are likely to be protected against domestic violence with increased hours of electricity. We also created another variable to record the number of 'Yes' answers to the six questions related to domestic violence. This variable will give us an understanding of the intensity of

the domestic violence faced by women and how electricity hours affect it. Another index that we created using the six violence questions is the per cent of questions for which the woman answered 'Yes'. This variable also gives an understanding of the intensity of domestic violence as a proportion of the number of 'Yes' over the total number of questions answered of the six violence-related questions.

As presented in Table 1, we can see a clear trend of increased exposure to domestic violence. In IHDS-I, 36% of women were subjected to violence at home for leaving without permission, as opposed to a staggering 51% women in IHDS-II in 2012. A similar trend is present for the other five variables of physical violence as well. The proportion of women facing domestic violence in the form of physical assault has increased categorically. Furthermore, it is also evident that the highest risk of physical violence is in the case of an extra-marital affair, with roughly 84% of women answering in the affirmative. These statistics highlight that the reason behind violence is also a significant factor in the incidence of domestic violence. We, therefore, focus our study on these variables to gain a nuanced understanding of domestic violence.

4 Empirical strategy

4.1 Baseline Model and Endogeneity

In this paper, the main hypothesis is whether the prevalence of domestic violence against women in the household is affected by electricity reliability. The preliminary analysis (baseline model) that we run uses the following specification for a woman i in district d at time t, employing the longitudinal dataset as described above:

$$Y_{idt} = \beta E_{idt} + \gamma X_{idt} + \theta_d + \pi_t + \epsilon_{idt} \tag{1}$$

where, Y_{idt} represents the outcome variable of interest, specifically various measures of domestic violence against women i in district d at time t, as discussed in the previous section (3). The variable E_{idt} denotes the hours of electricity in the household of the woman i in dis-

trict d at time t. The vector X_{idt} includes controls for individual observable demographic and socioeconomic characteristics such as the woman's age, education, marital status, whether the husband is from the same village, her relationship to the household head, husband's education, household size, household size by age and gender categories (adults aged 21+, male adults aged 21+, female adults aged 21+, boys under 15, girls under 15), household size by marital status (married males, married females), annual income, poverty status (using Tendulkar's cutoffs (Planning Commission, 2009)), urban residency, socio-religious categories, and amount of the electricity bill. District-fixed effects θ_d are included to control for district-specific traits that are common to individuals within a district over time but vary across districts. This basically addresses any omitted district-level characteristics that may influence electrification status and the prevalence of domestic violence towards women within the household. Likewise, we also include year-fixed effects π_t which account for unobserved changes that occur over time.

In the above specification, the term ϵ_{iht} represents the error term, reflecting the measurement errors and unobserved, time-varying variations in household and individual characteristics. Given the controls in place, if this error term is not correlated with the variable indicating electricity reliability (E_{idt}), then the coefficient β will establish a relationship between higher electricity reliability and the prevalence of domestic violence. However, this conditional exogeneity assumption might be violated if there are omitted variables that influence both domestic violence against women and household electricity reliability. These omitted variables can be both observed and unobserved, leading to bias.

For instance, household income is a potential observed confounding variable because wealthier households tend to have more reliable electricity (Burlig & Preonas, 2016) and they also experience fewer incidents of domestic violence against women due to reduced economic stress (Peterman et al., 2022). Similarly, unobserved factors, such as household perceptions of electricity benefits or area-specific characteristics, may affect both electricity availability and household outcomes (S. R. Khandker et al., 2014). Additionally, district-level time-varying economic and infrastructure developments can simultaneously impact electric-

ity variables and domestic violence measures.

Therefore, the estimates derived from the panel fixed effects model (baseline model: equation 1) can only be considered causal if household electrification occurred randomly. However, in India, households are not randomly connected to electricity (S. R. Khandker et al., 2014). Instead, electricity supply, consumption, and distribution are influenced by various economic and political factors (Aklin et al., 2016; Lee et al., 2020; Sedai, Nepal, & Jamasb, 2021). Therefore, the estimates from equation 1 are likely biased due to the endogeneity of electricity hours. As a result, we exercise caution in interpreting the regression coefficient β from the baseline model and prefer to treat these estimates as indicative of an association between reliable electricity and the prevalence of domestic violence rather than definitive evidence of causality.

4.2 Instrumental Variable

To address the potential endogeneity concerns discussed in the previous subsection 4.1, an ideal experimental design would involve randomly assigning hours of electricity availability to households and subsequently studying changes in the prevalence of domestic violence against women. A comparison of the mean prevalence of domestic violence before and after the randomization would provide a causal estimate of the impact of reliable electricity on domestic violence towards women in the household. However, such an experiment is both practically infeasible and ethically problematic, as it would subject participants to the hardships of denied or restricted electricity. Therefore, we must rely on observational data and employ quasi-experimental identification methods to determine the true causal effect. We propose an instrumental variable (IV) design to potentially overcome the endogeneity problem associated with reliable electrification.

An IV in this context must impact the prevalence of domestic violence solely through its effect on the hours of electricity in a household. In other words, the IV should be highly correlated with the endogenous variable X (household's hours of electrification) and affect the outcome variable Y (prevalence of domestic violence) exclusively through X. Following

Bai et al. (2019), we use the average hours of household electricity in the state, excluding the district of the i-th woman, as an instrument for her household's hours of electrification. This instrument has been previously employed by Dang and La (2019); Sedai, Vasudevan, et al. (2021); Sedai, Nepal, and Jamasb (2021). The variable satisfies both conditions for being a 'good' instrumental variable: relevance and exogeneity.

This instrument is relevant because if neighbouring districts acquire more hours of electricity and experience economic and social gains from improved electrification reliability, then fewer electricity hours in one's own district may signal a lower socioeconomic status. Thus, an increase in the average hours of electricity in neighbouring districts is likely to influence the electricity hours in a woman's own district. Consequently, her household is also more likely to acquire more hours of electricity, assuming they can afford the connection costs.

For meeting the exclusion restriction, as discussed in the section 4.1, it is crucial to exclude the household's own district-level electrification from the instrument. Thus, we argue that our leave-one-out instrument satisfies the exogeneity condition and is therefore valid, as electricity availability in other districts should not directly affect domestic violence incidents in a woman's home district. Instead, the instrument would influence domestic violence outcomes solely through its impact on electricity availability in the woman's district. The literature suggests that factors such as household income, individuals' relative bargaining power, education, health, age, and labour force involvement influence domestic violence Duflo (2012); Fletcher et al. (2017); Buller et al. (2018); Klasen et al. (2021); Peterman et al. (2022). These factors are expected to be influenced indirectly through improvements in district electricity reliability, which eventually affects domestic violence incidents in the household. This supports the exogeneity condition and effectively addresses endogeneity concerns. Moreover, using this district-level instrumental variable eliminates any biases due to reverse causality at the household level Dang and La (2019).

We implement the instrumental variable (IV) design using two-stage least squares (2SLS). For each woman i in district d at time t, we run the following regressions:

$$E_{idt} = \eta I_{dt} + \gamma X_{idt} + \theta_d + \pi_t + \epsilon_{idt} \tag{2}$$

$$Y_{idt} = \beta \hat{E}_{idt} + \gamma X_{idt} + \theta_d + \pi_t + \epsilon_{idt} \tag{3}$$

Here, I_{dt} denotes the average household electricity hours in the state of residence for the i-th woman at time t, excluding the hours from her own home district d. It measures district-level variation over time and thereby, enabling us to capture the unobserved heterogeneity that varies with each survey wave. This temporal component is important as it helps to account for trends that may not be apparent when examining a single point in time. The coefficient η represents the effect of the instrumental variable I_{dt}. All other variables and notations remain the same as specified in the baseline model (Equation 1).

Equation 2 captures the first-stage effect of the leave-one-out instrument ηI_{dt} on our endogenous variable, the household's hours of electrification (E_{idt}). The first-stage results are presented in Table 2, which also demonstrates the relevance of the instrument. In Equation 3, we estimate the impact of reliable electricity on domestic violence measures within households using the instrumental variable approach. Here, β is the parameter of interest, capturing the effect of reliable electricity on the prevalence of domestic violence against women in households.

We incorporate district fixed effects (θ_d) and year fixed effects (π_t) in both equations. In our study, given that the instrument used to address the endogeneity of electricity hours and the outcome variable is the average hours of electricity at the district level (excluding the respondents' own district), incorporating district and year fixed effects allows us to control for time-varying district-level characteristics, thereby eliminating any biases due to direct reverse causality at the household level (Dang & La, 2019). Additionally, these models include various control variables (X_{idt}) for the respondent's observable demographic and socioeconomic characteristics, as well as those of her household, as specified in the baseline model (Equation 1). We employ robust standard errors in all our estimates.

So, by utilizing this IV approach, we aim to address potential endogeneity concerns and thereby estimate the causal effect of electricity hours on domestic violence.

4.3 IV Probit

Given the binary nature of our variables of interest — the prevalence of domestic violence for different reasons of violence (refer Section 3) — along with the linear IV model discussed in the previous subsection, we also apply a non-linear probability model, the IV probit model. Following Wooldridge (2010), we opted for this approach as we are dealing with a binary endogenous variable. Additionally, following Angrist and Pischke (2009), we recognize that the estimation of true standard errors in the marginal effects of non-linear models is non-trivial. The literature suggests that probit models address certain limitations of the linear IV model, such as heteroskedasticity, ensuring predicted probabilities lie within the [0, 1] interval, and correctly specifying the functional form of the relationship to account for the non-linear nature of binary choice models (Horrace & Oaxaca, 2006).

In the Probit model, the probability of the measures of domestic violence is modeled as:

$$P(Y_{idt} = 1 \mid X_{idt}, \hat{E}_{idt}) = \Phi(\alpha + \beta \hat{E}_{idt} + \delta X_{idt} + \theta_d + \pi_t)$$

where Φ is the cumulative distribution function of the standard normal distribution. The latent variable framework for the Probit model is:

$$Y^*_{idt} = \alpha + \beta \hat{E}_{idt} + \delta X_{idt} + \theta_d + \pi_t + u_{idt}$$

$$Y_{idt} = \begin{cases} 1 & \text{if } Y^*_{idt} > 0 \\ 0 & \text{otherwise} \end{cases}$$

This IV probit model provides a robust check on our findings, ensuring that our causal estimates of the impact of reliable electricity on domestic violence are consistent and unbiased.

5 Results

We present our main findings about the impact of reliable electricity on the prevalence of domestic violence in Tables 3 and 4. These tables include results from three models discussed in the empirical strategy (Section 4): the baseline model, the linear probability model with an instrumental variable, and the probit model with an instrumental variable.

As discussed in the data section (Section 3), in our study, for measuring the prevalence of domestic violence against women, we focus on the domestic violence module of the IHDS dataset. This module includes questions answered by women about incidents of domestic violence against them for various reasons. Therefore, first, in Table 3, we present the impact of an additional hour of electricity on the reduction of incidence of domestic violence for specific causes, including leaving without permission, extramarital affairs, lack of dowry, and cooking inadequacy. Then, later, in Table 4, we also demonstrate the impact on overall domestic violence, irrespective of the reason for violence.

Panel A of Table 3 shows results from the baseline model described in Equation (1). These results make it evident that an increase in reliable electricity in the household is associated with a decrease in the prevalence of domestic violence against women. Across the board, for all analyzed reasons, we find a negative coefficient, suggesting that more hours of electricity are correlated with a lower prevalence of domestic violence. However, these associations may not be causal due to potential endogeneity, as discussed in the empirical strategy (refer subsection 4.1). Keeping this in mind, we also explore the relationship using the IV method. In Panel B, we report results from the linear IV specification (2SLS regressions), where the household's hours of electrification are instrumented by the leave-one-out instrument discussed in the empirical strategy. We find that, across all analyzed causes of domestic violence, the linear IV specification results align with the baseline model, suggesting a causal link between hours of electricity and the prevalence of domestic violence, though the linear IV coefficients are small. The relevance and exogeneity of the instrument are further supported by the first stage F-statistics, which exceed the critical value of 10 as established by Staiger

and Stock (1997), as demonstrated in Tables 3 and 4, indicating that weak instruments are not a concern in our analysis.

Given that these variables of interest are binary, in Panel C, we present the results from the IV probit model to obtain more reliable estimates of the causal impact of reliable electricity on domestic violence, accounting for the non-linear nature of binary choice models and correctly specifying the functional form of the relationship. We find that an additional hour of electricity in the household reduces the likelihood of domestic violence due to a woman leaving without permission by 1.4 percentage points, due to extramarital affairs by 1.4 percentage points, due to lack of dowry by 2.5 percentage points, and due to cooking inadequacy by 1.4 percentage points. All these estimates are statistically significant at the traditional significance levels, except for neglecting household duties and not being respectful, indicating that its coefficient is imprecisely estimated. These coefficients and their significance levels suggest that while the likelihood of domestic violence for all analysed reasons reduces with improved reliability of household electricity, the most significant reduction is seen for lack of dowry, followed by leaving the house without permission, cooking inadequacy, and extramarital affairs.

The literature, as discussed in Section 2, suggests that increased hours of electricity can positively impact a household's economic standing, women's economic security, productivity, living conditions, and bargaining power. This explains why we observe a more significant reduction in domestic violence due to reasons like leaving the house without permission or cooking inadequacy compared to reasons like disrespect. So, we conjecture that the differences in the reduction of domestic violence across various reasons are due to the pathways through which improved reliability of household electricity impacts its prevalence. We discuss these pathways in detail in the next section.

Overall, despite variations in the magnitude or significance of the estimates, the consistent direction of the estimates across various reasons, the majority being statistically significant, indicates that the likelihood of incidents of domestic violence against women decreases with improved electricity reliability. Therefore, it becomes imperative also to observe the effect

of reliable electricity on overall domestic violence, irrespective of the reason for violence. To achieve this, as discussed in the data section (3), we created three indices: a dummy variable indicating whether a woman was ever beaten for any reason, the number of questions/reasons for which the woman answered "yes" to being beaten, and the percentage of questions/reasons for which the woman answered "yes" to being beaten.

Following the approach used in Table 3, the results for these three indices for overall domestic violence (irrespective of the reason), presented in Table 4, are also analysed using the three models discussed in the empirical strategy (Section 4): the baseline model, the linear probability model with an instrumental variable, and the probit model with an instrumental variable[3]. Each panel corresponds to the results from one of the models for these three measures.

After examining the consistent reduction in domestic violence across various reasons, it is anticipated that an improvement in reliable household electricity will also reflect a decrease in overall domestic violence indices. Therefore, as shown in Table 4, our findings across all three indices and models demonstrate a strong association between increased hours of household electricity and a lower prevalence of domestic violence. The IV specification provides causal estimates for these domestic violence indices. Specifically, we find that an additional hour of electricity results in one percentage point decrease in the incidence of women being beaten, the number of reasons for the abuse, and the proportion of reasons for the abuse.

These results, presented in panels A, B, and C of both tables (3 and 4), are at the extensive margin of electricity access. To ensure the comprehensiveness of our study on the causal effect of electrification on domestic violence, we also present results for the extensive margin of reliability and hours of electricity in panel D of both tables for their associated variables. While the intensive margin of electricity access shows consistent and significant progress, the extensive margin results also indicate a reduction in domestic violence, albeit with less consistency.

[3]The two indices—the number of questions/reasons for which the woman answered 'yes' to being beaten, and the percentage of questions/reasons for which the woman answered 'yes' to being beaten—are not analysed using the probit IV model because the probit model can only be applied to binary outcome variables.

In order to shed light on the potential heterogeneous effects of reliable electricity, we employ the main empirical framework, specifically the IV specification, on sub-samples of our dataset. Our goal is to determine if there is any heterogeneity in the impact of reliable electricity on domestic violence across different sects of the population.

First, for socio-economic heterogeneity, we analyse the effects separately for poor and non-poor households. Our findings indicate that the reduction in domestic violence due to improved reliable electricity is more pronounced for non-poor households. This result aligns with (Sedai, Vasudevan, et al., 2021) study, which suggested that the impact of reliable electricity on women's labour force participation is higher and significant for non-poor households. At the same time, it remains insignificant for poor households. Their study also showed a weaker impact of reliable electricity in rural areas compared to urban areas. Consistent with this, our analysis also reveals geographic heterogeneity, showing stronger results for households in urban regions. These findings are presented in Panel A and B of Table 5. Furthermore, we conduct a heterogeneity analysis based on caste and religion, with the results displayed in Table 6. The effects of reliable electricity are more pronounced for backward castes compared to forward castes, while the religious impact is mixed.

6 Mechanism

In our study, we demonstrate that improved access to reliable electricity leads to a reduction in domestic violence against women. Therefore, it becomes crucial to empirically test the pathways through which electricity impacts the prevalence of domestic violence. To explore these potential mechanisms, we explore two distinct strands of literature: (1) factors that can reduce violence against women Farmer and Tiefenthaler (1997); Duflo (2012); Fletcher et al. (2017); Buller et al. (2018); Klasen et al. (2021); Peterman et al. (2022), and (2) the effects of electrification on the well-being of households and individuals (Dinkelman, 2011; Rathi & Vermaak, 2018; Winther et al., 2017; Dasso & Fernandez, 2015; Stöckl et al., 2013; Grogan & Sadanand, 2013; Samad & Zhang, 2019; Sedai, Nepal, & Jamasb, 2021; Chhay &

Yamazaki, 2021; Das et al., 2023). Based on this synthesis, we propose a theory of change, as discussed in subsection 2.3, outlining the path/channels for electrification to impact domestic violence against women. This section empirically tests these proposed channels using our main empirical strategy (i.e., IV specification) on the dataset under consideration.

Electrification in a region stimulates the creation of new enterprises and boosts productivity in existing ones, thereby increasing labour demand and reducing unemployment. This, in turn, improves individuals' earnings and the overall economic well-being of households (Dinkelman, 2011; Dasso & Fernandez, 2015; Fletcher et al., 2017; Van de Walle et al., 2017; Rathi & Vermaak, 2018; Ferrant & Thim, 2019; Klasen, 2019; Grogan & Sadanand, 2013; Chhay & Yamazaki, 2021). Table **??** demonstrates that households move up in asset and income quantiles with improved reliable electricity. The likelihood of households having bank and post office accounts also increases, along with other financial securities such as bank savings, stocks/securities, gold, fixed deposits, pensions or other long-term safety nets. Additionally, outstanding debt decreases by approximately 700Rs. with each additional hour of electricity. These indicators suggest an overall economic standing improvement and reduced household financial stress. These findings align with existing literature on the effects of electrification (Dinkelman, 2011; Rathi & Vermaak, 2018; Dang & La, 2019; Sedai, Vasudevan, et al., 2021; Sedai, Nepal, & Jamasb, 2021). Literature on domestic violence suggests that financial stress leads to intra-household conflicts. Therefore, reducing financial stress due to economic gains from electrification can lead to fewer intra-household conflicts, thereby reducing violence against women.

Moreover, the increased labour demand due to reliable electricity provides economic benefits to men and creates more employment opportunities for women. In fact, Sedai, Vasudevan, et al. (2021) points out that women benefit more in labour force participation (workdays) than men. We demonstrate (Table 8) that with reliable electricity, women's economic strength and independence increase significantly as their work participation rises. Women's earnings, on average, increase by 94 Rs. for each additional hour of electricity. For her being financially more secure, we also find a significant increase in the likelihood of

women having bank accounts and owning houses in their names. Additionally, we see that reliable electricity increases their probability of making decisions about their own work or work related to farms/animals and managing their shopping. These indicators suggest that electrification not only improves household economic status in the region but also enhances women's financial independence and security, which, according to women empowerment literature, further reduces the incidence of violence against women (Fox et al., 2002; Anderson & Baland, 2002; Anderson & Eswaran, 2009; Duflo, 2012; Winther et al., 2017; Buller et al., 2018; Peterman et al., 2022).

One argument we discussed for women's increased labour force participation is the heightened labour demand, affecting men's and women's employment. Another reason is that women, primarily involved in daily household chores, save time and increase productive work hours with reliable electricity through the use of electric appliances (Dinkelman, 2011; Fletcher et al., 2017; Rathi & Vermaak, 2018; Ferrant & Thim, 2019; Klasen, 2019). In Panel A of Table 11, we show a significant increase in the ownership of electricity-based appliances such as refrigerators, electric fans, and TVs. Literature suggests that these appliances not only enhance productivity in household chores but also improve overall living conditions and comfort, reducing intra-household stress and conflicts.

Among all electric appliances, media & communication devices like TVs and radios provide comfort and entertainment and expose viewers to new information and lifestyles. In Panel A of Table 11, we demonstrate a significant increase in the ownership and viewership of TVs among all household members (men, women, children) with improvement in reliable electricity. Literature suggests that this exposure may shift attitudes and behaviours in favour of women (Jensen & Oster, 2009). The increased viewership with additional hours of electricity indicates a potential progressive shift in attitudes towards women[4]. This shift in attitude, coupled with the improved economic standing of women due to increased work participation, enhances women's status within the household.

[4]Given our focus on IHDS 1 and IHDS 2, the survey periods for our study are 2004-2005 and 2011-2012. During these years, internet penetration and mobile phone usage were relatively low. A significant increase in internet subscriptions occurred between 2016 and 2017, primarily due to the launch of free Reliance Jio services in late 2016 (Agrawal, 2021). Before this surge, during the period of our study, television was the primary medium for the Indian population to access new information and lifestyles.

We empirically demonstrate the enhanced status of women in Table 10. In Panel A of Table 10, we show that women are significantly more likely to have higher bargaining power in significant household decisions, such as land purchases, child's illness, own illness, child's weddings, and wedding expenses, as well as in minor matters like cooking. We also show that women's mobility significantly increased with the improvement in reliable electricity, as they are less required to seek permission for outside activities and more likely to visit health centres, friends' homes, shops, or take bus trips alone (Panel B of Table 10). This increased physical mobility can further boost their confidence. This improved confidence is demonstrated in Panel C of Table **??**. We show that with reliable electricity, women are significantly more likely to take part in community activities/organisations like women's groups, self-help groups, and political organisations. Additionally, we find that the prevalence of purdah practice reduces with increased reliable electricity, indicating a shift in attitudes and improved confidence of women (Amin, 1997; Jabeen et al., 2020). Even surveyors noted that women appeared significantly more confident, knowledgeable about household expenditures, and assertive during interviews (looking at surveyors). These indicators suggest that reliable electricity improves women's status both within and outside the household, making them less prone to domestic violence.

Another potential channel for reducing domestic violence is the improved health of women (Duflo, 2012; Buller et al., 2018; Peterman et al., 2022). Electrification can impact women's health due to the enhanced status of women and reduced financial stress in the household, leading to more equitable resource distribution between genders and therefore, higher nutritional intake by women. In Panel B of Table 11, we show that reliable electrification significantly decreases the consumption of dirty fuels and improves the overall cooking environment. Given that women predominantly work in the kitchen in India, and elsewhere in developing countries (Dinkelman, 2011; Kapsos et al., 2014; Fletcher et al., 2017; Ferrant & Thim, 2019), improved cooking convenience is expected to enhance their health. In Table 9, we highlight that various parameters, such as the number of days women were ill, unable to work, or experienced general illnesses like fever, cough, and diarrhoea, significantly decreased

with reliable electrification. This improvement extends to reproductive health (Panel B of Table 9), with increased contraceptive use, fewer children, and a lower desire for more children. We also find a decreased preference for having a boy as an additional child, which is again indicative of a shift in household attitudes.

7 Robustness

7.1 Concern about exclusion restriction

For a 2sls IV strategy to provide reliable causality estimates, two conditions have to be met. First is the relevance of the instrument, and second is the validity of the instrument. While relevance is rather straightforward, where the instrument variable has to be correlated with the independent variable, in our case, the electricity access of the household and the average electricity hours in the state need to be correlated strongly. To ensure this we present the First-Stage estimates in Table 2. We find that the instrument and household electricity access is strongly correlated, making the instrument relevant in this study. The relevance assumption ensures the estimates are robust and do not vary with sample selection.

The second condition poses a challenge, i.e., the validity assumption. The validity assumption posits that the instrument is exogenous, meaning the IV is as good as random. In other words, the instrument does not directly affect the dependent variable; any variation is only through electricity access. This is rather a strong claim that the IV is exogenous; therefore, to support this claim, we present a few robustness checks.

The IV in this study is the mean hours of electricity availability in the home state (excluding the home district). Reliable electricity source acts as a catalyst for economic development and the overall well-being of individuals. Therefore, it can be argued that a region receiving more electricity hours, is perhaps being governed by an efficient government. Even though some private entities also provide electricity in some places, the government is the major electricity provider. Therefore, it is likely that the populace with high electricity hours may have increased confidence in the state government, local self-governments or police. Hence,

the incidence of domestic violence may be affected due to these secondary influences of the IV. To address this issue, we control for the confidence in government and present the estimates in Figure 2a. We also control for other indicators that act as a proxy of confidence in the government, i.e., confidence in police and local self-governments. We present the estimates in Figure 2b and Figure 2c respectively. As observed, even after controlling for possible channels through which electricity might affect violence against women, our initial findings show no significant changes. The consistency of our findings alleviates the concerns about the validity of our IV.

7.2 Plausibly exogenous

As discussed above, the primary concern in an IV approach is the exclusion restriction of the IV that underlies the validity of the IV estimate. While the 2sls estimates are based on the assumption of strict exclusion restriction. It can be argued that the IV does not satisfy the exclusion restriction, and hence, the 2sls estimates are biased and cannot be deemed reliable. In our case, for instance, districts with the higher state average of electricity may be systematically better in terms of economic and infrastructural development, which eventually affects the violence against women. To circumvent such issues in the empirical estimates, (T. Conley et al., 2010) proposed a novel method which does not rely on the strict exclusion restriction criterion for reliable IV estimates. As discussed by (T. Conley et al., 2010), to draw causal estimates we consider the IV to be 'plausibly exogenous'. We follow the given equation in this framework:

$$Y_{idt} = \alpha + \beta E_{idt} + \delta IV_{idt} + \gamma X_{idt} + \theta_d + \pi_t + \epsilon_{idt} \tag{4}$$

where Y_{hdt} represents the outcome variable i.e. incidence of violence against women i in district d at time t (as discussed in the empirical strategy section). The variable E_{jdt} denotes the hours of electricity in the household of the woman i in district d at time t, and the variable IV_{idt} is the IV used in our study, i.e. the average hours of household electricity at the district level, excluding the district of the i-th women's household in the state. In

the 2sls specification, discussed earlier, we assume strict exclusion restriction and thereforeδ takes value 0. However, even if δ is close to 0 and not exactly 0, the IV can still be considered to be 'plausibly exogenous'. Using this plausibly exogenous IV we can estimate the causal effect of the endogenous variable on our dependent variable for certain values of δ. Following the literature (Azar et al., 2020; Biswas & Das, 2022), we first estimate the reduced form equation with the IV and other covariates excluding the endogenous variable electricity hours and estimate the lower bound of $\hat{\delta}$. Using the value of δ from $\hat{\delta}$ to 0, we present the bound of the effect of electricity hours on violence against women in the second stage equation in Table 12.

As presented in Table 12, we estimate the upper and lower bounds for α for our dependent variable. The estimates suggest that even if the IV is only 'plausibly exogenous' the causal effect will take the upper bound value of α. The upper bound value α remains negative in our case, suggesting a decrease in violence against women due to an increase in hours of electricity within the household, even if the IV used is not strictly exogenous. Essentially, our point estimates are likely to vary between the upper and lower bound of α, with varying levels of endogeneity of the instrument. If we consider the IV to be strictly exogenous we get the lower bound of α, and we consider the IV to be endogenous it will take the value of the upper bound of α.

7.3 Lewbel instrumental variable

We discussed the possibility of the IV not being strictly exogenous in the previous section and presented an alternate approach to alleviate that concern. However, it is also possible to question the relevance as well as exclusion restriction of the IV. The main issue with IV estimation is finding an instrument which is significantly related to electricity hours received by the household and is also orthogonal to the residual error of the equation. In such cases where it is challenging to find strong and reliable instruments, (Lewbel, 2012) suggests creating an internal instrument based on the heteroskedasticity of the model. The main advantage of relying on the Lewbel IV approach is that it can be used when there is no

instrument variable available in the data or when the instrument variable does not satisfy the exclusion restriction sufficiently. The Lewbel approach is not based on certain assumptions. Therefore, the approach has been utilised in several studies. The only assumption this approach makes is the presence of heteroskedasticity in the model. Using the Lewbel IV, we present our findings in Table 13.

As presented, we look at the effect of additional hours of electricity on violence against women. We find that the estimates of Lewbel IV are in tandem with our previous IV estimates presented in Table 3 and Table 4.

7.4 Propensity score matching

In this section, we present the effect of hours of electricity in households on the incidence of violence against women using an alternate empirical method. The Propensity Score Matching (PSM) method is used as an additional robustness check. Several studies across different contexts Chatterjee and Pal (2021); Biswas and Das (2022) rely on PSM to draw causal estimates in a non-experimental setup using observational data.

In our context, we create a binary variable based on the median hours of electricity hours received by households. The choice for using the median hours of electricity as a cutoff is preferred over mean hours of electricity as in any distribution which is non-normal, the median value provides a better central measure. Furthermore, using a median value also circumvents the issue of outliers; the mean value is significantly affected by outliers, but the median provides a robust central value even in the presence of outliers.

Therefore we base the dummy variable on the median hours of electricity in the household. The dummy variable takes value 1 if the hours of electricity in household i are greater than the median hours of electricity in the sample and takes value 0 otherwise. Essentially, we compare the households which are very similar across the observable characteristics and only differ in their electricity access enabling us to draw causal conclusions. Using the PSM technique, which identifies similar households across the two groups, i.e. electricity hours higher than median electricity hours or lower than the mean electricity hours in the

sample. The matching technique is an approximation of random assignment enabling us to draw causal estimates. The matching is pretty simple, where households having lower hours of electricity are matched with households having higher hours of electricity based on the observable characteristics. Then we estimate the effect of higher electricity hours on the violence against women.

We find that there is a decrease in violence against women in households with higher electricity hours as compared to household with lower electricity hours after matching. This suggests that two households which are similar to each other in terms of education of individuals, income, household composition and other socio-economic factors which have been discussed in the empirical section, the increased hours of electricity reduce the incidence of violence against women. The findings from the alternate method corroborate the estimations from the IV specification. The estimates presented are the Average treatment effect on the Treated (ATT), we find that the likelihood of violence decreases by 2.19% with higher electricity hours within households. Similarly, the reasons for which a women may be experiencing violence has also gone down as suggested by the decrease of 3.12% and 17.03% in "percent of yes" and "number of yes" variables respectively.

7.5 Test of exact randomization

To ensure that we capture the "true" effect of reliable electricity on violence against women, following Bharadwaj et al. (2014), we run a falsification exercise: test of exact randomization[5]. To ensure that the effect is not coincidental or spurious and in fact due to increased hours of electricity, we randomly assign the "hours of electricity" and then re-run our baseline model ten thousand times. Essentially, in these simulations, the entire sample remains the same, but we do a random assignment of "hours of electricity". Given the random nature of our independent variable in the simulation, the effect on violence should not exist. We demonstrate it by plotting these simulated coefficients in a density plot. We find that the coefficients from these simulations fall in a normal curve centered around zero, indicating

[5]Results are available upon request

no effect when electricity hours are randomized. Whereas, the actual effect from our original dataset is far from zero (lies outside the density plot). Hence, we can be sure that the coefficient is not erroneous and in fact a true estimate of association between the hours of electricity and the prevalence of domestic violence.

8 Conclusion

In this paper, we study if increased access to electricity can reduce the incidence of violence against women. To establish a causal effect between increased hours of electricity and domestic violence, we rely on the instrumental variable design. We use the average hours of household electricity in the state, excluding the home district of a woman, as an instrument for her household's hours of electrification. Using this leave-one-out instrument, we estimate the causal effect of electricity hours on domestic violence. We also use alternate IV specifications to alleviate any concerns about the validity of the instrument variable. Furthermore, a set of checks and balances were conducted to ensure that the findings are robust to alternate empirical methods. Through all the different specifications, we find that the increased access to electricity reduces violence against women in households. This effect is also observed at the granular level, i.e. violence on different accounts of reasons go down as well as the overall phenomena of domestic violence also reduces with increasing hours of electricity access.

We also investigate the potential mechanisms through which increased electricity hours can affect domestic violence within households. We find that increased electrification affects several key aspects of everyday life, shifting the power dynamics within households and reducing domestic violence. The increased access to electricity tends to increase the utilisation of household appliances, such as TV, radio, lighting devices, and refrigerators. These appliances improve the comfort within the household, provide entertainment and information, and reduce the time utilised for household chores. This increased leisure time for women enables them to participate in the labour force. The increased electrification also increases enterprises' productivity, which complements this increase in the labour force supply

of women with increased labour force demand. Increased income reduces the financial stress in a household, along with increased comfort and entertainment, reduces overall stress and conflict. These findings are also backed by existing literature, highlighting the cascading effects of electrification (Cecelski, 2005; IEG, 2008; Kanagawa & Nakata, 2008; Jensen & Oster, 2009; Dinkelman, 2011, 2011; S. Khandker et al., 2014; Lenz et al., 2017; Fletcher et al., 2017; Rathi & Vermaak, 2018; Ferrant & Thim, 2019; Klasen, 2019; Pueyo & Maestre, 2019; Sedai, Vasudevan, et al., 2021; Das et al., 2023).

Our findings offer significant insights for policymakers regarding reliable electricity. Reliable electrification can be a potent tool in addressing domestic violence with broader societal impacts. As demonstrated, improved electricity reliability can increase labour demand, enhance women's participation in the workforce, shift attitudes toward gender roles, and improve women's health outcomes. Therefore, reliable electrification can catalyse societal development and significantly reduce domestic violence, transforming society, particularly in developing nations like India.

Although our study offers causal evidence of the impact of reliable electrification on physical violence, domestic violence also encompasses mental and sexual abuse of women by spouses or family members. Due to data limitations, our focus is on physical abuse. Alternatively, we could have used National Family Health Survey (NFHS) data, which contains variables related to physical, mental and sexual violence, which could be valuable in this direction. However, as we aim to understand the impact of reliable electricity on domestic violence, this study does not rely on the NFHS dataset as it lacks information on electricity hours, only indicating whether a household has access to electricity. In future, researchers could explore the impact of reliable electricity on various other forms of violence against women.

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Tables and Figures

Table 1: *Summary Statistics*

	IHDS-1 (2005)		IHDS-2 (2012)			
Variables	Observations	Mean	Observations	Mean	Min	Max
Outcomes:						
Beaten for Leaving Without Permission	33,342	0.3623	39,490	0.5140	0	1
(= 1 if Yes)		(0.4807)		(0.4998)		
Beaten for Extramarital Affair	33,286	0.8323	39,481	0.8432	0	1
(= 1 if Yes)		(0.3736)		(0.3636)		
Beaten for Lack of Dowry	33,348	0.2598	39,482	0.3257	0	1
(= 1 if Yes)		(0.4385)		(0.4686)		
Beaten for Neglecting Household Duties	33,366	0.3199	39,477	0.4243	0	1
(= 1 if Yes)		(0.4664)		(0.4942)		
Beaten for not being Respectful	0	–	39,479	0.4752	0	1
(= 1 if Yes)		–		(0.4993)		
Beaten for cooking inadequacy	33,372	0.2651	39,432	0.3198	0	1
(= 1 if Yes)		0.4414		(0.4664)		
Explanatory Variables:						
Age	33,538	33.0482	39,575	36.3112		
		(8.0206)		(9.8801)	15	78
Highest education (Completed Years)	33,394	4.5664	39,574	5.1664	0	15
		(4.7967)		(4.8810)		
Highest education: adult	33,499	7.7069	39,575	8.6937	0	15
		(4.9614)		(4.7996)		
Highest education: female adult	33,397	4.8727	39,533	6.0302	0	15
		(5.0010)		(5.1876)		
Highest education: male adult	32,119	7.3391	37,417	8.1375	0	15
		(4.9575)		(4.8274)		
Household Size	33,538	5.5373	39,575	5.4518	1	21
		(2.4221)		(2.4486)		
Household Size: adult (age = 21+)	33,538	2.9272	39,575	3.2082	0	12
		(1.4321)		(1.5414)		
Household Size: male adult (age = 21+)	33,538	1.4573	39,575	1.5659	0	6
		(0.8630)		(0.9351)		
Household Size: female adult (age = 21+)	33,538	1.4694	39,575	1.6416	0	6
		(0.7652)		(0.8384)		
Household Size: boys (age < 15)	33,538	0.9880	39,575	0.8316	0	6
		(1.0086)		(0.9374)		
Household Size: girls (age < 15)	33,538	0.9054	39,575	0.7619	0	6
		(1.0391)		(0.9765)		
Household Size: married male	33,538	1.2547	39,575	1.2995	0	6
		(0.6807)		(0.7448)		
Household Size: married female	33,538	1.3055	39,575	1.3930	0	6
		(0.6875)		(0.7538)		
Annual Income	33,538	1,01,233.8	39,575	1,37,957.8	-1037040	12000000
		(149287.4)		(222857.8)		
Urban	33,538	0.3596	39,575	0.3179		
		(0.4798)		(0.4656)	0	1
Socio-religious categories	33,538	3.6142	39,575	3.6242	2	7
		(1.3934)		(1.3709)		
Poor (using Tendulkar's cutoffs)	33,511	0.2108	39,566	0.1708	0	1
		(0.4079)		(0.3763)		
Electricity bill (Rs.)	25,623	350.3069	34,744	290.747	0	15769.23
		(472.9935)		(435.7195)		
Relationship to HH Head	33,538	2.5212	39,575	2.6035		
		(1.3097)		(1.4797)	1	12
Marital Status	33,538	1.0575	39,575	1.0899		
		(0.4756)		(0.6184)	0	5
Husband from same village	33,359	0.1388	39,382	0.1140	0	1
		(0.3458)		(0.3178)		
Husband's education	31,802	6.8205	36,892	7.0898	0	15
		(4.8614)		(4.7727)		

Table 2: ***First stage of IV Specification***

Electricity Hours	
Instrumental Variable	-0.0029***
	(0.0047)
Controls	Yes
FE	Yes
Observations	54,094

Notes: Robust standard errors are reported in parentheses. *** p < 0.01 **p < 0.05 *p< 0.1.

Table 3: ***Domestic Violence Causes: Detailed questions***

Panel A: OLS

	Beaten for					
	Leaving Without Permission	Extramarital Affair	Lack of Dowry	Neglecting Household duties	Not being respectful	Cooking inadequacy
Electricity Hours	-0.0014***	-0.0004	-0.0040***	-0.0008**	-0.0037***	-0.0025***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0005)	(0.0003)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54,928	54,871	54,923	54,933	31,237	54,896

Panel B: Instrument Variable

	Beaten for					
	Leaving Without Permission	Extramarital Affair	Lack of Dowry	Neglecting Household duties	Not being respectful	Cooking inadequacy
Electricity Hours	-0.0054***	-0.0036***	-0.0081***	-0.0006	-0.0008	-0.0045***
	(0.0006)	(0.0004)	(0.0005)	(0.0006)	(0.0008)	(0.0005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53,995	53,939	53,990	54,001	30,760	53,964
First Stage F-stat	36427	36437	36410	36429	21812	36392

Panel C: IV Probit

	Beaten for					
	Leaving Without Permission	Extramarital Affair	Lack of Dowry	Neglecting Household duties	Not being respectful	Cooking inadequacy
Electricity Hours	-0.014***	-0.014***	-0.025***	-0.001	-0.002	-0.014***
	(0.0142)	(0.0143)	(0.0253)	(0.0013)	(0.0021)	(0.014)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53980	53725	53982	53995	30659	53841

Panel D: Extensive Margin

	Beaten for					
	Leaving Without Permission	Extramarital Affair	Lack of Dowry	Neglecting Household duties	Not being respectful	Cooking inadequacy
Electricity Hours	-0.0687	0.0931	-0.1743	-0.0979	-	-0.2677*
	(0.1469)	(0.1392)	(0.1475)	(0.1556)	-	(0.1534)
Controls	Yes	Yes	Yes	Yes	-	Yes
FE	Yes	Yes	Yes	Yes	-	Yes
Observations	55,011	54,954	55,006	55,016	-	54,979

Notes: Robust standard errors are reported in parentheses. *** $p < 0.01$ **$p < 0.05$ *$p < 0.1$.

Table 4: ***Main Results- Domestic violence Index***

Panel A: OLS			
	Ever beaten	Count of questions answered 'Yes'	% of questions answered 'Yes'
Electricity Hours	-0.0002	-0.0089***	-0.0018***
	(0.0002)	(0.0011)	(0.0002)
Controls	Yes	Yes	Yes
FE	Yes	Yes	Yes
Observations	54,957	55,031	54,957
Panel B: Instrument Variable			
	Ever beaten	Count of questions answered 'Yes'	% of questions answered 'Yes'
Electricity Hours	-0.0023***	-0.0221***	-0.0044***
	(0.0004)	(0.0018)	(0.0004)
Controls	Yes	Yes	Yes
FE	Yes	Yes	Yes
Observations	54,024	54,094	54,024
First Stage F-stat	36423	36475	36423
Panel C: IV Probit			
	Ever beaten	Count of questions answered 'Yes'	% of questions answered 'Yes'
Electricity Hours	-0.01***	-0.01***	-0.01***
	(0.0019)	(0.0019)	(0.0019)
Controls	Yes	Yes	Yes
FE	Yes	Yes	Yes
Observations	53655	53725	53655
Panel D: Extensive Margin			
	Ever beaten	Count of questions answered 'Yes'	% of questions answered 'Yes'
Electricity Access	0.1146	-0.5208	-0.1028
	(0.1377)	(0.6738)	(0.1347)
Controls	Yes	Yes	Yes
FE	Yes	Yes	Yes
Observations	55,040	55,114	55,040

Notes: Robust standard errors are reported in parentheses. *** $p < 0.01$ **$p < 0.05$ *$p < 0.1$.

Table 5: ***Heterogeneity: socio-economic and geographic disparities***

Panel A: Socio-economic						
	Wealthy			Poor		
	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'
Electricity Hours	-0.0026***	-0.025***	-0.005***	-0.0003	-0.0052	-0.0012
	(0.0004)	(0.0019)	(0.0004)	(0.001)	(0.0051)	(0.001)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	45911	45967	45911	8113	8127	8113
First stage F-stat	0	0	0	0	0	0
Panel B: Geographic						
	Urban			Rural		
	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'
Electricity Hours	-0.0087***	-0.0431***	-0.0087***	0.0006	-0.0144***	-0.0029***
	(0.0008)	(0.0033)	(0.0007)	(0.0004)	(0.0022)	(0.0004)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21053	21093	21053	32971	33001	32971
First stage F-stat	0	0	0	0	0	0

Notes: Robust standard errors are reported in parentheses. *** $p < 0.01$ **$p < 0.05$ *$p< 0.1$.

Table 6: ***Heterogeneity: caste and religion-based disparities***

Panel A: Caste						
	Forward Caste			Backward Caste		
	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'
Electricity Hours	-0.0022**	-0.0013	-0.0003	-0.002***	-0.0342***	-0.0069***
	(0.0008)	(0.0033)	(0.0007)	(0.0005)	(0.0025)	(0.0005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13517	13540	13517	32498	32530	32498
First stage F-stat	0	0	0	0	0	0
Panel B: Religion						
	Hindu			Minority		
	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'	Dummy Variable	No. of Questions Answered 'Yes'	% of Questions Answered 'Yes'
Electricity Hours	-0.0021***	-0.0235***	-0.0047***	-0.0039***	-0.0162***	-0.0033***
	(0.0004)	(0.002)	(0.0004)	(0.001)	(0.0047)	(0.0009)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46015	46070	46015	8009	8024	8009

Notes: Robust standard errors are reported in parentheses. *** p < 0.01 **p < 0.05 *p< 0.1.

Table 8: ***Mechanism: Women's Economic Security***

	Work participation (4 categories)	Earnings (Rs.)	Has bank account	House ownership papers in her name	Decision maker		Does own shopping
					own work	farm/animal work	
Electricity Hours	0.014***	93.475*	0.001	0.001***	0.008***	0.009***	0.008***
	(0.0017)	(51.825)	(0.0007)	(0.0004)	(0.001)	(0.0007)	(0.0006)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54094	54094	32630	51975	25684	26969	53958

Notes: Robust standard errors are reported in parentheses. *** p < 0.01 **p < 0.05 *p< 0.1.

Table 7: ***Mechanism: Economic Standing of Household***

	Total HH assets (quantiles)	Total HH income (quantiles)	HH Has							Part of Credit Society	Outstanding HH Debt (Rs.)
			bank account	bank savings	Post Office account	stocks/ securities	Fixed Deposit	Pension, LIC, others	Gold & jewellery		
Electricity Hours	0.011***	0.002	0.004***	0.009***	0.008***	0.002***	0.009***	0.004***	0.005***	0.001***	-704.34***
	(0.001)	(0.0013)	(0.0005)	(0.0008)	(0.0005)	(0.0002)	(0.0005)	(0.0006)	(0.0005)	(0.0004)	(223.9313)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54088	54094	53918	30701	30694	30701	30699	30686	30668	30695	47352

Notes: Robust standard errors are reported in parentheses. *** $p < 0.01$ **$p < 0.05$ *$p < 0.1$.

Table 9: *Mechanism: Health of Women*

Panel A: General health (Short-term morbidity)					
	Days	Days unable	Incidence of		
	ill	to work	Fever	Cough	diarrhea
Electricity Hours	-0.018***	-0.021***	-0.002***	-0.001**	-0.0003*
	(0.0041)	(0.003)	(0.0004)	(0.0003)	(0.0002)
Controls	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes
Observations	54094	54094	54094	54094	54094
Panel B: Reproductive Health					
	Number of	Current	Contraceptive	Desired more	Prefer boy
	Children Born	Pregnancy	Usage	children	for extra child
Electricity Hours	-0.009***	-0.001***	0.011***	-0.011***	-0.004**
	(0.0012)	(0.0002)	(0.0006)	(0.002)	(0.0015)
Controls	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes
Observations	53570	53324	50854	6334	26459

Notes: Robust standard errors are reported in parentheses. *** p < 0.01 **p < 0.05 *p< 0.1.

Table 11: *Mechanism: Life being comfortable*

Panel A: Electric Asset Usage						
	Owns			Watching TV		
	Electric fan	Refrigerator	TV	Men	Women	Children
Electricity Hours	0.002***	0.002***	0.004***	0.005***	0.008***	0.006***
	(0.0004)	(0.0005)	(0.0004)	(0.0008)	(0.0008)	(0.0009)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54077	54031	54068	53743	53654	44563
Panel B: Cooking Convenience						
	Cooking Environment			Dirty Fuel Usage (Rs.)		
	Cooking Place	Separate Kitchen	Ventilation	Firewood	Dung	Kerosene
Electricity Hours	0.003***	0.003***	0.002***	-3.437***	-9.108***	-0.226*
	(0.0007)	(0.0005)	(0.0005)	(0.6456)	(0.8766)	(0.1319)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54065	54065	43169	14143	3765	37338

Notes: Robust standard errors are reported in parentheses. *** p < 0.01 **p < 0.05 *p< 0.1.

Table 10: *Mechanism: Women's position in household and society*

Panel A: Bargaining power in household								
	Women's say						**Discuss**	
	Buy Land	Cooking	Wedding expense	If sick	Child's ill	Child's wed	Expenditure	Work/farm
Electricity Hours	0.0009	0.0007**	0.0009*	0.0023***	0.0031***	0.0031***	0.0143***	0.0167***
	(0.0007)	(0.0003)	(0.0006)	(0.0005)	(0.0004)	(0.0004)	(0.0007)	(0.0008)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30363	54042	30648	30742	51647	51081	53915	53794
Panel B: Physical Mobility								
	Permission for				**Visit alone**			
	Health center	Friend's home	Kirana shop	Bus trip	Health center	Friend's home	Kirana shop	Bus trip
Electricity Hours	-0.017***	-0.0137***	-0.0109***	-0.0108***	0.0144***	0.0162***	0.0141***	0.014***
	(0.0005)	(0.0005)	(0.0006)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0008)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53836	53520	44298	29902	52943	52474	48623	30503
Panel C: Women's confidence								
	Purdah Practice	Looked at interviewer	Knows expenditure	Confidence	Member Mahila Mandal	Member Self-help	Member Political org	Attended panchayat
Electricity Hours	-0.0105***	0.0178***	0.0142***	0.0139***	0.0028***	-0.0012**	0.0004***	0.0044***
	(0.0005)	(0.0007)	(0.0008)	(0.0007)	(0.0004)	(0.0005)	(0.0002)	(0.0005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54013	53938	53918	53937	30774	30773	30765	30736

Notes: Robust standard errors are reported in parentheses. *** $p < 0.01$ **$p < 0.05$ *$p < 0.1$. Self 1; Husband 2; Senior male 3; Senior female 4; Others 5

Table 12: *Plausibly Exogenous IV*

Electricity Hours	δ	β(LB)	β(UB)	Controls	FE
Ever beaten	-0.0021	-0.0041	-0.00032	Yes	Yes
Count of questions answered 'Yes'	-0.0199	-0.0041	0.0194	Yes	Yes
% of questions answered 'Yes'	-0.0040	-0.0041	0.0018	Yes	Yes

Notes: Robust standard errors are reported in parentheses. *** p < 0.01 **p < 0.05 *p< 0.1.

Table 13: *Lewbel IV*

	Ever beaten	Count of questions answered 'Yes'	% of questions answered 'Yes'
Electricity Hours	0.0009	-0.0292***	-0.0059***
	(0.0018)	(0.0091)	(0.0018)
Controls	Yes	Yes	Yes
FE	Yes	Yes	Yes
Observations	54,957	55,031	54,957
Cragg-Donald Wald F-stat	33.93	33.97	33.93
Kleibergen-Paap F-stat	14.54	14.57	14.54

Panel B: Individual Variables

	Leaving Without Permission	Extramarital Affair	Lack of Dowry	Neglecting Household duties	Not being respectful	Cooking inadequacy
Electricity Hours	-0.0035	-0.0037*	-0.0105***	-0.0016	-0.0115***	-0.01090***
	(0.0028)	(0.0020)	(0.0025)	(0.0027)	(0.0033)	(0.0025)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54,742	54,871	54,923	54,933	31,237	54,896
Cragg-Donald Wald F-stat	33.94	33.68	33.96	33.97	24.56	33.90
Kleibergen-Paap F-stat	14.55	14.45	14.56	14.56	9.72	14.52

Notes: Robust standard errors are reported in parentheses. *** p < 0.01 **p < 0.05 *p< 0.1.

Table 14: ***Propensity Score Matching***

	Treated (1)	Controls (2)	Difference (3)	S.E (4)	T-stat (5)
Ever beaten	0.8427	0.8647	-0.0219	0.0047	-4.69
Percent of Yes	0.3939	0.4251	-0.0312	0.0046	-6.85
Number of Yes	2.1352	2.1352	-0.1703	0.0228	-7.48

Notes: Matching is done after controlling for covariates as discussed in the empirical strategy section.

Figure 2: ***Exclusion restriction***

(a) ***Confidence in state govt*** **(b)** ***Confidence in police*** **(c)** ***Confidence in panchayat***



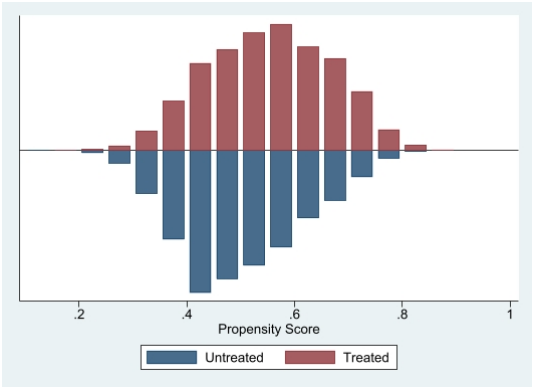


Figure 3: ***Estimate of Propensity score: Criteria of Common Support***

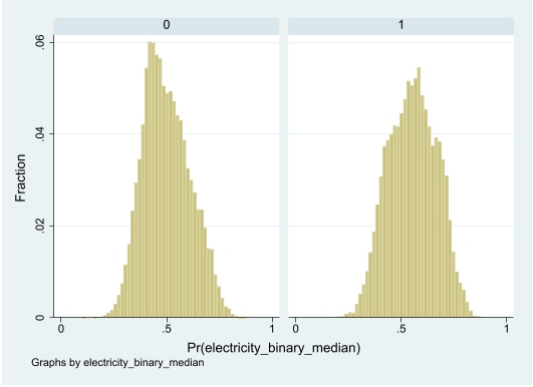


Figure 4: ***Propensity Score Distribution***

Figure 5: ***PSM***

(a) ***Confidence in state govt*** **(b)** ***Confidence in police***

