



ISSN 2248-9649

International Journal of Research in Chemistry and Environment

Available online at: www.ijrce.org

Research Paper

Women's Health, Indoor Air Pollution (IAP) and Sustainable Energy

Dabral Sumit¹, Joshi Janak², Bhatt Bindu²

¹DM, NHPC Ltd., Tawang Hydro-Electric Project Stage I, Nehru Market,
Distt: Tawang – 790104, Arunachal Pradesh, INDIA

²Department of Geography, Faculty of Science, The Maharaja Sayajirao University of Baroda,
Vadodara 390 002, Gujarat, INDIA

(Received 16th January 2016, Accepted 28th February 2016)

Abstract: Air pollution is usually thought about ambient or outdoor air pollution – smokestacks spouting dark grey clouds of toxic smoke into the atmosphere or choking exhaust from vehicles and industrial effluents. It is not surprising, then, that whatever pollution monitoring is done takes place within the ambient environment. It is a common belief that while indoors, one is safe from harmful pollutants. On the contrary, the scientific evidence has shown that indoor air at homes can be more seriously polluted than outdoor air in industrialized cities. In fact, the United States Environmental Protection Agency estimates that the air indoors can be two to five times more polluted than the air outside. A silent majority of the population, namely poor women and children, continue to suffer from air pollution in the indoor environment. Women and children in low socio-economic groups, especially in rural areas and informal urban settlements and in the developing countries are breathing air that is highly polluted. It is estimated that, each year, 4.3 million premature deaths, mainly of women and children, are associated with inhaling toxic fumes from fuels such as wood, animal waste, and charcoal used for cooking and heating. Nearly a quarter of all premature deaths due to stroke and 15 percent of those due to ischemic heart disease as well as one-third of those from chronic-obstructive lung disease in low- and middle-income countries, are thought to be due to exposure to household air pollution. In children, it almost doubles the risk of pneumonia. It is considered as oldest pollution source in human history by definition with the greatest health consequence remains invisible or ignored. The impact of this environmental exposure has been relatively neglected by research and policy makers. Good quality of air is just as vital as safe water or food for life. Hence, the study intends to explore links between women's health, indoor air pollution and path toward achieving sustainable development.

Keywords: Women, Indoor Air Pollution (IAP), Sustainable Energy.

© 2016 IJRCE. All rights reserved

Introduction

Indoor air pollution has a much longer history than usually thought. Archaeological evidences suggest that indoor pollution was widely experienced in the distant past. The soot found on the ceilings of prehistoric caves provides further evidence of indoor pollution associated with open fires as first human habitations were poorly ventilated^[1]. It can be traced to prehistoric times when humans first moved to temperate climates and it became necessary to construct shelters and use fire inside them for cooking, warmth and light. Fire led to exposure to high levels of pollution, as evidenced by the soot found in prehistoric caves^[2].

Thus, it is estimated that from 300,000 to 400,000 y ago onward, that fire became a significant part of the human technological repertoire and when, hearths became a regular feature in human habitation. A problem that has lasted one-third of a million years is showing no sign of quickly going away by itself. The impact of this environmental exposure has been relatively neglected by research and policy makers. Good quality of air is just as vital as safe water or food for life. While most media attention has focused on outdoor air pollution in the last few years, Indoor air pollution is typically underreported and less regulated than its counterpart. Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems in homes.

Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the home. High temperature and humidity levels can also increase concentrations of some pollutants.

Women and Energy

Modern energy services are crucial to human well-being and to a country's economic development. Access to modern energy is essential for the provision of clean water, sanitation and healthcare and for the provision of reliable and efficient lighting, heating, cooking, mechanical power, and transport and telecommunications services. It is an alarming fact that today billions of people lack access to the most basic energy services: as World Energy Outlook 2015 shows 1.2 billion people are without access to electricity and more than 2.7 billion people rely on the traditional use of biomass for cooking, which causes harmful indoor air pollution.

Approximately half the world's population and up to 90% of rural households in developing countries still rely on unprocessed biomass fuels in the form of wood, dung and crop residues^[3]. These are typically burnt indoors in open fires or poorly functioning stoves. As a result there are high levels of air pollution, to which women, especially those responsible for cooking, and their young children, are most heavily exposed.

In India, about 67.3 % of the total population uses solid fuels for cooking, mainly consists of wood, crop residue and cow dung cake, whereas only 28.5 % uses liquefied petroleum gas (LPG)^[4]. India has the highest burden of diseases in the World due to negative effects of indoor air pollution in the household. IAP is responsible for nearly half a million women and children deaths each year in India. Statistically, India alone accounts for 28% of all deaths among developing countries due to IAP^[5].

The biomass fuel users usually cook indoors, using open fires or poorly functioning, inefficient stoves with inadequate ventilation facilities. The smoke generating from biomass fuels contains a large number of pollutants that include carbon monoxide, carcinogens such as benzo[a]pyrene and benzene, formaldehyde, nitrogen dioxide, small particles and sulphur dioxide (this mainly from coal)^[6]. These pollutants are dangerous for the cook and her associates and render indoor environment unliveable. Smoke from the combustion of biomass fuels contains a large number of potentially hazardous pollutants. Exposure to these pollutants, especially suspended particulate matter, is a risk factor for a wide range of diseases, including acute respiratory infections ARI, chronic obstructive pulmonary disorder (COPD), cancers, cataract, and low birth weight. Relatedly, indoor pollution from the use of cooking stoves is also a serious health problem for women, girls and boys under the age of 5^[7] By 2030, indoor air pollution from biomass use is likely to

cause more than 1.5 million deaths per year^[8]. Factors such as workload and poor nutrition also increase women's susceptibility to health risks, including anaemia and perinatal mortality^[9,10]. Moreover, drudgery from energy-collection (e.g. fetching and carrying fuel wood) takes a significant toll on women's and girls' health and well-being, affects prenatal mortality and increases post-delivery complications

Women's Health and Indoor Pollution

Women are the primary cooks and care taker for children in nearly all culture, so their children are prone to receive the greatest exposure to the smoke from solid fuel combustion. The exposure leads to higher risks for women as well as children^[11]. Health and safety are major concerns of women in their use of biomass fuels. Biomass fuels emit 6 major pollutants, viz., particulate matter, carbon monoxide, oxides of nitrogen, formaldehyde, sulphur dioxide and benzopyrene. In addition, hundreds of other simple and complex organic compounds including polyaromatic hydrocarbons are also emitted [WHO, 1992]. In biomass combustion, exposure to particulate matter is between 17 and 26 mg/hour/m³. It is even higher for dung-cake. In the case of LPG and kerosene exposure to particulate matter is 0.4 mg and 2.4 to 3.6 mg respectively [WHO, 1992]. For every kg of wood burnt, 40 mg of carbon monoxide, 2g of particulates, 1mg of benzopyrene and 200 mg of formaldehyde are emitted^[12]. In order to reduce the cooking time, women increase the burning rate, which increases the indoor emissions and decreases thermal efficiency.

The design of the stove leads to high radiation losses, thus reducing the thermal efficiency of the stove, which is of the order of 10% to 15%. Fuel consumption is, therefore, high in these stoves. Because of this inefficiency the cooking time increases. Traditional cook-stoves do not have chimneys and hence emit smoke into the kitchen, particularly in the cooking zone. Added to this, the house and kitchen design features, such as low roofing, poor ventilation, and close settlements, aggravate the problem of smoke. Cooking is inconvenient in smoke-filled kitchens. It creates health problems.

A number of quantitative epidemiological studies of specific diseases have been done in developing countries that for the first time allow estimation of the total burden of disease (mortality and morbidity) attributable to use of solid fuels in adult women and young children, who jointly receive the highest exposures because of their household roles. Severe health effects from IAP include acute respiratory infection (ARI) in children and chronic obstructive pulmonary disorder (COPD), asthma and lung cancer in women, and adverse indoor air quality (IAQ) due to use of biomass fuel is considered as one of the main sources of these diseases (Smith 2000b). More than 1 million people die each year from COPD that develops due to exposure to such indoor air pollution (WHO 2011).

Several studies established the association between IAP and deteriorating women health [13,14,15,16,17,18,19,20,21,22& 23]. The observed phenomenon thereby stands that the IAP has a significant negative impact on human health, wherein women and children suffer the most. Several researchers [24 & 25] found a linkage between indoor smokes the exposure and increase the risk of respiratory tract infections and lung cancer among house wives [26]. In India, usually women spend their 3 to 7 hours near the stove for cooking and highly exposed during cooking [27].

As reported in observational research conducted in developing countries, young children in households using solid biomass fuels are 2 - 3 times more likely to suffer acute lower infections than children in households that use alternate fuels. Similarly, women exposed to biomass fires for 15 years or more are 2 - 4 times more likely to develop COPD compared with other women [28].

Studies have shown that PM10 concentrations range from 500-2000 µgm³ during cooking sessions in typical Indian households, which is several times the USEPA, standard of 24-hour average of 150µgm³. Particles with diameter below 10microns (PM10) and particularly those less than 2.5 microns (PM2.5) are small enough to penetrate deeply into the lungs and appears to have greatest potential for damaging the health.

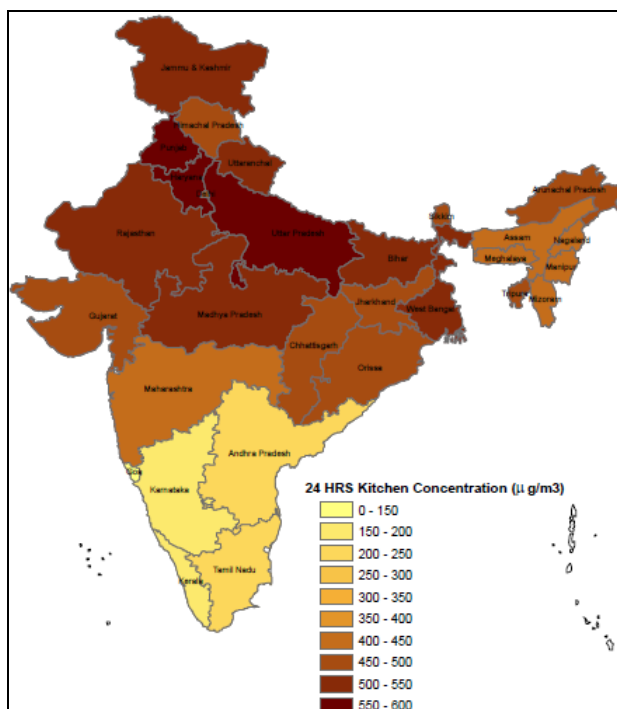


Figure 1: State-wise estimate of 24-h kitchen concentrations of PM_{2.5} in India Solid-fuel using households (Source: Balakrishnan et al. 2013)

But while all these findings hold enough evidence to link indoor air pollution to increasing morbidity and mortality,

the choice of cooking fuel in India is influenced largely by social, cultural and financial aspects. Habit, availability and more importantly, affordability are the main factors which influence the choice of fuel in India. The principle reason behind opting for biomass combustion is its abundance and the low-price. Poverty is one of the main barriers to the adoption of cleaner fuels. The slow pace of development in many countries suggests that biomass fuels will continue to be used by the poor for many decades.

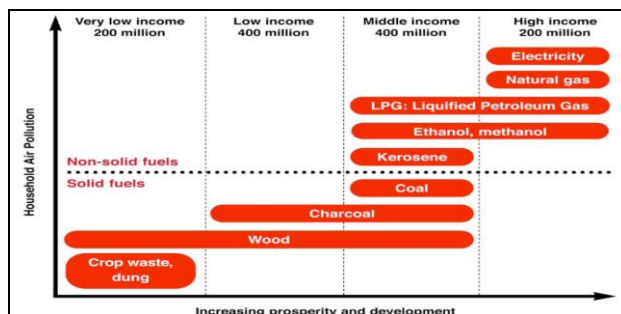


Figure 2: Air pollution and the energy ladder in Asian cities (Source: Smith KR et al)

In general the types of fuel used become cleaner and more convenient, efficient and costly as people move up the energy ladder. People tend to move up the ladder as socioeconomic conditions improve.

Exploring Links: Sustainable Energy for All (SE4All)

“Women and children bear the main negative impacts of fuel collection and transport, indoor air pollution, and time-consuming and unsafe cooking technologies [30]. The UN’s sustainable energy goal (SDG7) that aims to ensure access to affordable, reliable, sustainable and modern energy for all also aims for bringing clean cooking solutions to the 2.9 billion who do not have it today. Sustainable Development Goal 7 -- "Ensure access to affordable, reliable, sustainable, and modern energy for all" -- recognizes that energy underpins progress in all areas of development. Besides being in line with SDG7, clean cooking solutions also lay a pathway for achieving other targets, like the sustainable energy goal on health (SDG3) and gender (SDG5), as well as the World Bank’s fundamental goal of ending extreme poverty. To draw global attention to this issue and spur the international community toward action, in December 2010, the UN General Assembly designated 2012 as the International Year of Sustainable Energy for All. A major factor in this momentum is Sustainable Energy for All, an initiative set up after Rio+20, the UN's 2012 Conference on Sustainable Development in Rio de Janeiro. In 2012 the United Nations General Assembly (UNGA) unanimously declared 2014-2024 as the Decade of Sustainable Energy for All, underscoring the importance of energy issues for sustainable development and for the elaboration of the post-2015 development agenda.

Similarly, recognizing that the effects of energy-poverty as most devastating to women and children including more deaths (four millions or 80%) from indoor pollution and worse than HIV and malaria combined, and children dying pneumonia, premature asthma among others, CEO Yumkella announced that the initiative on Sustainable Energy for All is dedicating the first two years of the decade (2014-2015) to the Energy-Women-Children-Health Nexus to raise awareness about the potential benefits modern energy services can bring to women and children.

The SE4All initiative has high-level leadership and strong political support. Co-led and chaired by UN Secretary General Ban Ki-moon and World Bank Group President Jim Yong Kim, it has quickly brought together the public sector, private sector and civil society around three ambitious goals: ensuring universal access to modern-energy services; doubling the rate of improvement in energy efficiency; and doubling the share of renewable energy in the global-energy mix. Anita Marangoly George, World Bank Senior Director, Energy & Extractives “Let us challenge ourselves to bring clean cooking to the front burner and address the urgent needs of 2.9 billion people. Spices and aromas belong in a kitchen, Smoke and soot do not” (published on the World Bank Group Energy blog).

Unsustainable patterns of energy production and consumption threaten not only human health and quality of life but also affect ecosystems and contribute to climate change. Sustainable energy, therefore, can be an engine for poverty reduction, social progress, equity, enhanced resilience, economic growth, and environmental sustainability.

Conclusion

Energy is the golden thread that connects economic growth, increased social equity and a healthy environment. “Sustainable development is not possible without sustainable energy,” said UN Secretary-General Ban Ki-moon. It is not an end in itself but a means of satisfying needs. People do not need “energy” but the services that energy provides in helping to meet needs such as lighting, cooking, space heating or cooling, water pumping, information, and entertainment. Indoor air pollution is a major by-product of the traditional use of biomass, which diminishes the quality of life; especially for women and young children. Good quality of air is just as vital as safe water or food for life.

As humankind enters the new millennium, it is important to highlight energy’s critical relationship to major global problems. The timeliness of the challenge derives from three critical elements that are converging to make the world thirstier for energy services: aspirations for a higher living standard, booming economies in large regions, and

population growth. Energy is also a fundamental building block for human wellbeing and sustainable development.

References

1. Spengler J.D. & Sexton K., *Indoor Air Pollution: A Public Health Perspective*. Science, **221(4605)**, 9-17, (1983)
2. Albalak R., Cultural practices and exposure to particles pollution from indoor biomass cooking: effects on respiratory health and nutritional status among the Aymara Indians of the Bolivian Highlands [Doctoral dissertation]. University of Michigan (1997)
3. World Resources Institute, UNEP, UNDP, World Bank, world resources: a guide to the global environment. Oxford, Oxford University Press, (1998)
4. Office of the Registrar General of India Ministry of Home Affairs, Census of India. New Delhi, India. (2011)
5. Smith K. R., Fuel combustion, air pollution exposure and health: The situation in developing countries. *Annual Review of Energy and the Environment*, **18**, 529–566 (1993)
6. Bruce N., Perez-Padilla R., Albalak R., Indoor air pollution in developing countries: A major environmental and public health challenge for new millennium Bulletin of the World Health Organization, **78(9)**, 1078–1092 (2000)
7. World Bank, Gender Equality and the Millennium Development Goals, Washington, DC, (2003)
8. UNDP 2011a, note 1
9. World Health Organization, ‘Gender, Climate Change and Health’ (2011)
10. World Health Organization, Indoor air pollution and health. Fact Sheets (2011)
11. Dasgupta S., Huq M., Khaliquzzaman M., Pandey K., Wheeler D., Who Suffers From Indoor Air Pollution? Evidences from Bangladesh. World Bank, 1-23 (2004)
12. Agarwal A., Narain S., and Sen S., The Citizens’ Fifth Report, Centre for Science and Environment, New Delhi (1999)
13. Awasthi S., Glick H.A., Fletcher R.H., Effect of cooking fuels on respiratory diseases in preschool children in Lucknow, India, *The American Journal of Tropical Medicine and Hygiene*, **55(1)**, 48-51 (1996)
14. Behera D., Jindal S.K., Malhotra H.S., Ventilatory function in non-smoking rural Indian women using different cooking fuels, *Thorax*, **46(5)**, 344–346 (1991)

15. Mishra V., Rutherford R., Cooking smoke increases the risk of acute respiratory infections in children. *NFHS Bulletin* No. 5 (1997)
16. Pandey M.R., Prevalence of chronic bronchitis in a rural community of the hill region of Nepal, *Thorax*, 39, 331–336 (1984)
17. Ramakrishna J., Durgaprasad M.B., Smith K.R., Cooking in India: The impact of improved stoves on indoor air quality, *Environment International*, 15, 341–352 (1989)
18. Smith K.R., Aggarwal A.L., Dave R.M., Air pollution and rural biomass fuels in developing countries: A pilot village survey in India and implications for research and policy, *Atmospheric Environment*, 17, 2343–2362 (1983)
19. Smith K.R., Samet J.M., Romieu I., Bruce N., Indoor air pollution in developing countries and acute lower respiratory infections in children, *Thorax*, 55, 518–532 (2000)
20. Smith K.R., Indoor air pollution in developing countries: Growing evidence of its role in the global disease burden. In 7th International conference on indoor air quality and climate. SEEC ISHIBASHI Inc. Japan (1996)
21. Smith K.R., Indoor air pollution implicated in alarming health problems. In: Indoor Air Pollution – Energy and Health for the Poor, Newsletter published by World Bank, 1 (2000)
22. Smith K.R., Indoor air pollution implicated in alarming health problems, In Indoor air pollution energy and health for the poor, Newsletter Published by World Bank (2000)
23. Smith K.R., The national burden of disease in India from indoor air pollution, *Proceedings of the National Academy of Sciences*, 97, 13286–13293 (2000)
24. Mirza U.K., Ahmed N., Majeed T., An overview of biomass energy utilization in Pakistan, *Renew. Sustain. Energy Rev.*, 12, 1988-1996 (2008)
25. Singh A.B., Saleha Jamal, Assessing Vulnerability of Women to Indoor Air Pollution, *Research Journal of Environmental and Earth Sciences* 4(11), 982-989 (2012)
26. Dabral S. Bhatt B., Indoor Air Pollution Exposure and its Impact on Health. *Journal of Ecology and Environmental Sciences*, 3(2), 74-76 (2012)
27. Singh A.L. and Parveen U., Fuel Choice, Indoor Air Pollution and Women's Health: A Household Level Perspective. In: Singh, A.L. (Ed.), *Environment and Health*. B.R. Publishers, New Delhi, 1-34 (2010)
28. Larson BA, Rosen S, Understanding household demand for indoor air pollution control in developing countries, *Soc. Sci. Med.*, 55, 571-584 (2002)
29. Balakrishnan K., Sambandam, S., Ramaswamy, P., Mehta, S., Smith, K.R., Exposure assessment for respirable particulates associated with household fuel use in rural districts of Andhra Pradesh, India. *Journal of Exposure Analysis and Environmental Epidemiology*, 14, S14-S25 (2004)
30. SE4ALL, Global Tracking Framework, 80, (2013).