CHAPTER V

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

1. Summary

While so many studies have been conducted on indoor air pollution related in most of developing countries there is no known study of this kind in Bhutan. This would be first kind of study to examine the associations between indoor air pollution and respiratory disorders. A cross-sectional study was carried to investigate effects of indoor air pollution on risk of acute respiratory infections and other respiratory disorders in children under age five at Thimphu, Bhutan. The information was collected from the mothers attending mother and child clinics in relatively urban and rural areas of Thimphu. This study is done to investigate whether indoor air pollution from household cooking or heating with biomass fuels associated with increased risk of acute respiratory infections and respiratory symptoms in children under five years of age.

Socio-Demographic Features

The age of child ranged from minimum 1 to maximum 59 months. There were more males than females child (55 % and 45 respectively). 55.0% of the respondent age was in age group of 14- 49 years. There were more mothers who were illiterate (51.1%). This result shows that 61.5% of respondent were a housewife and 19.4 % were farmers. The study result shows that 71.6 % of respondents have only one child and 95.3% of children were breast-fed. It was found that, 49.8 % of household used biomass for cooking or heating.

Acute Respiratory Infection and other respiratory Illness

In this study over all prevalence of ARI in last two weeks was 19.0 %(this results was combination of unexposed and exposed), and prevalence of ARI was 16.2 % among children who were exposed to cooking or heating smoke from biomass combustion. These findings are very similar to those of study done in Zimbabwe (Mishra, 2003). This lends some confidence in the results observed in this study.

In this study the prevalence of respiratory symptoms was very high. Illness with cough in last 6 weeks was reported in 66.4 % of children. Due to logical inconsistency in questionnaire, prevalence of ARI in the last 6 weeks could not be ascertained. Cough and phlegm was reported in 21.8% of children. Wheezing was reported in 28.4 % of children. The higher incidence of cough could be because of seasonal changes; more over the data were collected in cold winter month. The pneumonia was reported in 17.1% of children. The prevalence of ARI was 22.4 % in male and 14.7 % in female. ARI morbidity was observed highest (24.2%) in infancy period (between 0-11 months) and found decreasing with increasing age. This could be because children at this age are more likely to be susceptible to infections. ARI prevalence was seen higher (31%) in urban area than rural (19%). This could be because of more environmental pollution in urban than rural area and there may be variation since data was collected at different time period.

Association of independent variables with ARI in last 2 weeks

No association was observed between wood used for cooking or heating and ARI.This was statistically not significant (p-value 0.307). Even though statistically not

significant but prevalence of ARI was 16.2% in the children who were exposed to cooking or heating smoke. This result is consistent with the study done in Zimbabwe were the prevalence of ARI was 18 % (Mishra, 2003). This finding suggests that exposure to wood smoke during cooking or heating was associated with increase risks of ARI in young children. However, rates of ARI in the last 2 weeks were somewhat higher in homes that used wood than in those that did not. Thus, there was no association on biomass fuel burning with very recent ARI.

Presence of chimney was statistically significantly with increased ARI frequency. (p=0.029). But there was a higher rate of ARI (28.3 %) prevalence where there was presence of chimney. It may be because even the best improved biomass cook stoves (ICs) leak smoke into the room and some of the smoke released from the chimney out door makes its way back into the same house or others (Smith, 2000).

This study showed reducing trends in prevalence of ARI with increasing age of a child. The study of (Detels et al., 2002) stated that most of children have about four to nine infections each year during the first two years and drop to three to four by the school age. Again, this observation lends confidence to the results observed in this study. This study showed that prevalence of ARI was more in children under one year. It may be because children at this age are likely to get exposed to higher level of cooking smoke as young children mostly stay indoors with their mothers while older children are likely to spend considerable amounts of time outdoors. The prevalence of ARI was higher in male child (22.4 %) than female child (14.7 %). The study in India found that girls have a lower rate of ARI than boys since sons were given strong

preference (Mishra et al., 1997). But this was not the case in Bhutan. Even so, again, there was no association of biomass burning with recent ARI in this study.

No association was observed when crowding measured by the number of children under five but this was negatively associated with increased ARI frequency. This study result found higher rate of ARI (21.9%) in child less than one and than more than one child (11.7 %). This was marginally statistically significant (p-value 0.089). Children whose mothers were illiterate and housewife or farmers have higher frequency of ARI than more educated or higher in occupation. A possible explanation is that illiterate mothers may be less likely than more-educated mothers to report incidents of ARI among their children as stated by (Mishra, 2001).). However, higher education and occupation were associated with lower illness frequency.

Smoking by anyone ever was not associated and was not statistically significant (p-value 0.774). Location was not associated with ARI and was not statistically significant (p-value 0.321). But this study found that ARI rate is higher in urban than in rural areas. This may be due to dusty environment or air pollution To analyze separately on urban and rural and ARI in last 2 weeks is not possible for wood for heating or cooking, because all rural residents used wood for cooking or heating.

Association between independent variables and cough in last six weeks

Chi-square test was done between wood used for cooking or heating and cough in last six weeks. It was found that reported prevalence of cough was higher among children living in the households using biomass fuel wood (76.6%) than among those

living in households not using wood (56.6%). The use of wood for cooking, for heating and cooking or heating was significantly associated with increased frequency of cough. (p-value at least= 0.011). The study by Nikie (1999) stated that indoor pollution has influence on respiratory symptoms. There was not much difference in prevalence of cough by age and was not statistically significant (p-value 0.432). Prevalence of illness of cough in last six weeks was higher in children less than one and was negatively associated and statistically significant (p-value 0.012). Further, frequency of cough in last 6 weeks was higher in males than females. The prevalence of cough was more in the children whose mothers were illiterates (71.7 %) but marginally significantly associated (p-value 0.099). Illness with cough in last six weeks was 69.9 % in children whose mothers were housewife or farmers. This was statistically significant (p-value 0.042). However, higher education and occupation were associated with lower illness frequency.

This study shows that prevalence of cough was 77.3 % in children who are exposed to passive smoking and statistically significant (p-value0.012). The findings of this study suggest that passive smoking is an important cause of respiratory symptoms in children under aged five. This finding is consistent with study of Nikie (1999).

Cough was reported in (80.3 %) of children in rural than in urban (60.7 %). This was statistically significant (p-value 0.006). On balance, these findings suggest that exposure to wood smoke has an adverse effect on recent cough in children under 5 years old.

Association between independent variables and cough with sputum of any duration

There were marginally statistically significant positive associations of wood for heating and wood for cooking or heating with prevalence of cough and sputum of any duration. Use of wood for cooking was also positively associated with this outcome, but not statistically significant. Prevalence of cough and sputum was higher in children aged group of 12-23 months (37.2%) and this was statistically significant (p-value 0.001).

Prevalence of these symptoms did not vary much by sex but frequency of illness was observed more in male child. There was not much influence on this symptom by mother's education and occupation and statistically not significant (p-value 0.103 and 0.327 respectively). Exposure to passive smoking was not statistically significant (p-value 0.903). However, Nikie (1999) stated that respiratory symptoms were significantly more common to parental smoking, especially cough and phlegm. This symptom was more in children from rural (27.9%) than urban (19.3 %). This could be possible because the children were exposed to higher level of cooking smoke in rural area since the wood is common fuel used for cooking or heating. That is, use of wood was quite strongly associated with urban/ rural status in this study (higher rate of wood use in the rural area).

Association between independent variables and wheeze

There was positive association between wood used for cooking with wheeze. This was statistically significant (p-value 0.014). Use of wood for cooking, and for

cooking or heating, was also positively associated with this out come, but not significantly so. Age did not vary in prevalence of wheeze, however the prevalence was more in age group of 12-23 months. The number of children and gender was not statistically significant. The wheeze was reported higher (36.8%) in children whose mother were illiterate and this was marginally statistically significant (p-value 0.007). Further prevalence rate of wheeze was observed more in children whose mother's were housewife or farmers. This study result found that exposure to passive smoking was associated with wheeze and was statistically significant (p-value 0.014). This finding suggests that exposure to wood smoke and passive smoking have an effect on prevalence of reported wheeze. Further, passive inhalation of smoke might have a direct inflammatory effect on air mucosa or increase susceptibility to infection (Lux et al., 2000). The prevalence was much higher (38.7%) among children exposed to passive smoking than among children not exposed (22.8%). The findings of this study suggest that smoking have an effect on prevalence of wheeze. A study (Lux et al., 2000) stated that there is strong evidence that cigarette smoke exposure is an important cause of wheeze.

This study results found that the prevalence was higher in rural (39.3%) than urban (24.0%) and statistically significant (p-value 0.025). Again, this may reflect the association of wood use with rural status. Indeed, in this study it is difficult to separate the respiratory effects of wood use with urban/rural status

2. Conclusion

The results of this study show that even though exposure to wood smoke is not statistically significantly associated with ARI in the last 2 weeks, the prevalence rate of ARI is consistent with the study done in Zimbabwe. The study showed that among children, who were exposed to wood smoke, there is an increased risk of ARI. The reported prevalence of ARI was higher in male child than female child. This lends some confidence in the results observed in this study.

In this study the prevalence of respiratory symptoms is very high. This result shows that among the respiratory conditions, cough and wheeze are common illness that children under age five are suffering from. The findings from this study suggest that among risk factors wood used for cooking or heating and passive smoking may be the risk factors for occurrence of respiratory illness. These findings suggest that exposure to woods smoke and passive smoking is an important cause of respiratory symptoms. Geographical locations have independent effects on the prevalence on respiratory conditions. This result suggests that respiratory symptoms prevalence (although not ARI in the last 2 weeks) is may be related to the fuel used for cooking or heating and smoking as well as passive smoking. As mentioned above, it is difficult to separate effects of wood used and urban/rural status.

There are several factors that could affect the validity of this conclusion. Fuel type is not an ideal measure of exposure and reports of respiratory disorders by mothers may not as accurate as clinical measures of the diseases. There may be possibility of underreporting due to lack of awareness that children had the disease during the two-

week reference period. The 211 children included in analysis represented only 180 mothers. There may be information bias coming from some mothers answering the questionnaire for >1 child. Also, two weeks is short time and frequency of ARI may well vary considerably with different two–weeks calendar periods. Furthermore, in this study the interviews for urban and rural mothers were not conducted at the same time, so the preceding two weeks were not identical for these two groups. As mentioned above, use of wood and urban/rural status are not independent in this study (there was considerably more use of wood in rural area). This may have affected the reliability of the ARI metric as a test of respiratory effects of biomass fuel use in this study.

In conclusion, this study found that exposure to wood smoke and passive smoking were often associated with frequency of respiratory symptoms. This result provides support for the hypothesis that use of biomass fuel (wood) for cooking or heating is associated with increased risk of respiratory symptoms among children under 5 years of age, but not very recent ARI. Overall, the observed association of wood smoke exposure with respiratory disorders was limited and rather inconsistent, so it would not be appropriate to conclude that the main research hypothesis was confirmed. At the same time, these results raise suspicion that biomass smoke exposure is harmful to respiratory health in Bhutan, and this justify further research on this topic.

3. Recommendations

1. Further studies are required even in other age groups where people use wood fuel for cooking or heating to see the effects in respiratory illness and their prevalence.
2. Using results of this study the ARI program in Bhutan can plan out strategies for additional intervention (for e.g. educating mothers to protect their young child from pollution, either by placing the child away from the kitchen or relocating cooking place) so that the prevalence of ARI, a leading cause of morbidity, could be brought down.
3. Further studies in future should use clinical measures in addition to taking history from mothers for prevalence of ARI.Further a direct measure of smoke exposure could help to further substantiate the outcome.
4. It could be useful to analyze the results of this study with multivariable methods (e.g., logistic regression models or random effects methods
5. It would be desirable to study health benefits of indoor air pollution reduction.
6. It would be desirable to compare the present results to those of analyses that include only one child per mother (total 180 children). Unfortunately, this was not possible in the present study, because individual mothers' information was not linked to children's information in the analytical dataset.

4. Limitations of the Study

1. Since the design for data collection was cross sectional study, the findings measures the exposure and effects at same time not over the time.
2. Information on ARI and other respiratory disorders is based on mother's reports and no clinical measurements were under taken. Smoke exposure was ascertained from the type of fuel used for cooking and heating and not by direct measurement.
3. Data was collected in very cold season and collected in different time between urban and rural. As mentioned above, this might well tend to limit the validity of ARI in the last 2 weeks as a test of respiratory effects of wood use
4. Exposure to passive smoking was based on whether the family member smoked or not and the history did not include the quantity of cigarettes smoked in inside the house.
5. Multivariable analysis would be needed to assess the relative impact of biomass burning and other factors on respiratory problems in children. These actors include passive smoking, socioeconomic situation, and urban/rural status
6. There may be information bias from some mother's with >1 child answering same questionnaire.