HOUSEHOLD AIR POLLUTION RELATED TO RESPIRATORY SYMPTOMS AMONG PEOPLE LIVING IN RURAL AND URBAN AREA IN VIENTIANE CAPITAL, LAO PDR

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A Thesis Submitted in Partial Fulfillment of Requirements

for the Degree of Master of Public Health Program in Public Health

College of Public Health Sciences

Chulalongkorn University

Academic Year 2011

มลพิษทางอากาศในบ้านเรือนที่เกี่ยวข้องกับอาการของโรคในระบบทางเดินหายใจของประชาชนที่อาศัยในพื้นที่เมืองและชานเมืองหลวงเวียงจันทน์ สาธารณรัฐประชาธิปไตยประชาชนลาว

นายเวียงนคร วงไส

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต
สาขาวิชาสาธารณสุขศาสตร์
วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2554

Thesis Title	HOUSEHOLD AIR POLLUTION RELATED TO RESPIRATORY SYMPTOMS AMONG PEOPLE LIVING IN RURAL AND URBAN AREA IN VIENTIANE CAPITAL, LAO PDR
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เวียงนคร วงไส: มลพิษทางอากาศในบ้านเรือนที่เกี่ยวข้องกับอาการของโรคในระบบทางเดินหายใจของประชาชน ที่อาศัยในพื้นที่ เมือง และชานเมืองหลวงเวียงจันทน์ สาธารณรัฐประชาธิปไตยประชาชนลาว (HOUSEHOLD AIR POLLUTION RELATED TO RESPIRATORY SYMPTOMS AMONG PEOPLE LIVING IN RURAL AND URBAN AREA IN VIENTIANE CAPITAL, LAO PDR) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ. ดร. วัฒน์สิทธิ์ ศิริวงศ์, 87 หน้า

การศึกษาชนิดภาคตัดขวางนี้มีวัตถุประสงค์เพื่อศึกษาแหล่งกำเนิดมลพิษทางอากาศในบ้านเรือน การปฏิบัติตัวของสมาชิกในครอบครัว และปัจจัยต่างๆที่มีความสัมพันธ์กับภาวะเสี่ยงต่อโรคในระบบทางเดินหายใจของประชาชนในเขตชุมชนเมืองและชานเมืองของเมืองหลวงเวียงจันทน์ สาธารณรัฐประชาธิปไตยประชาชนลาว ในการศึกษาครั้งนี้ใช้บ้านเรือนจำนวน 422 ครัวเรือน ประกอบด้วยผู้ใหญ่ (ชายและหญิง) จำนวน 770 คน และเด็กอายุต่ำกว่า 15 ปี จำนวน 243 คน โดยทำการเก็บข้อมูลในช่วงกลางเดือนกุมภาพันธ์ ถึง มีนาคม 2555 โดยใช้แบบสอบถามแบบมีโครงสร้าง และวิเคราะห์ผลการศึกษาโดยใช้สถิติวิเคราะห์ข้อมูลตัวแปรสองตัวและหลายตัวแปร ผลการศึกษาเชิงพรรณนา พบว่าประชากรที่อยู่ในเขตชานเมืองทั้งเด็กและผู้ใหญ่มีภาวะเสี่ยงต่อการเกิดโรคในระบบทางเดินหายใจมากกว่าในเขตเมืองหลวง ซึ่งมาจากสาเหตุของความเจ็บป่วยและปัจจัยอื่นๆ ในการศึกษาเชิงวิเคราะห์ พบความสัมพันธ์ในเชิงบวกของบางปัจจัย ได้แก่ ลักษณะของครัวเรือน การปฏิบัติตัวของสมาชิกทั้งหมดในครัวเรือน การปฏิบัติตัวของสมาชิกแต่ละคนในครัวเรือน ลักษณะทางสังคมและสภาวะสุขภาพปัจจุบันทั้งในเด็กและผู้ใหญ่ อย่างไรก็ตามผลจากการศึกษาข้างต้นยังไม่สามารถบ่งชี้ได้ชัดเจนถึงเหตุและปัจจัยทั้งหมด ดังนั้นควรมีการศึกษาเพิ่มเติมและหน่วยงานด้านสาธารณสุขหรือผู้กำหนดนโยบายควรพิจารณาถึงแนวทางในการป้องกันและแก้ไข เช่น การให้ส่งเสริมความรู้ การเข้าถึงและเยี่ยมบ้าน และการดูแลทำความสะอาดบ้านเรือน เป็นต้น

สาขาวิชา: สาธารณสุขศาสตร์ ลายมือชื่อนิสิต :

ปีการศึกษา: 2554 ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก

##5478813653: MAJOR PUBLIC HEALTH
KEYWORDS: HOUSEHOLD AIR POLLUTION / RESPIRATORY SYMPTOMS / RURAL / URBAN / VIENTIANE CAPITAL / LAO PDR

VIENGNAKHONE VONGXAY: HOUSEHOLD AIR POLLUTION RELATED TO RESPIRATORY SYMPTOMS AMONG PEOPLE LIVING IN RURAL AND URBAN AREA IN VIENTIANE CAPITAL, LAO PDR. ADVISOR: ASST. PROF. WATTASIT SIRIWONG, Ph.D., 87 pp.

The objective of this cross-sectional study was to investigate whether household air pollution source from house characteristic, practice and other considerably possible factors are associated with risk of respiratory symptoms among people living in rural and urban area of Vientiane Capital, Lao PDR. Of 422 households as total were studied, including 770 adult respondents (male and female) and 243 children less than 15 years. Data were collected from mid-February to March 2012, using structured questionnaire. Bivariate analysis and multivariate analysis were performed in this study.

In descriptive findings, the study found that people in rural area, both adult and children, are more vulnerable than people in urban according to the percentage of illnesses and many other conditions. In analytical findings, positive associations were found in some factors of household characteristic, household practice, personal practice, socio-demographic conditions and health background with each respiratory symptom in both adult and child.

However these findings do not prove the causality, further investigations are still necessary. Regarding the results, it should be recommended for the health sector, or policy maker to consider and find out further protection in people or by using some kind of solving intervention, such as giving knowledge, campaign on house visiting of health personnel, household-environmental cleaning, etc.

Field of Study Public Health Student's Signature ----------

Academic Year 2011 Advisor's Signature ----------

ACKNOWLEDGEMENTS

I would like to express my deep appreciation to Asst. Prof. Dr. Wattasit Siriwong, Ph.D., my thesis advisor, for his guidance and supervision throughout this study. His precious advices have motivated me on doing this research.

I also would like to thank my thesis exam committee, Assoc. Prof. Dr. Sathirakorn Pongpanich, Ph.D. as the chairperson, Dr. Robert Sedgwick Chapman, MD, M.P.H as my examiner, and Dr. Daisy Morknoy, PhD. as my external examiner, for providing me valuable suggestions and comments on my proposal and thesis.

I take this opportunity to thank the Thai Fogarty Committees for supporting my research grant and thank to the College of Public Health Sciences, Chulalongkorn University, for providing all facilitations during my study.

My sincerely thanks to the Faculty of Postgraduate Studies, University of Health Sciences, Laos, for supporting lots of encouragements, experiences and facilitation in local.

Sincerely thanks to my family for their love and encouragement during my study in Thailand. And I also would like to thank all my friends, classmates, and senior students for their kind and friendly support.

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LIST OF ABBREVIATIONS

ARI:	Acute Respiratory Infection
ATS:	American Thoracic Association
CI:	Confidence Interval
COPD:	Chronic Obstructive Pulmonary Diseases
DALYs:	Disability Adjusted Life Years Loss
ETS:	Environmental Tobacco Smoke
HH:	Household
NGO:	Non-Government Organization
OR:	Odd Ratio
PM:	Particulate Matter
TSP:	Total Suspended Particulate
WHO:	World Health Organization

CHAPTER I

INTRODUCTION

1.1 Background

Air pollution is one environmental issue, both indoor and outdoor, which modifies the natural characteristics of the atmosphere. Common sources of air pollution are household combustion device producing articulate matter, carbon monoxide, ozone, nitrogen dioxide and sulfur dioxide which are included as pollutants of major public health concern. Indoor air pollution causes respiratory and other diseases, which can be fatal (WHO, 2011a). Furthermore, long-term exposure to combustion-related fine particulate air pollution is also an important environmental risk factor for cardiac, pulmonary and lung cancer mortality (WHO, 2011b).

Respiratory disease is one dominant health concern as one leading cause of worldwide morbidity and mortality (WHO, 2008), and the disease has been mentioned as attributable to low air quality in many studies. Considering on household combustion, children under 5 years of age and women are the most vulnerable population because they are most likely to be exposed to indoor air pollution every day and easily to get respiratory health effects. Moreover, indoor air pollution also leads an increased prevalence of wheezing in the chest apart from colds, or of wheezing most days or nights, increased prevalence or incidence of chest tightness, increased prevalence or incidence of cough or phlegm production, requiring medical attention, increased incidence of acute upper respiratory infections, and eye - nose - throat irritation that may interfere with normal activity (WHO, 2011b).

Household air pollution was estimated to cause approximately 2 million premature deaths by the year 2004, mostly in developing countries; almost half of these deaths are due to pneumonia in children under 5 years of age (WHO, 2009a) (WHO, 2011c). The WHO Air quality guidelines indicate that by reducing particulate matter (PM_{10}) pollution from 70 to 20 micrograms/m^3, we can cut air quality related deaths by around 15% (WHO, 2005a). Clean air is considered to be a basic requirement of

human health and well-being. However, air pollution continues to pose a significant threat to health worldwide (WHO, 2005b).

Table 1: **Ranking of selected risk factors: 10 leading risk factor causes of death by income group, 2004** (WHO, 2009a)

Rank	Risk factor	Deaths (millions)	% of Total	Rank	Risk factor	Deaths (millions)	% of Total
	World				Low-income countries[a]		
1	High blood pressure	7.5	12.8	1	Childhood underweight	2	7.8
2	Tobacco use	5.1	8.7	2	High blood pressure	2	7.5
3	High blood glucose	3.4	5.8	3	Unsafe sex	1.7	6.6
4	Physical inactivity	3.2	5.5	4	Unsafe water, sanitation, hygiene	1.6	6.1
5	Overweight and obesity	2.8	4.8	5	High blood glucose	1.3	4.9
6	High cholesterol	2.6	4.5	6	Indoor smoke from solid fuels	1.3	4.8
7	Unsafe sex	2.4	4.0	7	Tobacco use	1.0	3.9
8	Alcohol use	2.3	3.8	8	Physical inactivity	1.0	3.8
9	Childhood underweight	2.2	3.8	9	Suboptimal breastfeeding	1.0	3.7
10	Indoor smoke from solid fuels	2.0	3.3	10	High cholesterol	0.9	3.4
	Middle-income countries[a]				High-income countries[a]		
1	High blood pressure	4.2	17.2	1	Tobacco use	1.5	17.9
2	Tobacco use	2.6	10.8	2	High blood pressure	1.4	16.8
3	Overweight and obesity	1.6	6.7	3	Overweight and obesity	0.7	8.4
4	Physical inactivity	1.6	6.6	4	Physical inactivity	0.6	7.7
5	Alcohol use	1.6	6.4	5	High blood glucose	0.6	7.0
6	High blood glucose	1.5	6.3	6	High cholesterol	0.5	5.8
7	High cholesterol	1.3	5.2	7	Low fruit and vegetable intake	0.2	2.5
8	Low fruit and vegetable intake	0.9	3.9	8	Urban outdoor air pollution	0.2	2.5
9	Indoor smoke from solid fuels	0.7	2.8	9	Alcohol use	0.1	1.6
10	Urban outdoor air pollution	0.7	2.8	10	Occupational risks	0.1	1.1

a Countries grouped by gross national income per capita – low income (US$ 825 or less), high income (US$ 10 066 or more).

Table 2: Ranking of selected risk factors: 10 leading risk factor causes of DALYs by income group, 2004 (WHO, 2009a)

Rank	Risk factor	DALYs (millions)	% of Total	Rank	Risk factor	DALYs (million)	% of Total
	World				Low-income countries[a]		
1	Childhood underweight	91	5.9	1	Childhood underweight	82	9.9
2	Unsafe sex	70	4.6	2	Unsafe water, sanitation, hygiene	53	6.3
3	Alcohol use	69	4.5	3	Unsafe sex	52	6.2
4	Unsafe water, sanitation, hygiene	64	4.2	4	Suboptimal breastfeeding	34	4.1
5	High blood pressure	57	3.7	5	Indoor smoke from solid fuels	33	4.0
6	Tobacco use	57	3.7	6	Vitamin A deficiency	20	2.4
7	Suboptimal breastfeeding	44	2.9	7	High blood pressure	18	2.2
8	High blood glucose	41	2.7	8	Alcohol use	18	2.1
9	Indoor smoke from solid fuels	41	2.7	9	High blood glucose	16	1.9
10	Overweight and obesity	36	2.3	10	Zinc deficiency	14	1.7
	Middle-income countries[a]				High-income countries[a]		
1	Alcohol use	44	7.6	1	Tobacco use	13	10.7
2	High blood pressure	31	5.4	2	Alcohol use	8	6.7
3	Tobacco use	31	5.4	3	Overweight and obesity	8	6.5
4	Overweight and obesity	21	3.6	4	High blood pressure	7	6.1
5	High blood glucose	20	3.4	5	High blood glucose	6	4.9
6	Unsafe sex	17	3.0	6	Physical inactivity	5	4.1
7	Physical inactivity	16	2.7	7	High cholesterol	4	3.4
8	High cholesterol	14	2.5	8	Illicit drugs	3	2.1
9	Occupational risks	14	2.3	9	Occupational risks	2	1.5
10	Unsafe water, sanitation, hygiene	11	2.0	10	Low fruit and vegetable intake	2	1.3

a Countries grouped by gross national income per capita – low income (US$ 825 or less), high income (US$ 10 066 or more).

It can be said that to avoid respiratory disease/infection and other related diseases, air pollution levels are needed to be reduced (WHO, 2011c), and especially indoor air pollution from household combustion is a major environmental risk to health, mostly in women's and young children's respiratory health. However, in Asian cities, the magnitude and prevalence of exposure to indoor air pollution are high, especially among people living in poverty (HEI, 2010).

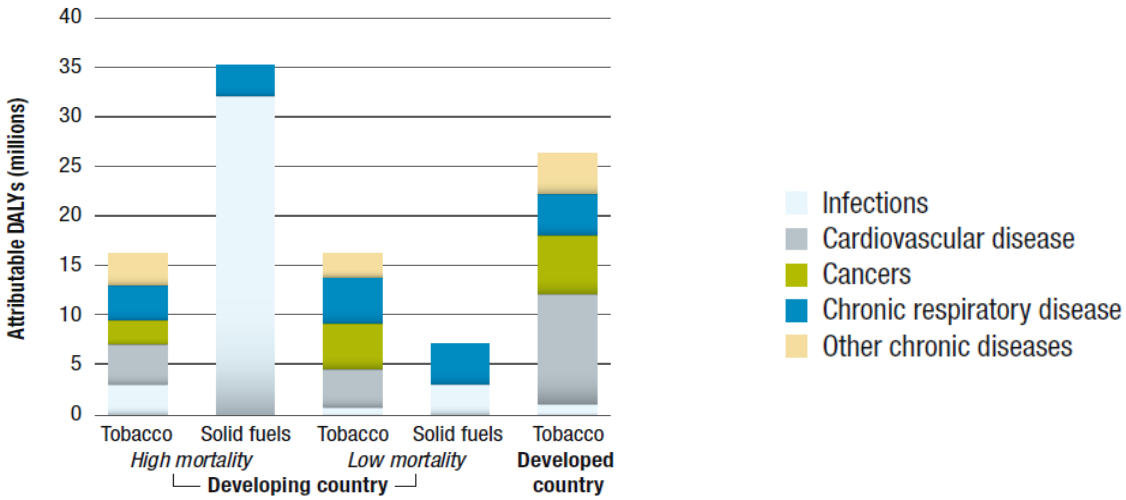


Figure 1: Burden of disease attributable to tobacco and indoor smoke from solid fuel (WHO, 2011b)

In Laos, 2001, approximately 81.60% of the population used biomass fuels for cooking or heating (National Statistic Center, 2005a). In 2006, a survey found that children age 1-4 years, 69.4% have cough, 33.0% have difficulty of breathing at any time, and 48.2% wake up at night with cough or wheeze; in women, 21.3% have dry cough, 33.9% have shortness of breath, and 22.1% wake up at night with cough or wheeze and those are from asking about respiratory symptoms in the past 2 weeks and considered as attributable to household air quality (Mengersen et al., 2006). Further information according to a report about the environmental burden of disease for selected risk factors, based on national exposure and WHO country health statistics 2004, Geneva 2009, there has been more than 95% of households having solid fuel use and has been estimated that indoor air pollution from households attribute to 2,600 death/year, together with 11 DALYs/1000cap/year (WHO, 2009b).

Figure 2: Traditional Lao Stoves (picture a and b). Children sometimes play near the stove, or around the cooking place

1.2 Rationale

In the Lao People's Democratic Republic, air pollution is also one of environmental issues. Lao PDR is a small landlocked country in South East Asia, with the climate is typically tropical monsoon and the rainy season starts from April to October. The country also has already been known as being concerned by the impact of indoor air pollution nowadays, especially adverse respiratory health in women and children who most likely to stay in the house every day (Mengersen et al., 2006). And while the country has been accountable to the harming of respiratory diseases; for instance pneumonia, influenza, and tuberculosis are promoted by poor air quality. These diseases and risk factors are significant in Lao PDR as they comprise the top causes of morbidity and mortality (WHO, 2005c).

Total population of Lao PDR is 5.62 million, 2.82 million females and 2.80 million males (National Statistic Center, 2005b). The average household size is 5.9 persons/household (National Statistic Center, 2005a). 23% of the population had never been to school, with a much higher percentage of women than men (National Statistic Center, 2005e).73% of population lives in rural areas, with a considerably strong trend to move to cities. Migration within the country per year, from a province to another, 40% moves to Vientiane capital. With the population of around 700,000 people, Vientiane Capital has the highest proportion of urban area, about 82% (National Statistic Center, 2005b)**,** meaning that distribution of people living in Vientiane capital is differently opposite in proportion of urban and rural area comparing to the country population distribution. Estimated Life Expectancy is 63

years for women and 59 years for men (National Statistic Center, 2005c). 96% of the Lao households, people own their own houses/dwelling units. For Vientiane Capital, there are about 91% of households people own their own houses/dwelling units, while rural areas people own their own houses/dwelling units are close to 100% (National Statistic Center, 2005d).

Census 2005 showed that approximately 80% of all Lao households use fuel wood, and 15% charcoal, for cooking, heating and lighting purposes. The use of these polluting fuels can pose a significant burden on the health of poor families (PEI, 2010). Energy use in the country is dominated by household consumption of traditional fuels, mainly wood and charcoal. In general, air quality in Laos is considered to be very good; however, in Vientiane capital, air pollutant level has been found to be quite high, especially PM_{10}; with poor ventilation, pollution is therefore trapped in the areas where they are generated (WHO, 2005c).

A previous study in some districts of Laos found some positive associations between indoor air pollutants and respiratory illness among women and children (Mengersen et al., 2006); however, further study is also essential and needed to show a comparison or differentiation of those associations between subjects who lived in rural area and urban area, the study sites are required to be clarified whether to represent as rural or urban. In case of being affected by household air pollution, considerably, all age groups and genders should be included in the study, as they all involve in home scale activity.

Since there has not been any study of this type in Vientiane capital before, respiratory health of people in Vientiane capital is one thing interesting in public health, due to crowded living of people who came from every part of the country with usual traditional lifestyle that poor quality of household air can be assumed and also behaves as a factor influencing some kind of respiratory symptoms. With a heavy trend of household combustion, expectedly people in Vientiane capital therefore seem to be more and more affected by household air pollution which is generated from some sources within their households; for instance cooking and burning, etc.

This can be said that it is very important and interesting to know about the health status of people, specifically respiratory symptoms in children, female and male, related to household air pollution knowledge, practice and household characteristics of those people who live in Vientiane capital, in both urban area and rural areas.

1.3 Research Questions

(1). What is the prevalence of each respiratory symptom among people living in rural and urban area?

(2). How does the exposure to household air pollution associate with respiratory symptom among people living in rural and urban area in Vientiane capital, Lao PDR?

(3). Is there any difference of respiratory health status between people living in urban area and people living in rural area?

1.4 Hypotheses

In Vientiane capital,

a) There is an association between household characteristics/household practice/knowledge on household air pollution and respiratory symptoms of people living in rural and urban area.

b) There is a difference of respiratory health status between people living in urban area and people living in rural area.

1.5 Objectives

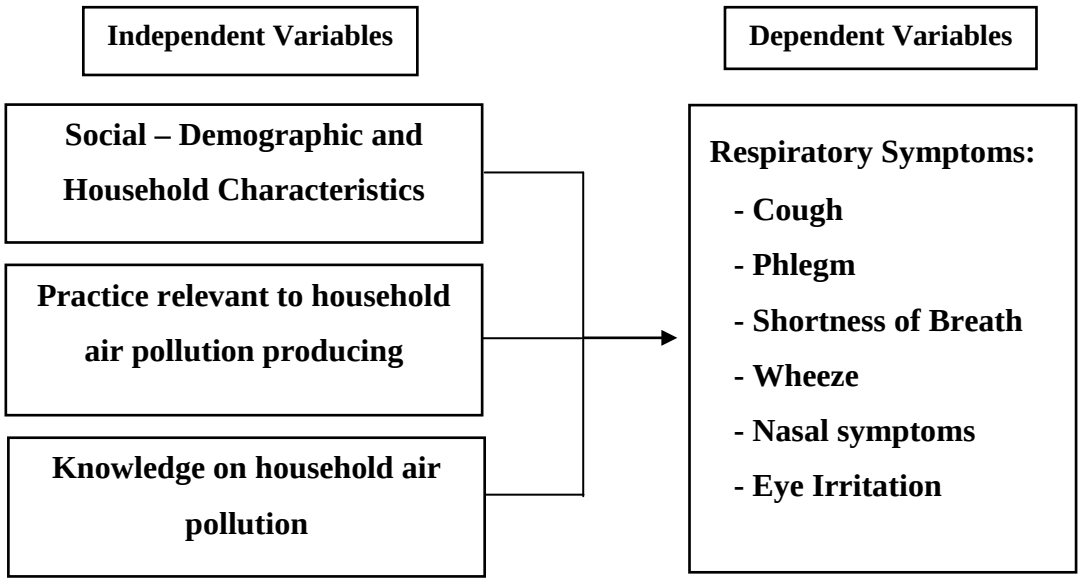
1.5.1 **General Objective:**

To investigate how the exposure to household air pollution associated with respiratory symptom among people living in rural and urban area in Vientiane capital, Lao PDR, and to compare the occurring of respiratory symptoms between those two populations based on those factors.

1.5.2 **Specific Objectives**

- To compare the socio-demographic between the people who live in rural and urban area in Vientiane capital, Lao PDR.
- To compare the household practice/knowledge on household air pollutions between the people who live in rural and the people who live in urban in Vientiane capital, Lao PDR.
- To identify the association between those factors and respiratory symptoms of those target population and compare between those two groups of sample (rural and urban).
- To determine common factor influencing respiratory symptoms in the target population.
- To contribution to the accumulation of evidence in order to provide more reliable estimates of risk and useful information for policy/decision-maker.

1.6 Conceptual Framework



Respiratory symptoms of people living in urban and rural area behave as Dependent Variable, while other factors such as social-demographics, knowledge,

practice related to air pollution and household characteristics are acting as Independent Variables.

1.7 Operational Definition

Household Air Pollution: air pollution occurs within home scale; smoke from cooking, smoking, burning, etc. In this study, researcher focuses on sources of pollution with in home scale of subjects such as relevant household practice like cooking in house, burning, etc. and even knowledge and household characteristics.

Knowledge: knowledge on household air pollution means knowing that what things in the house can produce air pollution in the household, how to protect, etc.; for instance: people know (or don't know) where the household air pollution comes from, does it impact their health? What can be done to the impact, etc.?

Practice: practice related to household air pollution means some actions that risk of producing air pollutant, or any behavior that is able to produce pollutants to the air. In this study, researcher focuses on some traditional practice of each household; for instance: burning, smoking, cooking in the house with traditional fire-setting, etc.

Household Characteristics: means the appearances of the house consisting of some relevant points of the house to the study such as type of stove, kitchen in the house, windows, house near industry, near dusty road, etc.

Respiratory Symptoms: In this study, researcher focuses on common symptoms related to respiratory health occurring in subjects such as cough with/without cold, wheeze with/without cold, phlegm with/without cold, shortness of breath with/without cold, nasal symptom without cold, and eye irritation at home.

Rural Area: In this study, rural area means the area which has lower status in economics, lower population density and located far from the city**.**

Urban areas: In this study, urban area means the area that has better status in economics, higher population density and located within the city**.**

CHAPTER II

LITERATURE REVIEW

2.1 Review of Study

A cross sectional study conducted in some district of Vientiane province and Bolikhamxay province in Laos, 2006, found that, of the 199 houses in which air measurements were made, mean indoor PM10 and NO2 concentrations were significantly higher in Vientiane province (PM10 = 1275 - 98 lg/m3, 95% CI 1081 - 1469 lg/m3; NO_2 = 1210 - 94 lg/m3, 95% CI 1023 - 1396 lg/m3) than in Bolikhamxay province (PM_{10} = 1183 - 99 lg/m^3, 95% CI 984 - 1382 lg/m3; NO2 = 561 - 45 lg/m3, 95% CI 471 - 651 lg/m3), but CO concentrations were significantly higher in Bolikhamxay (CO = 0.430 - 0.032 ppm, 95% CI 0.367 - 0.494 ppm compared to CO = 0.490 - 0.059 ppm, 95% CI 0.372 - 0.609 ppm respectively). PM_{10} has played a positive association with adverse lung function of children 1 - 4 years at OR = 2.04 (CI: 1.09 - 3.84; p-value = 0.026), and of women at OR = 2.11 (CI: 1.13 - 3.96; p-value = 0.019). Carbon monoxide also has positive association with adverse lung function of women at OR = 2.29 (CI: 1.09 - 4.84; p-value = 0.029). Almost of household pollutants also have positive association with most of respiratory symptoms of those women and children. Of those two provinces, 51.8% of women spent time for cooking more than 4 hours/day, 66.2% spent time by fire more than 4 hours/day and even 30% of children 1 - 4 years also spent time by the cooking place more than 2 hours/day (Mengersen et al, 2006). This study has contributed very essential information and it was the first study on health related to indoor air pollution in Laos PDR.

A cross-sectional study conducted in 2009, Thailand, found that mosquito coils burning, as an indoor air pollutant, has a positive significant association with cough (with/without cold) in respondents (OR=1.84, 95% CI=1.02 to 3.33, p=0.045). In children, there was a marginally significant positive association of cough (with/without cold) with mosquito coil use (OR=2.85, 95% CI=0.99 to 8.22, p=0.052). Moreover, there are also other respiratory symptoms significantly found such as phlegm (OR=2.02, 95% CI=1.28 to 3.19, p=0.003) and wheeze (OR=2.47,

95% CI=1.52 to 4.00, p=0.001). These study results strongly suggest that mosquito coils burning, as indoor air pollutant, is a risk factor for respiratory symptoms (Tharaphy, 2009).

However, further studies will still be required to find out more evidence on other factors about indoor/household air pollution and its association with health of people.

2.2 Review of General Information on Indoor Air Pollution Effects

Air pollution leads to adverse respiratory health effects worldwide such as: Increased mortality, increased incidence of cancer, increased frequency of symptomatic asthma attacks, increased incidence of lower respiratory infections, increased exacerbations of disease in people with cardiopulmonary diseases, decreased ability to cope with daily activities (e.g. shortness of breath), increased hospitalization (both frequency and duration), increased number of visits to emergency ward or physician, increased need for pulmonary medication, and decreased pulmonary function (WHO, 2011b).

In Thailand, with the population of 64.2 million, urbanization 32%, people living in cities greater than 100 000 inhabitants 16%, and life expectancy 72 years (2006), the Environmental burden of disease for selected risk factors, per year has Estimated based on national exposure and WHO country health statistics 2004, that Indoor air pollution has attributed as a factor of death 10,500 deaths/year, with 1.9 DALYs/1000cap/year (WHO, 2009c).

In China, with the population of 1,315.8 million, urbanization 40% , people living in cities greater than 100 000 inhabitants 37% , and life expectancy 73 years (2006). Environmental burden of disease for selected risk factors, per year, has estimates based on national exposure and WHO country health statistics 2004, that Indoor air pollution has attributed as a factor to 548 900 deaths/year with 3.2 DALYs/1000cap/year (WHO, 2009d). It has been estimated that about 80% of the Chinese households use solid/biomass fuels for cooking or heating. Monitoring data from 388 cities shows that only 31% met the Chinese standard for air quality and some large Chinese cities have been ranked as the most seriously polluted in the

world. Comparisons show that the concentrations of Total Suspended Particulates (TSP) were higher in the north than in the southern cities where as the levels of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) were about the same in the north and south. Several major cities had SO_2 well above the WHO standard of 60ug/m3 which means that about 600 million Chinese citizens are exposed to levels above the standard. The emissions of sulphur dioxide and particulate in waste gases have been falling over recent years but for 2002 the total SO_2 and particulate emissions were 1926x104 and 1953x104 tons (which includes soot and industrial dusts) respectively. In general terms about 74% of the Chinese population lives in areas where the air quality does not meet the standard. In addition to the ambient atmospheric environment, many people especially women will be exposed to air contamination inside their households (WHO, 2005d).

In 2000, Vietnam had more than 95% of the population was using solid/biomass fuels for cooking especially in the rural areas. Much of Vietnam's large population relies heavily on noncommercial biomass energy sources such as wood, dung, and rice husks. Vietnam's per capita commercial energy consumption is among the lowest in Asia. The top ten causes of morbidity in Vietnam are pneumonia, acute pharyngitis/tonsillitis, acute bronchitis, diarrhea/gastroenteritis, transport accident, primary hypertension, influenza, appendicitis, gastritis and fracture of the limbs. Respiratory diseases are still the main causes of illness in Vietnam, which have been associated with poor air quality and congestion (WHO, 2005e).

In Cambodia, with the population 14 million, urbanization 20%, and people living in cities greater than 100,000 inhabitants 8%, the Environmental burden of disease for selected risk factors, per year has estimated based on national exposure and WHO country health statistics 2004, that Indoor air pollution has attributed to 6,600deaths/year, with 16 DALYs/1000cap/year (WHO, 2009e). Cambodia relies heavily on biomass for its energy needs. Fuels from biomass include wood, charcoal, dung and agricultural residues; these are considered major sources of air pollution and greenhouse gas emissions. In 1999, almost 97% of the population used biomass fuels for cooking or heating: 91.2% fuel wood, 5.1% charcoal and 0.5% agricultural residues including cow dung. In Phnom Penh, 39% of the households use charcoal

with about 11% in other urban areas. Acute respiratory infections, cough and tuberculosis are in the top ten leading causes of morbidity. Majority of the cases for morbidity are due to ARIs with a rate of 7,182 per 100,000 populations. Tuberculosis is the sixth cause of illness with 14,758 cases. Acute respiratory infections and tuberculosis are also ranked in top ten leading causes of mortality (WHO, 2004a).

In Myanmar, with the population of 50.5 million, urbanization 31%, and people living in cities greater than 100,000 inhabitants 14%, the Environmental burden of disease for selected risk factors, per year has estimated based on national exposure and WHO country health statistics 2004, that Indoor air pollution has attributed to 18 100 deaths/year, with 9 DALYs/1000cap/year (WHO, 2009f). In 2000, Myanmar had more than 95 percent of the population used solid or biomass fuels for cooking or heating. Respiratory tuberculosis and other diseases of the respiratory system were ranked in the top ten leading causes of mortality (WHO, 2004b).

A study in Europe determined that acute lower respiratory tract infections attributable to indoor air pollution from solid fuel use alone, account for 4.6% of all deaths and 3.1% of all DALYs in children aged 0-4. Adding the effects of indoor and outdoor air pollution and other indoor conditions, at least 42% (95% Confidence Interval: 32-47%) of all lower respiratory infections were estimated to be attributable to the environment in developing countries. In developed countries, this rate was about halved to 20% (15-25%). It was more difficult to quantify the influence of other environmental factors (e.g. chilling, crowding), and the co-morbidities with other diseases that are partly attributable to the environment (e.g. malaria and diarrhea), but they may add to the environmental health burden of lower respiratory infection (WHO, 2004c).

Air pollution affects our health in different ways, causing both simple and serious problems. Air quality, both indoor and outdoor, is the main environmental factor of concern for acute lower respiratory infections. Contributing risk factors include tobacco smoke, solid fuel use, housing conditions and possibly hygiene. Previous estimates showed that 36% of lower respiratory infections worldwide were

attributable to solid fuel use alone, and 1% of all respiratory infections to outdoor air pollution. In developing countries, about 24% of upper respiratory infections were attributable to environmental risk factors, such as outdoor and indoor air pollution, environmental tobacco smoke and housing conditions. As with lower respiratory infections, the rate for upper respiratory infections was estimated to be lower in developed countries, at 12% (5-18%). Globally, more than 1.5 million deaths annually from respiratory infections are attributable to the environment (Pollution, 2011).

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Design

This cross-sectional study design was conducted to describe the prevalence of each respiratory symptom among children, female and male population in the study site. The study also assessed the association between the household air pollution factors and respiratory symptoms among those people who live in rural and urban area in Vientiane capital, Lao PDR.

3.2 Study Area

The study was conducted in Thongsangnang Village of Chanthabouly District as one village in urban area and Natharm Village of Pakngeum District as one village in rural area, of Vientiane Capital, Lao PDR.

3.3 Study Population

The study populations in this study were the households which had been residing in the study area for at least 6 months, both private and collective households, and two representatives of each household, one male and one female, were asked for information needed.

3.3.1 Inclusion Criteria:

- Age of subject in this study must be in rank of 0 - 59 years.
- To answer the questionnaire interview, the household representative must truly be a member of that household, for instance: head of the household, father, mother, adult son/daughter, etc. and must truly be older than 15 years of age and lower than 60 years of age.
- Household representative must truly be able to communicate orally face to face.

- The household and household representative must have been residing in the target village for at least 6 months.

3.3.2 Exclusion Criteria:

- The household representative who do not agree to participate.
- The household that resides exceeding target area.

3.4 Sample Size Calculation

The sample size in this research was calculated by Cochran's formula (Tharaphy, 2009)

$$n = \frac{z^2pq}{d^2}$$

- n = Number of sample
- Z = 95 percent CI = 1.96
- d = significance level (power of the test) = 0.05
- p = probability of case occurrence assumed (prevalence) = 0.5
- q = 1 – p

$n = \frac{(1.96)^2 x 0.5 x 0.5}{(0.05)^2} = 384$ Add 10% for missing data and refusals to participate

n = 384 + 10% = 422 households

According to the purpose of the research as to compare the situation of respiratory symptoms associated with household air pollution between rural and urban area, these 422 households had to be divided in to two proportions appropriately as for rural and urban. Since the proportion of urban was much larger and more crowded people and household than the proportion of rural area, the proportion of 2 to 1 for urban to rural respectively was considered to be suitable (2:1, urban households : rural households).

- Number of households in Rural area: n_R = 422/3 x 1 = 141 households
- Number of households in Urban area: n_U = 422/3 x 2 = 281 households

n = 422

3.5 Sampling Technique

The study used multi-stage sampling including Purposive Sampling, Cluster Sampling and Simple Random Sampling; purposively selected Vientiane capital as the most crowded province in Laos with diversity of people and ethnics from any place in the country, then started from two zones of Vientiane capital as the first 2 big cluster which are called city zone (or urban zone) and out-city zone (or suburb/rural zone), there were 5 districts in the first zone and 4 districts in the second zone, then one district for each zone was randomly selected and finally only one village for each selected district was randomly chosen. (Figure 3 and 4)

This cross-sectional study was conducted in Vientiane capital, Lao PDR; which consists of 9 districts (4 rural districts and 5 urbanized districts). For rural area, Pakngeum District was randomly selected from four districts of rural area in Vientiane capital (Pakngeum, Naxaythong, Sangthong and Hadxayfong); then Natharm Village was randomly selected from 53 villages in Pakngeum District. For urban area, Chanthabouly District was randomly selected from five districts of urban area in Vientiane capital (Sayasettha, Chanthabouly, Sisattanak, Sikhottabong and Xaythany); then Thongsangnang Village was randomly selected from 30 villages in Pakngeum District.

141 households in the rural village and 281 households in urban village were surveyed. Three people per one household were subjected as an adult male, an adult female, and a child. For each household, one adult might be absent if he/she was not at home, or a child's information might not be collected if there were not any children less than 15 years in the household. Data collecting had to be based on the willingness of the subjects. If there were more than two people for a gender willing to participate, the data collector had to random for only one for a gender and do the same thing if there were more than one child in the household.

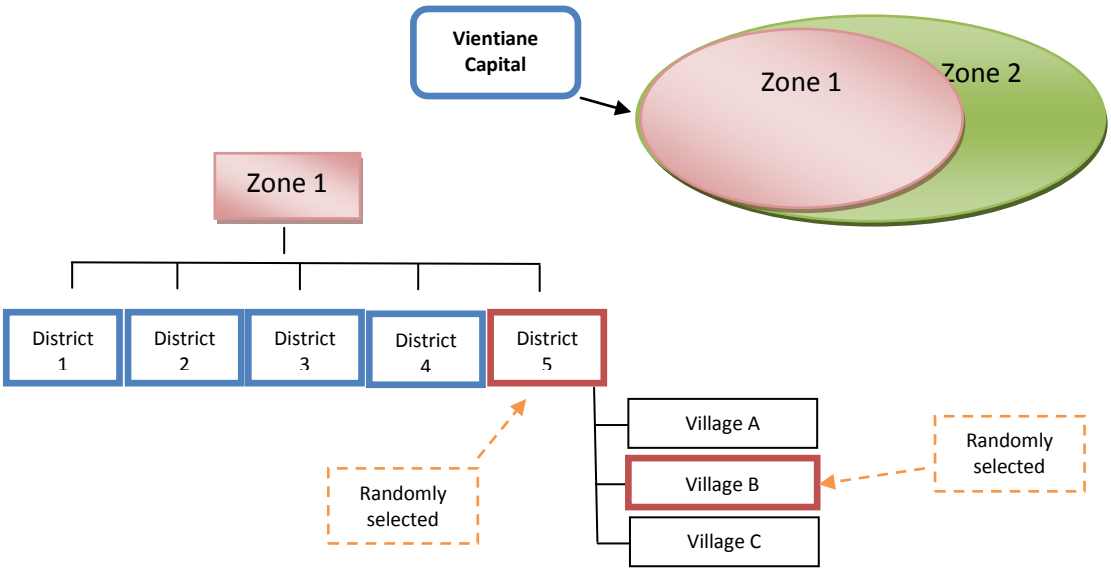


Figure 3: Process of how the study villages are selected (This figure shows the way of site selection in both zone 1 and zone 2 is the same).

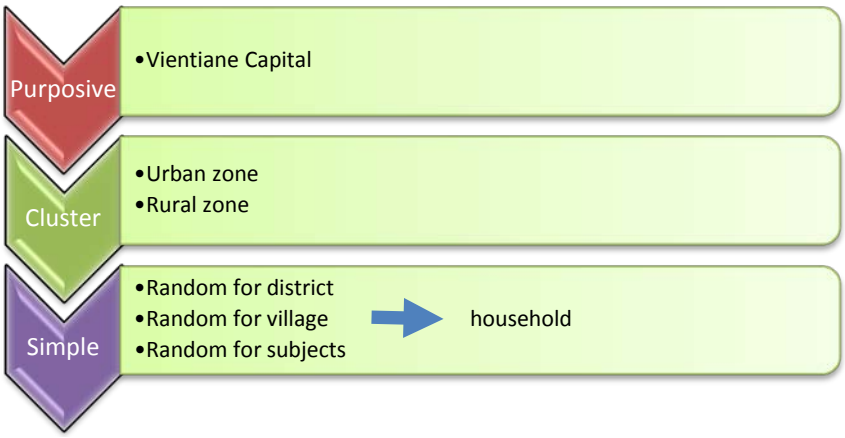


Figure 4: Sampling Flow Chart

3.6 Measurement Tools

Questionnaire with 4 parts of data categorization as followed was used:

Part 1: Socio-demographic and Characteristics of Household: cooking place, windows, fire place, chimney, location, income, number of people living in the house, etc. This part was for household representative only.

Part 2: Knowledge: have ever heard about household air pollution, knowing sources of household air pollution, etc. This part was for household representative only.

Part 3: Practice: means practice of people in household; for instance smoking in family, waste burning, chemical use, etc. This part was for household representative only.

Part 4: Personal information and respiratory health information: This part consisted of 2 sub-parts, A and B; Sub-part A: for adult with 2 copies, one for household representative and another for opposite sex respondent who was one member of that household. This sub-part included age, sex, smoker/non-smoker, respiratory symptoms, etc. For sub-part B, it included some necessary information about respiratory health of children less than 15 years of age; only one child/household was randomly selected to be asked about and this sub-part B was for house hold representative only. Respiratory symptoms included generally common symptoms, past 2 week and past one month - history of cough, phlegm, wheeze, eye irritation, or could also ask for other respiratory illness occurred in family/household.

3.7 Validity and Reliability

For validation of the tool, the questionnaire was reviewed by three experts of Environmental and Occupational health, Dr. Robert S. Chapman, Asst. Prof. Dr. Wattasit Siriwong (adviser) and Dr. Daisy Moknoy, to ensure validity and completeness of the questionnaire. Pretesting of 40 questionnaires, in Lao language, for reliability was conducted in Nongsangthor Village, Saysettha District, Vientiane, far out of study site. The Cronbach's alpha coefficient was 0.74 which meant the questionnaire was acceptable and suitable to use.

3.8 Data Collection

After having had considered and approved from ethical consideration committee, researcher contacted the local authority and requested for permission. Structured questionnaires were based on extensive literature review (Tharaphy, 2009) (Mengersen et al., 2006). Some standard questions were adopted from existing question guide, such as American Thoracic Society 1978 Adult Questionnaire (ATS,

1978) and Recommended Respiratory Disease Questionnaires for Use with Adults and Children in Epidemiological Research (ATS, 1969), and some questions were structured by the purpose of the study according to conceptual frame work.

Before each interview, interviewers were permitted by the representative of the household. All the interviewers were Lao and were health personnel (medical doctor, or nurse) who were familiar in working with community, so that they would be able to give some advice to participant on self-care in respiratory health after each interview. Every single interviewer was well trained and understood well before going on field to ensure in obtaining correct and sufficient information. Each interviewer had to make sure to take not too long time on interview, as avoiding interruption the privacy of interviewees. Moreover, the samples or target group did not know the study objective prior to the coming of researcher or interviewers. In case there were more than one child, more than one woman, or more than one man in a house, one would be randomly selected for each to take the history of respiratory symptoms. Underlying diseases were also noted.

3.9 Data Analysis

The software named Statistical Package of Social Science of version 17 (SPSS v. 17) was used for data analysis. The analysis illustrated important numbers of the Descriptive Statistics, such as the socio-demographic characteristics and general information in frequencies and percentage for categorical data, and mean, median, minimum, maximum and standard deviation for continuous data.

Additionally, an appropriate Inferential Statistics method such as Chi-square and binary logistic regression were used to find out the association between every single independent variable and respiratory symptom as for crude OR and P-value. For any independent variable which have P-value less than 0.15 in previous bivariate test, the Multiple Variable Logistic Regression was then performed to investigate the relationship or association between those independent variables and dependent variables (respiratory symptoms) in order to find out the adjusted OR appropriately.

3.10 Ethical Consideration

Firstly, the research proposal was submitted to Ethical Consideration Committee of Chulalongkorn University to be approved and permitted for conducting the study. Secondly, Health sector in Vientiane Capital was contacted and involved for further process of sample random; for instance, standard list of districts located in Vientiane capital, rural and urban area, and list of current amount of villages in each district selected. Thirdly, the local authority of target area was informed and understood the purpose of the study; list of household were defined clearly, in order to be clear on field process. Fourthly, before interviewing, the subjects were well explained on the purpose of the study and the subject had to sign in the front sheet named consent form, in order to show their agreement of participation with well understanding. In case they were not willing to participate in this study, they could deny at any time without any impact on them whatsoever. All of given information from subjects had to be kept confidentially and data from the subjects as overall would be used for academic purpose only.

CHAPTER IV

RESULTS

The result of this study has been presented into two main parts accordingly to the research objectives. The first main part is the descriptive findings and the second is the analytical findings. Tables in the first main part demonstrate the descriptive information as a whole study sites and also compare those situations between rural and urban. Tables in the second main part demonstrate how independents variables or considerable factors associate with respiratory symptoms.

4.1 Descriptive Findings

4.1.1 Socio-Demography and Characteristics of Households

Table 3 shows some socio-demographic information of the studied households, including nationality, ethnicity, number of household member, duration of residence and monthly income. Of all 422 household studied, 99.8% were Lao households and only 1 household in urban village which was non-Lao citizen and was Chinese-Lao family; the members of this household, however, could communicate in Lao language and had been residing for years in the village. Most of Lao households were Lao Loom ethnic which covered 98.1%, the other two ethics like Lao Soong and Lao Theung covered only 1% for each.

The average number of household member was 6 people per household, which averagely consisted of 3 people for male, 3 people for female and one child averagely included for each household. These averages were not so different between household in rural and household in urban. As well as the average duration-year of residence of household that was about 22 years. The duration-year of residence in this study was used to classify whether the household was newer household or older household. The average income per household was 3,421,500 kip per month; however, there was a large difference between monthly household income in rural and monthly household income in urban which accounted for almost 1:4 (rural: urban). This average showed that the monthly income of people in rural area was almost 4 times less than the monthly income of people in urban area (See Table 3).

Table 3: Socio-Demographic of Households

Variables	Rural (%) n = 141	Urban (%) n = 281	Total (%) n = 422	Mean	SD	Range
Nationality: Lao	141	280	421			
Foreigner	(100)	(99.6)	(99.8)			
	0 (0.0)	1 (0.4)	1 (0.2)			
Ethnic: Lao Loom	136	277	413			
Lao Soong	(96.5)	(98.6)	(98.1)			
Lao Theung	2 (0.2)	2 (0.8)	4 (1.0)			
	3(0.3)	1 (0.6)	4 (1.0)			
House members				6	± 2	1 – 13
Male				3	± 1	0 – 7
Female				3	± 2	0 – 9
Child				1	±1	0 – 6
Years of family living				21.9	±11	0.5 – 100
House income (Kip): (1USD = 7,500kip)				3,421,500	± 4,322,000	100,000 – 40,000,000.
Rural				1,758,000	± 3,573,000	100,000 – 40,000,000.
Urban				4,256,500	± 4,428,500	300,000 – 40,000,000.

Most of households (61 - 73%) were located in small streets, both in rural and urban, and nearly half of all households were nearby or not so far from factory place. The structure of house in rural, 62.4% were wood-concrete mixed as covering most type, different to urban which had 49.5% as concrete house as the most popular type. House floors quite covered nearly same percentage between one floor and more than one floor. Most households had been concerning on dusty environment, especially in urban which had 67.6 % of households being in a very dusty environment. 78% of all households had a kitchen inside the house and 14.9% of all kitchens did not have any ventilator or windows. 69.7% of all households had electronic air ventilator in the house, and 74.2% had observed of smoke from fire setting and cooking flowed into the house (See Table 4).

Table 4: Household Characteristics

Variables		Rural (%) n = 141	Urban (%) n = 281	Total (%) n = 422	Mean	SD	Range
House location:	By road	37 (26.2)	110 (39.1)	147 (34.8)			
	In small street	104 (73.8)	171 (60.9)	275 (65.2)			
Near Factory		76 (53.9)	146 (52.0)	222 (52.6)			
House Type:	Wood	19 (13.5)	14 (5.0)	33 (7.8)			
	Concrete	34 (24.1)	139 (49.5)	173 (41.0)			
	Wood-Concrete	88 (62.4)	84 (29.9)	172 (40.8)			
	Apartment/Dorm	0 (0.0)	44 (15.6)	44 (10.4)			
House floor:	One floor	57 (40.4)	161 (57.3)	218 (51.7)			
	> 1 floor	84 (59.6)	120 (42.7)	204 (48.3)			
Dust in house:	Very dusty	39 (27.7)	190 (67.6)	229 (54.3)			
	A little dusty	102 (72.3)	91 (32.4)	193 (45.7)			
Kitchen location:	Inside the house	105 (74.5)	226 (80.4)	331 (78.4)			
	Outside the house	36 (25.5)	55 (19.6)	91 (21.6)			
Kitchen type:	With window	96 (68.1)	263 (93.6)	359 (85.1)			
	Without window	45 (31.9)	18 (6.4)	63 (14.9)			
Number of windows/house:					11.1	±7.2	1 – 40
	Rural				9.2	±5.3	2 – 28
	Urban				12.0	±7.8	1 – 40
Exhaust fan:		69 (48.9)	225 (80.1)	294 (69.7)			
Rooms:					3.9	±2.0	0 – 12
	Rural				2.7	±1.4	0 – 12
	Urban				4.4	±2.0	1 – 10
Observed cooking smoke in house		84 (59.6)	229 (81.5)	313 (74.2)			

4.1.2 Household Practice

Practice of household means any activity of people who live in the household. The study found that most of all households used charcoal as fuel for cooking (62.6%); especially in rural, 92.9% used charcoal for cooking but using electricity and gas was much lesser, and much lesser than the use in urban. 31.0% of all households still burned their waste; especially in rural, 77.3% of rural households burned their waste around their houses. Moreover, in urban, there were 6 out of 22 households that burned some waste inside the house. The prevalence of mosquito coil burning for total household was 41.2%, incense stick burning for religious purpose 59.9% and 43.4% of all households had at least one smoker in the household (See Table 5).

Table 5: Household Practice

Variables	Rural (%) n = 141	Urban (%) n = 281	Total (%) n = 422	Mean	SD	Range
Main Fuel for Cooking:						
Charcoal	131 (92.9)	133 (47.3)	264 (62.6)			
Wood	8 (5.7)	13 (4.6)	21 (5.0)			
Electric	1 (0.7)	45 (16.0)	46 (10.5)			
Gas	1 (0.7)	90 (32.1)	91 (21.6)			
Waste Burning (Yes)	109 (77.3)	22 (7.8)	131 (31.0)			
Once a week	48 (44.0)	6 (27.2)	54 (41.2)			
2 – 3 times/week	37 (33.9)	0	37 (28.2)			
> 3 times/week	6 (5.6)	0	6 (4.6)			
Every day	16 (14.7)	0	16 (12.2)			
Other	2 (1.8)	16 (72.7)	18 (13.7)			
Mosquito coil use	68 (48.2)	106 (37.7)	174 (41.2)			
Burn frequency:						
Once / long time	21 (30.8)	28 (26.4)	49 (28.2)			
1 – 2 times/month	8 (11.7)	27 (25.5)	35 (20.1)			
1 – 2 times/week	13 (19.2)	24 (22.6)	37 (21.3)			
3 - 4 times/week	6 (8.8)	5 (4.7)	11 (6.3)			
Every day (or > once/day)	20 (29.5)	22 (20.8)	42 (24.1)			
Incense burn frequency:						
Once / long time	12 (16.7)	19 (10.5)	31 (12.3)			
1 – 2 times/month	27 (37.5)	54 (29.8)	81 (32.0)			
1 – 2 times/week	26 (36.1)	99 (54.7)	125 (49.4)			
3 - 4 times/week	0	2 (1.1)	2 (0.8)			
Every day (or > once/day)	7 (9.7)	7 (3.9)	14 (5.5)			
Cigarette smoker in house	96 (68.1)	87 (30.9)	183 (43.4)			
Number of smoker				1.3	±0.6	1 – 6
House heating (Yes)	104 (73.7)	7 (2.5)	111 (26.3)			

4.1.3 Knowledge on Household Air Pollution

Table 6 describes about knowledge of household representatives regarding information on household air pollution, sources of information, and their thought about household air pollution sources. Of all representatives, 63.7% had ever heard about household air pollution while another 36.3% had never. For those who had ever heard about, 67.3% heard from only one source of information and another 32.7% heard from more than one source. The main source of information was television, while health personnel were much lesser. 87.2% believed that household air pollution could affect health, 79.4% thought that there was air pollution in their house, and most of participants (54.3%) thought that road dust was the main source of air pollution in their household (See Table 6)

Table 6: Knowledge of Household Representative on Household Air Pollution

Variables	Rural (%) n = 141	Urban (%) n = 281	Total (%) n = 422
About Household air pollution:			
Have heard	53 (37.6)	216 (76.8)	269 (63.7)
Never heard	88 (62.4)	65 (23.2)	153 (36.3)
Number of Information source:	[n = 53]	[n = 216]	[n = 269]
One source	41 (77.4)	140 (64.8)	181 (67.3)
> 1 source	12 (22.6)	76 (35.2)	88 (32.7)
Main source: Television	44 (83.0)	152 (70.4)	196 (72.9)
Radio	0	25 (11.6)	25 (9.3)
Newspaper/Magazine	0	13 (6.0)	13 (4.8)
Health personnel	5 (9.5)	10 (4.6)	15 (5.6)
NGO	0	1 (0.5)	1 (0.4)
Relative/friend/Neighbor	3 (5.6)	14 (6.4)	17 (6.3)
Other	1 (1.9)	1 (0.5)	2 (0.7)
Think that household air pollution affects health	95 (67.4)	273 (97.1)	368 (87.2)
Source of household air pollution:			
1. Smoke from cooking, mosquito coil, incense, waste burn, spray, and pain.	49 (34.8)	94 (33.5)	143 (33.9)
2. Dust from road, factory, and forest/farm burning.	43 (30.5)	127 (45.2)	170 (40.3)
3. Both 1 and 2	34 (24.1)	56 (19.9)	90 (21.3)
4. No idea	15 (10.6)	4 (1.4)	19 (4.5)
Think that air pollution in your house Yes	76 (53.9)	259 (92.2)	335 (79.4)
No	34 (24.1)	16 (5.7)	50 (11.8)
Not sure	31 (22.0)	6 (2.1)	37 (8.8)
Think of Main source of household air pollution in your house: Smoke from cooking	[n = 76] 17 (22.4)	[n = 259] 20 (7.7)	[n = 335] 37 (11.0)
Smoke from mosquito coil	0	10 (3.9)	10 (3.0)
Smoke from incense burn	1 (1.3)	7 (2.7)	8 (2.4)
Smoke from waste burn	15 (19.7)	10 (3.9)	25 (7.5)
Smoke from cigarettes	17 (22.4)	20 (7.7)	37 (11.0)
Dust from road	16 (21.1)	166 (64.0)	182 (54.3)
Dust from factory	6 (7.9)	10 (3.9)	16 (4.8)
Smoke from forest/farm burn	1 (1.3)	0	1 (0.3)
Spray	1 (1.3)	8 (3.1)	9 (2.7)
Others	2 (2.6)	8 (3.1)	10 (3.0)

4.1.4 General and Health Information of Subjects

There were 770 respondents as adult subjects. The average age of respondents was almost 37 years old. Most of them were moved-in residents (53.4%) especially in

urban, but contradicted with rural village. Educational level of people in urban was higher than in rural. Main job of rural residents was farmer, while main job of urban residents was office staff. 15% of all respondents were current smokers. (See Table 7)

Table 7: Socio-Demographic and Practice of Participants (Adult age 15+)

Variables		Rural (%) n = 217	Urban (%) n = 553	Total (%) n = 770	Mean	SD	Range
Age:					36.9	11.5	16 – 59
Hometown:							
	Original villager	164 (75.6)	195(35.2)	359 (46.9)			
	Moved in	53 (24.4)	358 (64.8)	411 (53.4)			
Sex:	Male	93 (42.9)	268 (48.4)	361 (46.9)			
	Female	124 (57.1)	285 (51.6)	409 (53.1)			
Marital status:	Single	6 (2.8)	149 (26.9)	155 (20.1)			
	Married	207 (95.4)	391 (70.7)	598 (77.7)			
	Divorced	2 (0.9)	10 (1.8)	12 (1.6)			
	Widow/widower	2 (0.9)	3 (0.5)	5 (0.6)			
Education:	Post graduate	0	29 (5.2)	29 (3.8)			
	Tertiary/Bachelor	2 (0.9)	212 (38.3)	214 (27.8)			
	Midlevel/Vocational	3 (1.4)	58 (10.5)	61 (7.9)			
	Upper secondary	28 (12.9)	136 (24.6)	164 (21.3)			
	Lower secondary	52 (23.9)	72 (13.0)	124 (16.1)			
	Primary	123 (56.7)	44 (8.0)	167 (21.7)			
	Illiterate	9 (4.2)	2 (0.4)	11 (1.4)			
Main Job:	Office staff	3 (1.4)	243 (43.9)	246 (31.9)			
	Farmer	172 (79.3)	2 (0.4)	174 (22.6)			
	Factory worker	5 (2.3)	22 (4.0)	27 (3.5)			
	Construction labor	5 (2.3)	14 (2.5)	19 (2.5)			
	Unemployed	4 (1.8)	37 (6.7)	41 (5.3)			
	Merchant	10 (4.6)	128 (23.1)	138 (17.9)			
	Student	0	39 (7.1)	39 (5.1)			
	Business Owner	1 (0.5)	14 (2.5)	15 (1.9)			
	House wife	10 (4.6)	35 (6.3)	45 (5.8)			
	Tailor	0	9 (1.6)	9 (1.2)			
	Other	7 (3.2)	10 (1.8)	17 (2.2)			
Current Smoker:		52 (23.5)	70 (12.7)	122 (15.7)			
Average Cigarettes/day:					9.21	6.41	1 – 20
Years of smoking					16.11	10.49	0 – 40
Past smoker		4 (1.8)	25 (4.5)	29 (3.8)			
Never Smoker		162 (74.7)	458 (82.8)	620 (80.5)			
Stay most in house		140 (64.5)	294 (53.2)	434 (56.4)			
Cook for family		136 (62.7)	289 (52.3)	425 (55.2)			
Minutes spent in kitchen					90.31	78.94	5 – 480
Minutes spent by fire					46.49	69.65	0 – 480

The percentage of current smoker was quite higher in rural. 56.4% of all respondents spent time mostly inside the house and 55.2% cooked for family (See Table 7).

In all respondents, 80.8% reported of having cough when they had a cold, 15.1% also cough even without cold, 15.8% had shortness of breath when having a cold, 3.9% had shortness of breath without cold, 71.4% had phlegm with cold, 10.9% had phlegm without cold, 8.1% had wheezing when having a cold, and 1.0% had wheezing without cold (See Table 8).

Table 8: Respiratory Symptoms in Adult in both Male and Female (age 15 - 59)

Variables		Rural (%) n = 217	Urban (%) n = 553	Total (%) n = 770
Cough:	With cold	186 (85.7)	436 (78.8)	622 (80.8)
	Without cold	46 (21.2)	70 (12.6)	116 (15.1)
Phlegm:	With cold	167 (76.9)	383 (69.3)	550 (71.4)
	Without cold	25 (11.5)	59 (10.7)	84 (10.9)
Wheezing:	With cold	35 (16.1)	27 (4.9)	62 (8.1)
	Without cold	3 (1.4)	5 (0.9)	8 (1.0)
Shortness of Breath:	With cold	82 (37.8)	40 (7.2)	122 (15.8)
	Without cold	14 (6.5)	16 (2.9)	30 (3.9)
Nasal symptom without cold at home		86 (39.6)	404 (73.1)	490 (63.6)
Eye irritation at home		82 (37.8)	265 (47.9)	347 (45.1)
Sore throat without cold		109 (50.2)	385 (69.6)	494 (64.2)
Sore throat past month		83 (38.2)	148 (26.8)	231 (30.0)
Time/past 12 months, had cold with cough:				
	Never	32 (14.7)	119 (21.5)	151 (19.6)
	One time	67 (30.9)	230 (41.6)	297 (38.6)
	Two times	59 (27.2)	163 (29.5)	222 (28.8)
	Three times or more	59 (27.2)	41 (7.4)	100 (13.0)
Have asthma		15 (6.9)	12 (2.2)	27 (3.5)
Had bronchitis last year		12 (5.5)	9 (1.6)	21 (2.7)
Pneumonia last year		12 (5.5)	14 (2.5)	26 (3.4)
Have underlying disease:		56 (25.8)	112 (20.3)	168 (21.8)

The study also found the prevalence of asthma in adult which covered 6.9% in rural, 2.2% in urban and 3.5% in total. Moreover, 21.8% of all interviewed

participants had at least one underlying disease (e.g. asthma, hyper blood pressure, diabetes mellitus, allergy, gout, etc.).

Information about health of children less than 15 years was collected through questioning the household representatives or their parents. Age of children in this study ranged from 1 month to 14 years and mean age was 7.2 years. There were 243 children as total child in the study, 43.2% were male and 56.8% were female. 32.9% were reported as usually spent time in cooking place or in the kitchen, with average time-length of 53 minutes, and about 50 minutes for time spent by stove with fire (See Table 9).

Table 9: Age, Sex and Practice of Children (age < 15 years)

Variables		Rural (%) n = 111	Urban (%) n = 132	Total (%) n = 243	Mean	SD	Range
Age					7.2	4.5	.08 - 14 yrs
Sex:	Male	48 (43.2)	57 (43.2)	105 (43.2)			
	Female	63 (56.8)	75 (56.8)	138 (56.8)			
Spending time by cooking place:		35 (31.5)	45 (34.1)	80 (32.9)			
Minutes/day					52.8	56.7	2 - 240
Spending time by fire:		32 (28.8)	38 (28.8)	70 (28.8)			
Minutes/day					50.8	± 65.6	1 - 420

In all 243 children, 79.8% had cough when they had a cold, 9.9% also cough even without cold, 31.3% had shortness of breath when having a cold, 4.1% had shortness of breath without cold, 66.3% had phlegm with cold, 2.9% had phlegm without cold, 20.2% had wheezing when having a cold, and 3.7% had wheezing without cold. All symptoms most last less than one month (See Table 10). The study also found the prevalence of asthma in children which covered 7.2% in rural, 2.3% in urban and 4.5% in total. Moreover, 8.2% of all children in the study had underlying disease (e.g. asthma, allergy, thalassemia, etc.).

Table 10: Respiratory Health Information in Children age < 15 years

Variables		Rural (%) n = 111	Urban (%) n = 132	Total (%) n = 243
Cough:	With cold	94 (84.7)	100 (75.7)	194 (79.8)
	Without cold	13 (11.7)	11 (8.3)	24 (9.9)
Phlegm:	With cold	85 (76.6)	76 (57.6)	161 (66.3)
	Without cold	3 (2.7)	4 (3.0)	7 (2.9)
Wheezing:	With cold	35 (31.5)	14 (10.6)	49 (20.2)
	Without cold	8 (7.2)	1 (0.8)	9 (3.7)
Shortness of Breath:	With cold	57 (51.4)	19 (14.4)	76 (31.3)
	Without cold	7 (6.3)	3 (2.3)	10 (4.1)
Nasal Symptom without cold		36 (32.4)	93 (70.5)	129 (53.1)
Eye Irritation at home		19 (17.1)	48 (36.4)	67 (27.6)
Sore throat without cold		46 (41.4)	76 (57.6)	122 (50.2)
Sore throat in past month		43 (38.7)	37 (28.0)	80 (32.9)
Times/past 12 months, had cold with cough:				
	Never	12 (10.8)	31 (23.5)	43 (17.7)
	One time	23 (20.7)	43 (32.6)	66 (27.2)
	Two times	29 (26.1)	37 (28.0)	66 (27.2)
	Three times or more	47 (42.4)	21 (15.9)	68 (28.0)
Have asthma		8 (7.2)	3 (2.3)	11 (4.5)
had bronchitis last year		3 (2.7)	5 (3.8)	8 (3.3)
had pneumonia last year		13 (11.7)	3 (2.3)	16 (6.6)
Have underlying disease:		10 (9.0)	10 (7.6)	20 (8.2)

Superficially looking, health information of children in rural area and urban area was not too much different, also in adult subjects. However, some percentages have shown that respiratory symptoms usually occur in rural subjects more than in urban subjects accordingly to table 6, 8 and 10. This might be caused by, or related to some conditions of household, either environment or practice, or both. Therefore, further analysis for associated factors with respiratory symptoms was needed.

4.2 Analytical Findings

For analytical result, this part is divided into two sub-parts, Bivariate Analysis and Multivariable Analysis, to show the association of households factors focusing on these following respiratory symptoms: Cough with/without cold, Shortness of Breath

with/without cold, Phlegm with/without cold, Wheezing with/without cold, Nasal Symptom without cold and Eye Irritation at home.

4.2.1 Bivariate Analysis

The bivariate analysis result show the association between each independent variable (Socio-demographic, household characteristic, practice, and knowledge) and each dependent variable (respiratory symptoms) in adult and children with P-value, Crude Odd Ratio, and 95% Confidence Interval. Those independent variables which have P-value of greater than 0.15 were not included in these tables. All independent variables with $p \leq 0.15$ will be included in the step of multiple variable logistic regressions (see table 22 – 31 in appendix E).

Some continuous data were dichotomized into higher level and lower level by using median as the cut point, such as household income, age, household member, and number of smoker in house, number of cigarettes smoke/day, years of smoking, minutes spent in kitchen/day and minutes spent by fire/day. Some categorical data were re-categorized from many levels into fewer levels, such as education levels (from 7 levels into 3 levels as primary education, secondary education and tertiary education), jobs (from 11 jobs into 5 types of job as office staff, farmer, labor, unemployed people, and private business), house type (from 4 types into 3 types as wood, concrete, and wood-concrete), and main fuel use (from 4 types into 2 main types as biomass fuels and non-biomass fuels).

4.2.1.1 Bivariate Analysis for Adult

All 40 independent variables, classified for 5 groups of independent variables, such as socio-demographic of household, household characteristics, household practices, knowledge on household air pollution, and personal practices and health, were found that most of all factors in each groups were statistically and marginally significant in association with each respiratory symptom in adult (See Table 22 - 26 in appendix E).

4.2.1.2 Bivariate Analysis for Children

There were 33 independent variables (cut off some variables which appeared only in adult, e.g. marital status, education, job, home town, smoking, number of cigarettes smoked/day, and years of smoking), classified for 5 groups of independent variables, such as socio-demographic of household, household characteristics, household practices, knowledge on household air pollution, and personal practices and health. Also many factors in each groups were found statistically and marginally significant in association with each respiratory symptom in children (See Table 27 – 31 in appendix E).

4.2.2 Multivariable Logistic Regression

All tables below present the association between each independent variable (Socio-demographic, household characteristic, and practice) and each dependent variable (respiratory symptoms) with statistical significance, Adjusted Odd Ratio and confidence interval, after adjustment by using multiple variable logistic regressions. These following tables were constructed from the final multivariate logistic regression (2^{nd} Step) which included only those independent variables that have P-value ≤ 0.15 from semi-final (1^{st} step) of multiple variable regressions, which is not shown in here. Only those findings with P-value considerably closed to or/and ≤ 0.05 are shown.

4.2.2.1 Multivariable Logistic Regressions for Respiratory Symptoms in Adult

In table 11, for cough with cold, positive association was found in biomass fuel use (OR = 1.4, 95% CI: 0.9 – 2.1, p = 0.069), mosquito coil use (OR = 1.6, 95% CI: 1.1 - 2.4, p = 0.024) and heavy smoking (OR = 3.4, 95% CI: 1.2 - 9.9, p = 0.022). For cough without cold, positive association was found in house located by road (OR = 1.7, 95% CI: 1.1 - 2.8, p = 0.019), waste burning (OR = 3.04, 95% CI: 1.7 - 5.3, p < 0.001), and people with chronic disease (OR = 1.9, 95% CI: 1.2 - 3.1, p = 0.024).

Table 11: Final Multivariable Logistic Regression Model for Cough in Adult

Independent Variables	With Cold			Without Cold		
	Adjusted OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Household characteristics						
By road vs. In street				1.7	1.1-2.8	0.019
Household practice						
Waste burning				3.04	1.7-5.3	<0.001
Biomass fuel use	1.4	0.9-2.1	0.069			
Mosquito coil use	1.6	1.1-2.4	0.024			
Personal information						
Time stay in kitchen:						0.081*
0 minute				1		
1 - 60 minutes				0.8	0.4-1.4	0.560
> 60 minutes				1.6	0.8-3.1	0.157
Smoking status:			0.068*			
Non & past smoker	1					
Light smoker	0.9	0.4-1.8	0.874			
Heavy smoker	3.4	1.2-9.9	0.022			
Underlying disease				1.9	1.2-3.1	0.008

OR for Cough with cold: Adjusted with Dusty House, Number of windows in house, Nearby Factory, Fuel Main Use, Mosquito coil use, Spend Time Most In House, Main House Chef, Number Cigarettes/day, Minutes in kitchen and Underlying Disease. OR for Cough without cold: Adjusted with Area, Living Duration, HH location, Rooms in House, Waste Burning, Mosquito coil Burn, House Heating with Fire, Number of Smoker In House, Minutes In Kitchen, Minutes by Fire, Smoking Status, and Underlying Disease. (* P-value for whole factors of that independent variable, not for individual factor)

For phlegm with cold, positive association was found in the house located by road (OR= 2.1, 95% CI: 1.4 - 3.1, p = < 0.001), biomass fuel use (OR = 1.6, 95% CI: 1.2 - 2.3, p = 0.005), house with smoker (OR = 1.6, 95% CI: 1.1 - 2.4, p = 0.015), and current smoker (OR= 2.3, 95% CI: 0.9 - 5.4, p = 0.059). House with more than one floor seemed to be protective for phlegm. For phlegm without cold, house located by road, kitchen in house, biomass fuel use, house heating, longer year of smoking and chronic disease are all positively significantly associated (See table 12).

Table 12: Final Multivariable Logistic Regression Model for Phlegm in Adult

Independent Variables	With Cold			Without Cold		
	Adjusted OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Household characteristics						
By road vs. In street	2.1	1.4-3.1	<0.001	2.2	1.4-3.6	0.001
House floor:			0.005*			
1 floor	1					
2 floors	0.5	0.4-0.8	0.001			
> 2 floors	0.6	0.2-2.7	0.594			
Kitchen in House:				2.3	1.1-5.0	0.023
Household practice						
Biomass fuel vs. non-biomass	1.6	1.2-2.3	0.005	1.7	0.9-2.9	0.065
Smoker in house:	1.6	1.1-2.4	0.015			
House heating with fire				1.7	0.9-3.2	0.069
Personal Practice & Health						
Minutes spent in kitchen:						0.037*
0 min				1		
1 – 60 min				0.6	0.3-1.1	0.124
> 60 min				1.5	0.8-2.8	0.183
Current vs. Non/past smoker	2.3	0.9- 5.4	0.059			
Year of Smoking:						
0 yrs. vs. 1 - 16 yrs. or more				3.8	1.1-13.	0.026
Underlying disease				2.2	1.3- 3.7	0.003

OR for Phlegm with cold: Adjusted with Living Duration, HH location, House Floors, Dusty House, Main fuel use, Smoker In House, Number Cigarettes/day. OR for Phlegm without cold: Adjusted with House location, Kitchen In House, Main fuel use, House heating, Minutes in kitchen, Number of cigarettes/day, Year Smoking, and Underlying Disease. (* P-value for whole factors of that independent variable, not for individual factor)

In table 13, for wheezing with cold, positive association was found in house with less room (OR = 2.3, 95% CI: 1.1 - 5.3, p = 0.042), biomass fuel use (OR = 2.2, 95% CI: 0.9 - 5.3, p = 0.078), House heating (OR = 2.3, 95% CI: 0.9 - 5.9, p = 0.077), spending time most in house (OR = 3.1, 95% CI: 1.3 - 7.2, p = 0.009), longer minutes staying by fire (OR = 2.2, 95% CI: 0.9 - 4.9, p = 0.052), and chronic disease (OR = 2.5, 95% CI: 1.3 – 4.7, p = 0.004). Type of job was also significant to wheezing with cold. However, no household air pollution sources were found to be significant to wheezing without cold, except chronic disease (OR = 5.0, 95% CI: 1.1 - 22.0, p = 0.033).

Table 13: Final Multivariable Logistic Regression Model for Wheeze in Adult

Independent Variables	With Cold			Without Cold		
	Adjusted OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Socio-demographic						
Job:			0.053*			
Office staff	1					
Farmer	1.2	0.3- 4.3	0.749			
Labor	5.5	1.5-19.	0.007			
Unemployed	1.2	0.4-3.5	0.716			
Private business	1.05	0.3-3.1	0.937			
Household characteristics						
Rooms in house: ≤ 4 vs. > 4	2.3	1.1-5.3	0.042			
Household practice						
Biomass fuel vs. Non-biomass	2.2	0.9-5.3	0.078			
House heating with fire	2.3	0.9-5.9	0.077			
Personal Practice & Health						
Spend time most in house	3.1	1.3-7.2	0.009			
Minutes by fire:						
>30min vs. ≤30min	2.2	0.9-4.9	0.052			
Underlying Disease	2.5	1.3-4.7	0.004	5.0	1.1-22.	0.033

OR for Wheeze with cold: Adjusted with Job, Factory nearby House Type, Number of Windows, House Heating with Fire, Spend Time Most In House, Main House Chef, Minutes in kitchen, Minutes By Stove, and Underlying Disease. OR for Wheeze without cold: Adjusted with Age and underlying disease. (* P-value for whole factors of that independent variable, not for individual factor)

For shortness of breath (SOB) with cold, positive association was found in household in rural area (OR = 11.7, 95% CI: 5.4 – 25.1, p < 0.001), household with lower income (OR = 1.8, 95% CI: 1.1 – 2.8, p = 0.024), and spending time most inside house was found to be significantly associated. Type of job was found to be marginally significant as well. For SOB without cold, positive association was found in household in rural area (OR = 4.2, 95% CI: 0.9 - 1.8, p = 0.061), higher age group (OR = 2.5, 95% CI: 1.1 - 6.0, p = 0.039), and chronic disease (OR = 3.8, 95% CI: 1.8 - 8.4, p = 0.001). Time spent in kitchen and years of smoking were also found to be significantly associated with SOB without cold (See table 14).

Table 14: Final Multivariable Logistic Regression Model for Shortness of Breath in Adult

Independent Variables	With Cold			Without Cold		
	Adjusted OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Socio-demographic						
Rural vs. Urban	11.7	5.4- 25.0	<0.001	4.2	0.9-18.	0.061
Income: Lower vs. higher	1.8	1.1 -3.1	0.024			
Age: > 36 vs. ≤ 36				2.5	1.1 -6.0	0.039
Job:			0.095*			
Office staff	1					
Farmer	0.6	0.2-1.6	0.318			
Labor	1.6	0.5-4.9	0.345			
Unemployed	0.9	0.4-2.3	0.986			
Private business	1.7	0.8-3.6	0.161			
Personal Practice & Health						
Time spent in kitchen/day:						0.039*
0 minute				1		
1 – 60 minutes				0.5	0.1 -1.4	0.209
> 60 minutes				2.1	0.8 -5.1	0.113
Years of smoking:						0.004*
0 year				1		
1 – 15 years				5.2	1.9-14.	0.001
> 15 years				0.9	0.2- 4.5	0.952
Spent time most in house	1.8	1.1-2.8	0.017			
Underlying Disease				3.8	1.8- 8.4	0.001

OR for SOB with cold: Adjusted with Area, Job, House Income, Fuel Main Use, and Spend Time Most In House. OR for SOB without cold: Adjusted with Age Group, Minutes In Kitchen, Years of Smoking, and Underlying Disease. (* P-value for whole factors of that independent variable, not for individual factor)

In table 15, it was found that those people who had been living in rural area were statistically less likely to have nasal symptom without cold by OR = 0.1 ($p < 0.001$, 95% CI: 0.05 - 0.2) comparing to those who had been living in urban area. House located by road, house heating and mosquito coil burning were found to be risk factors for people to have nasal symptom without cold. For eye irritation, house located by road, biomass fuel use and underlying disease were found to be statistically and positively associated by OR = 1.5; 1.4; and 1.4 respectively.

Table 15: Final Multivariable Logistic Regression Model for Nasal Symptom without Cold and Eye Irritation at Home in Adult

Independent Variables	Nasal Symptom at Home without Cold			Eye Irritation at Home		
	Adjusted OR	95% CI	P-Value	Adjusted OR	95% CI	P-Value
Socio-demographic						
Area: Rural vs. Urban	0.1	0.05 - 0.2	< 0.001			
House Characteristics						
By road vs. In street	2.7	1.8 - 3.9	< 0.001	1.5	1.1 – 2.02	0.009
Household practices						
Biomass Non-biomass				1.4	1.04 – 1.9	0.027
Mosquito coil burning	1.9	1.4 - 2.8	< 0.001			
House heating	2.7	1.4 – 5.3	0.002			
Health						
Underlying disease(s)				1.4	0.9 – 1.9	0.055

Nasal Symptom: OR Adjusted with Area, Education, House location, House Income, Kitchen In House, Mosquito coil Burn, House Heating with Fire, and Number Cigarettes/day. Eye Irritation: OR Adjusted with House location, Main Fuel for Cooking, Minutes In Kitchen, and Underlying Disease. (*P-value for whole factors of that independent variable, not for individual factor)

4.2.2.2 Multivariable Logistic Regression for Respiratory Symptoms in Children

All tables below present the association between each independent variable (Socio-demographic, household characteristic, and practice) and each dependent variable (respiratory symptoms) with statistical significance, Adjusted Odd Ratio and Confidence Interval, after adjustment by using multiple variable logistic regressions. These following table were constructed from the final multiple logistic regression (2^{nd} Step) which included only those independent variables that had P-value ≤ 0.15 from semi-final (1^{st} step) of multiple variable regression, which is not shown in here. Only those findings with P-value considerably closed to or/and ≤ 0.05 are shown.

Table 16 shows that female children were 0.4 time less likely to have cough without cold when compare to male children (95%CI: 0.1 - 0.9, p = 0.029). Waste burning was also found to be a risk of having cough with cold (OR = 4.7, 95%CI: 1.5 - 15.6, p = 0.010) and cough without cold in children (OR = 2.4, 95% CI: 0.9 - 5.7, p

= 0.053). House types, number of rooms in the house, and playing in kitchen were also found to have association with cough with cold in children.

Table 16: Final Multivariable Logistic Regression Model for Cough in Children

Independent Variables	With Cold			Without Cold		
	Adjusted OR	95% CI	P-Value	Adjusted OR	95% CI	P-Value
Socio-demographic						
Sex: Female vs. Male				0.4	0.1 – 0.9	0.029
House Characteristics						
Type of House:			0.016*			
Wood	1					
Concrete	1.3	0.3 - 2.4	0.690			
Wood-Concrete	6.05	1.4 - 25.7	0.015			
Rooms: ≤ 3 vs. > 3	2.6	0.8 – 7.6	0.084			
Household Practices						
Waste Burning	4.7	1.5 - 15.6	0.010	2.4	0.9 - 5.7	0.053
Incense stick burn				2.3	0.8 – 6.1	0.100
Child Practice						
Play in kitchen	4.8	1.4 – 16.5	0.012			

With cold: Adjusted with: House Type, Kitchen In House, Waste Burning, Number of smoker in house, and Play in kitchen. Without Cold: Adjusted with Sex, Waste Burning, and Incense Burn. (* P-value for whole factors of that independent variable, not for individual factor)

Table 17 shows that some factors were found to have association with phlegm with cold in children such as house with exhaust fan and lesser number of windows in house were positively associated with phlegm with cold in children (OR = 1.9, 95% CI: 1.07 - 3.6, p = 0.028 and OR = 2.01, 95% CI: 1.1 - 3.6, p = 0.020). Mosquito coil use and underlying disease were also risky for phlegm with cold (OR = 2.1, 95% CI: 1.2 - 3.9, p = 0.012 and OR = 3.3, 95% CI: 0.9 - 12.2, p = 0.068). There were no variables found to be significant to phlegm without cold in children.

Table 17: Final Multivariable Logistic Regression Model for Phlegm in Children

Independent Variables	With Cold		
	Adjusted OR	95% CI	P-Value
House Characteristics			
Windows: ≤10 vs. >10	2.01	1.1 - 3.6	0.020
House with exhaust fan	1.9	1.07 - 3.6	0.028
Household Practices			
Mosquito coil use:	2.1	1.2 - 3.9	0.012
Child Health			
Underlying disease(s):	3.3	0.9 - 12.2	0.068

Phlegm with Cold: Adjusted with Area, House with exhaust fan, Windows in house, Dusty House, and Underlying Disease. Phlegm without Cold: No variables were found as significant or nearly significant.

In table 18, it was found that lower age group, house nearby factory, house located by road and underlying disease were positively associated with wheezing without cold by OR= 7.5: 10.2; 3.4 and 6.1respectively. Underlying disease was found to have positive association with wheezing with cold by OR = 5.03 (95% CI: 1.7 - 14.8, p = 0.003). House nearby factory, less rooms in house and house with exhaust fan were found positively associated with wheezing with cold in children. House type was also found to be significant for wheezing with cold.

Table 18: Final Multivariable Logistic Regression Model for Wheezing in Children

Independent Variables	With Cold			Without Cold		
	Adjusted OR	95% CI	P-Value	Adjusted OR	95% CI	P-Value
Socio-demographic						
Age: ≤ 7yrs vs. >7yrs				7.5	0.8 – 63.5	0.065
House Characteristics						
House nearby factory	2.7	1.2 - 5.8	0.009	10.2	1.1 – 90.2	0.036
Rooms: ≤ 3 vs. > 3	5.7	2.5 – 13.4	< 0.001			
House type:			< 0.001*			
Wood	1					
Concrete	0.2	0.07 – 0.8	0.022			
Wood-concrete	1.3	0.4 – 4.2	0.604			
By road vs. In street				3.4	0.8 - 14.5	0.097
With Exhaust fan	4.1	1.7 – 10.0	0.002			
Child Health						
Underlying Disease	5.03	1.7 - 14.8	0.003	6.1	1.2 - 30.9	0.029

Wheeze with Cold: Adjusted with House Type, Factory nearby, House with exhaust fan, Room in house, and Underlying Disease. Wheeze without Cold: Adjusted with Age group, House location, Factory nearby, and Underlying Disease. (* P-value for whole factors of that independent variable, not for individual factor)

In table 19, positive associations to SOB with cold were found in rural area (OR = 8.2, 95% CI: 4.07 - 16.7, p < 0.001) and lower age group (OR = 2.6, 95% CI: 1.3 - 5.1, p = 0.005). Female children were found to be 0.5 times less likely than male children to have SOB with cold. Living in the house near factory was also risky to have SOB without cold (OR = 9.1, 95% CI: 1.1 - 75.9, p= 0.041). Children with underlying disease were risky to have SOB both with cold and without cold by OR = 8.1 (95% CI: 2.5 - 26.2, p < 0.001) and OR = 9.6 (95% CI: 2.2 - 41.1, p = 0.002), respectively.

Table 19: Final Multivariable Logistic Regression Model for Shortness of Breath in Children

Independent Variables	With Cold			Without Cold		
	Adjusted OR	95% CI	P-Value	Adjusted OR	95% CI	P-Value
Socio-demographic						
Area: Rural vs.Urban	8.2	4.07-16.7	< 0.001			
Sex: Female vs. Male	0.5	0.3 - 0.9	0.034			
Age: ≤ 7 yrs vs. > 7 yrs	2.6	1.3 - 5.1	0.005			
House Characteristics						
Factory nearby				9.1	1.1-75.9	0.041
Household Practices						
Incense stick burning	0.5	0.2-1.08	0.085			
Child Health						
Underlying Disease	8.1	2.5-26.2	< 0.001	9.6	2.2-41.1	0.002

With Cold: Adjusted with Area, Sex, Age group, Incense Burn, and Underlying Disease. Without Cold: Adjusted with Area, Factory nearby, and Underlying Disease.

Table 20 shows that only two factors were found to be significant for nasal symptom without cold in children. They were rural area, which had negative association with nasal symptom by OR = 0.2 (95% CI: 0.07 - 0.3, p < 0.001), and house located by road which had positive association (OR = 2.0, 95% CI: 1.1 – 3.7, p = 0.029). Female children had more chance than male children to have eye irritation at home (OR= 1.8, p = 0.080, 95% CI: 0.9 - 3.4).

Table 20: Final Multivariable Logistic Regression Model for Nasal Symptom without Cold and Eye Irritation at Home in Children

Independent Variables	Nasal Symptom without cold			Eye Irritation at Home		
	Adjusted OR	95% CI	P-Value	Adjusted OR	95% CI	P-Value
Socio-demographic						
Area: Rural vs.Urban	0.2	0.07 - 0.3	< 0.001			
Sex: Female vs.Male				1.8	0.9 - 3.4	0.080
House Characteristic						
By road vs. In street	2.0	1.1 – 3.7	0.029			

Nasal Symptom: Adjusted with Area, House location, and Rooms in house. Eye Irritation: Adjusted with Area, Sex, House Income, House with exhaust fan, Waste Burning, House Heating, Time spent in Kitchen, Play near Stove, and Time spent near fire stove.

CHAPTER V

DISCUSSION, CONCLUSIONS AND RECOMMENDATION

5.1 Discussion

The main objective of this cross-sectional study was to investigate whether household air pollution source from household characteristic, household practice, socio-demographic factor and other personal factors are associated with risk of respiratory symptoms, focusing on six main symptoms with/without cold as followed: cough, shortness of breath, phlegm, wheezing, nasal symptom and eye irritation at home, among people living in rural and urban area of Vientiane Capital, Lao PDR. 422 households were studied as total population calculated by using Cochran's formula. Inside, there were 770 adults (male and female) included as respondents and information about health of 243 children less than 15 years of age was collected via their parents.

Data were collected by using structure questionnaire with pretest done in Nongsangthor Village which is in another district far away from study site. Interviews with questionnaire were done by health personnel in local who were included in data collection team. The reason that researcher selected only health personnel to collect the data is because of the suitability of them in asking local people about health information, people in general are easily open hearted when talking with health personnel and health personnel are able to give advice accurately when they find health problems occurring in people. All data collectors were trained for one day and try simulated questioning/interview two by two among team in order to create familiar feeling to questionnaire interview and made sure for some words to be easily understood by people in general.

Questions in the questionnaire were constructed based on standard questionnaire of American Thoracic Society, from review of previous study and based on the purpose of researcher according to the real situation of study site. Most of questions in questionnaire were set be answered as Yes or No, or categorical choices.

All data were analyzed and shown as descriptive result and analytical result. In Descriptive findings, researcher intended to present all information that was collected in frequency, percentage as a whole together with comparing between rural and urban situation. In analytical process, knowledge and smoke observed were not included in the multiple regressions, as they were considered of non-practical in real situation.

5.1.1 Descriptive Information

In descriptive findings, it was found that percentage of biomass fuel use in this study (67.5%) was less than the percentage in previous records, e.g., in 2001, approximately 81.60% of the population used biomass fuels for cooking or heating (National Statistic Center, 2005a). The percentage of biomass fuel use is however sill high in rural (98.6%). There was also a study in China which found that rural population seemed to expose to household air pollution more higher percentage than urban population (Mestl et al., 2007). Average number of household member and proportion of male and female in the study were closed to the data of the country, e.g. Total population of Lao PDR is 5.62 million, 50.2% were females and 49.8% were males (National Statistic Center, 2005b). The average household size is 5.9 people/household (National Statistic Center, 2005a).

5.1.1. A: Prevalence of Respiratory Symptoms in Adult

The prevalence of each symptom is quite different to the prevalence in previous study in Burmese community in Thailand, for example Adult's cough with/without cold was 83.0%, phlegm with/without 49.3%, wheeze with/without 53.4%, SOB with/without cold 25.5%. (Tharaphy, 2009). Not so much different for cough, but quite different in other symptoms. These different might be due to differences of socio-demographic and other conditions.

5.1.1. B: Prevalence of Respiratory Symptoms in Children

In 243 children, 79.8% had cough when they had a cold, 9.9% also cough even without cold, 31.3% had shortness of breath when having a cold, 4.1% had shortness of breath without cold, 66.3% had phlegm with cold, 2.9% had phlegm without cold, 20.2% had wheezing when having a cold, and 3.7% had wheezing without cold. The

prevalence was lower than in previous study in Burmese community in Thailand (Tharaphy, 2009). When we compared these percentage by each area, it could be found as same as we compared in adult, because those prevalence were still higher in rural children. And also the same contrast when looking into the percentage of nasal symptom without cold and eye irritation at home (See Table 10). This contrast in children was the same as in adult and it was able to suggest an interesting question that why and how those contrasts happened.

5.1.1. C: Socio-Demography, Household Characteristics, Household Practice, Knowledge, Personal Practice and Health Background

There was a big different in household income between those two areas, urban house income was about 4 times higher than rural house income (See Table 3). Two more things that were quite pretty much different between those two areas were education level and main jobs. For instance, participants in urban had higher level of education than participants in rural, main job of people in rural was farmer but in urban was office staff, etc. (See Table 7).

Most of houses are concrete, have two floors and located in street rather than by road. Unfortunately, nearly half of those houses are located nearby or not so far from factory and the study did not specify the type of factory in questionnaire. Most of houses have the kitchen inside and about 74 % of household representatives reported that they could observe smoke from fire setting or cooking flew into their houses (See Table 4).

Charcoal was found to be the most popular fuel use for cooking in household and the highest percentage of charcoal use was in rural. In the question of main fuel use in house, the last answer choice was “other” that meant respondents could not specify which type of fuel that their households used the most and they had used mixed among those at least 2 types. Waste burn was still found in both areas and much higher percentage in rural, as well as mosquito coil burn and smoker in house. House heating with fire was rarely seen in urban. The question for house heating with fire pointed the practice of people in winter season, as it is known that people do not set fire for heating in other season except winter (See Table 5).

Knowledge on household air pollution, the study only collected this information from household representative to find the percentage of those household that had ever heard about household air pollution, what the sources of the information for their knowledge were, and what they knew as household air pollution source, even considering in their own house's environment. Luckily, more than half of them (63.7%) had heard about household air pollution, but percentage in rural was much lower (See Table 6). However, knowledge was not included in multiple regressions, as it was considered to be none practical to be included. This was because of whatever they know, their practice had shown out anyway, and so practice and other environmental factors were more practical to be included in multiple regressions rather than knowledge.

Information on personal practice was also collected such as smoking status, number of cigarettes per day, smoking years, cooking for family, spend time in kitchen, etc. as they could possibly be factors associated with respiratory symptoms. 15.7% of all respondents were current smoker, while the percentage in rural was almost doubly higher (See Table 7). This kind of information was also from literature review.

Health background of the subjects, both adult and child, were also interesting to be collected. The study found the prevalence of asthma in adult which covered 6.9% in rural, 2.2% in urban and 3.5% in total. 21.8% of 770 respondents reported of having at least one underlying disease (e.g. asthma, hyper blood pressure, diabetes mellitus, allergy, gout, etc.). In children, the study also found the prevalence of asthma in children which covers 7.2% in rural, 2.3% in urban and 4.5% in total. And 8.2% of all 243 children in the study were having underlying disease (e.g. asthma, allergy, thalassemia, etc.). Researcher also suspected that having underlying disease may create association with those respiratory symptoms mentioned. However, individual underlying disease was not specified in descriptive table nor included in analytical process, only coded as have or not have underlying disease.

Table 21: Study Variables

Independent Variables for Adult	Dependent Variables
Household Socio-demographic 1. Area (rural/urban) 2. House member (6 / > 6) 3. Years of Living (20 / > 20) 4. Household Income_ Kip (2,000,000 / > 2,000,000) **Household Characteristics** 5. House location (By road/In Soi) 6. Near factory (Yes/No) 7. House type (wood/concrete/…) 8. House floor (1fl / > 1 fl) 9. Dusty house (little / very) 10. Kitchen location (in / out house) 11. Kitchen type (ventilated/closed) 12. Windows in a house (10 / > 10) 13. House has electronic ventilator (Yes/No) 14. Rooms in house (4 / > 4) 15. Smoke from cooking observed (Yes/No) **Household Practice** 16. Main fuel for cooking (charcoal/wood/..) 17. Waste burning (Yes/No) 18. Mosquito coil burning (Yes/No) 19. Incense burning (Yes/No) 20. Smoker in house (Yes/No) 21. Number of Smoker (1 / > 1) 22. Spray use (Yes/No) 23. House heating (Yes/No) **Knowledge on HH Air Pollution** 24. Heard about HH air pollution (Yes/No) 25. Information Source (one/ > one) 26. Your house has air pollution (Yes / No-Not sure)	**Main Symptoms** 1. Cough with cold 2. Cough without cold 3. Shortness of Breath with cold 4. Shortness of Breath without cold 5. Phlegm with cold 6. Phlegm without cold 7. Wheezing with cold 8. Wheezing without cold 9. Sneeze, runny, block nose 10. Eye irritation
Personal information, Practice and Health of Adult 1. Age (37yrs. / > 37 yrs.) 2. Hometown (Original/Moved in) 3. Sex (Male/Female) 4. Marital status (single/married/divorced) 5. Education (Illiterate, primary,…) 6. Main Job (office/Farmer/…) 7. Smoking Status (Current/past/never) 8. Cigarette/day (non / 1 – 8: light / > 8: heavy) 9. Years of smoking (zero / 1- 15 / > 15) 10. Spend time most in house (Yes/No) 11. Cook for Family (Yes/No) 12. Minutes in the kitchen (60 / > 60) 13. Minutes by Fire (30 / > 30) 14. Underlying Disease (Yes/No)	
Personal information, Practice and Health of Children 1. Age (7yrs. / > 7 yrs.) 2. Sex (Male/Female) 3. Spend time in kitchen (Yes/No) 4. Minutes in the kitchen/day (30 / > 30) 5. Play near stove (Yes/No) 6. Minutes by Fire/day (30 / > 30) 7. Have Underlying Disease (Yes/No)	

5.1.2 Analytical Information

For the inferential result, the association between six respiratory symptoms and 40 independent variables for adult and 33 independent variables for children were made. With two levels of each outcome, bivariate analysis was performed by using Chi-Square for dichotomous independent variable and using univariate logistic regression for categorical independent variables (example: education level, etc.), to find P-value, Crude Odd Ratio and 95% confidence interval.

As there were quite a lot of independent variables (see table 21), factors that have P-value ≤ 0.15 in previous binary analysis were selected to perform semi-final multivariate analysis (Step 1 of multivariate analysis) to find out those variable which have P-value ≤ 0.15 again. Then cut off those with P-value > 0.15 and ran final multivariate analysis (Step 2 of multivariate analysis) with those variables that P-value ≤ 0.15. Adjusted Odd Ratio, P-value ≤ 0.05 (statistically significant) and $p \leq 0.10$ (marginally significant), and 95% Confidence Interval were collected from the Final Multiple variable Logistic Regressions and shown in the result.

5.1.2. A: Associations between Independent and Dependent Variables in Adult

In analytical findings, this study found some sources of household air pollution with had positive association with respiratory symptoms and might be able to support the findings in previous study that almost of household pollutants, such as CO, PM_{10} and NO_2, had positive association with most of respiratory symptoms of women and children (Mengersen et al., 2006), consistency to another research that focused on mosquito coil, as household air pollution source and respiratory symptoms, positive association significantly was found, for instant with cough with/without cold in respondents (OR=1.84, 95% CI=1.02 to 3.33, p=0.045) (Tharaphy, 2009).

Biomass fuel as the main fuels use in household were found to be positively associated with cough, phlegm and wheeze that has also shown consistencies to other previous studies in other countries, e.g. a case-control study in Turkey women with obstructive airway disease (Ekici et al., 2004), a study on exposure to biomass fuel

smoke in rural and urban of Africa (Fullerton et al., 2009), a meta-analysis study in 2002 (Ezzati et al., 2002), a study in China about urban and rural exposure to indoor air pollution from domestic biomass and coal burning (Mestl et al., 2007), a cohort study in China (Lan et al., 2002), etc.

While many studies focused on women's respiratory health regarding household air pollution exposure and found positive association (Mengersen et al., 2006) (Tharaphy, 2009) (Ekici et al., 2004) (Fullerton et al, 2007, 2009) (Mestl et al., 2007) (Jyoti, 2010), etc. this study found no association between gender and respiratory symptoms in respondents. This might be possible that there are not only women who cook for family or expose to household air pollution, but also men nowadays, or the population in this study were not specifically exposed to household combustion smoke daily like in specific ethnics, or might be because of the high percentage of smoking in men as well that could bring respiratory symptom even not exposed to household air pollution, etc. Further study may be needed according to this point.

Other studies found that arsenic from fertilizer in drinking water was statistically associated with respiratory symptoms (Debendra et al., 2000); however, this study did not include questions about using of fertilizer, further study may be needed.

Double-count of each symptom in one subject (both adult and child) may occur during the research process, for example: cough with cold and cough without cold might occur in the same person; however, this was not a big deal. The reason was each symptom did not occur at the same time, they therefore were considered to be independent to each other in general. Here are examples of questions "Do you usually have a cough when you have a cold? - No/Yes; do you usually have a cough even without cold? -No/Yes, etc.".

We normally found respiratory symptoms appear when people have a cold. However, even without cold, we also found that some variables also behave as factors associated with respiratory symptoms, such as house location by road, waste burning, time spent in kitchen, chronic disease, kitchen in house, biomass fuel use, house

heating, duration of smoking, rural area, higher age and spending time mostly inside the house.

5.1.2. B: Associations between Independent and Dependent Variables in Children

In analytical findings, the study found that exposure to some sources of household air pollution in children had positive association with respiratory symptoms and might be able to support the findings in previous study that almost of household pollutants, such as CO, PM_{10} and NO_2, had positive association with most of respiratory symptoms of women and children (Mengersen et al., 2006), consistency to another research that focused on mosquito coil, as household air pollution source and respiratory symptoms, positive association significantly was found, for instant with cough with/without cold in respondents (OR=1.84, 95% CI=1.02 to 3.33, p=0.045) (Tharaphy, 2009), and also other studies (Elizabeth et al., 2002) (Smith et al., 2011). House located by road was also found positively associated with respiratory symptom and consistent with a study in Italian children living near busy roads (Enrica et al, 2009)

Biomass fuel as the main fuels use in household were not found to be associated with respiratory symptoms in children, while another study found association in solid-fuel use and child mortality in India (Diego et al., 2010). House heating was not found to be associated in the final model either, while another study found association between infant respiratory symptoms and indoor heating sources (Elizabeth et al., 2002). However, many other sources were found to be risky to child's respiratory health, such as waste burning, mosquito coil use, incense stick burning, factory nearby, play in kitchen, etc.

House with exhaust fan was found to be positive associated with child's phlegm. This was quite strange. However, in general, house with exhaust fan must have air condition. Another study found association between use of air condition in working place and adult's phlegm and also other respiratory symptoms (Aminath, 2009). The study did not ask about using air condition of household or asking about how frequent a household used exhaust fan. This might be one limitation in this study.

House in rural area had negative association with nasal symptom in children by OR= 0.02 (p= 0.003, 95% CI: 0.002 - 0.2). This might be due to the ventilation in rural area was better than in urban, or rural might have less concern on outdoor air pollution than urban. Female children had more chance than male children to get eye irritation at home (OR= 1.9, p= 0.028, 95% CI: 1.07 - 3.5). This, generally, might be because of girls had involved in housework more than boys.

5.2 Conclusion

Descriptive Conclusion: People in rural area, both adult and children, were more vulnerable than people in urban according to the percentage of illnesses, air pollution related practice in household, educational level, household income and knowledge on household air pollution. Prevalence of respiratory symptoms such as cough, phlegm, shortness of breath, wheezing etc. in rural was higher than in urban. People still burned waste around their house, children usually played nearby stove, or by fire, frequently burning mosquito coil was usually found, etc. and people in rural seemed to know or hear about household air pollution less than people in urban. This might be due to various aspects which were different between those two areas, such as economical aspect, educational aspect, etc. In contrast, although urban people had better life condition, some respiratory symptoms like nasal symptom, eye irritation, sore throat, etc. were much higher than in rural. All about household practices and respiratory symptoms still existed in urban, though by lower percentage. Various conditions of socio-demography, household characteristic, practice relevant to air pollution producing and knowledge were reasonable to take account into a part of factors influencing respiratory illness.

Analytical Conclusion: In adult and children, some household characteristics were positively associated with respiratory symptoms, for instance: house located by road, kitchen in house, house with smoker(s), household in rural area, etc. Besides, some activities within home scale such as biomass fuel use, waste burning, mosquito coil use, and house heating were also found to be risky of having respiratory symptoms. Some personal behaviors were also supportive to increasing risk of having respiratory symptoms, e.g. spending time long in kitchen and by fire. Smoking could

pose risk of respiratory symptoms not only in smokers, but also in house members. These therefore can be said that household characteristics, household practices and personal behaviors behave as household air pollution sources and associated with respiratory symptoms in adult and children.

However these findings did not prove the causality; they were only to illustrate the respiratory health related information descriptively and association between household air pollution factors and respiratory symptoms with statistical confirmation.

5.3 Recommendation

According to those results, it should be recommended that the health sector or policy maker should consider and find out some ways for further protection in respiratory health of people, by using some kind of solving intervention such as giving knowledge, campaign on house visiting of health personnel, household-environmental cleaning motivation, life style modification for healthier life, etc. Knowledge about household air pollution should be added in some programs of community health education.

Further investigations are still needed to find more evidence of association between household air pollution/ air pollution source and respiratory health, as there are still some variables which show reversal association or not so clear in direction of association.

5.4 Limitation

The result of this research does not represent to Lao country as a whole. It is assumingly represents to a situation of respiratory symptoms in people living in Vientiane capital only.

The study did not include all the household members, only randomly selected one male, one female and one child, so health information of people could be limited. There could also be some kind of biases such as selection bias of respondents, measurement and information bias; for instance, wrong interpretation of information, improper assessment of naturalistic phenomenon which could lead to research bias, recall bias.

The study focuses on household indoor air pollution source and exposure only. Measurement of air pollutants in the household was not done as it might take too long time and might not appropriate for this cross sectional study. Also lung function was not taken due to insufficiency of equipment might happen for a very large number of participants. Further study may possibly consider on these limitations.

5.5 Expected Benefits and Application

Generally, the findings of the study will help readers gain more knowledge and be interested in environmental health issues in Laos, especially for other upcoming students, as there are not many study of this type before in this country. The result of this study show descriptive information and how the household air pollution factors associate to people's respiratory health; therefore we will gain more information and evidence regarding respiratory health which must be useful to readers.

To decision-maker and some technicians, this study may give some new points and stimulate them to consider and find out the way for further protection in people or some kind of solving intervention may be needed. To researchers, this may give another idea for further study to gain more knowledge-benefits for public health and society. And To health personnel, the findings of this study will be useful for health personnel to give advice to local people in order to stimulate people find the way to have healthier life in healthier environment.

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APPENDICES

APPENDIX A

Participant Information Sheet

Title of research project: "Household Air Pollution related to Respiratory Symptoms among People living in Rural and Urban area in Vientiane Capital, Lao PDR".

Principle researcher's name: Mr. Viengnakhone Vongxay, MD. **Position**: Student

Office address: College of Public Health Sciences, Chulalongkorn University

Home address: House 142- Unit 11 Nongsangthor village, Saysettha district, Vientiane capital, Lao PDR

Current Address: Pet Jinda Mansion 5, 988 Urupong, Rama 6 Soi 23, Rachathewi, Bangkok, Thailand

Telephone: (office) ……. **Telephone (home)** …85621 450990……

Cell phone: +66(0)886707369 **E-mail:** viengnakhone_poom@yahoo.com

1. You are being invited to take part in a research project. Before you decide to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and do not hesitate to ask if anything is unclear or if you would like more information.

2. This research project involves finding out the relationship between respiratory symptom and illness prevalence and household air pollution sources in urban and rural area in Vientiane Capital, Laos.

3. Objective (s) of the project.

    - In general, we would like to investigate how the exposure to household air pollution associated with respiratory symptom among people living in rural and urban area in Vientiane capital, Lao PDR, and to compare the occurring of respiratory symptoms between those two populations based on those factors.

- Specifically, we would like to:

  -Compare the socio-demographic, household characteristic, household practice, and knowledge on household air pollutions between the people who live in rural and the people who live in urban in Vientiane capital, Lao PDR.

  -Identify the association between those factors and respiratory symptoms of those target population and compare between those two groups of sample (rural and urban).

  -Determine common factor influencing respiratory symptoms in the target population.

  -Contribution to the accumulation of evidence in order to provide more reliable estimates of risk and useful information for policy/decision-maker.

4. Details of participant.
   - The participant will be male and female with aged less than 60
   - Number of households needed is 422 with participants is 844**.**

   4.1 **Inclusion criteria**

   - Age of subject in this study must be in rank of 0 – 59 years.

   - To answer the questionnaire interview, the household representative must truly be a member of that household, for instance: head of the household, father, mother, adult son/daughter, etc. and must truly be older than 15 years of age and lower than 60 years of age.

   - The household representative must truly be able to communicate orally and face to face.

   - The household and household representative must have been residing in the target village for at least 6 months.

4.2 **Exclusion criteria**

- The household representative who do not agree to participate.
- The household that resides exceeding target area.

5. By using Multi-Stage sampling method and with the help of the 10 assistants, researchers will ask you some questions which will take your time about 45 -60 minutes. Some of these survey questions will be asked about general characteristics of your house and practice such as the number of rooms, windows and doors, location of kitchen, fire setting, etc. All your information will be kept confidential and the presentation of research result will be used for academic purpose in an overall picture only.

6. Process of providing information which also be stated in the proposal.

   6.1 Researcher and 10 assistants will politely self introduce and provide information to potential participants.

   6.2 In case of the participant is illiterate, researcher and 10 assistants will give a very well explanation. Thump stamp will be used to ensure the consent and with witness signature.

7. You will have no risk when taking part in this research. Further research can be done depending on the data in this research.

8. Your participation in this research is voluntary and you have the right to refuse this participation or to withdraw at any given time with no harm on your benefit and there will be no adverse impact on you.

9. If you have any question or if you would like to obtain more information, the researcher is available at all time. If the researcher has a piece of new information regarding the benefit or the risk/harm, the participant will be immediately informed. This practice will provide an opportunity for you to decide whether to stay in/to leave the research.

10. Information that is directly related to you will be kept confidential. Results of the study will be reported as an overall statement with anonymity.

11. There is no payment or compensation for participation in this study.

12. If the researcher does not treat you as stated in the patient's information sheet, you can report to the Ethical Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University (ECCU). Institute Building 2, 4th Floor, Soi Chulalongkorn 62, Phyathai Rd., Bangkok 10330, Thailand, Tel: 0-2218-8147 Fax: 0-2218-8147 E-mail: eccu@chula.ac.th

APPENDIX B

Informed Consent Form (age 18 - 60)

Address ……

Date ……..

Code number of participant ……

I who have signed here below agree to participate in this research project.

Title: *"Household Air Pollution related to Respiratory Symptoms among People living in Rural and Urban area in Vientiane Capital, Lao PDR"*

Principle researcher's name: Mr. Viengnakhone Vongxay, MD

Contact address: In Laos**,** House 142- Unit 11 Nongsangthor village, Saysettha district, Vientiane capital; or in Thailand, Pet Jinda Mansion 5, 988 Urupong, Rama 6 Soi 23, Rachathewi, Bangkok. **Tel**: +66(0)886707369 (Thai), or +8562(0)96520096 (Lao)

I have **(read or been informed)** about rationale and objective(s) of the project, what I will be engaged with in details, risk/harm and benefit of this project. The researcher has explained to me and I **clearly understand with satisfaction.**

I willingly **agree** to participate in this project and allow the researcher to ask a series of questions in this structured face to face interview which covers general information, housing environmental condition, biomass fuel use, other factors from practice and respiratory symptoms and illness occurrence.

I have **the right** to withdraw from this research project at any time as I wish with no need to **give any reason**. This withdrawal **will not have any negative impact upon me** (**for instance, health care services are still received as usual, etc**).

Researcher has guaranteed that procedure(s) acted upon me would be exactly the same as indicated in the information. Any of my personal information will be **kept confidential.** Results of the study will be reported as overal picture. Any of personal information which could be able to identify myself will not appear in the report.

If I am not treated as indicated in the information sheet, I can report to the Ethical Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University (ECCU). Institute Building 2, 4 Floor, Soi Chulalongkorn 62, Phyat hai Rd., Bangkok 10330, Thailand, Tel: 0-2218-8147 Fax: 0-2218-8147 E-mail: eccu@chula.ac.th,

I also have received a copy of information sheet and informed consent form

Sign ……..……
(……..……)
Researcher

Sign ……..……
(……..……)
Participant

Sign ……..……
(……..……)
Witness

APPENDIX C

Informed Consent Form for Parent or Guardian

Address ……

Date …….

Code number of participant ……

I who have signed here below is (indicate: father/mother/legal guardian) of (name of participant) …..... agree to participate in this research project **Title** "……..……..……"
Principle researcher's name ……..
Contact address …….
Telephone ……

I and person under my care have been informed about rational and objective(s) of the project, and what will be done in details upon the person under my care, risk/harm and benefit of this project. I have read details in the information sheet and **clearly understand with satisfaction.**

I willingly **agree** to let the person under my care participate in this project and consent the researcher to Response to questionnaires, one time, for about 15 – 20 minutes.

Either the person under my care or I have **the right** to withdraw from this research project at any time as wished, with no need **to give any reason**. This withdrawal **will not have any negative impact upon person under my care or me.**

Researcher has guaranteed that procedure(s) which will be acted upon the person under my care would be exactly the same as indicated in the information. Any personal information of person under my care will be **kept confidential.** Results of the study will be reported as total picture. Any personal information which could be able to identify person under my care and myself will not appear in the report.

If the person under my care **is not treated as indicated in the information sheet**, I can report to the Ethics Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University (ECCU). Institute Building 2, 4 Floor, Soi Chulalongkorn 62, Phyat hai Rd., Bangkok 10330, Thailand, Tel: 0-2218-8147 Fax: 0-2218-8147 E-mail: eccu@chula.ac.th,

I also have received **a copy of information sheet and informed consent form**.

Sign ……
(……..……)
Researcher

Sign ……
(……..……)
Participant

Sign ……
(……..……)
Parents or guardian of participant

Sign ……
(……..……)
Witness

Note: *If the participant is aged between 8-17 years old, the child must co-sign with parent or the guardian.*

APPENDIX D

Questionnaire

Interviewer code number: _____ Date: _____

Householdcode number: _____ Name of Village: _____

Name of District: _____

Part I: Socio-Demographics and Characteristics of Household

1.1 Location of the house: 1. by road __ 2. In Soi __ 3. Other (specify ……..)

1.2 Nationality: 1. Lao __ 2. Not Lao (certify ……)

1.3 If Lao, what ethnic is your family: 1. Lao__ 2. Mong __ 3. KeumMouh __

1.4 How many people are there in your household? Certify number: _____ people

Adult male: _____ Adult female: _____ Children < 15 years old: _____

1.5 How long has your family been living in this house? ____year(s) _____month(s)

1.6 How much does your household earn per month (in Kip)? _____ Kip

1.7 Is there an industrial plant nearby (in the village)? 1. Yes ___ 2. No ___

1.8 Type of house: 1. Wood ___ 3. Mixed (wood & concrete) ___

2. Concrete ____ 4. Room/apartment ____

1.9 How many floors does the house have?

1. One floor ___ 2. Two floors ___ 3. More than 2 floors ___

1.10 Do you see that your house is always dusty? 1. Yes ___ 2. No ___

1.11 Is your kitchen inside the house? 1. Yes ___ 2. No ___

1.12 Does your kitchen have any window or chimney? 1. Yes ___ 2. No ___

1.13 How many windows does your house have? _____ windows

1.14 Do you have a fireplace in your house? 1. Yes ___ 2. No ___

1.15 Does your house have a chimney? 1. Yes ___ 2. No ___

1.16 How many rooms are there in your house? (except bathroom) _____

1.17 Did you observe cooking smoke in your house? 1. Yes ___ 2. No ___

Part II: Practice

2.1 What kind of fuel do you use most for cooking? (Check one only)

1) Wood __ 3) Gas _____ 5) Other
2) Charcoal ____ 4) Electricity ___ (……)

2.2 Does your family burn waste? 1. Yes __ 2. No __

2.2.1 If yes, Inside or outside the house? 1. Inside ___ 2. Outside ___

2.2.2 How often do you burn the waste? (Check one only)

1) Once a week ___
2) 2-3 times a week ___
3) > 3 times a week __
4) Every day ___
5) Other (…….)

2.3 Does your family burn mosquito coils in the house? 1. Yes ___ 2. No ___

2.3.1 If yes, how often does your family burn the coils last month? (Check one only)

1) Seldom ___
2) 1 - 2 times per month __
3) 1 - 2 times per week __
4) 3 - 4 times per week __
5) Every day (more than one time per day) ___

2.4 Does your family burn incense stick for religious purpose? 1. Yes ___ 2. No ___

2.4.1 If yes, how often does your family burn the incense last month? (Check one only)

1) Seldom ___
2) 1 - 2 times per month ___
3) 1 - 2 times per week _
4) 3 - 4 times per week ____
5) Every day (more than one time per day) ___

2.4 Is there at least one member of your family currently smokes regularly in the household? 1. Yes ___ 2. No ___

2.4.1 If yes, specify number _____

2.6 Does your family use any kind of spray? 1. Yes ___ 2. No ___

2.6.1 If yes, how often does your family use the spray? (Check one only)

1) Seldom ___
2) 1 - 2 times per month ___
3) 1 - 2 times per week _
4) 3 - 4 times per week ____
5) Every day (more than one time per day)____

2.7 In winter or cool season, does your family set fire for warming? 1. Yes__ 2. No__

2.7.1 If yes, inside the house or outside the house? 1. Inside___ 2. Outside___

Part III: Knowledge

3.1 Have you ever heard about household air pollution? 1. Yes ___ 2. No ___

3.1.1 If yes, what is the main source of that information for you?(Check one)

1. Television ___
2. Radio___
3. Newspaper/Magazine___
4. Health staff ___
5. NGO program ___
6. Other (specify ……)

3.2 Do you think household air pollution can affect health? 1. Yes ___ 2. No ___

3.3 Do you think your house has indoor air pollution? 1. Yes__ 2. No__ 3. Not sure__

3.4 In general, what do you think can be sources of household air pollution? (one check only)

1. Smoke from cooking, Smoke from mosquito coin, incense burning, waste burning, cigarettes smoking, Spray and Paint.
2. Dust from road, factory, forest/farm burning
3. Both 1 and 2
4. Don't know

3.5 In general, what do you think is the main household air pollution source that can affect to health of household members? (one check only)

3.6 What do you think is the main source able to make air polluted in your household? (one check only)

No.	Sources	Q 3.5	Q 3.6
1	Smoke from cooking		
2	Smoke from mosquito coin		
3	Smoke from incense burning		
4	Smoke from waste burning		
5	Smoke from cigarettes smoking		
6	Dust from road		
7	Dust from industry		
8	Burning forest and crops		
9	Spray		
10	Paint		
11	All		
12	Other (Specify……)		

Part IV: Personal and Respiratory Health Information

A. Adult age 15^{+}(Two copies for this part "A" for a household, 1 male & 1 female)

NAME: _____ _____

A1. AGE: _____

A2. Place of Birth: _____

A3. Sex: 1. Male ____ 2. Female ____

A4. What is your marital status? 1. Single ____ 2. Married ____
3. Widowed ____ 4. Separated/Divorced ____

A5. Nationality: 1. Lao 2. Not Lao (certify …….)

A6. Educational level?

1. Primary school__
2. Lower secondary__
3. Upper secondary__
4. Middle level/Vocational__
5. higher/Bachelor __
6. Post graduate__

A7. What is your job (main work)?

1) Office staff __
2) Farmer __
3) Factory/industrial worker __
4) Construction labor __
5) Unemployed __
6) Other (specify: ……..)

A8. Do you regularly smoke cigarettes? 1. Yes ___ 2. No ___

If yes; A8.1. How many cigarettes do you smoke per day? _____

A8.2. How long have you been smoking cigarettes?

_____ year(s). _____ month(s)

If no; A8.3. Are you an ex-smoker? 1. Yes ___ 2. No ___

A8.3.1 If yes, how long had you smoked? ___ year(s) ___ month(s)

A9. Do you spend time in a day mostly inside the house? 1. Yes ___ 2. No ___

A10. Do you usually cook for the family? 1. Yes ___ 2. No ___

A10.1 If yes, how many hours do you stay in kitchen in a day? ____ hrs ___ min

A11. How many hours do you spend time by fire in a day? _____ hrs ____ min

SYMPTOMS

These questions pertain mainly to your chest. Please answer yes or no if possible. If you are in doubt about whether your answer is yes or no, record no.

COUGH:

A12. Do you usually have a cough when you have a cold? 1. Yes ___ 2. No ___

A13. Do you usually have a cough even without cold? 1. Yes ___ 2. No ___

If yes to A12 or A13:

A14. How long with this cough? _____ year(s) _____ month(s)

A15. For how many months do you cough in a year? Check one only.

1. Less than one month ___ 2. 1 – 2 months ___ 3. Three months up ___

PHLEGM:

A20. Do you usually bring up phlegm whenever you have a cold? 1. Yes __ 2. No __

A21. Do you usually bring up phlegm even without cold? 1. Yes __ 2. No __

If yes to A20 or A21:

A23. How long with this phlegm? _____ year(s) _____ month (s)

A22. For how many months do you bring phlegm from your chest in a year? Check one only. 1. Less than one month ___ 2. 1 – 2 months ___ 3. Three months up ___

WHEEZING:

A24. Do you usually feel wheezing in your chest when you have a cold?

1. Yes ___ 2. No ___

A25. Do you usually feel wheezing in your chest even without cold?

1. Yes ____ 2. No ___

If yes to A24 or A25:

A26. How long with this wheezing? _____ year(s) _____ month (s)

A27. For how many months do you feel wheezing in chest in a year? Check one only.

1. Less than one month ___ 2. 1 – 2 months ___ 3. Three months up ___

SHORTNESS OF BREATH:

A16. Do you usually have shortness of breath when you have a cold?

1. Yes ____ 2. No ____

A17. Do you usually have shortness of breath even without cold?

1. Yes ____ 2. No ____

If yes to A16 or A17:

A18. How long with this shortness of breath? _____ year(s) _____ month(s)

A19. For how many months do you feel shortness of breath in a year? Check one only. 1. Less than one month ___ 2. 1 – 2 months ___ 3. Three months up ___

SORE THROAT AND RHINITIS:

Since you had been living here:

A28. Do you ever have a sore throat without a cold? 1. Yes ___ 2. No ___

A29. Without cold, do you ever have a problem with sneezing, or a runny, or a block nose? 1. Yes ___ 2. No ___

A30. Do your eyes ever feel sore or itchy or irritated when you are at home?

1. Yes ___ 2. No ___

A31. In the past 12 months, about how many times have you had a cold with a cough or flu? 0. Never__ 1. One time__ 2.Two times__ 3. Three times or more__

A32. Did you have a sore throat in the past month? 1. Yes ___ 2. No ___

ASTHMA:

A33. Has a doctor ever said that you have asthma? 1. Yes ___ 2. No ___

BRONCHITIS:

A34. Has a doctor ever said that you have bronchitis in the past year?

1. Yes ____ 2. No ____

PNUEMONIA:

A35. Has a doctor ever said that you have pneumonia in the past year?

1. Yes ____ 2. No ____

A36. Do you have any underlying disease? 1. Yes_ (Specify_____)

2. No _

B. Children age < 15 years (only one child randomly selected)

Child Name: _____

B1. Gender: 1. Male 2. Female

B2. Age: _____

B3. Does your child usually spend time by cooking place? 1. Yes __ 2. No __

B3.1 If yes, how many hours a day? _____ hour(s)

B4. Does your child usually spend time by fire? 1. Yes __ 2. No __

B4.1 If yes, how many hours a day? _____ hour(s)

COUGH:

B5. Does your child usually have a cough when having a cold? 1. Yes ___ 2. No ___

B6. Does your child usually have a cough even without cold? 1. Yes ___ 2. No ___

If Yes to B5 or B6:

B7. How long with this cough? _____ year(s) _____ month(s)

B8. For how many months does your child cough in a year? Check one only.

1. Less than one month __ 2. 1 – 2 months ___ 3. Three months up ___

PHLEGM:

B13. Does your child usually bring up phlegm whenever having a cold?

1. Yes___ 2.No ___

B14. Does your child usually bring up phlegm even without cold?

1. Yes ___ 2. No ___

If yes to B13 or B14:

B15. How long with this phlegm? _____ year(s) _____ month(s)

B16. For how many months does your child bring phlegm like this in a year? Check one only. 1. Less than one month ___ 2. 1 – 2 months ___ 3. Three months up __

WHEEZING:

B17. Does your child usually have wheezing in his/her chest whenever having a cold?

1. Yes ___ 2. No ___

B18. Does your child usually have wheezing in his/her chest even without cold?

1. Yes ___ 2. No ___

If yes to B17 or B18:

B19. How long with this wheezing? _____ year(s) _____ month(s)

B20. For how many months does your child have wheezing in his/her chest like this in a year? 1. Less than one month __ 2. 1–2 months __ 3. Three months up __

SHORTNESS OF BREATH:

B9. Does your child usually have shortness of breath when having a cold?

1. Yes___ 2.No ___

B10. Does your child usually have shortness of breath even without cold?

1. Yes ___ 2.No ___

If yes to B9 or B10:

B11. How long with this shortness of breath? _____ year(s) _____ month(s)

B12. For how many months does he/she feel shortness of breath in a year? (Check one only) 1. Less than one month ___ 2. 1 – 2 months ___ 3. Three months up __

SORE THROAT AND RHINITIS:

B21. Does your child ever have a sore throat without a cold? 1. Yes ___ 2. No ___

B22. Without cold, does your child ever have a problem with sneezing, or a runny, or a block nose? 1. Yes ___ 2. No ___

B23. Do your child's eyes ever feel sore or itchy or irritated when he/she is at home?

1. Yes ___ 2. No ___

B24. In the past 12 months, about how many times did your child have a cold with a cough? 0. Never__ 1. One time__ 2.Two times__ 3. Three times or more__

B25. Did your child have a sore throat in the past month? 1. Yes ___ 2. No ___

ASTHMA:

B26. Has a doctor ever said that your child has asthma? 1. Yes __ 2. No__

BRONCHITIS:

B27. Has a doctor ever said that your child has bronchitis in the past year?

1. Yes __ 2. No__

PNUEMONIA:

B28. Has a doctor ever said that your child has pneumonia in the past year?

1. Yes __ 2. No__

B29. Does your child have any underlying disease? 1. Yes _ (Specify _____)

2. No _

THANK YOU VERY MUCH FOR YOUR KIND COOPERATION

APPENDIX E

Tables of Bivariate Analysis

Table 22: Bivariate Analysis for Cough in Adult

Independent Variables	With Cold			Without Cold		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	1.6	1.04 - 2.4	0.029	1.8	1.2 - 2.8	0.003
Age group: > 36 vs. ≤ 36	1.4	0.9 – 1.9	0.075			
Main Job (5 levels)						0.074*
Home town: Original vs. Moved in				1.3	0.9 – 1.9	0.162
Duration of Living:						
> 20 years vs. ≤ 20 years				1.9	1.2 – 2.8	0.002
House member: > 5 vs. ≤ 5	1.4	0.9 -1.9	0.087			
Household Characteristic						
House location:						
By road vs. In small street				1.6	1.1 – 2.4	0.016
House nearby factory:	1.4	0.9 – 1.9	0.072	1.5	1.02 - 2.3	0.039
Type of House (4 levels)						0.087*
Kitchen in house vs. Outside	0.6	0.4 – 1.1	0.101			
Kitchen with windows				0.6	0.4 – 1.1	0.096
House with exhaust fan				0.5	0.3 – 0.7	0.001
House windows: >10 vs. ≤10	0.7	0.5 – 1.1	0.157	1.5	1.01 - 2.2	0.042
Dust in house: Very dusty vs. Little dusty	0.6	0.4 – 0.9	0.036			
Household Practice						
Main fuel for cooking:						
Biomass vs. Non-biomass	1.7	1.2 – 2.5	0.003			
Waste Burning				2.8	1.9 - 4.2	< 0.001
Mosquito coil use	1.6	1.1 – 2.4	0.011	1.5	0.9 – 2.2	0.056
Smoker(s) in the house	1.5	1.0 – 2.1	0.047			
House heating with fire				2.2	1.4 – 3.3	< 0.001
Observed Smoke from cooking flows into the house	1.7	1.2 – 2.6	0.004			
Knowledge						
Heard about Household Air Pollution				0.5	0.3 – 0.7	< 0.001
Information Source:						
1 source vs. > 1 source	1.7	1.1 – 2.6	0.026	0.5	0.3 – 0.9	0.025
Think that your house has air pollution				0.4	0.2 – 0.6	< 0.001
Personal Practice and Health						
Spend time most in house	1.6	1.1 – 2.3	0.008			
Cook for family	1.4	0.9 – 1.9	0.110			
Minutes spent in the kitchen/day (3 levels)			0.144*			0.021*
Minutes spent by fire:						
> 30 min vs. ≤ 30 min	1.3	0.9 – 1.9	0.154			
Smoking Status (3 levels)						0.002*
Number of cigarettes/day (3 levels)			0.065*			0.003*
Years of Smoking (3 levels)			0.135*			0.002*
Have underlying disease(s)	1.9	1.2 – 3.3	0.006	2.0	1.3 – 3.1	0.001

* P-value for whole factor of that independent variable, not for any individual level.

Table 23: Bivariate Analysis for Phlegm in Adult

Independent Variables	With Cold			Without Cold		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	0.033	1.03 - 2.1	0.033			
Educational level (3 levels)			0.070*			
House member: > 5 vs. ≤ 5				1.8	1.1 - 2.9	0.008
Duration of Living:						
> 20 years vs. ≤ 20 years	1.3	0.9 - 1.8	0.075	1.7	1.1 - 2.7	0.020
Household Income:						
≤ 2,000,000k vs. > 2,000,000k				0.5	0.3 - 0.8	0.005
Household Characteristic						
House location:						
By road vs. In small street	1.4	1.03 - 2.0	0.032	2.2	1.4 - 3.4	0.001
House nearby factory				1.4	0.8 - 2.2	0.146
Kitchen in house vs. Outside	0.7	0.4 – 1.0	0.062	2.4	1.2 - 4.9	0.013
Kitchen with window				1.9	0.8 - 4.2	0.111
House Floor (3 levels)			0.057*			
Dust in House:						
Very dusty vs. Little dusty	0.7	0.5 - 0.9	0.027			
House windows: > 10 vs. ≤ 10	0.7	0.5 - 1.07	0.130	1.7	1.1 - 2.7	0.016
Rooms in house: ≤ 4 vs. > 4	1.4	1.02 - 1.9	0.039	0.6	0.3 - 0.9	0.030
Household Practice						
Main fuel for cooking: Biomass vs. Non-biomass	1.7	1.3 – 2.4	0.001	0.7	0.4 - 1.1	0.154
Mosquito coil use	1.4	1.04 - 2.0	0.027	1.5	0.9 - 2.4	0.054
Smoker(s) in the house	1.9	1.3 – 2.6	< 0.001			
House heating with fire	1.4	0.9 – 2.0	0.115	1.4	0.8 - 2.3	0.186
Observed Smoke from cooking enters the house	2.4	1.7 – 3.5	< 0.001			
Knowledge						
Heard about Household Air Pollution				0.7	0.4 - 1.1	0.131
Number of Info Source:						
1 source vs. > 1 source				0.2	0.1 - 0.3	< 0.001
Think that your house has air pollution	1.5	1.1 – 2.3	0.022			
Personal Practice and Health						
Spend time most in house	1.3	0.9 – 1.8	0.054	0.6	0.4 - 1.0	0.052
Cook for family	1.5	1.1 – 2.1	0.008			
Minutes spent in the kitchen/day (3 levels)			0.047*			0.068*
Smoking Status (3 levels)			0.063*			0.042*
Cigarettes/day (3 levels)			0.018*			0.018*
Years of Smoking (3 levels)			0.023*			0.002*
Have underlying disease(s)				1.9	1.2 - 3.2	0.007

* P-value for whole factor of that independent variable, not for any individual level.

Table 24: Bivariate Analysis for Wheezing in Adult

Independent Variables	With Cold			Without Cold		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	3.7	2.2 - 6.3	< 0.001			
Age group: > 36 vs. ≤ 36				3.3	0.6 - 16.5	0.121
Home town: Original vs. Moved in	1.6	0.9 – 2.7	0.060			
Job (5 levels)			< 0.001*			
Educational level (3levels)			0.001*			
House Income/month						
≤ 2,000,000k vs. > 2,000,000k	2.4	1.4 - 4.2	0.002			
Household Characteristic						
House location:	0.6	0.3 – 1.1	0.149			
By road vs. In small street						
House nearby factory	1.6	0.9 – 2.8	0.084			
Kitchen in house vs. Outside	0.6	0.3 – 1.0	0.057			
Type of House (3levels)			0.002*			
House with exhaust fan	0.6	0.4 – 1.1	0.087			
Dust in House:	0.6	0.3 - 1.0	0.061			
Very dusty vs. Little dusty						
House windows: > 10 vs. ≤ 10	0.6	0.3 – 1.1	0.124			
Rooms in house: ≤ 4 vs. > 4	2.7	1.4 – 5.3	0.002			
Household Practice						
Main fuel for cooking:	2.1	1.1 – 3.9	0.018			
Biomass vs. Non-biomass						
Waste Burning	2.2	1.3 - 3.8	0.002			
Smoker(s) in the house	2.2	1.3 – 3.7	0.003			
House heating with fire	3.9	2.3 – 6.6	< 0.001			
Observed Smoke from cooking enters the house	0.6	0.3 – 1.1	0.101			
Knowledge						
Heard about Household Air Pollution	0.4	0.2 – 0.7	0.001			
Number of Information Source: 1 source vs. > 1 source				1.5	1.4 – 1.6	0.103
Think that your house has air pollution	0.6	0.3 – 1.1	0.076			
Personal Practice and Health						
Spend time most in house	2.6	1.4 – 4.7	0.001			
Cook for family	1.5	0.9 – 2.6	0.124			
Minutes spent in the kitchen/day (3levels)			0.017*			
Minutes spent by fire/day:						
> 30 min vs. ≤ 30 min	3.2	1.8 – 5.6	< 0.001			
Have underlying disease(s)	2.9	1.7- 4.9	< 0.001	6.1	1.5 - 25.9	0.015

* P-value for whole factor of that independent variable, not for any individual level.

Table 25: Bivariate Analysis for Shortness of Breath (SOB) in Adult

Independent Variables	With Cold			Without Cold		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	7.8	5.1 - 11.9	< 0.001	2.3	1.1 - 4.8	0.022
Sex: Female vs. Male	1.3	0.9 – 1.9	0.155			-
Age group: > 36 vs. ≤ 36	1.5	1.03 – 2.4	0.035	3.1	1.4 – 7.1	0.004
Main Job (5 levels)			<0.001*			0.141*
Educational level (3 levels)			< 0.001*			0.070*
Marital Status (3 levels)			0.021*			
Home town: Original vs. Moved in	2.3	1.5 – 3.5	< 0.001	1.7	0.8 – 3.7	0.134
Duration of living:						
> 20 years vs. ≤ 20 years	1.6	1.1 – 2.4	0.013	1.8	0.8 – 3.9	0.102
House income/month:						
≤ 2,000,000k vs. > 2,000,000k	3.5	2.3 – 5.4	< 0.001			
Household Characteristic						
House location:	0.7	0.4 – 1.1	0.112			
By road vs. In small street						
Type of House (4 levels)			< 0.001*			
Kitchen with window	0.5	0.3 – 0.8	0.012			
House with exhaust fan	0.4	0.3 – 0.6	< 0.001	0.5	0.2 – 1.1	0.083
House windows > 10 vs. ≤ 10	0.6	0.4 - 1.01	0.055			
Rooms in house: ≤ 4 vs. > 4	2.5	1.6 - 4.1	< 0.001	1.8	0.7 – 4.4	0.149
Dust in house:	0.4	0.2 – 0.6	< 0.001			
Very dusty vs. Little dusty						
Household Practice						
Main fuel for cooking:						
Biomass vs. Non-biomass	2.7	1.7 – 4.5	< 0.001	1.7	0.7 – 4.2	0.183
Waste Burning	4.2	2.8 – 6.2	< 0.001	2.1	1.01 - 4.5	0.042
Incense stick burning				1.8	0.8 – 4.2	0.132
Smoker(s) in the house	2.2	1.5 – 3.3	< 0.001			
House heating with fire	3.9	2.6 – 5.9	< 0.001			
Observed Smoke from cooking Flows into the house	0.7	0.4 – 1.0	0.06			
Knowledge						
Heard about Household Air Pollution	0.5	0.3 – 0.7	0.002	0.3	0.1 – 0.6	0.001
Think that your house has air pollution	0.5	0.3 – 0.7	0.001	0.4	0.2 – 0.9	0.041
Personal Practice and Health						
Spend time most in house	1.9	1.2 – 2.8	0.002			
Cook for family	1.5	1.03 – 2.3	0.034			
Minutes spent in the kitchen/day(3 levels)			0.001*			0.035*
Minutes spent by fire/day:						
> 30 min vs. ≤ 30 min	2.9	1.9 – 4.5	< 0.001			
Smoking Status (3 levels)			0.136*			0.018*
Number of cigarettes/day (3 levels)			0.147*			0.106*
Years of Smoking (3 levels)			0.068*			0.021*
Have Underlying disease(s)	1.6	1.01 - 2.4	0.045	4.4	2.1 – 9.3	< 0.001

* P-value for whole factor of that independent variable, not for any individual level.

Table 26: Bivariate Analysis for Nasal Symptom without Cold and Eye Irritation at Home in Adult

Independent Variables	Nasal Symptom			Eye Irritation		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	0.2	0.1 – 0.3	< 0.001	0.6	0.5 – 0.9	0.011
Job (5 levels)			<0.001*			
Educational level (3levels)			<0.001*			
Marital Status (3levels)			0.003*			0.026*
Home town: Original vs. Moved in	0.7	0.5 -1.01	0.061			
Household Income:						
≤ 2,000,000k vs. > 2,000,000k	0.4	0.3 – 0.6	< 0.001	0.8	0.6 - 1.06	0.132
Household Characteristic						
House location:						
By road vs. In small street	2.9	2.1 – 4.2	< 0.001	1.5	1.2 – 2.1	0.003
House nearby factory	1.4	1.05- 1.9	0.023			
Type of House (4 levels)			0.001*			
House Floor (3 levels)			0.001*			
Kitchen in house vs. Outside	1.4	1.0 – 2.0	0.049			
Kitchen with window	2.02	1.3- 3.04	0.001			
House with exhaust fan	2.4	1.7 – 3.3	< 0.001	1.4	1.0 - 1.8	0.048
House windows: > 10 vs. ≤ 10	1.3	0.9 – 1.8	0.061			
Rooms in house: ≤ 4 vs. > 4	0.6	0.5 – 0.9	0.012	0.7	0.5 – 0.9	0.023
Dust in house:						
Very dusty vs. Little dusty				1.4	1.08 - 1.9	0.013
Household Practice						
Main fuel for cooking:						
Biomass vs. Non-biomass	0.5	0.4 – 0.7	< 0.001	0.6	0.5 – 0.9	0.011
Waste Burning	0.5	0.3 – 0.6	< 0.001			
Mosquito coil use	1.7	1.3 – 2.4	< 0.001			
Incense stick burning	1.2	0.9 – 1.7	0.152			
Smoker(s) in the house	0.5	0.4 – 0.7	< 0.001			
Number of Smoker in house: > 1 vs. 1	1.8	1.01- 3.1	0.045			
House heating with fire	0.4	0.3 – 0.6	< 0.001			
Observed Smoke from cooking flows into the house	3.9	2.8 – 5.6	< 0.001	1.5	1.1 – 2.1	0.010
Knowledge						
Heard about Household Air Pollution	1.6	1.2 – 2.2	0.002			
Number of Info Source:						
1 source vs. > 1 source	1.3	0.9 – 1.9	0.134	0.7	0.5 - 1.02	0.066
Think that your house has air pollution	2.1	1.4 – 3.0	< 0.001	1.5	1.08 - 2.3	0.018
Personal Practice and Health						
Minutes spent in the kitchen/day (3 levels)						0.148*
Minutes spent by fire/day:						
> 30 min vs. ≤ 30 min	0.6	0.4 – 0.9	0.010			
Cigarettes/day (3 levels)			0.067*			
Years of Smoking (3 levels)			0.034*			
Have underlying disease(s)				1.4	0.9 – 1.9	0.071

* P-value for whole factor of that independent variable, not for any individual level.

Table 27: Bivariate Analysis for Cough in Children

Independent Variables	With Cold			Without Cold		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	1.8	0.9 – 3.4	0.084			
Sex: Male vs. Female				2.4	1.01-5.6	0.044
House member: > 6 vs. ≤ 6				2.6	1.1 - 6.1	0.023
Household Characteristic						
House nearby factory				2.1	0.8 - 5.0	0.106
Type of House (4 levels)			0.011*			
House Floor (3 levels)						0.321*
Kitchen in house vs. Outside	0.5	0.2 – 1.2	0.146			
House windows: > 10 vs. ≤ 10				0.4	0.1 - 1.2	0.116
Rooms in house: > 3 vs. ≤ 3	0.5	0.2 – 0.9	0.003			
Dust in house: Very dusty vs. Little dusty	0.5	0.3 – 1.1	0.082			
Household Practice						
Waste Burning	2.03	1.01-4.1	0.044	1.9	0.8 - 4.6	0.111
Mosquito coil use	1.6	0.8 - 3.1	0.157			
Incense stick burning				2.05	0.7 - 5.4	0.136
House heating with fire	2.03	0.9 - 4.1	0.048			
Number of Smoker in house: > 1 vs. 1	2.4	0.6 - 8.8	0.158			
Observed Smoke from cooking	1.7	0.9 - 3.4	0.092			
flows into the house						
Knowledge						
Heard about Household Air Pollution				0.4	0.1 - 0.8	0.020
Think that your house has air pollution	0.5	0.2 - 1.2	0.129			
Personal Practice and Health						
Spend time in kitchen	2.5	1.2 - 5.6	0.015			
Minutes spent in the kitchen/day (3 levels)			0.034*			
Play near fire	2.04	0.9 – 4.4	0.071			
Minutes by fire/day (3 levels)			0.049*			

* P-value for whole factor of that independent variable, not for any individual level.

Table 28: Bivariate Analysis for Phlegm in Children

Independent Variables	With Cold		
	OR	95% CI	P-Value
Socio-Demographic			
Area: Rural vs. Urban	2.4	1.4 – 4.2	0.002
Household Income: ≤ 2,000,000k vs. > 2,000,000k	1.5	0.8 – 2.6	0.127
Household Characteristic			
Type of House (4 levels)			0.104*
House with exhaust fan	1.6	0.9 – 2.8	0.083
House windows: > 10 vs. ≤ 10	0.4	0.2 – 0.8	0.004
Rooms in house: > 3 vs. ≤ 3	0.4	0.2 – 0.8	0.005
Dust in house: Very dusty vs. Little dusty	0.4	0.2 – 0.6	0.001
Household Practice			
Waste Burning	1.9	1.08 – 3.3	0.025
Mosquito coil use	2.04	1.1 – 3.5	0.012
House heating with fire	2.1	1.2 – 3.8	0.011
Knowledge			
Number of Information Source: 1 source vs. > 1 source	0.5	0.2 – 1.2	0.119
Personal Practice and Health			
Play in kitchen	1.7	0.9 - 3.03	0.083
Have underlying disease(s)	3.1	0.8 - 10.9	0.064

* P-value for whole factor of that independent variable, not for any individual level.

Table 29: Bivariate Analysis for Wheezing in Children

Independent Variables	With Cold			Without Cold		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	3.9	1.9 – 7.7	< 0.001	10.2	1.2 -82.7	0.013
Age group: ≤ 7 vs. > 7	1.8	0.9 – 3.5	0.055	8.1	1.0-66.1	0.036
Household Income:						
≤ 2,000,000k vs. > 2,000,000k	2.8	1.4 – 5.7	0.003			
Household Characteristic						
House location: By road vs. In street				3.2	0.8-12.2	0.077
House nearby factory	2.3	1.2 – 4.5	0.011	8.1	1.1-66.1	0.036
Type of House (4 levels)			0.003*			
House with exhaust fan	2.2	1.03 – 4.7	0.037			
Rooms in house: > 3 vs. ≤ 3	0.3	0.1 – 0.6	0.001	0.1	0.02- 1.2	0.082
House Windows: > 10 vs. ≤ 10	0.6	0.3 – 1.2	0.137			
Household Practice						
Main fuel for cooking:						
Biomass vs. Non-biomass	5.04	1.7 – 14.6	0.001	1.4	1.2 - 1.5	0.068
Waste Burning	2.8	1.5 – 5.3	0.001			
Incense stick burning	0.6	0.3 – 1.1	0.113			
Smoker(s) in the house	1.8	0.9 – 3.4	0.084			
House heating with fire	2.6	1.4 – 4.9	0.003	3.6	0.8-14.9	0.078
Knowledge						
Heard about Household Air Pollution	0.6	0.3 – 1.1	0.088			
Think that your house has air pollution				1.3	1.2 - 1.4	0.118
Personal Practice and Health						
Have underlying disease(s)	4.7	1.8 – 12.1	0.002	6.3	1.4- 27.7	0.029

* P-value for whole factor of that independent variable, not for any individual level.

Table 30: Bivariate Analysis for Shortness of Breath (SOB) in Children

Independent Variables	With Cold			Without Cold		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	6.3	3.4 -11.6	< 0.001	2.9	0.7 -11.5	0.115
Sex: Female vs. Male	1.9	1.1 – 3.2	0.023			
Age group: ≤ 7 yrs vs. > 7 yrs	2.2	1.3 -3.9	0.005			
House member: > 6 vs. ≤ 6	2.6	1.1 – 6.1	0.023			
Household Income:						
≤ 2,000,000k vs. > 2,000,000k	3.1	1.7 – 5.8	< 0.001			
Household Characteristic						
House nearby factory				9.2	1.1 - 74.1	0.019
Type of House (3 levels):			0.013*			
House windows: > 10 vs. ≤ 10	0.4	0.2 - 0.8	0.008			
House rooms: > 3 vs. ≤ 3	0.3	0.1 - 0.5	< 0.001			
Household Practice						
Main fuel for cooking:						
Biomass vs. Non-biomass	4.3	1.9 – 9.5	< 0.001			
Waste Burning	2.7	1.5 – 4.6	< 0.001			
Incense stick burning	0.5	0.3 – 0.8	0.008			
Smoker(s) in the house	2.6	1.4 – 4.5	0.001			
House heating with fire	3.7	2.1 – 6.6	< 0.001			
Personal Practice and Health						
Play near stove	0.6	0.3 – 1.1	0.135			
Underlying disease(s)	6.06	2.2 - 16.4	< 0.001	9.04	2.3 - 35.3	< 0.001

* P-value for whole factor of that independent variable, not for any individual level.

Table 31: Bivariate Analysis for Nasal Symptoms without Cold and Eye Irritation at Home in Children

Independent Variables	Nasal Symptom			Eye Irritation		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Socio-Demographic						
Area: Rural vs. Urban	0.2	0.1 – 0.3	< 0.001	0.3	0.2 – 0.6	0.001
Sex: Male vs. Female				0.5	0.3 – 0.9	0.044
House member: > 6 vs. ≤ 6	1.7	0.9 – 2.7	0.102			
Household Income:						
≤ 2,000,000k vs. > 2,000,000k	0.4	0.3 – 0.8	0.003	0.5	0.3 – 0.9	0.020
Household Characteristic						
House location:						
By road vs. In small street	1.9	1.1 – 3.5	0.019			
Kitchen in house vs. Outside	1.6	0.9 – 2.9	0.111			
House with exhaust fan	1.8	1.1 – 3.2	0.021	1.6	0.8 – 3.1	0.122
Rooms in house: > 3 vs. ≤ 3	1.8	1.1-3.03	0.024	1.9	1.08 - 3.4	0.024
Household Practice						
Main fuel for cooking:						
Biomass vs. Non-biomass	0.3	0.2 – 0.6	0.001			
Waste Burning	0.4	0.2 – 0.6	< 0.001	0.5	0.3 - 1.1	0.068
Incense stick burning	1.7	0.9 - 2.8	0.050			
House heating with fire	0.4	0.2 – 0.6	< 0.001	0.5	0.2 – 2.9	0.025
Observed Smoke from cooking flows into the house	1.9	1.1 – 3.5	0.020	2.03	1.01-4.1	0.045
Knowledge						
Heard about Household Air Pollution	1.5	0.9 - 2.5	0.114	1.5	0.8 – 2.8	0.142
Number of Info Source:						
1 Source vs. > 1 source				0.6	0.2 – 1.2	0.140
Think that your house has air pollution	1.8	1.02-3.3	0.041			
Personal Practice and Health						
Spend time in kitchen	1.9	1.1 – 3.3	0.020			
Minutes in the kitchen/day (3 levels)			0.001*			0.003*
Play near fire/stove	2.7	1.5 – 4.9	0.001	2.1	1.1 – 3.7	0.015
Minutes spent by fire/day (3 levels)			0.001*			0.008*

* P-value for whole factor of that independent variable, not for any individual level.

APPENDIX F

Administration and Time Schedule

Order	Activities	2011					2012				
		Jun-Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	Preparation and papers review										
2	Thesis Draft, Thesis Proposal Presentation										
3	Detail and Tool development										
4	Ethical consideration										
5	Research tool try out (pilot) - test validity and reliability										
6	Revise the tool										
7	Recruitment of interviewer team										
8	Making appointment with target area authority										
9	Conduct survey/data collection/data entry										
10	Data analysis and interpretation										
11	Report writing										
12	Presentation and publication										

APPENDIX G

Budget Plan

No.	Activity	Unit	Unit Price (THB)	Quantity	Total Price (THB)
1	Pretest - Travel expense (BKK – VTE) - Accommodation - Questionnaire photocopy & stationery - Ethical approval fee in Local	 1 person 1 person 42 sets	 1500 500/day/person 10/set	 2 (go & back) 5 days -	 3,000 2,500 420 1,000
2	Data Collection - Travel expense (BKK – VTE) - Accommodation - Questionnaire photocopy - Interviewers per diem - Souvenir for households	 1 person 1 person 422 sets 10 person 422 HH	 1500 500/day/person 10/set 500/day 40/HH	 2 (go & back) 7 days - 7 days	 3,000 3,500 4,220 35,000 16,880
3	Team Work Training	10 person	300/day	1 day	3,000
4	Spare cost for other administrative necessities			-	3,000
5	Transportation cost (within VTE during data collection period)	10 person	60/person	7 days	4,200
6	Data Entry	422 form	20/form	-	8,440
7	Preliminary Finding Presentation in Local			-	2,500
8	Estimated Expense for Completion process (Documentation & Thesis Examination)	-	-	-	5,000
Total Budget					**95,660**

VITAE

Personal Information:

First name: Viengnakhone Last name: VONGXAY

Sex: Male Age: 26 Date of birth: 07th July, 1985

Place of birth: Nongsangthor village, Saysettha district, Vientiane capital, Lao PDR

Marital status: Single Religion: Buddhism Profession: MPH student

Language: 1. Lao (Maternal) 2. English (good), Thai (good), French (Fair)

Address in Laos: House 142 - Unit 11 Nongsangthor village, Saysettha district, Vientiane capital.

Current Address: Rm 710, Pet Jinda Mansion 5, 988 Urupong, Rama 6 Soi 23, Rachathewi, Bangkok, Thailand

Contact: In Laos: 85620 77805222, or 856 21 450990. In Thailand: 088 6707369

Email: viengnakhone_poom@yahoo.com

Education:

2009: Graduated Bachelor of general medicine from University of Health Sciences

2002: Finished Vientiane high school

Experiences:

2004 - 2006: A part of leaders for NUOL Youth volunteers against Drug and HIV/AIDS.

2006: Representative of NUOL for the 8th Educational Forum and Young Speakers Contest in Singapore.

2007: Assisted the 9th Educational Forum and Young Speakers Contest in Laos, Visited Nippon Medical University, Tokyo, Japan.

2009: Participated in the Doping Control Team for the 25th Sea games in Vientiane capital, Lao PDR.

2009 - 2011: work at the Faculty of Postgraduate Studies, University of Health Sciences

Scholarship received: Chulalongkorn University International Scholarship for Neighboring Countries.