IMPACT OF ELECTRIFICATION ON WOMEN EMPOWERMENT: EVIDENCE FROM NEPAL

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Abstract

This study aims to investigate the relationship between household electrification and women's empowerment, as measured by a range of indicators such as decision-making power, freedom of movement, control over resources, degree of sexual autonomy, and perception of domestic violence, using data from the Nepal Demographic and Health Survey 2016. An empowerment index was constructed from these indicators, and an ordered logistic regression model was used to predict the association between household electrification and the index. To establish a causal link, various propensity score matching techniques were employed. The results reveal that the odds of women being better empowered are 1.4 times higher for those living in households with access to electricity compared to those without. These findings underscore the importance of household electrification as a means to enhance women's empowerment in Nepal.

JEL Classification :D120 ,D910 , Q580
Keywords: Electrification, Women Empowerment, Nepal, Propensity Score Matching

1. INTRODUCTION

According to the World Economic Forum's Global Gender Gap Index, achieving full gender parity globally is estimated to take around 130 years, while the South Asian region is projected to close the gender gap in an alarming 197 years, performing poorly compared to other regions (World Economic Forum, 2022). In this context, women's empowerment becomes a crucial development goal, and various interventions, such as microcredit programs, promoting girls' education, and self-help groups, are being implemented. The electrification of households, while appearing to modernize agriculture and improve living standards, significantly impacts women's empowerment by reshaping time allocation and household dynamics.

In Nepal, the Community Rural Electrification Program (CREP) was launched in 2003/04 by the Nepal Electricity Authority to increase access to electricity in areas without power (CREP Nepal – Energypedia, n.d). Since then, national electrification rates have risen from 24% in 2001 to 90% in 2020 (World Development Indicators, 2020). However, the impact of this impressive growth in electrification on women's empowerment is still a subject of investigation. The electrification of households has positive effects on women, such as reducing gender-based violence, alleviating time constraints, providing access to educational resources through television and the internet, and increasing opportunities for education and employment (Samad and Zhang, 2019)

Evaluating the impact of infrastructure projects like electricity provision presents econometric challenges due to the lack of experimental data. In non-experimental settings, addressing potential sample selection bias is a major challenge since electrified households may differ from non-electrified households, which could bias the impact assessment. To address this issue, this research utilizes the propensity score matching technique to examine the causal relationship between household electrification and women's empowerment in the absence of appropriate data and a reliable instrument.

The literature review in Section 2 discusses the definitions of empowerment and the relationship between household electrification and women's empowerment. Section 3 explains the variables and methodology, including data sources, construction of the empowerment index, and empirical strategy. The results are discussed in Section 4, followed by the conclusion in Section 5.

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2. LITERATURE REVIEW

2.1. DEFINITIONS OF EMPOWERMENT

Researchers and different institutions have adopted a range of definitions of and approaches to understanding empowerment. Most of the definitions converge to an agreement that an individual's empowerment entails at least the exercise of control to enhance their livelihood. The literature is rife with words like control (Jejeebhoy and Sathar 2001), power (Agarwal 1997) agency, autonomy (Dyson, Tim, and Moore, 1983), and bargaining power (Beegle, Frankenberg, and Thomas 2001) which in essence allude to women's ability to make decisions for themselves and their family members and are relevant in the discussion of empowerment.

The World Bank identifies empowerment as a key element to alleviating poverty and defines it as the "expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control, and hold accountable institutions that affect their lives." UNICEF (2018) says that empowerment is about women, men, girls and boys taking control over their lives: setting their own agendas, developing skills (including life skills), building self-confidence, solving problems, and developing self-reliance. The process of empowerment enables women, men, girls, and boys to question existing inequalities as well as act for change.

Scholars have viewed empowerment as a process or an outcome or both. Kabeer (1999) views empowerment as a "process of change" that entails exercising consequential choices given that the decision-maker has the ability to choose among other alternatives. The ability to make choices has three dimensions: resources, agency, and achievement. Resources include material resources and social relationships which enhance the decision-maker's ability to exercise choice. Agency implies the ability of the individual to set goals for themselves and pursue them. Achievements of the decision-maker can range from the individual's fulfillment of basic necessities to their representation in political space depending upon the context. Bennet (2002) defines empowerment as a process of "the enhancement of assets and capabilities of diverse individuals and groups to engage, influence, and hold accountable the institutions which affect them." Dixon-Mueller (1993) defines empowerment as "both a group and an individual attribute; both process (that of gaining power) and a condition (that of being empowered)." Along the lines of encapsulating both the dimensions of empowerment (process and outcome), Batliwala (2007) says that "women's empowerment is thus the process, and the outcome of the process, by which women gain greater control over material and intellectual resources, and challenge the ideology of patriarchy and the gender-based discrimination against women in all the institutions and structures of society". Batliwala (2007) has also emphasized on "empowerment spiral" in addition to grass-roots level initiations to galvanize macro level transformative political action. Malhotra et al. (2002) point out that empowerment frameworks identify a number of unique dimensions, suggesting that empowerment must occur along economic, socio-cultural, familial/interpersonal, legal, political, and psychological lines.

Given the literature and data availability, this paper aims to capture women empowerment in terms of their decision-making power, freedom of movement, control over resources, degree of sexual autonomy, and perception of domestic violence.

2.2. ELECTRIFICATION AND EMPOWERMENT

Electrification of a household has a profound impact on women empowerment. Access to electricity allows women to engage in various activities that enhance their economic and social well-being. Energy also provides social power by facilitating information access, connections to extended family through mobile phones and TV, and improved health outcomes. In Bamiyan, Afghanistan, electric lighting had a transformative effect. It improved visibility, reducing accidents in the home, such as unintentionally harming children in the darkness. Additionally, it ensured that meals were cooked to perfection, enhancing their quality. This positive change not only boosted women's self-esteem in their relationships with their husbands and extended families but also improved overall marital dynamics. The efficient fulfilment of responsibilities resulted in fewer complaints and increased harmony. The introduction of electricity brought significant

improvements to the community's well-being (Standal & Winther, 2016). Empirical studies show that electrification disproportionally benefits women. Access to electricity has multiple empowering effects on women in developing countries. Firstly, it increases the efficiency of home production, allowing women to allocate more time to income-generating activities. This boosts their assets and income prospects. Secondly, electricity reduces indoor air pollution caused by alternate lighting sources, improving women's health and productivity. Lastly, access to electronic media enhances knowledge and information, enabling economic empowerment and increased participation in public life (Samad and Zhang, 2019). Adoption of time saving appliances after electrification allowed women to be freed from housework, and it was one of the primary factors leading to steady increase in female labor supply in the United States during the 20th century, according to an influential paper by (Greenwood, Seshadri, and Yorukoglu 2005). Between 1880 and 1990 in the United States electrification decreased fertility and delayed the timing of childbearing of young women and that higher levels of required educational attainment increased the employment response of young women to electrification (Vidart, 2022).

Sedai, Nepal, and Jamasb (2022) show that having access to electrification enhances women's economic autonomy, agency, mobility and decision-making abilities in India. Polansky and Laldjebaev (2021) find that women in grid-supplied communities are on average 27% more literate and complete more years of schooling compared to women in off-grid communities in Afghanistan. Rathi, Singh, and Vermaak (2018) show that household electrification delayed dinner-time by one hour on average (by raising productive hours) while increasing women's income by 20%. Solar electrification has been shown to improve women's empowerment through economic independence in West Africa (Burney et al. 2017).

In Nepal, there is a noticeable scarcity of studies examining the impact of infrastructural projects, such as household electrification, on women's empowerment. This research gap underscores the significance of this study, which seeks to investigate the relationship between electrification of households and the empowerment of women. By establishing a causal relationship between these two variables, this paper aims to contribute to the understanding of how electrification influences women's empowerment in the Nepalese context.

Furthermore, this study will outline key policy implications derived from its findings, offering valuable insights for policymakers and stakeholders involved in promoting women's empowerment and sustainable development in Nepal.

3. METHODOLOGY

3.1. DATA

This study uses 2016 Nepal Demographic and Health Surveys (DHS). DHS is a nationally representative population-based survey with a large sample size and is funded by the United States Agency for International Development (USAID). The DHS data can offer the benefits of large datasets while allowing for an analysis of decision-making and women's autonomy in the household at the individual level. The survey includes information on women's socio-demographic characteristics, employment characteristics, decision-making abilities, control over resources (earnings), control over sexual activities, perception of domestic violence, and freedom of movement. The total sample size of the dataset is 12, 862.

3.2. VARIABLES

Drawing from the extant literature, this study uses information on women's decision-making, freedom of movement, control over resources, sexual autonomy, and perception of domestic violence as indicators of women's empowerment and their relationship with women's employment represented by women's working status, occupation and who they work for.

Explanatory Variable
The main explanatory variable is the dummy variable electrification of a household that takes value 0 if the household does not have access to grid electricity and 1 if it does.

Indicators of Empowerment
i) Decision-making
Two questions about who makes decisions about the

respondent's major household purchases and healthcare are used to gauge decision-making. In this case, the response categories were changed to 0 for "spouse or others" and 1 for "respondent alone or jointly with partner". Finding the average of the answers produced a dichotomous decision-making variable with numerical codes 0 and 1.

ii) Freedom of movement

The questions that asked if the respondent needed permission to visit their family and relatives were used to gauge the respondent's freedom of movement. If the answer to this variable was "yes," it was recoded as 0, and if it was "no," it was recoded as 1.

iii) Control over resources

Who decided the control over the respondent's earnings and if the respondents had a financial account were the questions that best captured financial autonomy. Answers to the question on control over wages were recoded to 0 if the decision-maker is "spouse or others" and 1 if the respondent is "respondent alone or jointly with partner". If they did not have a financial account, the response to the inquiry was recorded as 0, and if they did, it was recorded as 1.

iv) Views on violence against women

A variable of views on violence against women was constructed by combining six questions that asked respondents if it was justifiable for the husband to beat their wife if the wife went out without telling, neglected the children, argued with the husband, refused to have sex with husband, and burnt the food. The response is recorded as 0 if the woman reports that violence against wives is acceptable in one or more situations. Having a record of 1, and therefore saying that wife-beating is never okay, is associated with empowerment.

v) Sexual autonomy

The ability to deny sex and request that a partner take contraceptives was used to test the final indicator of empowerment, control over sexual autonomy. Like the decision-making variable, the final sexual autonomy variable was constructed by finding the average of the two questions.

Covariates

The study in this research takes the literature into account and adjusts for a few significant respondents' socio-demographic traits. Education level is broken down into no education, primary school, secondary school, and higher school. Together with age, marital status, and religion, a respondent's sociodemographic characteristics that are essential including whether they live in an urban or rural location.

Women's response to their marital status includes being married, widowed, divorced, not living with their husbands, and never in a union. I categorize the responses into "married" if the respondents are married or are cohabiting and "others" for the rest. I divided religious affiliation into "major religions" and "others" to examine if women's ties to major religions facilitated their empowerment. A measure of the household head's sex and age are also included. I combined the poorest and poor categories to make a final category poor and rich and richer categories to make a final category rich in the wealth index. Table 1 shows the frequency distribution of women based on the mentioned socio-demographic characteristics.

Table 1 : *Socio- Demographic Characteristics of the Sample*

Variable	Frequency
Type of Place of Residence	(n = 12, 862)
Urban	64.37
Rural	35.63
Education Level	(n = 12, 862)
No Education	22.79
Primary	16.18
Secondary	36.04
Higher	13.99
Age	(n = 12, 862)
15-19	20.39
20-24	17.93
25-29	16.28
30-34	13.91
35-39	12.32
40-44	10.39
45-49	8.79
Wealth Index Combined	(n = 12, 862)
Poor	42.24
Middle	20.21
Rich	37.54

Source : Author's Calculations

3.3. CONSTRUCTION OF EMPOWERMENT INDEX

Because empowerment is multidimensional in nature, it is important to be careful about constructing an empowerment index. Inappropriate combining of indicators may mask the differential impact of individual variables on the outcome of interest (Malhotra and Schuler 2005). Since the indicators are collectively indicative of women's ability to make decisions in various aspects of their life, empowerment index can be confidently constructed. I first computed the mean score of women's responses (1 or 0).

I computed the 33rd and 66th percentiles of the index to turn it into an ordinal variable. Women in the 33rd percentile were labeled less empowered, between 33rd and 66th percentile were labeled partially empowered and beyond the 66th percentile were labeled highly empowered.

Mathematically, let x be the mean score of women's responses (ranging from 0 to 1). p33 represents the 33rd percentile of the empowerment index. p66 represents the 66th percentile of the empowerment index. The ordinal categorization of the empowerment index can be expressed as follows:

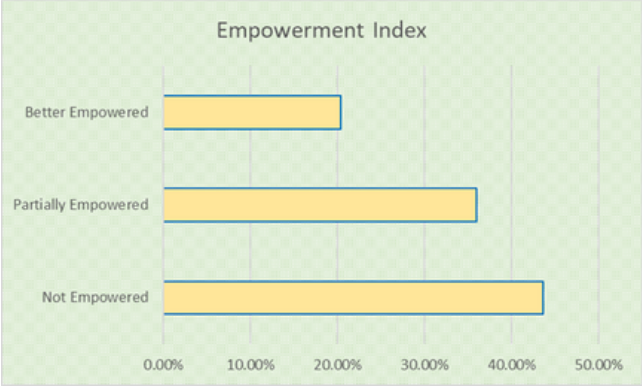
If x ≤ p33, the woman is labeled as "less empowered."

If p33 < x ≤ p66, the woman is labeled as "partially empowered."

If x > p66, the woman is labeled as "highly empowered."

I computed the frequency for the empowerment index as shown in Figure 1. More than 40 percent of respondents fall under the category of not empowered.

Figure 1: *Empowerment Index Frequency*



Source : Author's Calculations

3.4. EMPIRICAL STRATEGY

Since the dependent variable, the empowerment index, is ordinal in nature (no empowerment, partial empowerment, better empowerment) I use the ordinal logistic model, using equation 1, to identify the association between household electrification and the empowerment index. The ordinal logistic regression is considered a generalization of a binary logistic regression model when the response variable has more than two ordinal categories. This model is used to estimate the odds of being at or below a particular level of the response variable, however, with some manipulation, it can be used to estimate the odds of being beyond a particular level of the response variable as well. One of the main assumptions of the ordinal logistic model is the proportional odds assumption which means that the relationship between each pair of outcome groups is the same. I run regressions assuming that this holds true. The ordinal logistic regression model that estimates the odds of being beyond a particular level can be expressed in the logit form as follows:

$$\text{logit}\,[\pi\,(y> j|x_1, \ldots, x_p)] = \alpha j + (\beta_{1j}\, x_1 + \beta_{2j} x_2 + \ldots + \beta_{pj}\, x_p)$$

where,

αj = intercepts or cut points

βij = logit coefficients

Xp = a vector of independent variables

y = Empowerment Index

3.5. MATCHING ANALYSIS

Establishing a causal relationship between the empowerment index score of women and access to electricity requires careful consideration. Merely comparing the scores of women with and without electricity is insufficient, as household connectivity to electricity depends on various factors, leading to a potential sample selection bias. Since it is impossible to compute the empowerment index score for the same woman in both scenarios, a quasi-experimental method called Propensity Score Matching (PSM) is used to mimic a randomized controlled trial. Each observation is assigned a probability or propensity score based on covariates, and participants from the treatment and control groups are matched to form a counterfactual group (Gertler et al., 2016). The resulting matched data helps establish a causal relationship between household electrification and the empowerment index of women.

Several studies have employed the propensity-score matching method to investigate the causal relationship between household electrification and household welfare. Using the Indian Human Development Survey, Samad and Zhang (2019) found that electrification enhances women's empowerment, leading to an 11-percentage point increase in the overall empowerment index in rural India. Rathi, Singh, and Vermaak (2018) discovered that women who work benefit the most from the productivity gains of electrification, experiencing greater increases in earnings compared to men. Salehi-Isfahani and Taghvatalab (2022), utilizing propensity score matching, determined that electrification contributed to the narrowing of the gender gap in literacy, providing a potential solution to the puzzle of female empowerment in the face of

rising patriarchy in Iran. The PSM technique relies on two assumptions. The first assumption is conditional independence, which considers the probability of receiving treatment given the covariates. The second assumption requires a substantial overlap between participants in the treatment and control groups within the common support region, where propensity scores are close to each other (Khandker, Koolwal, and Samad 2010). Accordingly, the first step in the PSM technique is to select relevant covariates. Table 2 displays the chosen covariates, such as working status, education, residence, ownership of livestock, household head sex, household head age, age squared, and wealth level, based on their positive association with the treatment variable, electricity.

Table 2: *Difference in Means of Covariates*

Covariate	Electricity	Non-Electricity	Difference in Means
Working	0.58	0.68	-0.1***
Education	1.33	0.81	0.52***
Residence	0.67	0.43	0.17***
Owns Cow	0.46	0.72	-0.26***
Owns Horse	0.01	0.02	-0.01***
Owns Poultry	0.41	0.52	-0.11***
Household Head Sex Female	1.32	1.33	-0.01
Household Head Age	44.9	42.5	2.4***
Household Head Age Square	2187.9	1958.1	229.8
Wealth Level	1.04	0.06	0.98***

*** p<.01, ** p<.05, * p<.1
Source: Author's Calculation

Once the first assumption is fulfilled, the next step is to conduct propensity score matching. The ultimate goal is to ensure reduction of bias. These matching techniques give us the Average Treatment Effect (ATE), Average Treatment Effect on the Treated (ATET), and the Average Treatment Effect on the Untreated (ATEU). The three PSM techniques I compare are nearest neighbor, radius caliper, and kernel. Based on the chosen technique, the number of matched observations will vary but the number of observations off common support will remain the same i.e. 1 untreated observation and 904 treated observations.

I find that nearest neighbor PSM technique produces the least amount of bias i.e. 12.8 compared to 19.2 and 21.2 of radius caliper and kernel techniques, respectively. Thus, I use the nearest neighbor PSM technique to conduct the analysis using the probability weights generated by matching. According to Khandker, Koolwal, and Samad (2010) the nearest neighbor matching technique matches each treatment unit to k control units on the selected set of covariates. The number of nearest neighbors (k control units) may be specified but the consensus is to set the same between 3 and 5.1 limit the matching to 5 nearest neighbors. The total number of observations in the common support region in nearest neighbor matching is 8,438 (963 from untreated and 7,475 from treated).

4. RESULTS

4.1 PRE-MATCHING ANALYSIS

The outcome variable, the empowerment index, has been summarized in Table 3 which suggests that women who reside in house with access to electricity are more empowered than women who reside in home without access to electricity.

Table 3: *Summary Statistics of the Empowerment Index*

Outcome Variable	Electricity	Non-Electricity	Mean Difference
Empowerment Index	1.94	1.62	0.32***

*** p<.01, ** p<.05, * p<.1
Source: Author's Calculation

As shown in Table 4, the results of the pre-matching Ordinal Logistic Regression demonstrate a positive relationship between women's empowerment and household electrification. An odds ratio greater than 1 indicates a positive relationship, while a ratio below 1 signifies an inverse relationship. Holding other predictors constant, women in households with electricity have 1.51 times the odds of being better empowered compared to women in households without electricity. This result is statistically significant at $p < 0.01$ and aligns with the existing literature mentioned earlier.

Furthermore, women's empowerment is directly associated with their working status, with working women being more likely to experience empowerment than non-working women. Higher levels of education also increase the likelihood of empowerment compared to lower levels or no education. Residing in urban areas is linked to a higher likelihood of empowerment. While the likelihood of empowerment initially increases with age, it does so at a decreasing rate, as indicated by an odds ratio of age squared less than 1. Contrary to expectations, being affiliated with the majority religion exhibits a lower likelihood of empowerment. Higher household wealth contributes to a higher likelihood of empowerment, and having a female household head positively influences the respondent's empowerment.

The likelihood of empowerment decreases with the age of the household at an increasing rate, as represented by an odds ratio less than 1 for household head age and greater than one for household head age squared. This may be due to older households being less likely to change and women facing more traditional norms. Lastly, having at least one child under the age of five decreases the likelihood of empowerment. This could be because after having children, women often choose to take on traditional roles at home, resulting in a loss of income and decision-making power. All covariates exhibit statistically significant odds ratios at $p < 0.01$, except for religion, which is insignificant.

While the findings of Table 4 indicate a higher likelihood of empowerment for women with access to electricity, these results do not establish a causal relationship. The next section will present the results of the nearest neighbor PSM technique and the corresponding odds ratios obtained from the generated weights.

Table 4: *Ordered Logit Model Predicting Average Empowerment Index by Electrification Status and Socio-Demographic Characteristics before Propensity Score Matching*

Variables	Odds Ratios
Electricity (Yes)	1.51***
	(0.11)
Working Status	
Yes	1.49***
	(0.069)
Highest Education Qualification	
Primary	1.39***
	(0.08)
Secondary	2.18***
	(0.13)
Higher	4.25***
	(0.34)
Residence	
Urban	1.33***
	(0.061)
Age	1.49***
	(0.03)
Age Squared	.99***
	(0.00)
Religion	
Majority: Hindu	.97
	(0.063)
Wealth Level (Base: Poor)	
Middle	1.21***
	(0.072)
Rich	1.53***
	(0.08)
Household Head Sex (Base: Male)	
Female	2.24***
	(0.10)
Household Head Age	0.84***
	(0.01)
Household Head Age Square	1.001***
	(0.00)
Children Under Five (Yes)	.803***
	(0.035)
Cut 1	4.5***
	(0.43)
Cut 2	5.7***
	(0.0.43)
Pseudo R- Squared	0.1291
Observations	9, 795

****p<0.01, **p<0.05, *p<.1*
Source: Author's Calculation

4.2. MATCHING ANALYSIS

As mentioned earlier, the nearest neighbour matching technique produces the least bias i.e. 12.8. The technique enables us to estimate the Average Treatment Effect (ATE), Average Treatment Effect on the Treated (ATET) and Average Treatment Effect on the Untreated (ATEU) for the outcome variable, empowerment index. Table 5 presents the results of the same and shows an increase in the treatment effect on the matched sample as opposed to the unmatched sample.

Table 5: *Treatment Effects for Unmatched and Matched Samples (Nearest Neighbour Matching)*

Sample	Treated	Control	Difference
Unmatched	1.93	1.61	0.31
ATT	1.91	1.61	0.29
ATU	1.61	1.76	0.14
ATE	--	--	0.27

***Source**: Author's Calculation*

Source: Author's Calculation

The odds ratios are presented in Table 6. As can be observed, odds for women with access to electricity being better empowered are 1.4 times the odds for women without access to electricity in the household when holding all the other predictors constant. The result is statistically significant at $p<0.01$. We can now establish that electrification of the household positively empowers women.

The relationship between some covariates and empowerment has either changed or become less significant after the matching process. Working women have lower odds of experiencing empowerment, possibly due to facing exploitation in the workplace while also fulfilling domestic responsibilities (Batliwala 2007; Pearson 2004). Although the association between higher education and empowerment remains, its significance has decreased after matching. Similarly, the impact of wealth level and residing in urban areas has also become less significant. Robustness checks using radius caliper and kernel matching techniques, presented in Appendix Table 7, support the findings from the nearest neighbor PSM technique. Across all three matching techniques, electrification of households consistently emerges as a positive and statistically significant determinant of women's empowerment. However, the significance level decreases in radius caliper and kernel matching techniques, and the direction of the relationship between wealth and empowerment becomes inverse.

The consistent significance and relationship between electrification and empowerment, both before and after matching, while other variables change, suggest that even after accounting for non-randomized access to electricity, household electrification is associated with a higher level of women's empowerment.

Table 6: *Ordered Logit Model Predicting Average Empowerment Index by Electrification Status and Socio-Demographic Characteristics after Propensity Score Matching (Nearest Neighbor)*

Variables	Odds Ratios
Electricity	1.4***
	(0.17)
Working Status	
Yes	0.63
	(0.31)
Highest Education Qualification	
Primary	2.76*
	(1.31)
Secondary	2.2*
	(0.92)
Higher	2.1
	(1.7)
Residence	
Urban	1.3
	(0.39)
Age	1.75***
	(0.34)
Age Squared	.99**
	(0.003)
Religion	
Majority: Hindu	1.2
	(0.44)
Wealth Level (Base: Poor)	
Middle	0.60
	(0.28)
Rich	1.46
	(0.31)
Household Head Sex (Base: Male)	
Female	2.57***
	(0.78)
Household Head Age	0.84**
	(0.06)
Household Head Age Square	1.01
	(0.00)
Children Under Five	
Cut 1	6.57
	(3.32)
Cut 2	7.91
	(3.33)
Pseudo R- Squared	0.129
Observations	7, 921

***p<0.01, **p<0.05, *p<.1
Source: Author's Calculation

5. CONCLUSION AND POLICY IMPLICATIONS

This study used the Nepal Demographic and Health Survey 2016 to find the impact of household electrification on women empowerment. This paper defines women empowerment based on the indicators of decision-making power, freedom of movement, control over resources, degree of sexual autonomy, and perception of domestic violence. An empowerment index was created to form an average representation of empowerment based on those indicators. To address the issue of non-random nature of electrification, this paper used different propensity score matching technique and established a positive causal link between electrification and women empowerment index. Access to electricity can be an important policy tool for empowering women. Nearest neighbor matching produces least mean bias and radius caliper and kernel matching techniques are used as robustness checks.

In addition to electrification, this paper has found higher levels of education, the presence of a female household head and age of the respondent to be positive determinants of women empowerment in all three matching techniques. The impact of age on empowerment increases at a decreasing rate. Presence of at least one child lowers the likelihood of empowerment. Associated religion and level of wealth are not significant determinants of empowerment. The relationship of working status with women empowerment switches from positive to negative after the matching analysis. The fact that the significance and direction of relationship for covariates has changed but remained the same for the coefficient of electrification means that the propensity score matching has worked and a causal link between household electrification and women empowerment has been established.

Firstly, the results suggest that promoting household electrification can be an effective policy tool for empowering women. Governments and policymakers should prioritize the expansion of electricity infrastructure to households, particularly in rural areas, to ensure that women can benefit from access to reliable electricity. Secondly, the study found that education, female household heads, and the age of the respondent were positive determinants

of women's empowerment. Policymakers should focus on promoting education for girls and women, supporting female-headed households, and implementing policies that target women of all ages to enhance their empowerment. Lastly, the study indicates that working status can have both positive and negative effects on women's empowerment, depending on the context. Policymakers should consider the potential impact of employment policies on women's empowerment and design interventions that promote gender equality in the workplace. Overall, the findings of this study suggest that promoting household electrification, improving electricity infrastructure, investing in education for girls and women, supporting female-headed households, and promoting gender equality in the workplace can enhance women's empowerment and promote gender equality.

APPENDIX

Table 7: *Ordered Logit Model Predicting Average Empowerment Index by Electrification Status and Socio-Demographic Characteristics after Propensity Score Matching (Kernel and Radius Caliper)*

Variables	Radius Caliper	Kernel
Electricity	1.37***	1.43***
	(0.14)	(0.13)
Working Status		
Yes	1.41	1.07
	(0.42)	(0.35)
Highest Education Qualification		
Primary	1.66	1.77
	(0.66)	(0.74)
Secondary	1.74	1.27
	(0.69)	0.56
Higher	1.52	1.36
	(0.96)	0.92
Residence		
Urban	1.22	1.03
	(0.31)	0.28
Age	1.43**	1.56***
	(0.19)	(0.22)
Age Squared	.99**	0.99**
	(0.002)	(0.00)
Religion		
Majority: Hindu	1.65	1.62
	(0.66)	(0.68)
Wealth Level (Base: Poor)		
Middle	.81	0.78
	(0.24)	(0.23)
Rich	0.63	0.68
	(0.37)	(0.05)
Household Head Sex (Base: Male)		
Female	2.92***	2.31***
	(0.80)	(0.65)
Household Head Age	0.98	0.90
	(0.06)	(0.06)
Household Head Age Square	0.99	1.00
	(0.00)	(0.00)
Children Under Five	0.46***	0.39***
	(0.12)	(0.1)
Cut 1	6.75	5.96
	(2.66)	(2.6)
Cut 2	8.18	7.42
	(2.66)	(2.66)
Pseudo R- Squared	0.129	
Observations	7, 921	

***p<0.01, **p<0.05, *p<.1
Source: Author's Calculation

Table 8: *Treatment Effects for Unmatched and Matched Samples (Radius Caliper and Kernel Matching)*

Sample	Treated	Control	Difference
Unmatched	1.93	1.61	0.31
ATT	1.91	1.61	0.29
ATU	1.61	1.76	0.14
ATE	--	--	0.27

Source: Author's Calculation

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