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### **Assessing the Adverse Health Effect of Biomass using DALYs as Outcome Measure: A Field Study from Burkina Faso.**

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Biomass solid fuel is a type of fuel many poor households use for cooking in developing countries. Its usage in this regard has adverse health effects and this has become the focus of several scientific and political debates. The adverse effects can be measured using Disability-Adjusted-Life-Years (DALYs), a composite indicator of mortality and morbidity. One DALY is equivalent to a lost year of healthy life. Biomass smoke is an environmental risk factor, and one of the most important risk factors for lower respiratory infections. The burden associated with these infections is ranked third in the Nouna Health District, Burkina Faso.

This doctoral thesis has two major parts. The first part deals with the measurement of the disease burden of using biomass fuel. The disease burden, expressed as DALYs, was calculated using two components, namely years of life lost to premature mortality (YLL) and years lived with disability (YLD). Disability weights are required in YLD calculations. This part has two objectives. The first study objective was to locally elicit disability weights for twenty health states from seven communities. The second objective was to explore the discrepancies that exist between and within individual and group disability weights across the communities. The second part of the thesis deals with the fraction of the disease burden that is attributable to biomass. The third study objective was to calculate the attributable fraction of the burden of acute lower respiratory infections (ALRI) in children under five years old given exposure to biomass smoke.

We aimed to achieve the objectives using the datasets from the Nouna Health District Household Survey (NHDHS), the Demographic Surveillance System (DSS) as well as two field studies. The health states reported in the NHDHS between 2000 and 2001 were described using a spectrum of health dimensions. Purposely selected respondents from seven randomly selected communities assigned disability weights to 20 health state scenarios. The distribution of the weights showed significant differences in individual valuation of health states. Group scores had even a wider range and were significantly higher than individual mean valuations by 20 percent. Within the communities, group and individual rankings of health state scenarios showed differences. Across the seven communities, they correlated positively.

There were 778 deaths recorded in the DSS between 2000 and 2001. This yielded approximately 19,000 YLL. Sixty-two percent of this burden was borne by children under five years. There were 53 pneumonia and 3 bronchitis death cases. These ALRI amounted to 981 YLL. Fifty-six percent of

this burden was born by children under five years. Seventy-seven morbidity cases of bronchitis were reported in the same period. In children under five years, approximately 10 YLD were calculated after incorporating other possible cases of ALRI, which may not have been captured during the survey period. ALRI caused approximately 556 DALYs in children under five years.

Ninety-eight percent of our study sample was exposed to the smoke from biomass. The majority of the households cooked outside on the traditional stove (three stones). At least 55 percent of the burden of ALRI is attributable to biomass use. Improving cooking device and indoor ventilation in a small confined space will reduce the attributable fraction, but more gains are made (at least 50 percent reduction) if the cooking location is shifted from indoor (small confined space) to outdoor where there is higher ventilation and lower likelihood of pollutant accumulation. The burden of ALRI in children under five years due to exposure to the pollutants from biomass smoke is in the range of 256 to 339 DALYs.

The slight differences in the description of the acute and chronic health states indicate that the dimensions and items currently used to describe health states can be further developed into generic or disease-specific description tools. The disability weights for the 20 health states can be used to value the disability associated with other health states. They can be used for calculating composite measures of disease burden. The distribution of the weights showed differences between and within individuals and groups from seven communities. The weights by groups suggested that the disability associated with health states were valued as more severe by groups than by individuals. The use of group weights could more clearly identify the preferences of different community groups. The validity of the disability weights could have been biased by differences in the way the community respondents understood the health state scenarios. However, describing the states the way we did and using a valuation tool developed in the study area strengthens our results regarding the health state disability weights. We recommend further development and validation of the tool used by households to describe their illnesses within the NHDHS framework. We also recommend that studies that involve the elicitation of weights should be specific on the length of time allowed for discussion.

The adverse effect of biomass smoke in children under five years resulted in a higher burden attributable to mortality than morbidity. The attributable fraction of 55 percent of the burden of ALRI in children under five years in our study sample is considerable if compared to the 41 percent that was set in the World Health Report for all developing regions with high mortality. We recognize that our estimates of the morbidity aspect of the disease burden are not based on purely clinical data. However, we set out the goal of assessing the burden borne by a population and we are confident that our estimates of YLD are based on the burden as reported by the people themselves. They are also the best estimates for this region as this is the first research effort to estimate YLD in this area. Even though as much as 98 percent of our study population use this fuel type, adopting the right cooking behaviour can considerably reduce associated adverse health burden. The scenarios we created using the results of our exploratory study on biomass use strengthens this. Risk estimates from studies on the health impact of biomass use should always adjust for ventilation-related factors like stove location and type. We need to understand more clearly, the factors that are involved in the household decision to cook outside so that we can better advise them on how to minimize the adverse health effects of biomass use within these societal constructs.

