J Nepal Health Res Counc 2010 Apr;8(16):1-4

Environmental Burden of Acute Respiratory Infection and Pneumonia due to Indoor Smoke in Dhading

Dhimal M,[1] Dhakal P,[1] Shrestha N,[2] Baral K,[3] Maskey M[4]

[1]Nepal Health Research Council, Ramshah Path, Kathmandu, [2]Cist College affiliated Pokhara University, [3]Patan Academy of Health Sceinces, Lagankhel, [4]Nepal Public Health Foundation, Baluwatar

ABSTRACT

Background: ARI and pneumonia is one of the major public health problems in Nepal which always ranks highest position among the top ten diseases. One of the risk factor of ARI and pneumonia is indoor smoke from kitchen where primary source of cooking is solid biomass fuel. This study was carried out in order to estimate the burden of ARI and pneumonia due to indoor smoke. ARI and pneumonia was chosen as it is one of the significant public health problem among under five children in Nepal and responsible for high number of premature deaths.

Methods: A cross-sectional study was conducted in Dhading district. Multistage cluster sampling technique was used for data collection considering ward as a cluster. The environmental burden of ARI and pneumonia due to indoor smoke was calculated using the WHO Environmental Burden of Disease Series.

Results: About 87 percent of households were using solid biomass fuel as a primary source of fuel. The under five children exposed to solid fuel use was 41313. The total 1284 Disability Adjusted Life Years were lost due to ARI and pneumonia and about 50 percent of it was attributed by Indoor smoke in household.

Conclusions: The solid biomass fuel was primary source of energy for cooking in Dhading district which is attributing about 50 percent of burden of ARI and pneumonia among under five children.

Key words: acute respiratory infection, environmental burden of disease, indoor smoke, pneumonia, solid fuel us

INTRODUCTION

In this study acute respiratory infection (ARI) and pneumonia is defined as continuum of a spectrum of acute respiratory problem among under five population; at one end represented by ARI with mild respiratory symptoms and at the other end with severe respiratory difficulty and other symptoms. Person exposed to solid biomass-fuel smoke has 16.8% prevalence of ARI and pneumonia as compared to the person exposed to processed fuel which is 7%.[1] About 83.3 percent households of Nepal (Urban 39.1% and rural 92.3%) use solid fuel as primary source of energy.[2] Biomass smoke caused significantly more respiratory disorders than did cleaner fuels.[3] The exposure to solid biomass fuel is an important risk factor in ARI and pneumonia which is a leading cause of infant and child mortality in developing countries like Nepal.[4-5] This study was conducted to estimate the environmental burden of diseases due to ARI and pneumonia using diagnostic protocol of Community Based-Integrated Management of Childhood Illness (CB-IMCI) among under five population due to indoor air pollution.

Correspondence: Mr. Meghnath Dhimal, Environmental Health Research Unit, Nepal Health Research Council, Ramshah Path, Kathmandu, Nepal. Email: meghdhimal@gmail.com, Phone: 9841467581.

METHODS

A cross-sectional study was conducted in Dadading district of Nepal October, 2008 to January 2009. The ethical approval of the study was taken from Nepal Health Research Council. The study population was infants and children under the aged 59 months residing in Dhading district at least since six months. The sampling unit was the children under 5 year of age who were living in the selected wards and VDCs of Dhading district. The multistage cluster sampling technique was pursued considering ward as a cluster. At first, 30 clusters were selected using probability proportional to size (PPS) followed by selection of 50% of the total population of eligible children. The sampling frame of under 5 children of each cluster were obtained from the Vitamin A register maintained by FCHV of the respective wards. Primary data were collected by using structured questionnaire. The technique applied was face-to-face interview. Prime respondent was parents/guardian of the child. However, preference was given to mother as she is relatively close to her child. The data on type of fuel use, stove type and episode of Pneumonia among children from Pneumonia was collected of Fiscal year 2063/64. The secondary data were collected by cross matching CB-IMCI register and master register for finding out the ARI and pneumonia cases of that particular ward. Also, register maintained by respective FCHVs, treatment register by MCHW and VHW were also used to validate the data. The questionnaire and reporting format developed were pre-tested in Syabru-besi and Thulo Bharku VDCs of Rasuwa district and necessary modification was done. Reliability of data was maintained by collecting data from personal trained on CB-IMCI (Community Based Integrated Management of Childhood Illness). Data analysis was done using SPSS software. The data was also analyzed by modulation for finding out the incidence of pneumonia, calculated attributable burden of disease and attributable fraction.[6]

RESULTS

Different types of fuels were used in the Dhading district. The type of fuel use was categorized in three groups A (*Biomass fuel (dung, charcoal, wood, or crop residues and Coal)*, B (Kerosene/ LPG/ Bio-gas/ Electric Heater) and C means Mixed. The following 1 shows the type of fuel used in the study areas.

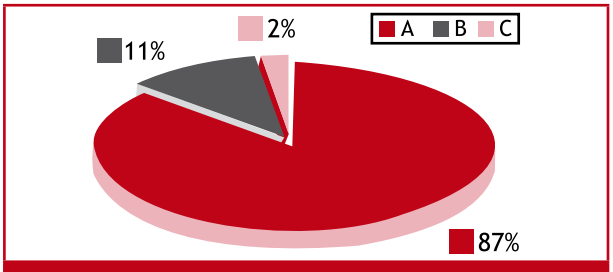

Figure1.Type of fuel used in Cooking

Majority of households (87%) in the study area used type A fuel. Only 11 percent of the household use type B fuel and very few used mixed type of fuel. About 73% people used to cook inside the house, 5% outside the home and 11% used improved stove for cooking. During our survey, we found one death case due to pneumonia of female aged 1month.

The following table 1 shows respiratory problem: ARI (no pneumonia), pneumonia and severe pneumonia. in the study under five population

Table 1. Respiratory problem (N=2011)

ARI and pneumonia episodes	Total
ARI: No pneumonia	659
Pneumonia	107
Severe pneumonia	6
Total Diagnosed child as Pneumonia	772

The diagnosis is based on CB-IMCI diagnosis protocol.

Incidence rate of ALRI in U5 children

The annual incidence rate of ARI and pneumonia in U5 children was calculated using the household survey data based on episodes. It was calculated 1.25 per person per year which is very high.

Population of Children Exposed to SFU

Population of U5 children exposed to SFU =

(Population size of U5 children) x (% of households using solid fuels with traditional stoves) x (ventilation coefficient of 1.00) + (population size of U5 children) x (% of households using solid fuels and either improved stoves or cooking outdoors) x (ventilation coefficient of 0.25)

= 54577 x 71.36x 1.00 + 54577 x 17.35 x 0.25

= 41313

Population using mixed fuels was also taken as population using solid fuels with traditional stoves and total Population of under 5 years children was taken from DOHS Annual Report 2063/64). The ventilation coefficients were taken from WHO Guide for Environmental Burden of Diseases series No 4.[6]

Calculation of Disability Adjusted Life Years **(DALY)**

Burden of ARI and Pnemonia in U5 children was calculated in terms of DALY. For the calculation of DALY

N= total number of estimated deaths due to ALRI in U5 children =27

LE= Standard life expectancy at particular age= 62.4 Years

IR= incidence rate of ALRI in U5 children = 1.25

DW= disability weight= 0.28 (Taken from Global Burden of Diseases Study)

Le= length/duration of illness in the children= 10 (Taken from Global Burden of Diseases Study)

The YLL with 3% discounting and uniform age weights was calculated 762

YLD with 3% discounting and uniform age weights was calculated 522

Hence, DALY was calculated 1284

Calculation of Attributable Fractions (AF)

To estimate the attributable fraction, the relative risk and the exposure level was inserted into equation for the attributable fraction, as shown below:

AF= ((% population exposed × relative risk + % population unexposed × 1) – 1)

/ (% population exposed × relative risk + % population unexposed × 1)

= (75.7% x 2.3 + 24.3% x1 -1)/ 75.7% x2.3 + 24.3%x1)

= 0.496

This means that about 50 % cases of ARI and pneumonia were attributed by indoor smoke in Dhading district. If it could avoid the indoor smoke in Dhading district, we could reduce the 50% cases of ARI and pneumonia among children under five years.

Calculation of Attributable Burdens

The calculated attributable fraction is then multiplied by the measure of disease burden to estimate total attributable burden of diseases due to ALRI.

Attributable burden of disease due to ALRI in U5 children from SFU

= attributable fraction × Burden of Disease due to ARI and pneumonia in U5 children

= 0.496 x 1284

= 637

This means that 637 DALYs were attributed by ARI and pneumia due to exposure of indoor smoke amongst the under five children in Dhading District.

DISCUSSION

The Environment Burden of Disease (EBD) from SFU is likely to be most significant in these situations where biomass is the chief source of fuel and contributes to extensive burden of disease. ARI is the leading cause of the global burden of disease and have been causally linked with exposure to pollutants from domestic biomass fuels in less-developed countries.[7] Each year 1.6 million people die due to the indoor air pollution from burning solid fuels in the world's poorest countries among which women and small children are far more likely to be killed estimated almost 1 million children under five every year.[8] Almost one half of the world's population still rely on solid fuels for their everyday cooking and heating; some 2.4 billion people burn biomass (wood, crop residues, charcoal and dung) and a further 0.6 billion burn coal.[9] The present study have shown agreement with Burden of Disease (EBD) due to indoor air pollution from SFU. About 86 percent people used biomass solid fuel in Dhading district which is greater than National level (83%).[2] More than 80 percent of the household rely on solid fuels like dung, charcoal, wood, or crop residues / coal, the smoke of which may be the risk factor for most of the respiratory diseases. The use of solid fuels in poorly ventilated conditions results in high levels of indoor air pollution, most seriously affecting women and their youngest children. An epidemiological study in a rural community of the hilly region of Nepal have shown significant positive correlation between the prevalence of chronic bronchitis and average amount of time of exposure to indoor air pollution both amongst smokers and non-smokers. The increasing trend of the prevalence rates as the level of exposure is increased, even after elimination of age effect, established a fact that domestic smoke pollution is an important contributing factor in chronic bronchitis.[10]

ARI and pneumonia episode of moderate and severe life threatening have made known in decreasing order at the current finding. The cases of No pneumonia (85.36%), Pneumonia (13.86%) and severe pneumonia (0.78%) have been observed in total 772 children for the diagnosis of pneumonia. Though, source of burning fuel, household characteristics, kitchen dwelling behavior of parents with child and passive smoking by infants and children from parental smoking habit has not yet decreased significantly.[3] The finding's of previous study in rural village Panchayats of Kathmandu have shown consistently positive association between domestic smoke pollution and acute respiratory infection, especially life threatening moderate and severe grades ($P<0.01$) in both exposure level and parental smoking habit. The current finding put forward health facilities may be played important role to control the acute respiratory infection.[11]

Combustion of biomass fuels produce a large amounts of indoor pollutants and small amounts of energy but, often emitting 50 times more pollutant concentrations than energy equivalent natural gas.[12] ARI and pneumonia

are the leading cause of burden of disease worldwide and have been causally associated with exposure to pollutants from domestic biomass fuels in developing countries.[13] Chronic bronchitis and chronic obstructive pulmonary disease (COPD) have reported a leading cause of death and disability, there has significant association between domestic smoke pollution for longer hours to the prevalence of chronic bronchitis.[14] In rural Nepal, nearly 15% of non smoking women had chronic bronchitis, a high rate for non smokers.[15] The intensity of indoor air pollution can be reduced by the use of improved stoves or cooking the food in the stove outside house. Exposure to the SFU is directly related with the incidence of the respiratory infections. We have calculated about 50 % cases of ARI and pneumonia were attributed by indoor smoke in Dhading district. It is possible to reduce the 50% cases of Pneumonia among children under five years after avoiding the indoor smoke in Dhading district. Exposure to indoor air pollution may be responsible for nearly 2 million excess deaths in developing countries and for some 4% of the global burden of disease. People in developing countries are commonly exposed to very high levels of indoor air pollution for 3-7 hours daily over many years especially women and young children.[16] There is an increasing trend of the incidence of ARI and pneumonia cases per 1,000 > 5 children in Nepal in past three years. The study showed that the annual incidence of ARI and pneumonia is very high which 1.25 which is extremely high however the incidence of ARI and pneumonia per 1,000 under 5 children was seen much lower (199) than national average (408).[17] This is a community based cross-sectional study, therefore, it has some limitations like tools used were new and there is obvious recall bias of illness for one year period. Hence it requires some caution to generalize its findings to other district of Nepal.

CONCLUSIONS

Burning of Solid biomass fuel is primary source of energy in Dhading district which produce indoor smoke. Indoor smoke pollution is major cause for environmental burden of ARI and pneumonia among infants and children. Total 1284 DALYs were lost due to ARI and pneumonia in Dhading district and about 50 % of total DALY were attributed by indoor smoke. The switching of fuel from solid biomass to clean fuel or use of improved cooking stoves can avoid about 50% of DALYs of ARI and pneumonia.

ACKNOWLEDGEMENTS

We would like to acknowledge WHO Country Officer Nepal for financial support and NHRC for entrusting us to conduct this study and allowing us to publish this paper.

REFERENCES

1. Nepal Health Research Council. Situation Analysis of Indoor Air Pollution and Development of Guidelines for Indoor Air quality Assessment and House Building for Health. Kathmandu, Nepal: Nepal Health Research Council; 2004.
2. Ministry of Health and Population (MOHP) [Nepal] New ERA, Macro International Inc. Nepal Demographic and Health Survey (NDHS 2006). Kathmandu, Nepal: Ministry of Health and Population, New ERA, and Macro International Inc; 2007.
3. Shrestha IL, Shrestha SL. Indoor air pollution from biomass fuels and respiratory health of the exposed population in Nepalese households. Int J Occup Environ Health. 2005;11(2):150-60.
4. Davidson CILSF, Pandey MR, Rasmussem, RA, Khalil MAK. Indoor and outdoor air pollution. The Himalayas 1896;20:561-7.
5. Joshi HD, Pandeya R, Dhakal B. Health impact of indoor pollution. J Nepal Health Res Counc. 2009 Oct; 7(15):69-75.
6. Desai MA, Mehta S, Smith KR. Indoor smoke from solid fuels: Assessing the environmental burden of diseases at national and local levels. Geneva; World Health Organization; 2004: WHO Environmental Burden of Diseases series, No. 4.
7. Ezzati M, Kammen DM. Quantifying the effects of exposure to indoor air pollution from biomass combustion on acute respiratory infections in developing countries. Environ Health Perspect. 2001 May;109(5):481-8.
8. United Nation Development Program. Smoke in the Kitchen: health impacts of indoor air pollution in developing countries. New York: United Nation Development Program; 2005.
9. Bruce N P-PR, Albalak R. Indoor air pollution in developing countries: a major environmental and public health challenge. World Health Organ. 2000;78(9):1078-92.
10. Pandey MR. Domestic smoke pollution and chronic bronchitis in a rural community of the hill region of Nepal. Thorax. 1984;39:337-9.
11. Pandey MR, Boleij JSM, Smith KR, Wafula EM. Indoor air pollution in developing countries and acute respiratory infection in children. Lancet. 1989;1:427–9.
12. Smith KR SJ, Romieu I, Bruce N. Indoor air pollution in developing countries and acute lower respiratory infections in children. Thorax. 2000;55:518-32.
13. Ezzati, M. and Kammen, D. Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: an exposure-response study. Lancet. 2001;358:619-24.
14. Pandey MR, Basnyat B, Neupane RP, Chronic bronchitis and cor pulmonale in Nepal. In: Monograph, Mrigendra Medical Trust; 1988.
15. Smith KR. Household Energy, Indoor Air Pollution and Health Impacts. Kathmandu: Winrock International Nepal; 2004.
16. Engel P, Hurtado E, Ruel M. Smoke exposure of women and young children in highland Guatemala: predictions and recall accuracy. Indian Journal of Medical Research 1998;54:408–17.
17. MoHP. Annual Health Report. Teku, Kathmandu: Department of Health service; 2004.