

## **Impact of Biomass Cooking on Women's Health in Rural**

**Sri Lanka**

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### **Introduction**

More than half of the developing world's population, particularly rural poor households, depend on solid fuels such as agricultural residue, green waste, wood and wood derivatives, charcoal, coal, crop waste, and dung for their primary cooking. This high level of dependence on traditional solid fuels and inefficient and polluting cook stoves imposes huge health, environmental, economic, and social costs on the people in these economies.

Biomass smoke contains an enormous number of substances, many of which damage or are injurious to human health. Most important are particulates, carbon monoxide, nitrous oxides, sulphur oxides, formaldehyde, and polycyclic organic matter causing respiratory infections, nasopharyngeal and airways irritation, wheezing, chronic bronchitis, chronic obstructive pulmonary disease, low birth weight, an increase in prenatal deaths, cancers of the lung, mouth, cataracts etc. (Banerjee et al., 2012).

Firewood collection, fuel processing (e.g., drying and cutting), cooking, and post-meal cleanup are traditionally female-gendered roles across the developing world. As a result, women are supposed to bear a disproportionate burden of the negative health, economic and time poverty effects of bio mass fuel. As per evidence gathered from several countries, exposure of women cooks to significantly higher particulate matter emissions is higher than men, up to four times men's levels in Kenya and up to double the level of men in South Asia studies. (Huq, et al., 2004). Recent research demonstrates evidence of greater incidence of respiratory illness and eye disease including a higher component of disadvantage towards women regarding depression, blindness headaches, coughing, eye itching. According to Fullerton, et al., (2008) women are also expected to have more incidences of headaches, anemia, and other symptoms of excessive carbon monoxide exposure because the negative impacts of carbon monoxide in women, especially pregnant women, occur at significantly lower proportions than men.

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Another part of evidence is injuries from firewood collection and transportation among female population (Warwick, & Doig, 2004). There are more strong informal evidence that the head loading of firewood and other physical strains caused by firewood transport by foot have resulted in headaches and musculoskeletal damage, along with several symptoms of back pains, neck stiffness and waist pains. These symptoms and related physical injuries have significantly higher incidence rates in women than for men (Wickramasinghe, 2003).

As in many countries, biomass fuel and wood burning stove use is most common in rural areas and the country's rural estates in Sri Lanka. Over 78% of households nationwide burn wood in biomass stoves; 84% of these households are in rural areas, and 96% are households on rural estates. This heavy use of wood-burning stoves is the leading contributor to indoor air pollution in the country. High concentrations of indoor air pollutants represent a significant health issue for Sri Lanka. Respiratory diseases, which may have been caused by cooking emissions, are one of the leading causes of hospitalisations and death. Despite Sri Lanka's well-established public health system and relatively good public health indicators compared to other developing countries, current issues are poorly studied to date. Although the adverse effects of indoor air pollution on respiratory health, birth weight, cataract, etc. are well documented in the world, limited literature suggests that the health impacts of indoor air pollution coupled with traditional cooking practices in Sri Lanka has not been adequately addressed and discussed. Hence this study aims at examining the effects of biomass fuel on women's health in the rural context enriching the sector specific evidences in the literature.

## Methodology

### *Empirical model*

Since the outcome variable is dichotomous, binary logistic model which specified below is estimated to examine the probability of being affected by indoor air pollution related issue. Hence, In this model, binary dependent variable takes value 1 if a household has related health issue or 0 for otherwise. Then the basic model takes the form of,

$$y_i = \sum_{j=0}^k X_{ij}\beta_j + \varepsilon_i \tag{1}$$

Where y denotes binary dependent variable,  $\beta$  is vector of parameters and the error term  $\varepsilon$  which has zero mean and logistic distribution. If  $P_i$  is the probability that a household report a health issue takes logistic distribution,

$$\ln\left(\frac{P_i}{1-P_i}\right) = \alpha + \sum \beta_j X_{ij} \tag{2}$$

With the logit transformation and taking the logarithm of the ratio of probabilities to get the log odds ratio, the full model can be specified as follows.

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 wealth + \beta_4 education \\ + \beta_5 cook\_fuel + \beta_6 stove + \beta_7 time_{cook} + \beta_8 kitc \\ + \beta_9 years\_cook + \varepsilon$$

### **Data and the variables**

Data were collected from a random sample of 300 households in Yagirala Udugama, Karapagala, and Walallawita GN Divisions in Walallawita divisional secretariat in Kalutara district. The main survey tool of the study was questionnaire which consisted close and open ended questions. Self administered method was used for a part of the field survey whilst interview method played a major role. The respondent for socio-economic and other variables was the chief cook in the household. For health-related issues the queries were put directly to all adult individuals present during the survey.

The data at household level were collected to get a comprehensive picture of socio-economic conditions, energy use pattern, housing characteristics, cooking behavior, willingness to pay to reduce indoor air pollution and environmental considerations. Energy use pattern included information on consumption of bio-fuels and commercial fuels for cooking, time and effort involved in collecting firewood, issues faced in collecting processing or utilising bio fuel. Housing characteristics included information on number of rooms, type of house and type of kitchen, location of kitchen, and number of doors and windows in the kitchen. Information on cooking behavior includes number of meals cooked using different fuels in a day, hours of cooking, cooking involvement in different age groups and type of involvement. People's willingness to reduce the impact of indoor air pollution included information on people's desire for type of intervention, reason for not using clean fuels, willingness to pay for clean fuel. Health profile data included information on smoking habits, involving dusty environment, cooking involvement, years of cooking and the Medical Research Council (MRC) questionnaire, 1986, UK, for respiratory symptoms was followed to construct health index.

## Results and discussions

The majority of the sample consists of females (93 %) while male representation is only a small fraction (7 %). It was observed that approximately half of the respondents were of the 18 – 40 age groups, while a higher proportion, 26.4 percent, is in the age groups of 30- 40 years. Only 2% of the respondents were illiterate, while 11% of them were educated to primary level indicating higher level of educational attainment in the country.

Almost all (99 %) sampled households use bio-fuels for cooking of which the majority (83 %) use fuel-wood. The percentage of houses using electricity for lighting is 98.2% of the sampled households. However, the use of electricity or biogas for cooking was almost negligible (less than 0.5%). Only 15.9% of households with electricity used gas as the main cooking fuel while the rest relying on biomass. About 98% of the households using fuel-wood gather it and the remaining 4% pay for workers to gather it. About 34% of households using firewood gather it from their own lands while government forests are the main source for more than 50%.

On average, availability, affordability and adaptability have been the main reasons for using biomass fuel. A majority of households use biomass fuel based on availability and since they find it more affordable and adaptable. Relatively less households consider its renewability when using it as a cooking fuel.

Table 1: Determinants of a household having air pollution related health issue:  
Regression results

Variable	Coefficient	OR	Wald
Constant	-2.035 (1.071)		3.608
Age	0.190 (0.502)	1.094	0.152
Gender	2.125* (0.540)	0.044	13.505
Edu	-0.400* (0.234)	0.741	4.473
Wealth	-0.208** (0.511)	0.812	2.538
Cook-fuel	1.162* (0.461)	3.196	6.349

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Cook-time	0.384 (0.385)	1.468	0.945
Cook-years	0.014* (0.008)	1.014	2.947
Cook-stove	0.449** (0.593)	2.584	2.565
Kitchen-type	0.251** (0.635)	1.285	0.156

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\*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$

Except age, estimated regression coefficients for all other variables were significant having expected signs. Wealth and education showed a negative relation confirming those who are wealthy and educated have low probability of falling into risk. However, the impact is very small and least significant compared to the other variables. Cooking fuel, cooking time, stove type etc were positively significant at 1% level of significance.

### **Conclusions**

The poor and less-educated who live in rural areas are found to be at greater risk for indoor air pollution related health issues while wealthier people are suggested to have comparatively low risk of falling ill due to this problem. More interestingly it was found that the other considerations such as the availability and affordability of wood, as well as attitudes, practices and life styles of the rural population can influence much on the type of principal cooking fuel used and thereby the health problems. Hence, considering the possibility of the continued use of wood as the main source of cooking fuel for many more years in Sri Lanka, measures should be taken to mitigate the health hazards due to indoor air pollution. Most importantly, improved stoves could be introduced as a national priority among wood users. Proposed stoves should be culturally acceptable, user friendly and of low cost for sustained use by the needy communities. Market access could be improved to facilitate with kerosene and LPG usage to help the households that are ready to consume cleaner fuel.

Possible structural changes would be another option to improve ventilation in the kitchens of households by having chimneys, exhaust fans and open windows or separating kitchen from living room by partition. Awareness programmes will be helpful in improving the knowledge about the health effects due to indoor air pollution and in changing the attitudes that lead to improper cooking practices. Specially increasing the female literacy can have a significant impact on reducing negative health issues through motivating them to demand for clean fuel.

Conducting further studies to monitor actual indoor air quality, ventilation levels in Sri Lankan households should be prioritized.

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