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Impact of Clean Cooking Energy on the Subjective Health of Rural Women: Evidence from District Vehari

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ABSTRACT

The primary use of unclean cooking energy significantly contributes to indoor air pollution posing various health risks, especially for women who devote more time to cooking. This study focused on assessing the health impacts on rural women, recognizing the importance of adopting clean cooking energy practices. Data was collected using a multistage sampling technique through a well-designed questionnaire. The Probit model was employed to analyze and estimate the results. The study found significant relationship between clean cooking energy and health. Reduced kitchen timing, presence of chimney in the kitchen, house style, local hospital access and women's control over finances were all significant and positively related to subjective health. However, age, income, family size, marital status, and education did not significantly impact the subjective health. The study is limited to District Vehari, however, it emphasizes the importance of clean cooking techniques for rural women's health in South Punjab.

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INTRODUCTION

Clean energy use and health pose vital global challenges. The use of polluting fuels, such as crop residuals and animal dung for cooking is particularly hazardous for the health of individuals, especially women. Despite progress, three billion people worldwide have limited access to clean cooking energy (Li et al., 2023). The persistent reliance on traditional cooking fuels in developing countries is a significant impediment to global sustainable development. Around 2.6 billion people in low-income economies consistently rely on biomass, wood and non-wood waste as their primary cooking energy (Wu, 2022). Households lacking clean cooking energy or relying on polluting fuels face severe health consequences, including respiratory and lung diseases, burns, and poisoning. The International Energy Agency reports that populations in low-income countries experience more diseases caused by household air pollution, which adds to 3.7 million early deaths annually, with females and kids every year, compared to developed countries (IEA, 2023). It is commonly recognized that using polluted fuels, such as crop leftovers, animal dung, and fuel wood, hurts both human and environmental health. Following an open fire, polluting fuels release chemicals and pollutants that harm human health (Ahmad et al., 2023).

In Pakistan, the dominance of traditional energy sources like biomass and firewood persists in part because of their easy availability, low cost, and unawareness. Household air pollution is linked to various health issues, significantly impacting women. Pakistan, the 5th largest developing country by population, has over 104.6 million people primarily relying on polluting fuel, with 10.16 million in city centers and 95.14 million in village areas (WHO, 2022). The majority rely on polluting fuel and reside in rural areas. The health of women in Pakistan is a pressing concern, as it is intrinsically linked to the health of their children. The dangerous effects of household air pollution, exacerbated by household duties, raise significant challenges. Additionally, environmental challenges associated with sustainable development pose a considerable threat to future generations (Lakshmi et al., 2013).

Women constitute 50% of the world's population, so addressing this issue is crucial. The use of cleaner energy not only reduces physical illness but also allows women to have more time for rest, as it diminishes the time spent on cooking and heating tasks (Shrestha et al., 2021). This is particularly significant as it lessens the time cost associated with activities like collecting fuelwood. Moreover, cleaner energy usage has broader societal implications. Women, freed from the burden of traditional cooking methods, can actively participate in social activities. This not only provides them with relief from the stress of household chores but also creates opportunities for them to showcase their hidden talents (Tran et al., 2020).

In Pakistan, many women in the rural population consistently face serious health issues due to the use of polluting cooking energy. There are numerous obstacles to achieving the required level of clean cooking energy and many

women are often overlooked by male-headed households (Yasmin & Grundmann, 2020). District Vehari, being an agricultural area, has 82.5% of its population residing in rural areas, of which 1.4 million are women (GOP, 2017). A considerable portion of this population spends most of their time cooking with unclean energy sources (Khalafzai & Nirupama, 2011).

A few studies were conducted on the impact of clean cooking energy on the subjective health of rural women (Li et al., 2023; Li et al., 2022; Imran et al., 2019; Yasmin & Grundmann, 2020). To the best of our knowledge, there is a dearth of literature in Pakistan, particularly in the Vehari region addressing the health concerns of rural women. So, this study is designed to estimate the effects of clean energy use on the subjective health of women through collecting primary data by using a well-designed questionnaire. The study also focusses on various socio-economic variables that can influence the use of clean energy and women's subjective health. Advocating for cleaner energy is not merely an environmental concern but a vital step towards achieving a more equitable and healthier society, particularly benefiting women on a large scale in rural Pakistan. In light of these issues, the present study focuses on understanding the effects of clean cooking fuels and other socioeconomic variables on the subjective health of rural women in District Vehari. The study addresses a critical gap by determining the type and pattern of fuel sources in village areas and evaluating the nexus between the type of fuel used and women's health conditions in a region with comparatively lower social and economic indicators. The analysis contributes significantly to the existing literature in several ways. Firstly, it stands out as one of the few studies specifically focusing on women's health in the rural areas of District Vehari. Secondly, the study will provide a positive insight into the benefits of using clean cooking fuel.

The remaining sections of this study are organized as follows. Section 2 discusses the study's empirical techniques and data sources. Section 3 summarizes the descriptive data and empirical findings on the effects of clean cooking energy and other socioeconomic variables on women's health. Section 4 summarizes the study findings and policy implications.

METHODOLOGY

Data sources

A multistage sampling technique was employed for a survey in three Tehsils of District Vehari. The final sample consisted of 390 women from 30 randomly selected villages, each contributing 13 women engaged in daily cooking. This sample size was sufficient for a population exceeding one million, as per Krejcie and Morgan's (1970) sampling table.

In this study, the subjective health status of rural women served as the dependent variable. The present study examined women's subjective health status (1 indicates that the women self-rated as healthy; 0 indicates that the women were unhealthy). This study's main explanatory variable was rural households' use of clean energy. Cooking energy accounts for the majority of rural energy usage and is closely linked to women's subjective health. In the current study, gas, solar energy, biogas, electricity, and natural gas were classified as clean energy sources, and rural households' clean energy consumption was defined as their use of one of these energy sources. Firewood and coal were classified as non-clean energy sources. In this case 1 indicating that the household used clean energy for cooking and 0 indicating that the household did not utilize clean energy. The study's control variable included age, family size, education level, monthly income, marital status, kitchen ventilation, time spent in the kitchen, partial cooking, house type (Kacha or Pacca), availability of hospital in the village, and women's control over finances.

2.2 Econometric Model

Women's subjective health assessments indicated as 1 or 0 resulted in a discrete data. Therefore, the study used the Probit model to assess the effect of cooking energy use on the subjective health of rural women. This is the most prevalent approach to subjective health quantitative analysis. The basic model established in the current study was as follows:

$$Z_i = \beta_0 + \beta_1 \text{Energy}_i + \beta_i X_i + \varepsilon_i \quad (1)$$

Where, subscripts i denote i^{th} female respondent. Z indicates the state of subjective health of rural women. Energy indicates home cooking energy options (in case of clean cooking 1, otherwise 0). X denotes control variables mainly education of women (measured in schooling years), kitchen ventilation (in case of ventilation 1, otherwise 0), age (measured in years), household income (PKR per month), marital status (in case of married 1, otherwise 0), Time spent in the kitchen (hours), partial cooking (if yes 1, otherwise 0), house type (in the case of pacca house 1, otherwise 0), presence of hospital in the village (if yes 1, otherwise 0) and control over finances (full control=2, some control=1, no control=0). β_0 denotes the constant term while β_i denote the parameters to be estimated and ε_i is the error term.

RESULTS AND DISCUSSION

This section describes the descriptive statistics and results of the probit model. Table 1 shows the results of descriptive statistics. The study participants' average age is 36.57 years, indicating a young to middle-aged population. The age range is 18 to 60 years, including young adults and those nearing retirement. The standard deviation is 10.56 years, indicating substantial variability and a range of ages around the mean. The average family

size is 6.28 people, with numbers ranging from 2 to 20. The 2.74 standard deviation suggests significant variability, showing smaller and much bigger families in the sample. The average monthly income was 55,618.32 PKR, ranging from 10,000 to 300,000 PKR. The large standard deviation of 64,585.1 PKR implies a significant income inequality, suggesting both low- and high-income families in the sample. The results show that 82.44% of women are married and largely responsible for cooking, whereas 17.56% are single but still do the cooking and other house works. The primary source of cooking is an important independent variable. If the major cooking source is clean energy (biogas, solar, natural gas, LPG, or electricity), it is classified as clean; otherwise, it is labeled as non-clean. In the sample, 38.93% use clean energy, whereas 61.7% use non-clean. The dependent variable was rural women's self-reported health status, coded 1 for healthy and 0 for unwell.

Table 1: Descriptive Statistics

Variables	Mean/percentage	Min	Max	S.D
Age (in years)	36.56743	18	60	10.5418
Family size (numbers)	6.282443	2	20	2.73938
Education(schooling years)	8.709924	0	18	5.70019
Income Monthly income(PKRs)	55618.32	10000	300000	64585.1
Marital status represents (in case of married 1, otherwise 0)	82.44%			
Main source of cooking (if clean 1, otherwise 0)	38.93%			
Self-reported health status (if yes 1, otherwise 0)	40.20%			
Time spent in the kitchen				
1-2 hours=0	19.59%			
2- 4 hours= 1	50.64%			
>4 hours= 2)	29.77%			
Kitchen ventilation (in case of ventilation 1, otherwise 0)	41.73%			
Partial cooking (if yes 1, otherwise 0)	58.52%			
House type (in the case of pacca house 1, otherwise 0)	45.80%			
Hospital in the village (if yes 1, otherwise 0)	28.75%			
Control over finances				
Full control=2	30.53%			
Some control=1	18.70%			
No control=0	51.40%			

In the study, 40.20% of women regarded themselves as healthy, whereas 59.80% rated themselves as unhealthy. Time spent in the kitchen, an important independent variable, was classified as 1 for 2-4 hours, 2 for more than 4 hours, and 0 for 1-2 hours. The percentages are 19.59% for 2-4 hours, 29.77% for 1-2 hours, and 50.64% for 4 hours or more. In the study, 41.73% of houses had ventilation in the kitchen, while 58.27% did not, which helped assess the impact of ventilation in the kitchen on women's subjective health. Partial cooking, which used both traditional and modern fuels, was scored as 1 for involvement and 0 for no involvement. According to the study, 58.52% of women cooked partially regularly, while 41.48% did not cook partially. The house type variable indicates the dwelling type and was coded as 1 for pacca and 0 for kaccha. The study discovered that 45.80% of houses were pacca, whereas 54.20% were kaccha. The variable for hospital availability was coded as 1 for present and 0 for absent. According to the research, 28.75% of villages had hospitals, whilst 71.25% did not. The study looked at how financial control affected women's health in terms of clean cooking energy consumption. The findings revealed that 30.53% of women had financial control, 51.40% had none, and 18.70% had some control.

The Results of the Probit Model

Table 2 presents the results of the main regression model. The study found that using clean cooking energy considerably improves the subjective health of rural women, with results significant at the 1% level of confidence, which supports the findings of Li et al. (2022) and Laxmi et al. (2003).

Table 2: The results of the probit model

Variable	Coefficients	Standard error	P-value
Clean Cooking	2.13825	0.5954638	0.000
Time spent in kitchen	-0.7673866	0.3796133	0.043
lnage	-1.046128	1.134857	0.157
lnfamily size	0.2968337	0.6661897	0.656
Kitchen ventilation	1.584686	0.709946	0.026
Marital status	0.3738955	0.6931453	0.59
lnincome	0.3103006	0.4070679	0.446
Partial cooking	-1.155781	0.6925701	0.095
lneducation	0.0361119	0.3330773	0.361
House type	1.053568	0.6029524	0.081
Presence of hospital in the village	1.060513	0.5851833	0.07
Control on finances	0.7079287	0.3893694	0.06
Total sample =390	Chi2(12)	= 485.12	
	Prob>chi2	= 0.000	
	Pseudo R2	= 0.9160	
	Log likelihood	= -22.253517	

The coefficient of time spent in the kitchen is significant at 5 percent level of confidence depicting that spending less time in the kitchen can lead to better health as corroborated by (Afridi et al., 2023). According to Khalequzzaman et al. (2007) and Kausar et al. (2023), the presence of a chimney has a good influence on health by improving ventilation and reducing indoor air pollution. The result of the kitchen ventilation is significant at the 5% level of confidence with positive sign. Using mixed fuels for partial cooking, on the other hand, is associated with poorer health and is significant at the 10% level, as shown by Ma et al. (2022). The result of the house type is significant at 10 percent level of confidence with positive sign indicating that living in pacca houses is more beneficial to health. It may be due to the reason that people living in pacca houses are more conscious about smoke. According to Lakshmi et al. (2013), better housing conditions are positively related to better health. Presence of hospital in the village and women's control of finances are both significant at 10 percent level of confidence having positive impacts on health. According to Li et al. (2023), access to hospitals improves health. Furthermore, Yasmin and Grundmann (2019) conclude that having control over finances has a substantial impact on health and the usage of sustainable energy. In this study, socioeconomic variables such as age, family size, education, income, and marital status have no significant effect on subjective health.

CONCLUSIONS

This study examined the impact of household cooking energy on the subjective health of rural women in District Vehari, South Punjab, using primary survey data and the Probit model. It found that clean cooking energy significantly improves women's subjective health. Contrary to conventional findings, variables such as age, family size, marital status, income, and education level did not show a significant relationship with subjective health in this context. The presence of ventilation in the kitchen and better housing conditions were positively associated with better health, while partial cooking was negatively associated. Access to a local hospital and women's control over household finances also had strong positive effects on health.

As for as limitations of this study are concerned, time constraints restricted the research scope, suggesting future studies could benefit from secondary data and explore dynamic relationships. Not all relevant demographic variables

were included, which might affect the findings. This is remained for the future studies. The study's focus on a specific area limits generalizability; broader research could provide more comprehensive insights. The district Vehari is a remote area and most of the respondents were from rural areas with very little or zero education so whether the results of this study apply to the other rural areas of Pakistan remains to be tested in future studies.

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