A CROSS COUNTRY STUDY OF AMBIENT AIR POLLUTION EXPOSURE AND ASSOCIATIATED CHILD HEALTH

1.1 INTRODUCTION

Household air pollution (HAP) is usually measured indoors and arises from domestic activities of cooking, heating, and lighting. Around 3 billion people still cook using biomass fuels (such as firewood, agricultural wastes, charcoal, coal and cow dung). These cooking practices are hazardous and produce a wide range of health-damaging pollutants causing high level household air pollution. The women and young children who spend most of their time near the domestic hearth are comparatively more exposed to a toxic amount of HAP every day.

The Global Burden of Disease Study indicated that household air pollution attributed almost 3.5 million deaths worldwide in 2010. The number further increased to 3.8 million caused by the inefficient use of solid fuels and kerosene for cooking in 2015. Among these 3.8 million deaths:

- 27% are due to pneumonia
- 18% from stroke
- 27% from ischaemic heart disease
- 8% from lung cancer.

Solid fuel can have serious adverse consequences on health as well as on the environment, and also on economic development. Around 1.3 million children face death prematurely each year because of exposure to indoor air pollution from solid fuel concerning health. As we descend the energy ladder to cheaper forms of fuel (such as charcoal, wood, and dung or crop residues), there are polluting fuels with both poor combustibility and highly toxic emissions. Simple homes built with mud, thatch, and animal skins rarely have a chimney and, when present, the chimney is usually a simple vent with no air-drawing flue.

The main burden of indoor air pollution is common in low and middle-income countries, where a significant part of the population are at the bottom of the energy ladder (Mortimer et al., 2012) It was recognized that a significant proportion of chronic obstructive pulmonary disease (COPD) could not be attributed to cigarette smoking, and although a causal mechanism has not been described, household air pollution is an established risk factor.(Eisner et al., 2010) There is also evidence of an association between solid fuel use and chronic bronchitis.(Jindal et al., 2012; Po et al., 2009) However, solid fuel was classed as "probably carcinogenic to humans" (group 2a) in a publication from the International Agency for Research on Cancer, 2010). Therefore, the purpose of this study is to **(i) To access the association of household air pollution on Child morbidity; (ii) To study the adjusted effect of household air pollution on child mortality at individual level covariates; and (iii) To examine the effect of household air pollution on premature births.**

RATIONALE BEHIND THE STUDY: Exposure to household air pollution almost doubles the risk for childhood pneumonia and is responsible for 45% of all pneumonia deaths in children less than 5 years old. Household air pollution is also a risk for acute lower respiratory infections and contributes to 28% of all deaths to pneumonia. There is also evidence of links between household air pollution and low birth weight, tuberculosis and laryngeal cancers. There is a need for more epidemiological studies uncovering the real picture of the underdeveloped countries and searching for avoidable exposure to household air pollution.

Data source and methodology

2.1 DATA SOURCE

Data Sources: The data source used was the Demographic and Health Survey (DHS). Recent available Standard DHS-VIII data of selected seventeen countries of Sub-Saharan African region have been taken.

The present study considers information from currently married women aged 15-49 years of selected Sub-Saharan African countries using recent DHS data of the respective countries. The following countries are included in this study viz. Angola, Benin, Burundi, Ethiopia, Ghana, Lesotho, Liberia, Madagascar, Malawi, Mozambique, Rwanda, Senegal, Sierra Leone, South-Africa, Tanzania, Togo, Uganda and Zimbabwe.

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2.3 Statistical analysis:

Objective 1

Differences in categorical variables were tested using Pearson's $\chi 2$ (chi-square) statistic, i.e., to understand the association between indoor air Pollution along with other Household amenities and morbidities among children.

Probit model: Since both treatment and outcome variable in our case are binomial, a simultaneous equation was used, i.e., probit regression in order to take into account the effect of Indoor air Pollution along with other household amenities. In the binary probit model, occurring of the events, here the diseases like fever, diarrhea, ARI and cough was taken as 1, and non-occurrence of the event was taken as 0.

The relationship between specific variables and the outcome probability is interpreted by means of the marginal effect, which accounts for the partial change in the probability. The marginal effect associated with continuous explanatory variables (x) on the probability P (Yi= 1| X), holding the other variables constant. The marginal effects provide insights into how the explanatory variables shift the probability of risk of morbidities. Using the command *'margins'* is stata marginal effects were calculated for each variable while holding other variables constant at their sample mean values.

Objective 2

Cox's proportional hazards regression model is used to assess the importance of various covariates in the survival times of individuals or objects through the hazard function. The exponentiated linear regression part of the model described the effects of explanatory variables on hazard ratio.

Objective 3

Associations were then tested using the Pearson Chi-square statistics. In order to assess the effect of HAP along with other household amenities and selected confounders on premature births, binary logistic regression was used.

FINDINGS

In order to meet (MDG-4) or sustainable Development Goal 3, to reduce under-five Mortality, prompt attention should be given to various factors affecting the equal distribution of resources and facilities to every part in these countries, especially the high-mortality countries. The government, non-governmental organizations, and the private sector should seek to invest in programs that promote a healthy and hygienic household environment and increase access to clean fuel, clean water, and proper sanitation as part of community development efforts.

Our analyses examined whether children aged below 5 years residing in households using solid fuels were at higher risk of death. The results indicate that the use of solid fuels increased the risk of post-neonatal and child deaths. Our study found that existing disparities among child

health in somewhere because of the household environment in the selected Sub Saharan African countries. The high infant or under-five mortality groups are at a relative disadvantage on basic household environmental variables that affect hygiene. There are also significant relationships between household air pollution and preterm births again. Some of the differences in childhood morbidity can also be explained by levels of household air pollution and other household amenities.

The relation between household air pollution and child health was evident from the study using nationally representative data for child health; the study shows that after controlling socioeconomic, demographic factors the negative association of household air pollution on child health remain unchanged. Malawi was found to have comparatively higher probabilities of occurrence of diseases and Tanzania occupied the bottom probabilities even after looking at the interaction effect of fuel use and source of drinking water. Results from survival analysis using Cox's proportional hazard model showed that children belonging to solid fuel using household are at a greater risk of mortality in almost all the selected countries. Contradicting many other findings few Ghana and Angola showed less risk of preterm birth in solid fuel using women. In South-Africa, Tanzania, Togo, Uganda and Zimbabwe the odds showed a higher risk of preterm birth among the women using solid fuels.