**Situation Analysis of Indoor Air Pollution and Development of Guidelines for Indoor Air Quality Assessment and House Building for Health**

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**Background**

Indoor air pollution in developing world from bio-mass smoke is considered to be a significant source of public health hazard, particularly to the poor and vulnerable women and children. About 50 % of the world’s population is estimated to use solid bio-fuels like animal dung, crop residues, wood and coal for cooking daily meals and heating homes and exposure from bio-mass smoke is estimated to cause a global death toll of 2.5 million every year equivalent to 4 to 5 % of total global deaths. In fact, the emerging data from recent studies indicate that risk-wise, it ranks only below malnutrition and poor quality of water/sanitation. In the context of Nepal, census 2001 report shows that 80 % of households depend upon solid bio-fuels for domestic uses. The total death from pneumonia alone is reported to be 4429 during the last 12 months preceding 2001 census (4.14 % of the total deaths). Similarly, the total deaths from asthma / bronchitis are reported to be 7170 (6.71%). According to Nepal Demography and Health survey, 2001, the prevalence of Acute Respiratory Infection (ARI) for children below 5 years old is found to be 23 %. The below 5 years population is 12.1 % of the total population.

**Methods**

The surveyed and studied household size is altogether 98, 58 from hills and 40 from terai inclusive of both rural and urban areas. The respondent size, mainly women who cook, is 168 in number, who went through medical examination and questionnaire interviews. Smoke / PM10 as well as CO were measured in each kitchen during cooking time. Other gaseous emissions (SO2, NO2, HCHO) were measured in kitchens during cooking time on campaign basis only. Measurements of PM10, gaseous concentrations were carried out in indoor and outdoor ambient air as and when necessary. On the basis of data / information obtained from above, indoor and outdoor air pollutions were estimated; smoke / PM10 exposures experienced by the respondents under various environmental settings were calculated; and the health outcomes assessed using various statistical tools. The basis for comparative risk assessment with respect to various diseases / symptoms is the binary fuel uses in the studied kitchens, namely, solid bio-fuel users and the users of cleaner fuels like gas and kerosene.

**Results**

The smoke pollution is found to be the highest in kitchens having traditional clay stoves and using solid bio-fuels (dung, crop residue and wood) while cooking where the mean PM10 concentration level is found to be 2418 µg/m3 (average of 62 readings). Under similar ventilation and other household conditions, the mean smoke / PM10 concentration level in kitchens using cleaner fuels (kerosene, LPG, biogas) is found to be 792 µg/m3 (26 readings) which is about 3 times low. ¾ Under above conditions, the daily integrated PM10 exposure index level is estimated to be 15.58 mghr/m3 for those exposed to solid bio-fuel smoke and 10.15 mg-hr/m3 for those exposed to cleaner fuels. ¾ While comparing smoke / PM10 pollution by eco-regions for solid bio-fuel users, the hill kitchens seem to be more polluted (Mean PM10, 2545 µg/m3 ) as compared to kitchens from plains (Mean PM10, 2186 µg/m3 ). Similarly, area-wise also, rural kitchens are more polluted (Mean PM10, 2427 µg/m3 ) compared to urban kitchens (2124 µg/m3 ). As has been observed in other countries, solid bio-fuels are the main sources of indoor air pollution for both hills and plains and also rural and urban homes of Nepal. Prevalence of Chronic Obstructive Pulmonary Disease (COPD) and LRI among unprocessed fuel users was found to be 16.8% compared to only 7% for those using processed fuels. 24.8% of the respondents using unprocessed fuels reported having breathlessness and wheezing and 14.4% reported having all respiratory symptoms. Statistically significant Odds Ratio (3.85) with 95% confidence interval, 1.11 – 13.84 was detected for chronic respiratory diseases. Similarly, statistically significant Odds Ratios with 95% confidence level were found for respiratory symptoms, namely Cough (3.71), Phlegm (3.08), Breathlessness (3.71) and Wheezing (5.39). The values show that Non-smokers have relatively higher odds ratio than smokers (5.21 for non-smokers and 1.52 for smokers) regarding COPD/Asthma taken jointly. The values show that for individuals aged below 40, the odds ratio is higher as compared to those aged 40 or above ( 3.04 for aged below 40 and 2.19 for aged 40 or above) regarding COPD/Asthma jointly

**Conclusions**

Indoor Air Pollution in Nepalese houses is real. The principal pollutant, smoke particulate originates from freshly combusted biomass. The ensuing smoke exposure conditions are unacceptable by any human standards and therefore, severe health effect attributable to indoor kitchen air seems indisputable. A wide range of interventions are available to reduce indoor air pollution, for instance, Changes in Energy Technology, such as, switching from bio-mass fuels to cleaner fuels like SKO / Cooking gas, Conclusion X Improving the design and construction of locally made traditional stoves by the use of chimney, fume hoods etc., and Changes in the living environment such as, improving the state of kitchen ventilation and raising awareness among the local people about the seriousness of the kitchen air pollution and building up participatory approach in the efforts made to reduce indoor air pollution.

**Keywords:** indoor air pollution; respiratory symptoms; situational analysis; solid bio-fuels.