Journal of Epidemiological Society of Nigeria Dec. 2017 Volume 1 No 1 :66-69

Review Article

An overview of the effect of biomass in-door-air pollution on household members

Chikaike Ogbonna, Community Medicine Department, Faculty of Medical Sciences University of Jos.
Email: chikaikeo@yahoomail.com

Introduction: Worldwide statistics show that 2.4 billion people depend on biomass fuel for cooking and heating.[1] Biomass are plant materials and animal waste used especially as source of fuel. Typically, burned in open fire or inefficient stoves without appropriate ventilation, biomass fuels emit substantial amounts of health damaging pollutants leading to high level of exposure. In developing countries the level is at least 10-20 times higher than World Health Organisation (WHO) guidelines.[2-3] Women and young children who spend many hours daily near the fire are the most exposed. A growing body of literature implicates in-door air pollution from biomass fuel as a risk factor for the development of Chronic Obstructive Pulmonary Disease (COPD) and Lung cancer in women and Acute Respiratory Infections (ARI) in young children.[4-8]

About two billion people have no access to modern energy and a billion have it only sporadically.[9,10] Household members especially women and children in rural settlements collect all kinds of materials that are hazardous for their source of household energy. This is peculiar to the rural populations and more so the poor communities. Biomass fuels are at the low end of the energy ladder in terms of combustion efficiency and cleanliness.[11] Smoke from biomass combustion produces a large number of health damaging air pollutants including inhalable particulate matter, Carbon Monoxide (CO), Nitrogen oxides, Formaldehyde, Benzene, 1,3 Butadiene, Polycyclic aromatic hydrocarbons, and many other toxic organic compounds.[12] In developing countries, where large proportions of households rely on biomass fuels for cooking and space heating, concentrations of these air pollutants tend to be highest indoors.[1] The fuels are typically burned in simple, inefficient, and mostly unvented household cook stoves, which, combined with poor ventilation, generate large volumes of smoke indoors. Moreover, cook stoves are typically used for several hours each day at times when people are present in-doors, resulting in much higher exposure to air pollutants than from out-door sources.[13] More than three billion people or half the world's population, cook in their homes using traditional fire and stoves, burning biomass fuels such as woods and crop waste materials. Household members breathe in the toxic fumes from these cooking fires daily.

Disease Burden: In-door Air Pollution currently claims the lives of 1.5 million people yearly worldwide, or one person every 20 seconds.[10] Those who are mainly affected are the women and children who make up 85% of these deaths due to their increased exposure in the cooking environment. The toxic smoke that is produced causes severe lung and respiratory illness and contributes to climate change. As a result, each year nearly two million people die from IAP. This problem is worse in Nigeria, a country that has the largest household wood-burning population in Africa. Acute Respiratory Infections (ARIs) are leading cause of childhood illnesses and deaths worldwide, accounting for an estimated 6.5% of the entire global burden of disease.[11] In Zimbabwe, as in many other developing countries, ARIs are the leading cause of childhood mortalities.[11]

Exposure levels are usually much higher among women who tend to do most of the cooking and among young children who stay in-doors and who are often carried on their mother's back or lap while cooking.[14] The WHO has assessed the contribution of a range of risk factors to the burden of disease and revealed IAP as the eight most important risk factor and responsible for 2.7% of the global burden of disease.[15] Globally, IAP from solid fuel use is responsible for 1.6 million deaths due to pneumonia, chronic respiratory disease and lung cancer, with the overall disease burden exceeding the burden from out-door air pollution five-fold. In high-mortality developing countries, in-door smoke is responsible for an estimated 3.7% of the overall disease burden, making it the most lethal killer after malnutrition, unsafe sex and lack of safe water and sanitation.[15]

Air pollution has both acute and chronic effects on human health. Health effects range anywhere from minor irritation of eyes and the upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and death. Air pollution has been shown to cause acute respiratory infections in children and chronic bronchitis in adults.[15] It has also been shown to worsen the condition of people with pre-existing heart or lung disease. Among asthmatics, air pollution has been shown to aggravate the frequency and severity of attacks. Both short-term and long-term exposures have also been linked with premature mortality and reduced life expectancy.

The evidence for a link with lung cancer from exposure to biomass smoke and for a link with asthma, cataracts and tuberculosis was considered moderate.[15] On the basis of the limited available studies, there is tentative evidence for an association between IAP and adverse pregnancy outcomes, in particular low birth weight, or ischaemic heart disease and nasopharyngeal and laryngeal cancers.[15] Exposure to biomass smoke has been strongly associated with ARI in preschool age children and with COPD or chronic bronchitis in women.[16] Exposure to IAP more than doubles the risk of pneumonia and is thus responsible for more than 900 000 of the 2 million annual deaths from pneumonia.[15] Women exposed to in-door smoke are three times as likely to suffer from COPD, such as chronic bronchitis, than women who cook and heat with electricity, gas and other cleaner fuels. Among men, exposure to this neglected risk factor nearly doubles the risk of chronic respiratory disease. Consequently, in-door air pollution is responsible for approximately 700000 out of the 2.7 million global deaths due to COPD.[15] Every year, more than one million people die from lung cancer globally, and IAP is responsible for approximately 1.5% of these deaths.[17] While more than two-thirds of in-door smoke deaths from acute lower respiratory infections in children occur in WHO's African and South East Asian Regions, over 50% of the COPD deaths due to IAP occur in the Western Pacific region.[18]

Areas for further research: There is need to strengthen both the quantity and quality of evidence linking air pollution and various health outcomes, especially for developing countries and for health conditions with weak or no evidence. This can be accomplished by measuring exposure levels more directly; by including clinical measures of disease outcomes; and by adequately accounting for social, behavioral, nutritional, and environmental confounding factors. In these efforts, there is need to use more powerful study designs, such as prospective cohort studies and randomized intervention trials, designed specifically for areas with weak data. A randomized intervention trial to study effects of improved stoves on acute respiratory infections in young children is a good example.

In addition to looking at health effects of individual

pollutants, epidemiologic studies need to examine the effects of different pollutant mixtures and interactions between components of pollutant mixtures. It is also important to identify groups that are more susceptible to adverse health effects of air pollution, and to understand the interactions with poverty, nutritional status, and other factors. In the meantime, policymakers in many developing countries need to design programs, set standards, and take action to mitigate adverse health effects of air pollution. These efforts need to carefully adapt available knowledge from other settings, keeping in mind the differences in pollutant mixtures, concentration levels, exposure patterns, and various underlying population characteristics.

Conclusion: The science of air pollution and health linkages is still under researched. The biological mechanisms through which air pollutants affect health are not fully understood. There is limited epidemiologic research on air pollution, limited mostly to the developed countries with very different pollution levels, exposure patterns, and underlying population characteristics than obtains in developing countries. The research on health effects of indoor air pollution from use of biomass especially in Nigeria is critical. Firewood is a major source of household energy across the length and breadth of the country. There is the need for more research work on IAP especially as the economy dwindles and IDP camps becoming ubiquitous and fire woods comparatively made more available and affordable.

References

1. Bruce N, Perez-Padilla R, Albalak R. Indoor air pollution in developing countries: a major environmental and public health challenge. Bull World Health Organ 2000;78**:**1080–92.
2. Naeher LP, Brauer M, Lipsett M et al. Wood smoke health effects: a review. Ihal Toxicol. 2007; 19: 67-106.
3. Diaz E, Bruce N, Pope RT. Lie et al. Lung Function and symptoms among indigenous Mayan Women exposed to high levels of indoor air pollution. Int J Tuberc Lung Dis 11. 2007. (27):1372-1379.
4. Smith KR, Samet JM, Romieu I, Bruce N. Indoor air pollution in developing countries and acute lower respiratory infections in children. Thorax. 2000. 55(6):518-532.
5. Ezzati M, Kammen D. Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: an exposure-response study. Lancet. 2001;358(9282):619-624.
6. Bruce N, Neufield L, Boy E, West C. Indoor biofuel air pollution and respiratory health: the role of confounding factors among women in highland Guatemala. International Journal of Epidemiology. 1998;27:454-458.
7. Regalado J, Perez-Padilla R, Sansores R, Paramo-Ramirez JI, Brauer M, Pare P et al. The effect of biomass burning on respiratory symptoms and Lung Function in rural Mexican women. American Journal of Respiratory and critical care medicine. 2006; 174: 901-905.
8. Clark ML, Peel JT, Burch JB, Nelson TL, Robenson MM, Conway S et al. Impact of improved cook stoves on indoor air pollution and adverse health effects among Honduran women. International Journal of Environmental Health Research. 2009: ISSN 0960-3123, DOI:10.1080/09603120902842705, 1-12.
9. Albalak R, Frisancho AR, Keeler GJ. Domestic biomass fuel combustion and chronic bronchitis in two rural Bolivian

villages. Thorax 1999;54**:**1004–08.

10. Abbey DE, Burchette RJ, Knutsen SF, Mcdonnell WF, Lebowitz MD and Enright PL. Long-term particulate and other air pollutants and lung function in non-smokers. American Journal of Respiratory Critical Care Medicine. 1998. 158(1)289-298.
11. Vinod Mishra. In door air pollution from biomass combustion and acute respiration illness in pre school age children in Zimbabwe. International journal of epidemiology. Vol. 32; Iss. 5 847-853.
12. Smith KR, Liu Y. Indoor air pollution in developing countries. In: Samet JM (ed.). Epidemiology of Lung Cancer, Lung Biology in Health and Disease Series 1994;**74:**151–84.
13. Smith KR. Indoor air pollution in developing countries: recommendations for research. Indoor Air 2002;12**:**1–7.
14. Behera D, Dash S, Malik SK. Blood carboxyhaemoglobin levels following acute exposure to smoke of biomass fuel. India J Med Res 1988;88**:**522–42.
15. WHO. Indoor air pollution and health. Fact Sheet No. 292. June 2005. 1-6.
16. Ezzati M, Kammen D. Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: an exposure-response study. Lancet 2001;358:619–1104.
17. Perez-Padilla R, Regalado J, Vedal S et al. Exposure to biomass smoke and chronic airway disease in Mexican women: A Case-control Study. Am J Respir Crit Care Med 1996;154**:**701–06.
18. Malik SK. Exposure to domestic cooking fuels and chronic bronchitis. Indian J Chest Dis Allied Sci 1985;27**:**171–74.