# ผลของมลพิษทางอากาศในบ้านที่อยู่อาศัยเนื่องจากการใช้ยากันยุงชนิดขด ต่อปัญหาระบบทางเดินหายใจในคนงานอพยพชาวพม่า ในอำเภอแม่สอด จังหวัดตาก ประเทศไทย

น.ส. ทาราฟี

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญา สาธารณสุขศาสตรมหาบัณฑิต
สาขาวิชาสาธารณสุขศาสตร์
วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2552

ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# THE EFFECTS OF HOUSEHOLD AIR POLLUTION DUE TO BURNING OF MOSQUITO COILS ON RESPIRATORY PROBLEMS IN MYANMAR MIGRANT WORKERS IN MAE SOT DISTRICT, TAK PROVINCE, THAILAND

Ms. Tharaphy

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Public Health Program in Public Health
College of Public Health Sciences
Chulalongkorn University
Academic Year 2009
Copyright of Chulalongkorn University

| | |
|---|---|
| Thesis Title | THE EFFECTS OF HOUSEHOLD AIR POLLUTION DUE TO BURNING OF MOSQUITO COILS ON RESPIRATORY PROBLEMS IN MYANMAR MIGRANT WORKERS IN MAE SOT DISTRICT, TAK PROVINCE, THAILAND |
| By | Tharaphy |
| Field of Study | Public Health |
| Thesis Advisor | Robert Sedgwick Chapman, M.D.(Harvard Univ.), M.P.H. |

---

Accepted by the College of Public Health Sciences, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

..... Dean of the College of Public Health Sciences

(Professor Surasak Taneepanichskul, M.D.)

THESIS COMMITTEE

..... Chairman

(Assistant Professor Ratana Somrongthong, Ph.D.)

..... Thesis Advisor

(Robert S. Chapman, M.D.(Harvard Univ.), M.P.H.)

..... External Examiner

(Nanta Auamkul, M.D., M.P.H.)

ทาราฟี:ผลของมลพิษทางอากาศในบ้านที่อยู่อาศัยเนื่องจากการใช้ยากันยุงชนิดขดต่อปัญหาระบบทางเดินหายใจในคนงานอพยพชาวพม่า ในอำเภอแม่สอด จังหวัดตาก ประเทศไทย (THE EFFECTS OF HOUSEHOLD AIR POLLUTION DUE TO BURNING OF MOSQUITO COILS ON RESPIRATORY PROBLEMS IN MYANMAR MIGRANT WORKERS IN MAE SOT DISTRICT, TAK PROVINCE, THAILAND) อาจารย์ที่ปรึกษาวิทยานิพนธ์หลัก : โรเบิร์ต เอส แชฟแมน, M.D., M.P.H., 68 หน้า.

การศึกษาภาคตัดขวางครั้งนี้มีวัตถุประสงค์เพื่อศึกษาความสัมพันธ์ระหว่างการเผาไหม้ของยากันยุงแบบขดที่ใช้ในครัวเรือนกับความเสี่ยงที่ทำให้เกิดโรคระบบทางเดินหายใจของแรงงานอพยพชาวพม่าในหมู่บ้านแม่กุ อำเภอแม่สอด จังหวัดตากในประเทศไทย โดยทำการศึกษาจากผู้หญิงจำนวน 412 คน ในจำนวนนี้เป็นเด็กที่อายุต่ำกว่า 7 ปี 153 คน โดยการใช้แบบสอบถามสัมภาษณ์ในเดือนมีนาคม 2553 ในการวิเคราะห์นี้ใช้ตัวแปรอิสระ 2 ตัวแปร ประเมินความสัมพันธ์ของอาการแต่ละอาการ ผลการศึกษาพบว่าทุกกลุ่มอาการมีความสัมพันธ์ต่อการใช้ยากันยุงแบบขด $p \leq 0.15$ ในทุกกลุ่มตัวอย่าง จากสมการ logistic regression พบว่าการใช้ยากันยุงแบบขด มีผลต่อการไอ (OR=1.84, 95% CI=1.02 ถึง 3.33, p=0.045) การมีเสมหะ (OR=2.02, 95% CI=1.28 ถึง 3.19, p=0.003), และการหายใจมีเสียงฟืดฟาด (OR=2.47, 95% CI=1.52 ถึง 4.00, p<0.001) และการใช้ยากันยุงแบบขด มีผลต่อการไอ (OR=2.85, 95% CI=0.99 ถึง 8.22, p=0.052) ในการศึกษาครั้งนี้มีข้อเสนอแนะให้นำไปศึกษาในสถานที่อื่นด้วยเพื่อยืนยันถึงความสัมพันธ์ระหว่างการเผาไหม้ของยากันยุงชนิดขดที่ใช้ในครัวเรือนกับความเสี่ยงที่ทำให้เกิดโรคระบบทางเดินหายใจ และเพื่อที่จะได้หาวิธีการในการป้องกันการเกิดโรคที่เกิดจากยุง

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2552 ลายมือชื่อ อ. ที่ปรึกษาวิทยานิพนธ์หลัก Robert S. Chapman

## 5279104353 : MAJOR PUBLIC HEALTH
KEYWORDS : HOUSEHOLD AIR POLLUTION/ MOSQUITO COILS SMOKE / RESPIRATORY PROBLEMS / MYANMAR MIGRANT WORKERS / MAE SOT.

THARAPHY: THE EFFECTS OF HOUSEHOLD AIR POLLUTION DUE TO BURNING OF MOSQUITO COILS ON RESPIRATORY PROBLEMS IN MYANMAR MIGRANT WORKERS IN MAE SOT DISTRICT, TAK PROVINCE, THAILAND. THESIS ADVISOR: ROBERT SEDGWICK CHAPMAN, M.D., M.P.H., 68 pp.

The objective of this cross-sectional study was to investigate whether household burning of mosquito coils is associated with increased risk of respiratory problems among Myanmar migrant workers in Mae Ku village, Mae Sot district, Tak Province, Thailand (total 500 households). 412 female respondents and 153 children under 7 years old were included. Data were collected using a standardized, pre-tested interviewer-administered questionnaire in March 2010. Prevalences of symptoms such as cough with or without colds, phlegm with or without colds, wheeze with or without colds, shortness of breath, sore throat without cold, rhinitis and eye irritation at home were assessed in relation to mosquito coil use and other 12 independent variables that could also be associated with respiratory symptoms. In a bivariate analysis, each independent variable was assessed separately in relation to each type of prevalence. For respondents and children, semifinal multiple logistic regression models were then constructed for all symptom types for which $p \leq 0.15$ for mosquito coil use in bivariate analysis. All other independent variables for which $p \leq 0.15$ were also included in these models. Final multiple logistic models were then constructed. In these, mosquito coil use was entered, as were all other independent variables for which $p \leq 0.15$ in semifinal models. Final logistic regression models showed that in respondents, mosquito coil use had positive significant associations with cough with or without colds (OR=1.84, 95% CI=1.02 to 3.33, p=0.045), phlegm with or without colds (OR=2.02, 95% CI=1.28 to 3.19, p=0.003), and wheeze with or without colds (OR=2.47, 95% CI=1.52 to 4.00, $p<0.001$). In children, there was a marginally significant positive association of cough with or without cold with mosquito coil use (OR=2.85, 95% CI=0.99 to 8.22, p=0.052). These results strongly suggest that mosquito coil burning is a respiratory risk factor in the study population, but do not prove causality. The observed associations should be investigated further. If they are confirmed, other methods of controlling exposure to mosquitoes (such as lemon grass) should be sought for preventing mosquito-borne diseases. Health and economic risks and benefits of mosquito coil burning should be characterized carefully before policy decisions are made.

Field of Study :Public Health Student's Signature

Academic Year :2009 Advisor's Signature Robert S. Chapman

# ACKNOWLEDGMENTS

I would like to express my deep appreciation to Doctor Robert Sedgwick Chapman, my thesis advisor, for his guidance and supervision throughout this study. His invaluable advices have motivated me on doing research.

I also would like to thank my thesis exam committee members, Assistant Professor Ratana Somrongthong, my chairperson and Doctor Nanta Auamkul, my thesis examiner, for providing me valuable suggestions and comments on my proposal and thesis as well.

I take this opportunity to thank Prof. Robson and the Thai Fogarty Committees for supporting to get scholarship for my research grant.

My sincere thanks to my family for their love and encouragement during my study in Thailand. I also want to thank my friends, classmate, for being my friends and supporting me in their kindly and friendly ways.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# CONTENTS

Page

# LIST OF TABLES

Page



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# LIST OF FIGURES



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# LIST OF ABBREVIATIONS

IAP: Indoor Air Pollution

ARI: Acute Respiratory Infections

LRI: Lower Respiratory Tract Infections

COPD: Chronic Obstructive Pulmonary Diseases

DALYs: Disability Adjusted Life Years Loss

MAP: Migrant Assistance Programme

NGO: Non Governmental Organization

LPG: Liquid Petroleum Gas

WHO: World Health Organization

PAHs: Polycyclic Aromatic Hydrocarbons

PM: Particulate Matter

ETS: Environmental Tobacco Smoke

OR: Odd Ratio

BCME: Bis cholomethyl ether

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# CHAPTER I
# INTRODUCTION

## 1.1 Background and Rationale

Globally, indoor and outdoor environments are widely contaminated by complex mixtures of gases and particles that are produced by combustion of various types of fuels. Sources of indoor pollution include cooking stoves, cigarettes smoking, burning of various fuels for indoor heating, burning of mosquito coils and burning of incense for religious purposes (Smith KR et al., 2000).

Indoor Air Pollution (IAP) is a major environmental and public health challenge in developing countries because exposure to IAP may be responsible for nearly 2 million excess deaths in developing countries, and it is accountable for about 4% of the global burden of disease (Indoor Air Pollution at a glance, 2002). There is strong evidence that chronic exposure to IAP increase the risk of respiratory illness including acute respiratory infections in children and chronic obstructive pulmonary disease in adults (Bulletin of WHO, Geneva 2000).

Globally, IAP ranks eighth in terms of disability adjusted life years lost (DALYs) and ranks eleventh in terms of mortality (Ezzati et al., 2002). In South Asia, Indoor Air Pollution ranks third among all major risk factors (Smith, 2003).

In many tropical and subtropical countries, burning mosquito coils is a key strategy for reducing mosquito bites. Although effective at combating mosquitoes, chemical-emitting coils may pose unintended hazards to respiratory health. Despite the fact that mosquito coil smoke may have many potential adverse health effects, large populations in developing countries use mosquito coils in their daily life to prevent vector bone diseases (Liu and Zhang et al.,2003).

In Asian countries where the Buddhism and Taoism are mainstream religions, such as China, Thailand, and Taiwan, incense burning is a daily practice. People who are exposed to incense fumes always inhale the whole complex mixture that contains particulate matter, gas products and many organic compounds. It is difficult to single out the health effects contributed by a certain component in the fumes. For example,

there hasn't been any report about the ill effects on human health directly caused by the particles in the incense smoke. Nevertheless, it is still helpful to know the composition of incense smoke in terms of types of pollutants and the corresponding toxicological effects (Lin et al., 2008).

Within the home environment, women and children are sometimes exposed to high levels of indoor air pollution from cooking fires, particularly when wood and charcoal combine with poor ventilation and overcrowding. The use of inefficient fuels such as charcoal and wood fuel is particularly common in poor households. Small-scale industries operated by poor women in the home and neighborhood environment such as fish smoking, brewing, and local food manufacturing add to the risks of indoor air pollution (Songsore and McGranahan, 1998).

Nearly half of the world‟s households are thought to cook daily with unprocessed solid fuels that are biomass fuels or coal. In a significant proportion of the household using biomass fuel, the bulk of the emissions is released to the living area (Smith KR,1987).

Tak province, located in northwest Thailand, shares a border of 570 kilometers with Burma and has a population of approximately 150,000 Burmese migrants. Migrants are primarily ethnic Karen from directly across the border where families are continuously uprooted. Whether fleeing conflict, persecution or economic destitution in Burma, those deemed illegal migrants primarily journey to Tak province, in search of protection and an economic livelihood in seasonal agricultural work or in one of hundreds of factories in the surrounding area. Mae Sot already has the largest Burmese population of any Thai town, estimated by aid workers at more than 80,000. Migrant Assistance Programme (MAP), an NGO, estimates between 1.5 and two million Burmese live in Thailand, of whom 500,000 are legally registered. With more than 50 large factories near Mae Sot, hundreds of smaller shop and house operations, and a large agricultural industry, Burmese migrant workers provide a source of cheap labor.

There are many Myanmar migrant workers in Mae Sot District in Thailand who use mosquito coils to protect themselves from disease bearing mosquitoes and some of them use incense for religious purposes. Some also use wood and charcoal fuel for cooking. Their homes often have poor ventilation because of indoor cooking and

share living in small rooms. Thus, they may be at high risk of respiratory problems due to indoor air pollution.

While many studies have been conducted on indoor air pollution related disease in developing countries, there is no known study of this kind in Myanmar migrant workers in Thailand. Thus, this study can be considered as a baseline to obtain frequency of respiratory effects associated with indoor air pollution among Myanmar migrant workers.

## 1.2 Objectives

### 1.2.1 Main objective

To investigate whether indoor air pollution from household burning of mosquito coils is associated with increased risk of respiratory problems in Myanmar migrant workers.

### 1.2.2 Specific objectives

1. To describe the environmental factors (indoor air pollution), demographic factors and respiratory problems in Myanmar migrant workers.

2. To examine the relationship between use of mosquito coils and respiratory problems in Myanmar migrant workers.

3. To examine the relationships between other environmental factors, e.g., cooking fuels and incense burning, and respiratory problems in Myanmar migrant workers.

4. To examine the relationships between socio-demographic factors and respiratory problems in Myanmar migrant workers.

**1.3 Research Questions**

1. Is exposure to mosquito coil smoke associated with increased risk of respiratory symptoms in Myanmar migrant workers in Mae Sot district in Tak province in Thailand?

2. Is variation in exposure to other environmental factors, e.g., cooking fuels and incense burning, associated with variation in prevalence of respiratory problems in Myanmar migrant workers in Mae Sot district in Tak province in Thailand?

3. Is variation in socio-demographic factors associated with variation in prevalence of respiratory problems in Myanmar migrant workers?

4. Is variation is behavioral factors associated with variation in prevalence of respiratory problems in Myanmar migrant workers?

**Research Hypotheses**

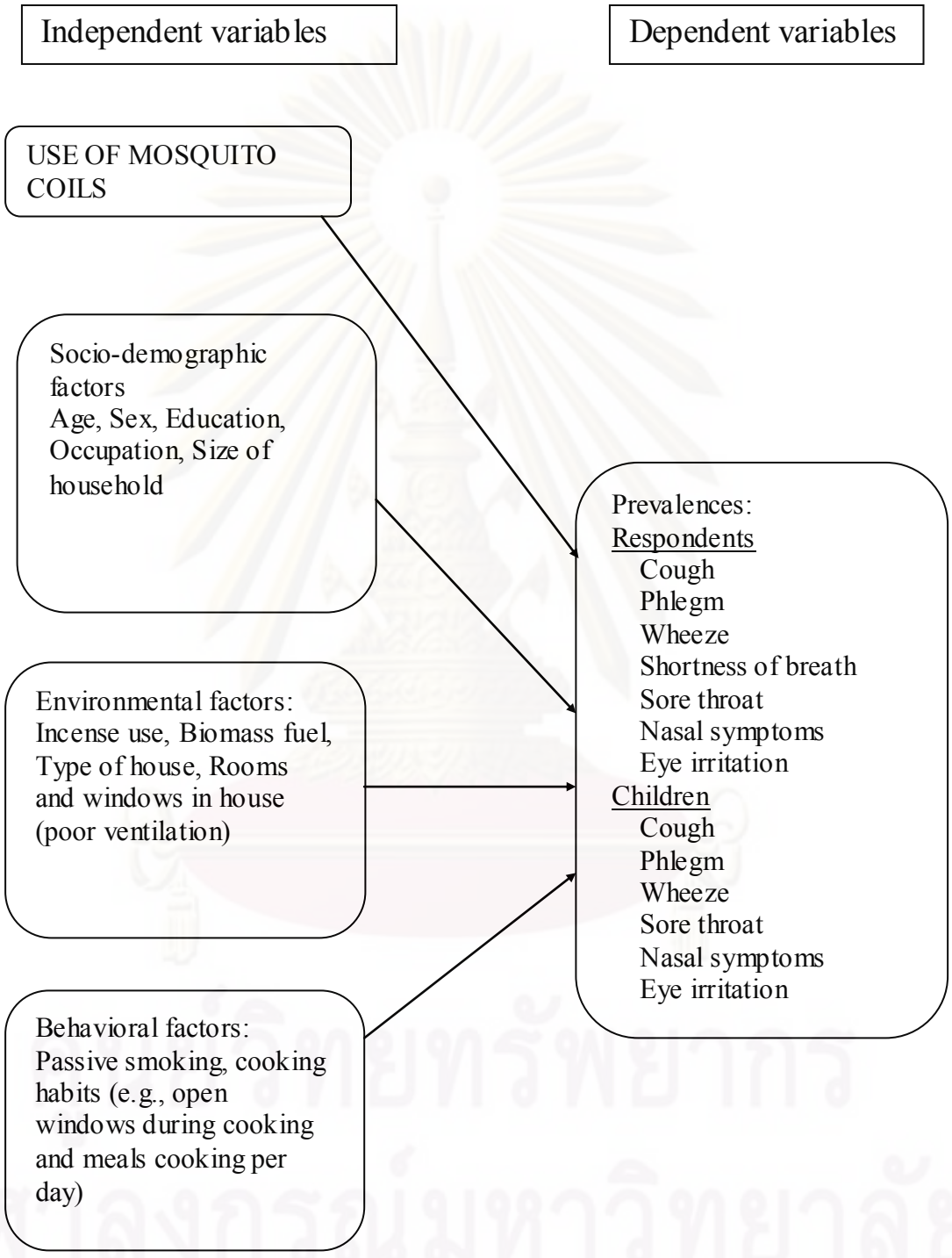
1. Exposure to mosquito coil smoke is associated with increased risk of respiratory symptoms in Myanmar migrant workers in Mae Sot district in Tak Province in Thailand.

2. Variation in exposure to other environmental factors, e.g., cooking fuels and incense burning, is associated with variation in prevalence of respiratory problems in Myanmar migrant workers in Mae Sot district in Tak Province in Thailand.

3. Variation in socio-demographic factors is associated with variation in prevalence of respiratory problems in Myanmar migrant workers.

4. Variation in behavioral factors is associated with variation in prevalence of respiratory problems in Myanmar migrant workers.

**1.4 Conceptual Framework**



### 1.5 Operational definitions

**Indoor air pollution:** mixture of gases and particles produced by combustion of mosquito coils, smoking, incense sticks, wood and charcoal fuels.

**Mosquito coils:** Mosquito coil is mosquito-repelling incense, usually shaped into a spiral, and typically made from a dried paste of pyrethrum powder.

**Incense:** incense is composed of aromatic biotic materials, which release fragrant smoke when burned and it is used mainly for religious purpose.

**Biomass fuel:** refers to wood or charcoal fuel burned for household cooking and heating.

**Passive smoking:** exposure from smoking by other family members.

**Socio-demographic factors:** age, sex and education of the migrants. (Socio-economic status of the family does not include because the participant would not wish to answer about income).

**Size of household**: number of people in the household.

**Respiratory prevalence:** An estimate of respiratory symptoms within a population over a certain period of time. A symptom is a departure from normal function or feeling which is noticed by a patient, indicating the presence of disease or abnormality.

**Cough:** coughs either with colds or in the absence of cold.

**Phlegm:** bringing up phlegm or mucus from the person"s chest either with colds or in the absence of colds.

**Wheeze**: ever wheeze with cold or sound wheezy or whistling in the chest in the absence of colds.

**Sore throat:** having sore throat without having a cold.

**Nasal symptoms**: problem with sneezing, or a runny, or a blocked nose in the absence of colds.

**Eye irritation:** feeling sore or itchy or irritated eyes at home.

# CHAPTER II
# LITERATURE REVIEW

## 2.1 Indoor Air Pollution

The annual global disease burden attributable to IAP at 1.8 million deaths and 53 million DALYs, more than 4% of the total global burden of disease, and three times the burden attributable to outdoor air pollution. (Indoor Air Pollution at a glance, 2002). In terms of its contribution to the global disease burden, Indoor Air Pollution ranks fourth among preventable risk factors, after malnutrition, lack of clean water and sanitation, and unsafe sex, and on par with tobacco and alcohol. China and India together account for about 58% of deaths and 48% of the DALYs from IAP (WHO, 2005).

Other sources of indoor air pollution exist in developing countries, beyond indoor fuel burning and inadequate ventilation. These sources include: smoke from nearby houses, the burning of forests, agricultural land and household waste and industrial and vehicle emissions. Pollution from these sources can easily infiltrate dwellings as windows and doors are often left open during the day, even during the winter. An inherent contradiction exists in these areas: windows must remain open to provide ventilation inside dwellings when cooking, but when open, windows allow neighborhoods and sometimes industrial pollution to enter the dwelling (Bruce et al., 2000). Additional sources, which have been examined in previous studies, include environmental tobacco smoke and pesticides (mosquito coils) (Dasgupta et al., 2004).

Indoor air pollution from biomass smoke is now regarded as a significant public health hazard in the developing world, where more than two billion people still rely on the use of solid bio-fuels such as dung, wood, crop residue, and coal for cooking daily meals and heating homes. About half of the world's households still use unprocessed solid fuels, ranging near zero in developed countries to more than 80% in the countries such as China, India, and Sub-Saharan Africa ( Smith, 2002).

In developed countries, modernization has without exception been accompanied by a shift from biofuel to petroleum products (kerosene, LPG) and

electricity. In developing countries, even where cleaner more sophisticated fuels are available, households often continue to use biomass (Smith, 1987). Although the portion of global energy derived from biofuel has fallen from 50% in 1900 to around 13% currently, this trend has leveled and there is evidence that biofuel use is increasing among the poor (WRI, 1999). Poverty is one of the main barriers to the adoption of cleaner fuels and slow pace of development in many countries implies that biofuels will continue to be used by the poor for many decades (WHO, 2000).

**2.2 Mosquito coils: Background and Exposure**

Mosquito coils, when used, are usually used on a daily basis to control mosquitoes in tropical areas and seasonally in subtropical and temperate areas. (Liu and Zhang et al., 2003). People in residences are often protected from nuisance and disease-bearing mosquitoes by insecticides or smoke generated from burning mosquito coils. Mosquito coils are frequently burned indoors in Asia and to a limited extent in other parts of the world, including the United States. (World Health Organization: Safety of Pyrethroids for Public Health Use, 2005). A World Health Organization (WHO) report estimated the worldwide annual consumption of mosquito coils to be approximately 29 billion pieces (WHO Pesticides Evaluation Scheme, 1998).

Mosquito coils are the preferred anti mosquito products in low income countries (Mulla et al.2001). The mosquito coil is widely known as an efficient mosquito repellent. The major active ingredients of the mosquito coil are pyrethrins, accounting for about 0.3–0.4% of coil mass (Lukwa and Chandiwana 1998). The remaining components of mosquito coil are organic fillers, binders, dyes, and other additives capable of smoldering well. The combustion of the remaining materials generates large amounts of sub micrometer particles and gaseous pollutants. These sub micrometer particles can reach the lower respiratory tract and may be coated with a wide range of organic compounds, some of which are carcinogens or suspected carcinogens, such as polycyclic aromatic hydrocarbons (PAHs) generated through incomplete combustion of biomass (mosquito coil base materials).

Burning one mosquito coil releases the same amount of particulate matter (PM2.5) as burning 75-137 cigarettes. Also, the emission of formaldehyde from burning one coil can be as high as that released from burning 51 cigarettes (Liu et al., 2003). Researchers have found that the gas phase of mosquito coil smoke contain some carbonyl compounds with properties that can produce strong irritating effects on upper respiratory tract, for example, formaldehyde and acetaldehyde (Chang and Lin, 1998).

When a mosquito coil is burned, the insecticides evaporate with the smoke, which prevents the mosquito from entering the room. Pyrethrins are thought to be of low chronic toxicity to humans and low reproductive toxicity in animals, although headache, nausea, and dizziness were observed in male sprayers exposed to 0.01–1.98 µg/m3 pyrethrins for 0.5–5 hr (Zhang et al., 1991).

**2.3 Mosquito Coils and Health Effects**

Toxicological effects of mosquito coil smoke on rats include focal deciliation of the tracheal epithelium, metaplasia of epithelial cells, and morphologic alteration of the alveolar macrophages. (Liu and Sun, 1988; Liu and Wong, 1987). For example, when a group of 30 female albino rats were exposed to mosquito coil smoke in a 22.5 m3 chamber for 8 hour per day, 6 days per week, for 6 months, these rats lost typical ruffled membranes of their alveolar macrophages. In addition, the levels of total protein and lecithin and the activities of lactate dehydrogenase, acid phosphatase, and beta glucuronidase in the lung- lavage fluid of the tars were significantly higher than those in a control group that was exposed to air for the same exposure duration (Liu et al., 1989).

Epidemiologic studies have shown that long-term exposure to mosquito coil smoke is associated with asthma and persistent wheeze in children (Azizi and Henry, 1991; Fagbule and Ekanem, 1994). The effects of Indoor Environmental Factors on Respiratory Illness were studied in 7- 12 year old school children in Kuala Lumpur. Higher prevalence of respiratory symptoms and illnesses were observed almost uniformly in children exposed to mosquito coil smoke and passive smoking. Exposure to mosquito coil smoke was confirmed to be independently associated with asthma

(odd ratio= 1.4, p= 0.001) and persistent wheeze (odd ratio= 1.4, p= 0.005). Indoor sources of air pollution belonged to three groups of activity, namely tobacco smoking, avoiding mosquito bites and cooking. Almost all of these activities could result in prolonged exposures to potentially harmful substances. (Azizi and Henry, 1991). A case-control study of home environmental risk factors for childhood asthma was studied in 140 pairs of children (mean age is 66 months) in Nigeria. Exposure to mosquito coil smoke was strong and significantly associated with asthma (odd ratio = 3.7, $p < 0.001$) (Fagbule and Ekanem, 1994).

Mosquito coil use (relative to non-use) (1.27; 0.99 to 1.62; p=0.058) had an impact on the respiratory health of male adults in Hong Kong. Odds Ratios of mosquito coil use on respiratory symptoms such as sore throat, morning cough, evening cough, phlegm in the morning, phlegm day or night and phlegm for 3 months were 1.84, 1.51, 1.68, 1.23, 1.36 and 1.01 respectively. Among these symptoms, sore throat and cough (both morning and evening cough) were significantly associated with mosquito coil use ($p < 0.05$). But there was no significant positive association between mosquito coils usage and phlegm. Exposure to incense smoke was not statistically significantly associated with any of the above respiratory symptoms (Hu and Wong et al., 2004).

The effects of ambient air pollution and environmental tobacco smoke on respiratory health of non smoking women (mean age 36.5 years, standard deviation= 3.0) were studied in Hong Kong. Mosquito coil use was significantly associated with respiratory symptoms (OR= 1.58, 95% CI: 1.14 to 2.21, p= 0.007). Cooking fuel type (gas stove) posed a high risk for non-smoking women, but it was not significant (OR= 2.16, 95% CI: 0.86 to 5.43, p= 0.101). Environmental Tobacco Smoke (ETS) exposure also showed a significant hazardous effect in non-smokers and mosquito coil use was found to be harmful to respiratory health of non-smoking women. There was no significant association between incense use and respiratory symptoms (Wong et al., 1999).

Researchers from the University of California-Riverside analyzed mosquito coils purchased in various retail outlets in Jakarta and Bandung, Indonesia, in addition to others purchased at several Asian markets in Southern California. The mosquito coils purchased in the U.S. contained octachlorodipropyl ether, known as S-2, a

substance not registered for any legal use in the United States. The packaging did not indicate S-2 was an ingredient. Use of those coils likely exposes those around it to bis (chloromethyl) ether, or BCME, an extremely potent lung carcinogen (Krieger et al., 2003).

**2.4 Incense**

The burning of incense is an integral part of daily life in large parts of Asia, and in addition to use in places of worship, approximately half of populations across South-East Asia burn incense at home on a daily basis ( Lee and Lin et al.,2003 ). Several studies from Asian populations, where different types of incense are burnt for religious purposes, reported significant associations between exposure to incense smoke and respiratory symptoms (Lin and Krishnaswamy et al., 2008).

Combusted incense, wood, cigarettes, and candles are important sources of residential indoor particulate matter, especially in the 2.5 µm size range and below (Fang GC, Chang CN et al., 2002).

**2.5 Environmental tobacco smoke (ETS)**

Exposure to environmental tobacco smoke is a major environmental health hazard. The association between environmental tobacco smoke exposure and respiratory morbidity has also been shown for older children and adolescents.

ETS contains the same constituents that are known to cause respiratory disease in people who smoke. In adults, ETS is a human lung carcinogen, responsible for approximately 3,000 lung cancer deaths annually in U.S. nonsmokers. In children, ETS exposure is associated with increased prevalence of respiratory symptoms of irritation (cough, sputum, and wheeze) and also increased risk of lower respiratory tract infections (LRIs) such as bronchitis and pneumonia. ETS exposure is a risk factor for new cases of asthma in children who have not previously displayed symptoms (US Environmental Protection Agency, 1992).Environmental tobacco smoke is a major source of indoor air contaminants. The ubiquitous nature of ETS in indoor environments indicates that some unintentional inhalation of ETS by

nonsmokers is unavoidable. Environmental tobacco smoke is a dynamic, complex mixture of more than 4,000 chemicals found in both vapor and particle phases. Many of these chemicals are known toxic or carcinogenic agents. Nonsmoker exposure to ETS-related toxic and carcinogenic substances will occur in indoor spaces where there is smoking (http://www.epa.gov/iaq/pubs/hpguide.html).

The role of exposure to tobacco smoke via active smoking as a cause of lung and other cancers, emphysema and other chronic obstructive pulmonary diseases, and cardiovascular and other diseases in adults has been firmly established (Samet and Marbury, et al, 1987).

**2.6. Respiratory Symptoms Prevalence's observed in selected Asian studies of adults and children**.

The following tables showed the prevalence"s of respiratory symptoms (cough, phlegm, persistent cough and phlegm, wheezing, asthma, shortness of breath, sore throat, rhinitis and bronchitis) in adults and children, as observed in many selected Asian studies. We have been able to find no information on respiratory symptom rates in Myanmar migrants. Thus, the purpose of making these tables was to try to form an expectation of what these symptom rates might be in Myanmar migrants, to support sample size calculations.

As the tables show, there was much variation in symptom rates among Asian studies. Thus, it was not possible to form expectations as to symptom rates in the study population. As discussed in the methods section, symptom rates were presumed to be 50%.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**Table 1. Prevalence of cough (in percent) observed on selected Asian studies of adults and children**.

| Citation | Description | Adult males | Adult females | Children |
|---|---|---|---|---|
| S.G Ong 1991, Studies on Respiratory Health of primary school children in urban communities of Hong Kong. | Morning cough<br>Night cough | 6.4 to 9.1<br>4.7 to 7.7 | 2.2 to 3.4<br>2.6 to 2.7 | 8.2 to 10.1<br>8 to 10.5 |
| Zhang 1999, Effects of Air Pollution on Respiratory Health of adults in 3 Chinese cities. | Cough with or without colds | 31 to 56.1 | 18.5 to 54.3 | |
| Zhang and Wei 2002, Children"s Respiratory Morbidity Prevalence in relation to Air Pollution in 4 Chinese cities. | Persistent cough <12 yrs | | | 5.7 to 14 |
| Chhabra 2001, Ambient Air Pollution and Chronic Respiratory Morbidity in Delhi. | Chronic cough | 9.7 | 10.8 | |
| Kumar 2004, Association of outdoor Air Pollution with chronic respiratory morbidity in industrial town in Northern India. | Morning cough<br>Day and night cough | 14.2<br>12.8 | 10.1<br>9.6 | |
| Ingle 2005, Exposure to vehicular pollution and respiratory impairment of Traffic policeman in Jalgaon City, India. | Frequent cough | 40 | | |
| Lahiri and Roy et al 2000, Air Pollution in Calcutta elicits adverse pulmonary reaction in children. | Cough unspecified | | | 19 |
| Duki 2003, Effects of Air Pollution on Respiratory Health in Indonesia and its economic cost. | Cough unspecified | | 16.5 to 29.3 | 11.6 to 41.0 |
| Hong 2004, Prevalence of Respiratory Symptom in children and air quality by village in Rural Indonesia. | Cough unspecified | | | 19.8 to 40.5 |
| Karita 2004, Effects of working and residential location area on air pollution related Respiratory symptoms in Policeman and their wives in Bangkok, | Cough unspecified | 18.3 | 5.1 | |

| | | | | |
|---|---|---|---|---|
| Thailand. | | | | |
| Karita 2001, Respiratory Symptom and Pulmonary function among Traffic Police in Bangkok, Thailand. | Cough unspecified | 8.8 to 15 | | |
| Tamura 2003, Particulate Air Pollution and chronic respiratory symptom among Traffic Policeman, Bangkok, Thailand. | Cough unspecified | 0.3 to 2.1 | | |
| Wongsurakiat 1999, Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Thailand. | Cough unspecified | 18.6 | | |
| Langkulsen 2006, Respiratory Symptoms and lung function in Bangkok school children. | Persistent cough | | | 1.7 to 8.2 |

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**Table 2. Prevalence of Phlegm (in percent) observed on selected Asian studies of adults and children**.

| Citation | Description | Adult males | Adult females | Children |
|---|---|---|---|---|
| S.G Ong 1991, Studies on Respiratory Health of primary school children in urban communities of Hong Kong. | Morning<br>Day or night | 15 to 17.2<br>9.3 to 12.4 | 5.5 to 7.4<br>3.1 to 4.9 | 10.8 to 13.7<br>10.8 to 11 |
| Zhang 1999, Effects of Air Pollution on Respiratory Health of adults in 3 Chinese cities. | Phlegm with or without colds | 24.2 to 35 | 12.7 to 23.1 | 1.9 to 13.6 |
| Chhabra 2001, Ambient Air Pollution and Chronic Respiratory Morbidity in Delhi. | Phlegm unspecified | 9.2 | 9.2 | |
| Kumar 2004, Association of outdoor Air Pollution with chronic respiratory morbidity in industrial town in Northern India. | Phlegm unspecified | 15.6 | 10.7 | |
| Duki 2003, Effects of Air Pollution on Respiratory Health in Indonesia and its economic cost. | Phlegm unspecified | | 6 to 16.4 | 6 to 36.6 |
| Karita 2004, Effects of working and residential location area on air pollution related Respiratory symptoms in Policeman and their wives in Bangkok. | Phlegm unspecified | 30.9 | 4.2 | |
| Karita 2001, Respiratory Symptom and Pulmonary function among Traffic Police in Bangkok, Thailand. | Phlegm unspecified | 16.4 to 24.4 | | |
| Tamura 2003, Particulate Air Pollution and chronic respiratory symptom among Traffic Policeman, Bangkok. | Phlegm unspecified | 1.3 to 3.3 | | |
| Wongsurakiat 1999, Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Thailand. | Phlegm unspecified | 18.6 | | |
| Langkulsen 2006, Respiratory Symptoms and lung function in Bangkok school children. | Persistent phlegm | | | 2.5 to 9 |

**Table 3. Prevalence of persistent cough and phlegm and chronic bronchitis (in percent) observed on selected Asian studies of adults and children.**

| Disorder and citation | Adult males | Adult females | Children |
|---|---|---|---|
| PERSISTENT COUGH AND PHLEGM | | | |
| Zhang 1999, Effects of Air Pollution on Respiratory Health of adults in 3 Chinese cities. | 1.3 to 9.1 | 0.2 to 2 | |
| Wongsurakiat 1999, Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Thailand. | 1.5 to 2.6 | | |
| CHRONIC BRONCHITIS | | | |
| Tamura 2003, Particulate Air Pollution and chronic respiratory symptom among Traffic Policeman, Bangkok. | 2.4 to 3 | | |
| Wongsurakiat 1999, Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Bangkok. | 2.1 | | |
| Langkulsen 2006, Respiratory Symptoms and lung function in Bangkok school children. | | | 1.7 to 8.1 |

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**Table 4. Prevalence of wheezing (in percent) observed on selected Asian studies of adults and children**.

| Citation | Adult males | Adult females | Children |
|---|---|---|---|
| S.G Ong 1991, Studies on Respiratory Health of primary school children in urban communities of Hong Kong. | | | 8.1 to 9 |
| Zhang 1999, Effects of Air Pollution on Respiratory Health of adults in 3 Chinese cities. | 2.4 to 21 | 1.1 to 14.3 | |
| Zhang and Wei 2002, Children"s Respiratory Morbidity Prevalence in relation to Air Pollution in 4 Chinese cities. | | | 6.6 to 18.8 |
| Chhabra 2001, Ambient Air Pollution and Chronic Respiratory Morbidity in Delhi. | 10.9 | 10.2 | |
| Kumar 2004, Association of outdoor Air Pollution with chronic respiratory morbidity in industrial town in Northern India. | 7 | 7.6 | |
| Lahiri and Roy et al 2000, Air Pollution in Calcutta elicits adverse pulmonary reaction in children. | | | 8 |
| Duki 2003, Effects of Air Pollution on Respiratory Health in Indonesia and its economic cost. | | | 3 to 17.4 |
| Hong 2004, Prevalence of Respiratory Symptom in children and air quality by village in Rural Indonesia. | | | 8.3 to 11.1 |
| Karita 2004, Effects of working and residential location area on air pollution related Respiratory symptoms in Policeman and their wives in Bangkok. | 27.7 | 17.9 | |
| Karita 2001, Respiratory Symptom and Pulmonary function among Traffic Police in Bangkok, Thailand. | 1.5 to 3.8 | | |
| Tamura 2003, Particulate Air Pollution and chronic respiratory symptom among Traffic Policeman, Bangkok. | 6.8 to 9.2 | | |
| Langkulsen 2006, Respiratory Symptoms and lung function in Bangkok school children. | | | 2.7 to 17.7 |

**Table 5. Prevalence of Asthma (in percent) observed on selected Asian studies of adults and children**.

| Citation | Adult males | Adult females | Children |
|---|---|---|---|
| S.G Ong 1991, Studies on Respiratory Health of primary school children in urban communities of Hong Kong. | 0.6 to 1 | 1.1 to 1.2 | |
| Zhang 1999, Effects of Air Pollution on Respiratory Health of adults in 3 Chinese cities. | 0 to 6 | 0.3 to 1.4 | |
| Zhang and Wei 2002, Children"s Respiratory Morbidity Prevalence in relation to Air Pollution in 4 Chinese cities. | | | 1.4 to 4.2 |
| Chhabra 2001, Ambient Air Pollution and Chronic Respiratory Morbidity in Delhi. | 11.8 | 11.2 | |
| Duki 2003, Effects of Air Pollution on Respiratory Health in Indonesia and its economic cost. | | 7.9 to 9 | 2 to 12.3 |
| Tamura 2003, Particulate Air Pollution and chronic respiratory symptom among Traffic Policeman, Bangkok. | 0.6 to 0.9 | | |
| Wongsurakiat 1999, Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Thailand. | 2.1 | | |
| Langkulsen 2006, Respiratory Symptoms and lung function in Bangkok school children. | | | 1 to 4.4 |

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**Table 6. Prevalence of shortness of breath, sore throat, rhinitis, and bronchitis (in percent) observed on selected Asian studies of adults and children**.

| Disorder and citation | Adult males | Adult females | Children |
|---|---|---|---|
| SHORTNESS OF BREATH | | | |
| Chhabra 2001, Ambient Air Pollution and Chronic Respiratory Morbidity in Delhi. | 10.5 | 11.7 | |
| Kumar 2004, Association of outdoor Air Pollution with chronic respiratory morbidity in industrial town in Northern India. | 13.8 | 24.9 | |
| Karita 2004, Effects of working and residential location area on air pollution related Respiratory symptoms in Policeman and their wives in Bangkok. | 4.3 | 6.2 | |
| Wongsurakiat 1999, Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Thailand. | 18.6 | | |
| SORE THROAT | | | |
| S.G Ong 1991, Studies on Respiratory Health of primary school children in urban communities of Hong Kong. | 10.3 to 10.5 | 6.8 to 8.6 | 5.6 to 8.7 |
| RHINITIS | | | |
| Lahiri and Roy et al 2000, Air Pollution in Calcutta elicits adverse pulmonary reaction in children. | | | 10 |
| Hong 2004, Prevalence of Respiratory Symptom in children and air quality by village in Rural Indonesia. | | | 4.1 to 9.5 |
| Wongsurakiat 1999, Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Thailand. | 17.8 | | |
| BRONCHITIS | | | |
| Tamura 2003, Particulate Air Pollution and chronic respiratory symptom among Traffic Policeman, Bangkok. | 3.5 to 9 | | |
| Zhang 1999, Effects of Air Pollution on Respiratory Health of adults in 3 Chinese cities. | 6.2 to 31.3 | 2.9 to 14.2 | |
| Zhang and Wei 2002, Children"s Respiratory Morbidity Prevalence in relation to Air Pollution in 4 Chinese cities. | | | 15.6 to 52.2 |
| Chhabra 2001, Ambient Air Pollution and Chronic Respiratory Morbidity in Delhi. | 4.6 | 5.9 | |
| Lahiri and Roy et al 2000, Air Pollution in Calcutta elicits adverse pulmonary reaction in children. | | | 1 |

# CHAPTER III

## RESEARCH METHODOLOGY

### 3.1 Research design

The research design was a quantitative, cross-sectional study.

### 3.2 Study area

The study was done in Mae Ku Village, which is about 22 kilometers away from Mae Sot Town in Tak Province, in the north of Thailand. Mae Sot Town is on the Moei River, across from Myawaddy, Karen State, Burma, which is due east of the capital Rangoon. While there is no reliable data available on migrant worker demographics in Mae Sot, non-governmental organizations (NGOs) estimate that 70 percent of migrant workers in Mae Sot are women, mostly in their teens to mid-twenties. Migrants are employed primarily in factories producing textile and garments, cement, food processing and ceramics. Migrants are also employed in agriculture, restaurants, construction, domestic work, sex work and in shops and small businesses.

### 3.3 Study period

Started from March 12$^{th}$ to March 22$^{nd}$, 2010.

### 3.4 Study population

In Mae Ku, there are 1423 males, 1281 females and 245 children in that area. Most of them are agricultural workers (corn farmers) with low education level and poor socio-economic status. There are about 500 households in that area. About 60% of the population use mosquito coils (from personal observation). Mother or female guardian or wife of the household and the children under seven years old age residing in Mae Ku (agricultural village) constituted the target study population. The child closet to the age of 5 years old was chosen because this is the age group in which the children's symptom questions were most applicable and relevant.

**3.5 Sampling technique**

Each interviewer went to a unique area of the village; interviewers collected data in 412 out of a total of 500 households in the village (82.4%). One area of the village was not covered in data collection. This could conceivably introduce bias, but according to the researcher's personal observation, there were no differences between that area and others covered in the study. Thus, the researcher is confident that any such bias would have been small.

**3.6 Measurement Tools**

Structure standardized questionnaire was used and interviewed female guardian and children closet to age of 5 years old. Questionnaire contained 1. General household situation, 2. About mosquito coil and incense use, 3. About respiratory problems. The structured questionnaires are based on extensive literature review. Some standard questions are adopted from literature (e.g. The American Thoracic Society‟s ATS Questionnaire and International Study of Asthma and Allergies in childhood ISAAC Questionnaire). Some are constructed in support of the study„s conceptual framework. The instrument was reviewed by experts to carry out content validity for this study to make the questions valid and reliable. Their comments was noted and changed made accordingly with discussion with the adviser. The draft questionnaire was pre-tested in 30 households of Myanmar migrants in Mae Sot town prior to data collection. All pre-tested respondents understood all questions clearly, so no questions were changed for the full-scale study.

**3.7 Data Collection**

Data were collected by 10 trained interviewers. Mother or female guardian or wife of the household and the children under seven years old age were asked related about indoor mosquito coils use and related question about respiratory symptoms. Information on children was collected directly from the mother. Data was collected by face to face interviews of the studied population. The interviewers were hired to interview the respondents. The interviewers were trained for 1 day to do the structured questionnaire interview. They were trained to use same language and terminology consistently while interviewing. They also were trained to demonstrate the nature of

respiratory symptoms (For example, if the respondent was not clear on wheeze, the interviewer simulated wheezing). The questionnaires were translated into Burmese language. All the respondents were asked the same questionnaire. After completion of interview, the interviewer would check the error or the omission of interviewer and the questionnaires were checked by the researcher immediately after interview.

**3.8 Sample size calculation**

Sample size in this research was calculated by Cochran's formula that is created by Daniel, (Daniel, 2005).

$$n = \frac{z^2 p q}{d^2}$$

n = sample size
z = standard value for 95% confidence interval = 1.96
d = error allowance = 0.05
p =0.5 (because a lot of variation and symptom rates were observed in literature review and cannot use as baseline symptom rates from those literature. So assume symptom prevalence as 50% in order to maximize the sample size)

q = 1-p = 1-0.5 = 0.5

$$n = \frac{(1.96)^2 (0.5) (0.5)}{(0.05)^2} = 384$$

Add 10% of the calculated for missing data and refusals to participate = 38

Total sample size = 422 (households). 412 households were included in the full-scale study. This represents 97.6% of the calculated sample size.

**3.9 Data Analysis**

Data collected were analyzed by SPSS (Windows software package) program as follows:

3.9.1 Descriptive statistics including frequencies and percentage were used to describe socio-demographic factors, characteristic of children, environmental factors, behavioral factors and respiratory symptom prevalences in respondents and in children. Mean, median and Standard Deviation (S.D.) were calculated in the socio-demographic characteristics of respondents and characteristics of children.

3.9.2 Analytical (inferential) component. The researcher analyzed the data to assess relationships between socio-demographic factors, characteristic of children,

environmental factors, behavioral factors (independent variables) and respiratory symptom prevalences (dependent variables which are dichotomous variables). In a bivariate analysis, chi-square test was used to find association between independent variables and dependent variables and analysis was performed separately for each independent variable, and separately for the adult female respondents and for children. In bivariate analysis tables, the researcher only included independent variables with p value less than or equal to 0.15.

Semifinal multiple logistic models were constructed for symptom types for which $p \leq 0.15$ for mosquito coil use. In these models, mosquito coil use and all other independent variables for which $p \leq 0.15$ were entered. Final logistic regression models were then constructed. In these, mosquito coil use and all other independent variables for which $p \leq 0.15$ in semifinal models were entered. Mosquito coil use was entered in these final models even if it showed a p-value greater than 0.15, because mosquito coil use was the characteristic of primary interest in this study.

**3.10 Ethical Consideration**

Before the interview, the purpose of the study was explained to the respondents. Then oral consent as well as written were taken from each respondent. The name of respondent was not recorded and data were coded. The respondents would be feel free to participate or withdrawal any time throughout the interview. Privacy was maintained throughout the interview.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# CHAPTER IV
# RESULTS

A cross sectional study was done at the Mae Sot District, Tak Province during March 12th to March 22nd, 2010. The interviewees were asked to complete a simplified Burmese version of The American Thoracic Society"s Respiratory Symptom Questionnaire, supplemented by questions on the living environments. The respondents were the guardian and the child closet to age of 5 years old per household. In this study, 412 respondents (All are females) and 153 children were interviewed. Information on children was collected directly from the guardian. The respiratory questions for the children were similar to those for the adult.

The findings of the data analysis are divided in two main sections: (1) Descriptive information and, (2) Analytical findings: relationships between independent and dependent variables.

## 4.1 Descriptive information

The results of this study are described as in the following order:

4.1.1 Socio-demographic characteristics of respondents

4.1.2 Characteristics of the children

4.1.3 Environmental factors

4.1.4 Behavioral factors

4.1.5 Prevalence"s of respiratory symptoms in respondents

4.1.6 Prevalence"s of respiratory symptoms in children

### 4.1.1 Socio-demographic characteristics of respondents

Socio-demographic characteristics are presented in table 7. All the respondents (n= 412) were female, age ranged from 17 to 80 years. The mean age was 35.2 years old. The age group between 31-40 years maintained the largest group about 37.9% of the total respondents.

Most of the populations in the study finished primary school 38.3%, followed by 35.7% of illiterate, and the rest 26% have above higher secondary school level. In describing occupation, majority of them were farmers 61.7% and others 38.3%

(mostly housewife). Most of them lived with 4-5 household members (47.6%), while 29.6% lived with 2-3 household members and 22.8% lived with more than 6 household members. The average number of people lived in the house was 4.40 people.

**Table 7. Socio-demographic Characteristics of the respondents (Total = 412)**

| Socio-demographic characteristics | Number | Percentage |
|---|---|---|
| Age (factor, 3 levels) | | |
| 17- 30 | 147 | 35.7 |
| 31-40 | 156 | 37.9 |
| >40 | 109 | 26.5 |
| (Mean= 35.02, SD= 9.15) | | |
| Education (factor, 3 levels) | | |
| never go to school | 147 | 35.7 |
| primary school | 158 | 38.3 |
| secondary and above | 107 | 26.0 |
| Occupation (dichotomous covariate) | | |
| Farmer | 254 | 61.7 |
| Others | 158 | 38.3 |
| Total household members (factor, 3 levels) | | |
| 2-3 | 122 | 29.6 |
| 4-5 | 196 | 47.6 |
| >6 | 94 | 22.8 |
| (Mean=4.40, SD= 1.47) | | |

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

### 4.1.2 Characteristics of the children

Characteristics of the children are presented in table 8. There were 153 children included in the study and the mean age of the children was 4.61 years. When the age is categorized into groups, 41.2% of children were age between 1-4 years and 58.8% of children were age between 5-7 years. There were more females than males (53.6% and 46.4%, respectively).

**Table 8. Characteristics of children under seven years old (Total= 153)**

| | Number | Percentage |
|---|---|---|
| Age Group (dichotomous covariate) | | |
| 1-4 yr | 63 | 41.2 |
| 5-7 yr | 90 | 58.8 |
| Gender (dichotomous covariate) | | |
| Male | 71 | 46.4 |
| Female | 82 | 53.6 |

Mean Age= 4.61 years, Standard Deviation= 1.52 years

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

### 4.1.3 Environmental Factors

The environmental factors are presented in table 9. The factors included mosquito coil and incense use, type of housing, rooms and windows per house and the main type of cooking fuel in the house. There were 55.2% of the household who used mosquito coils. About the incense use, most of the household used it (86.2%). Most of the respondents lived in wood housing about 74.8%. All houses had only one floor. 33.5% of houses had only one room and the others had two rooms and above two rooms, 44.7% and 21.8%, respectively. About 35.2% of the house had no windows and 43.7% had one window and the rest (21.1%) had two windows and above. Most of the household (83.7%) used wood as main type of cooking fuel and a few number of household (7.8%) used electricity.

**Table 9: Frequency and percentage of Environmental Factors**

| Environmental factor | Number | Percentage |
|---|---|---|
| Mosquito coil (dichotomous covariate) | | |
| Yes | 227 | 55.2 |
| No | 184 | 44.8 |
| Incense use (dichotomous covariate) | | |
| Yes | 355 | 86.2 |
| No | 57 | 13.8 |
| Type of house (dichotomous covariate) | | |
| Wood housing | 308 | 74.8 |
| Others | 104 | 25.2 |
| Rooms per house (factor, 3 levels) | | |
| One room | 138 | 33.5 |
| Two rooms | 184 | 44.7 |
| Above two rooms | 90 | 21.8 |
| Windows per house (factor, 3 levels) | | |
| No windows | 145 | 35.2 |
| One window | 180 | 43.7 |
| Two windows and above | 87 | 21.1 |
| Main Cooking Fuel (dichotomous covariate) | | |
| Wood | 344 | 83.7 |
| Others (Charcoal, Electricity) | 67 | 16.3 |

**4.1.4 Behavioral Factors**

The behavioral factors are shown in table 10. The factors included cooking habit (open windows during cooking, frequency of cooking per day) and house hold member current smoking. Half of the households opened windows during cooking. There were 74.0% of household who cooked two meals per day. At least one household member smoked in 52.7% of households.

**Table 10: Frequency and percentage of Behavioral Factors**

| Behavioral factor | Number | Percentage |
|---|---|---|
| Window opened during cooking (dichotomous covariate) | | |
| Yes | 210 | 51.0 |
| No | 202 | 49.0 |
| Meals cooking per day (factor, 3 levels) | | |
| 1 meal per day | 45 | 10.9 |
| 2 meals per day | 305 | 74.5 |
| 3 meals or more per day | 62 | 15.0 |
| Household member current smoking (dichotomous covariate) | | |
| Yes | 217 | 52.7 |
| No | 195 | 47.3 |

**4.1.5 Prevalences of respiratory symptoms in respondents**

The respiratory symptoms prevalence"s are presented in table 11. Cough with or without cold and phlegm with or without cold were reported in 83.0% and 49.3%, respectively. Wheeze with or without cold and shortness of breath were accounted for 53.4% and 25.5%, respectively. The prevalence"s of sore throat without cold, rhinitis and eye irritation at home were reported in 55.2%, 50.6% and 36.7%, respectively.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**Table 11. Frequency and prevalence (percent) of respiratory symptoms in respondents (Total=412).**

| Respiratory symptoms | Number | Prevalence |
|---|---|---|
| Cough with or without colds | 342 | 83.0% |
| Phlegm with or without colds | 203 | 49.3 |
| Wheeze with or without colds | 220 | 53.4 |
| Shortness of breath | 105 | 25.5 |
| Sore throat without cold | 227 | 55.2 |
| Rhinitis | 208 | 50.6 |
| Eye irritation at home | 151 | 36.7 |

**4.1.6 Prevalences of respiratory symptoms in children.**

Table 12 shows the prevalences of respiratory symptoms in children. Cough with or without cold, phlegm with or without cold and wheeze with or without cold were reported in 84.3%, 57.5% and 59.5%, respectively. Sore throat without cold, rhinitis and eye irritation at home were accounted for 45.4%, 65.1% and 31.1%, respectively.

**Table 12. Frequency and prevalence (percent) of respiratory symptoms in children (total=153).**

| Respiratory symptoms | Number | Prevalence |
|---|---|---|
| Cough with or without colds | 129 | 84.3% |
| Phlegm with or without colds | 88 | 57.5 |
| Wheeze with or without colds | 91 | 59.5 |
| Sore throat without cold | 69 | 45.4 |
| Rhinitis | 99 | 65.1 |
| Eye irritation at home | 47 | 31.1 |

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**4.2 Analytical findings: relationships between independent variables and dependent variables (respiratory symptoms)**

**4.2.1 Respondents**

There were 13 independent variables and 7 dependent variables for respondents. The independent variables were age, total household member, education, occupation, type of house, rooms in house, windows in house, mosquito coil use, incense use, windows open during cooking, main type of cooking fuel, meals cooking per day and frequency of household member current smoking. The dependent variables were cough with or without colds, phlegm with or without colds, wheeze with or without colds, shortness of breath, and sore throat without cold, rhinitis and eye irritation at home. The following tables show the bivariate analysis for respiratory symptoms in respondent. In the tables, the researcher only included independent variables with p value less than or equal to 0.15.

Table 13 summarizes chi-square tests for association of cough with or without colds with 9 independent variables. Among 412 respondents, 342 had cough with or without cold. There are 6 out of 9 variables which had significant positive relationship with cough symptoms. Rooms in house, windows in house and windows open during cooking were negatively and significantly associated with cough symptoms. Mosquito coil use was positively significantly associated with cough symptoms. Incense use and household member current smoking were $p<0.15$.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**Table 13. Bivariate analysis for cough with or without colds in respondents: independent variables for which p ≤ 0.15**

| | Cough with or without colds | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N=70) | | Yes (N=342) | | | | |
| | (N) | % | (N) | % | | | |
| Respondent age (factor, 3 levels) | | | | | | | |
| 17-30 | 37 | 25.2 | 110 | 74.8 | | | |
| 31-40 | 19 | 12.2 | 137 | 87.8 | | | |
| >40 | 14 | 12.8 | 95 | 87.2 | 10.86 | 2 | 0.004 |
| Total members in household (factor, 3 levels) | | | | | | | |
| 2-3 | 30 | 24.6 | 92 | 75.4 | | | |
| 4-5 | 23 | 11.7 | 173 | 88.3 | | | |
| >6 | 17 | 18.1 | 77 | 81.9 | 8.91 | 2 | 0.012 |
| Respondent education (factor, 3 levels) | | | | | | | |
| Never went to school | 19 | 12.9 | 128 | 87.1 | | | |
| Primary school | 24 | 15.2 | 134 | 84.8 | | | |
| Secondary and above | 27 | 25.2 | 80 | 74.8 | 7.24 | 2 | 0.027 |
| Rooms in house (factor, 3 levels) | | | | | | | |
| 1 | 40 | 29.0 | 98 | 71.0 | | | |
| 2 | 18 | 9.8 | 166 | 90.2 | | | |
| >2 | 12 | 13.3 | 78 | 86.7 | 21.71 | 2 | <0.001 |
| Windows in house (factor, 3 levels) | | | | | | | |
| None | 36 | 24.8 | 109 | 75.2 | | | |
| 1 | 22 | 12.2 | 158 | 87.8 | | | |
| ≥2 | 12 | 13.8 | 75 | 86.2 | 9.84 | 2 | 0.007 |
| Mosquito coil use (covariate, 2 levels) | | | | | | | |
| No | 45 | 24.5 | 25 | 11.0 | | | |
| Yes | 139 | 75.5 | 202 | 89.0 | 12.99 | 1 | <0.001 |
| Incense use (covariate, 2 levels) | | | | | | | |
| No | 14 | 24.6 | 56 | 15.8 | | | |
| Yes | 43 | 75.4 | 299 | 84.2 | 2.68 | 1 | 0.101 |
| Windows open during cooking (covariate, 2 levels) | | | | | | | |
| No | 43 | 21.3 | 27 | 12.9 | | | |
| Yes | 159 | 78.7 | 183 | 87.1 | 5.18 | 1 | 0.023 |
| Household member current smoking (factor, 3 levels) | | | | | | | |
| Never | 42 | 21.5 | 153 | 78.5 | | | |
| <5 sticks per day | 20 | 12.9 | 135 | 87.1 | | | |
| ≥5 sticks per day | 8 | 12.9 | 54 | 87.1 | 5.43 | 2 | 0.066 |

Bivariate analysis for phlegm with or without colds in respondent is shown in table 14. There were 203 out of 412 respondents who had phlegm symptoms. There were 6 out of 7 variables which had positive association with phlegm symptoms. Almost all the variables were significantly positively associated with phlegm with or without cold except incense use and household member current smoking, (p=0.082) and (p=0.103); respectively.

**Table 14. Bivariate analysis for phlegm with or without colds in respondents: independent variables for which p ≤ 0.15**

| | Phlegm with or without colds | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N=209) | | Yes (N=203) | | | | |
| | (N) | % | (N) | % | | | |
| Respondent age | | | | | | | |
| 17-30 | 88 | 59.9 | 59 | 40.1 | | | |
| 31-40 | 64 | 41.0 | 92 | 59.0 | | | |
| >40 | 57 | 52.3 | 52 | 47.7 | 10.89 | 2 | 0.004 |
| Rooms in house | | | | | | | |
| 1 | 68 | 49.3 | 70 | 50.7 | | | |
| 2 | 104 | 56.5 | 80 | 43.5 | | | |
| >2 | 37 | 41.1 | 53 | 58.9 | 5.91 | 2 | 0.052 |
| Windows in house | | | | | | | |
| None | 74 | 51.0 | 71 | 49.0 | | | |
| 1 | 102 | 56.7 | 78 | 43.3 | | | |
| ≥2 | 33 | 37.9 | 54 | 62.1 | 8.24 | 2 | 0.016 |
| Mosquito coil use | | | | | | | |
| No | 106 | 57.6 | 78 | 42.4 | | | |
| Yes | 102 | 44.9 | 125 | 55.1 | 6.53 | 1 | 0.011 |
| Incense use | | | | | | | |
| No | 35 | 61.4 | 22 | 38.6 | | | |
| Yes | 174 | 49.0 | 181 | 51.0 | 3.01 | 1 | 0.082 |
| Main type of cooking fuel | | | | | | | |
| Wood fuel | 184 | 53.5 | 160 | 46.5 | | | |
| Others (Charcoal, Electricity) | 25 | 37.3 | 42 | 62.7 | 5.87 | 1 | 0.015 |
| Household member current smoking | | | | | | | |
| Never | 108 | 55.4 | 87 | 44.6 | | | |
| <5 sticks per day | 76 | 49.0 | 79 | 51.0 | | | |
| ≥5 sticks per day | 25 | 40.3 | 37 | 59.7 | 4.55 | 2 | 0.103 |

Bivariate analysis for wheeze with or without colds is presented in table 15. There were 220 out of 412 respondents who had wheezing symptoms. There were 4 out of 7 variables which had positively significantly associated with wheezing symptoms. Total member of household and education were negatively and significantly associated with wheezing symptoms. Respondent age and mosquito coil use were $p<0.15$ and marginally significant with wheezing; ($p=0.099$). ($p=0.091$), respectively.

**Table 15. Bivariate analysis for wheeze with or without colds in respondents: independent variables for which $p \leq 0.15$**

| | Wheeze with or without colds | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 192) | | Yes (N=220) | | | | |
| | (N) | % | (N) | % | | | |
| Respondent age | | | | | | | |
| 17-30 | 69 | 46.9 | 78 | 53.1 | | | |
| 31-40 | 81 | 51.9 | 75 | 48.1 | | | |
| >40 | 42 | 38.5 | 67 | 61.5 | 4.63 | 2 | 0.099 |
| Total member of household | | | | | | | |
| 2-3 | 43 | 35.2 | 79 | 64.8 | | | |
| 4-5 | 98 | 50.0 | 98 | 50.0 | | | |
| >6 | 51 | 54.3 | 43 | 45.7 | 9.44 | 2 | 0.009 |
| Respondent education | | | | | | | |
| Never go to school | 86 | 58.5 | 61 | 41.5 | | | |
| Primary school | 75 | 47.5 | 83 | 52.5 | | | |
| Secondary and above | 31 | 29.0 | 76 | 71.0 | 21.78 | 2 | <0.001 |
| Windows in house | | | | | | | |
| None | 52 | 35.9 | 93 | 64.1 | | | |
| 1 | 97 | 53.9 | 83 | 46.1 | | | |
| ≥2 | 43 | 49.4 | 44 | 50.6 | 10.84 | 2 | 0.004 |
| Mosquito coil use | | | | | | | |
| No | 94 | 51.1 | 90 | 48.9 | | | |
| Yes | 97 | 42.7 | 130 | 57.3 | 2.85 | 1 | 0.091 |
| Windows open during cooking | | | | | | | |
| No | 77 | 38.1 | 125 | 61.9 | | | |
| Yes | 115 | 54.8 | 95 | 45.2 | 11.46 | 1 | 0.001 |
| Main type of cooking fuel | | | | | | | |
| Wood fuel | 170 | 49.4 | 174 | 50.6 | | | |
| Others (Charcoal, Electricity) | 22 | 32.8 | 45 | 67.2 | 6.19 | 1 | 0.013 |

Bivariate analysis for shortness of breath in respondent is given in table 16. Six observation of shortness of breath were missing out of 412 respondents. There were 105 respondents who had shortness of breath symptom. There were 5 out of 7 variables which had positive association with shortness of breath. Total member of household and rooms in house were negatively associated with shortness of breath. There were 4 variables which had significant positive association with shortness of breath symptom. Type of house (p=0.084), rooms in house (p=0.070), and meals cooking per day (p=0.101) were p<0.15.

**Table 16. Bivariate analysis for shortness of breath in respondents: independent variables for which p ≤ 0.15**

| | Shortness of breath | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 301) | | Yes (N=105) | | | | |
| | (N) | % | (N) | % | | | |
| Respondent age | | | | | | | |
| 17-30 | 117 | 81.2 | 27 | 18.8 | | | |
| 31-40 | 119 | 76.8 | 36 | 23.2 | | | |
| >40 | 65 | 60.7 | 42 | 39.3 | 14.36 | 2 | 0.001 |
| Total member of household | | | | | | | |
| 2-3 | 81 | 68.6 | 37 | 31.4 | | | |
| 4-5 | 155 | 79.9 | 39 | 20.1 | | | |
| >6 | 65 | 69.1 | 29 | 30.9 | 6.43 | 2 | 0.040 |
| Type of house | | | | | | | |
| Wood housing | 232 | 76.3 | 72 | 23.7 | | | |
| Others | 69 | 67.6 | 33 | 32.4 | 2.99 | 1 | 0.084 |
| Rooms in house | | | | | | | |
| 1 | 102 | 75.6 | 33 | 24.4 | | | |
| 2 | 142 | 77.6 | 41 | 22.4 | | | |
| >2 | 57 | 64.8 | 31 | 35.2 | 5.30 | 2 | 0.070 |
| Windows in house | | | | | | | |
| None | 97 | 68.8 | 44 | 31.2 | | | |
| 1 | 144 | 80.0 | 36 | 20.0 | | | |
| ≥2 | 60 | 70.6 | 25 | 29.4 | 5.88 | 2 | 0.053 |
| Meals cooking per day | | | | | | | |
| 1 | 30 | 66.7 | 15 | 33.3 | | | |
| 2 | 230 | 76.9 | 69 | 23.1 | | | |
| ≥3 | 41 | 66.1 | 21 | 33.9 | 4.59 | 2 | 0.101 |
| Household member current smoking | | | | | | | |
| Never | 147 | 75.8 | 47 | 24.2 | | | |
| <5 sticks per day | 123 | 82.0 | 27 | 18.0 | | | |
| ≥5 sticks per day | 31 | 50.0 | 31 | 50.0 | 23.94 | 2 | <0.001 |

Table 17 summarizes chi-square tests for association of sore throat without cold with 6 independent variables. Almost all the variables had positive association with sore throat without cold. 4 out of 6 variables were significantly associated with sore throat without cold. Rooms in the house (p=0.081) and windows open during cooking (p=0.140) were p<0.15.

**Table 17. Bivariate analysis for sore throat without cold in respondents: independent variables for which p ≤ 0.15**

| | Sore throat without cold | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 184) | | Yes (N=227) | | | | |
| | (N) | % | (N) | % | | | |
| Respondent age | | | | | | | |
| 17-30 | 79 | 53.7 | 68 | 46.3 | | | |
| 31-40 | 60 | 38.5 | 96 | 61.5 | | | |
| >40 | 45 | 41.7 | 63 | 58.3 | 7.71 | 2 | 0.021 |
| Type of housing | | | | | | | |
| Wood housing | 124 | 40.3 | 184 | 59.7 | | | |
| Others | 60 | 58.3 | 43 | 41.7 | 10.10 | 1 | 0.001 |
| Rooms in house | | | | | | | |
| 1 | 52 | 37.7 | 86 | 62.3 | | | |
| 2 | 85 | 46.4 | 98 | 53.6 | | | |
| >2 | 47 | 52.2 | 43 | 47.8 | 5.03 | 2 | 0.081 |
| Incense use | | | | | | | |
| No | 33 | 57.9 | 24 | 42.1 | | | |
| Yes | 151 | 42.7 | 203 | 57.3 | 4.61 | 1 | 0.032 |
| Windows open during cooking | | | | | | | |
| No | 83 | 41.1 | 119 | 58.9 | | | |
| Yes | 101 | 48.3 | 108 | 51.7 | 2.17 | 1 | 0.140 |
| Main type of cooking fuel | | | | | | | |
| Wood fuel | 145 | 42.3 | 198 | 57.7 | | | |
| Others (Charcoal, Electricity) | 38 | 56.7 | 29 | 43.3 | 4.73 | 1 | 0.030 |

Bivariate analysis for rhinitis in respondent is shown in table 18. There were 208 out of 412 respondents who had rhinitis symptoms. Incense use and household member current smoking were positively associated with rhinitis. Windows in house was negatively associated with rhinitis. Incense use had significant positive association with rhinitis where windows in house (p=0.101) and household member current smoking (p=0.118) were p<0.15.

**Table 18. Bivariate analysis for rhinitis in respondents: independent variables for which p ≤ 0.15**

| | rhinitis | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N=203) | | Yes (N=208) | | | | |
| | (N) | % | (N) | % | | | |
| **Windows in house** | | | | | | | |
| **None** | 68 | 46.9 | 77 | 53.1 | | | |
| **1** | 99 | 55.0 | 81 | 45.0 | | | |
| **≥2** | 36 | 41.9 | 50 | 58.1 | 4.57 | 2 | 0.101 |
| **Incense use** | | | | | | | |
| **No** | 38 | 67.9 | 18 | 32.1 | | | |
| **Yes** | 165 | 46.5 | 190 | 53.5 | 8.84 | 1 | 0.003 |
| **Household member current smoking** | | | | | | | |
| **Never** | 104 | 53.6 | 90 | 46.4 | | | |
| **<5 sticks per day** | 75 | 48.4 | 80 | 51.6 | | | |
| **≥5 sticks per day** | 24 | 38.7 | 38 | 61.3 | 4.27 | 2 | 0.118 |

Bivariate analysis for eye irritation at home in respondent is presented in table 19. There were 151 out of 412 respondent had eye irritation at home. Incense use and windows open during cooking were positively associated with eye irritation but not significant (p<0.15).

**Table 19. Bivariate analysis for eye irritation at home in respondents: independent variables for which p ≤ 0.15**

| | Eye irritation | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N=261) | | Yes (N=151) | | | | |
| | (N) | % | (N) | % | | | |
| **Incense use** | | | | | | | |
| **No** | 41 | 71.9 | 16 | 28.1 | | | |
| **Yes** | 220 | 62.0 | 135 | 38.0 | 2.09 | 1 | 0.148 |
| **Windows open during cooking** | | | | | | | |
| **No** | 121 | 59.9 | 81 | 40.1 | | | |
| **Yes** | 140 | 66.7 | 70 | 33.3 | 2.03 | 1 | 0.154 |

### 4.2.2 Children

There were 13 independent variables and 6 dependent variables for children. The independent variables were age, gender, respondent education, total household member, type of house, rooms in house, windows in house, mosquito coil use, incense use, windows open during cooking, main type of cooking fuel, meals cooking per day and frequency of household member current smoking. The dependent variables were cough with or without colds, phlegm with or without colds, wheeze with or without colds, sore throat without cold, rhinitis and eye irritation at home. The following tables show the bivariate analysis for respiratory symptoms in children. In the tables, the researcher only included independent variables with p value less than or equal to 0.15.

Table 20 summarizes chi-square tests for association of cough with or without colds with 4 independent variables. Among 153 children, 129 had cough with or without colds. Rooms in house and wood fuel use for cooking were negatively associated with cough symptoms. Three out of 4 variables had significant relationship with cough symptoms. Mosquito coil use was positively significantly associated with cough symptoms. Household member current smoking was marginally significant (p=0.058).

**Table 20. Bivariate analysis for cough with or without colds in children: independent variables for which p ≤ 0.15**

| | **Cough with or without colds** | | | | **χ2** | **df** | **P-value** |
|---|---|---|---|---|---|---|---|
| | No (N=24) | | Yes (N=129) | | | | |
| | (N) | % | (N) | % | | | |
| Rooms in house | | | | | | | |
| 1 | 15 | 28.8 | 37 | 71.2 | | | |
| 2 | 5 | 7.5 | 62 | 92.5 | | | |
| >2 | 4 | 11.8 | 30 | 88.2 | 10.63 | 2 | 0.005 |
| Mosquito coil use | | | | | | | |
| No | 17 | 24.3 | 53 | 75.7 | | | |
| Yes | 7 | 8.4 | 76 | 91.6 | 7.21 | 1 | 0.007 |
| Main type of cooking fuel | | | | | | | |
| Wood fuel | 23 | 19.0 | 98 | 81.0 | | | |
| Others (charcoal, electricity) | 1 | 3.1 | 31 | 96.9 | 4.82 | 1 | 0.028 |
| Household member current smoking | | | | | | | |
| Never | 10 | 14.1 | 61 | 85.9 | | | |
| <5 sticks per day | 14 | 22.2 | 49 | 77.8 | | | |
| ≥5 sticks per day | 0 | 0.0 | 19 | 100.0 | 5.70 | 2 | 0.058 |

Table 21 shows bivariate analysis for phlegm with or without colds in children. There were 88 out of 153 children had phlegm symptoms. Wood fuel use is negatively associated with phlegm symptoms. Type of house and meals cooking per day had significant negative association with phlegm symptoms where wood fuel use was $p<0.15$.

**Table 21. Bivariate analysis for phlegm with or without colds in children: independent variables for which $p \leq 0.15$**

| | phlegm with or without colds | | | | $\chi 2$ | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 65) | | Yes (N=88 ) | | | | |
| | (N) | % | (N) | % | | | |
| Type of house | | | | | | | |
| Wood housing | 53 | 48.2 | 57 | 51.8 | | | |
| Others | 12 | 27.9 | 31 | 72.1 | 5.20 | 1 | 0.023 |
| Meals cooking per day | | | | | | | |
| 1 | 2 | 13.3 | 13 | 86.7 | | | |
| 2 | 51 | 45.9 | 60 | 54.1 | | | |
| ≥3 | 12 | 44.4 | 15 | 55.6 | 5.80 | 2 | 0.055 |
| Main type of cooking fuel | | | | | | | |
| Wood fuel | 55 | 45.5 | 66 | 54.5 | | | |
| Others (charcoal, electricity) | 10 | 31.2 | 22 | 68.8 | 2.09 | 1 | 0.148 |

Bivariate analysis for wheeze with or without colds in children is given in table 22. There were 91 out of 153 children who had wheezed with or without colds. Mosquito coil use and windows open during cooking were positively associated with wheezing but not significant ($p<0.15$). Rooms in house were negatively associated with wheezing with or without cold.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**Table 22. Bivariate analysis for wheeze with or without colds in children: independent variables for which p ≤ 0.15**

| | Wheeze with or without colds | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 62) | | Yes (N= 91) | | | | |
| | (N) | % | (N) | % | | | |
| **Rooms in house** | | | | | | | |
| **1** | 26 | 50.0 | 26 | 50.0 | | | |
| **2** | 26 | 38.8 | 41 | 61.2 | | | |
| **>2** | 10 | 29.4 | 24 | 70.6 | 3.76 | 2 | 0.152 |
| **Mosquito coil use** | | | | | | | |
| **No** | 33 | 47.1 | 37 | 52.9 | | | |
| **Yes** | 27 | 34.9 | 54 | 65.1 | 2.34 | 1 | 0.126 |
| **Windows open during cooking** | | | | | | | |
| **No** | 25 | 32.9 | 51 | 67.1 | | | |
| **Yes** | 37 | 48.1 | 40 | 51.9 | 3.64 | 1 | 0.056 |

Table 23 shows bivariate analysis for sore throat without cold in children. One observation was missing. There were 69 out of 152 children had sore throat without cold. Child age was positively associated with sore throat symptoms and windows in house were negatively associated with sore throat symptoms. Child age and windows in house had significant relationship with sore throat with or without cold.

**Table 23. Bivariate analysis for sore throat without cold in children: independent variables for which p ≤ 0.15**

| | Sore throat without cold | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 83) | | Yes (N= 69) | | | | |
| | (N) | % | (N) | % | | | |
| Child age | | | | | | | |
| 1-4 | 42 | 67.7 | 20 | 32.3 | | | |
| 5-7 | 41 | 45.6 | 49 | 54.4 | 7.29 | 1 | 0.007 |
| Windows in house | | | | | | | |
| None | 35 | 62.5 | 21 | 37.5 | | | |
| 1 | 35 | 57.4 | 26 | 42.5 | | | |
| ≥2 | 13 | 37.1 | 22 | 62.9 | 5.90 | 2 | 0.052 |

Bivariate analysis for rhinitis in children is presented in table 24. Female had more rhinitis than male. Wood housing, mosquito coil use and meals cooking per day were positively associated with rhinitis. Rooms in house, windows in house and window open during cooking were negatively associated with rhinitis. Mosquito coil

use had significant positive association with rhinitis (p=0.042). Rooms in house (p=0.002), windows in house (p=0.009), windows open during cooking (p=0.046) and meals cooking per day (p=0.032), had significant relationship with rhinitis. Gender and type of housing were p<0.15.

**Table 24. Bivariate analysis for rhinitis in children: independent variables for which p ≤ 0.15**

| | rhinitis | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 53) | | Yes (N= 99) | | | | |
| | (N) | % | (N) | % | | | |
| Gender | | | | | | | |
| Male | 29 | 40.8 | 42 | 59.2 | | | |
| Female | 24 | 29.6 | 57 | 70.4 | 2.09 | 1 | 0.148 |
| Type of housing | | | | | | | |
| Wood housing | 34 | 30.9 | 76 | 69.1 | | | |
| Others | 19 | 45.2 | 23 | 54.8 | 2.74 | 1 | 0.097 |
| Rooms in house | | | | | | | |
| 1 | 27 | 52.9 | 24 | 47.1 | | | |
| 2 | 20 | 29.9 | 47 | 70.1 | | | |
| >2 | 6 | 17.6 | 28 | 82.4 | 12.51 | 2 | 0.002 |
| Windows in house | | | | | | | |
| None | 27 | 48.2 | 29 | 51.8 | | | |
| 1 | 20 | 32.8 | 41 | 67.2 | | | |
| ≥2 | 6 | 17.1 | 29 | 82.9 | 9.35 | 2 | 0.009 |
| Mosquito coil use | | | | | | | |
| No | 30 | 43.5 | 39 | 56.5 | | | |
| Yes | 23 | 27.7 | 60 | 72.3 | 4.12 | 1 | 0.042 |
| Windows open during cooking | | | | | | | |
| No | 32 | 42.7 | 43 | 57.3 | | | |
| Yes | 21 | 27.3 | 56 | 72.7 | 3.96 | 1 | 0.046 |
| Meals cooking per day | | | | | | | |
| 1 | 9 | 60.0 | 6 | 40.0 | | | |
| 2 | 32 | 29.1 | 78 | 70.9 | | | |
| ≥3 | 12 | 44.4 | 15 | 55.6 | 6.87 | 2 | 0.032 |

Table 25 shows bivariate analysis for eye irritation at home in children. Two observation were missing. There were 47 out of 151 children who had eye irritation symptoms. Mosquito coil use was positively associated with eye irritation and it was not significant (p=0.141). Rooms in house and wood fuel use were negatively associated with eye irritation. Rooms in house had significant positive association with eye irritation where wood fuel use for cooking was p<0.15.

**Table 25. Bivariate analysis for eye irritation at home in children: independent variables for which p ≤ 0.15**

| | Eye irritation | | | | χ2 | df | P-value |
|---|---|---|---|---|---|---|---|
| | No (N= 104) | | Yes (N= 47) | | | | |
| | (N) | % | (N) | % | | | |
| Rooms in house | | | | | | | |
| 1 | 37 | 72.5 | 14 | 27.5 | | | |
| 2 | 50 | 75.8 | 16 | 24.2 | | | |
| >2 | 17 | 50.0 | 17 | 50.0 | 7.43 | 2 | 0.024 |
| Mosquito coil use | | | | | | | |
| No | 51 | 75.0 | 17 | 25.0 | | | |
| Yes | 53 | 63.9 | 30 | 36.1 | 2.16 | 1 | 0.141 |
| Main type of cooking fuel | | | | | | | |
| Wood fuel | 86 | 72.3 | 33 | 27.7 | | | |
| Others (charcoal, electricity) | 18 | 56.2 | 14 | 43.8 | 3.01 | 1 | 0.082 |

Bivariate effects of mosquito coil use for respiratory symptoms of which p value more than 0.15 is shown in table 26. Shortness of breath in respondent and phlegm with or without colds in children were negatively associated with mosquito coil use. Sore throat without cold, rhinitis and eye irritation in respondent and sore throat without cold in children were positively associated with mosquito coil use.

**Table 26. Bivariate effects of mosquito coil use for outcomes for which p>0.15.**

| | Mosquito coil use | | | | χ2 | p-value |
|---|---|---|---|---|---|---|
| | Yes | | No | | | |
| | (N) | % | (N) | % | | |
| Respondents | | | | | | |
| Shortness of breath | 53 | 23.6 | 51 | 28.3 | 1.20 | 0.274 |
| Sore throat without cold | 127 | 55.9 | 99 | 54.1 | 0.14 | 0.708 |
| Rhinitis | 121 | 53.3 | 86 | 47.0 | 1.61 | 0.204 |
| Eye irritation | 85 | 37.4 | 66 | 35.9 | 0.11 | 0.742 |
| Children | | | | | | |
| Phlegm with or without colds | 47 | 56.6 | 41 | 58.6 | 0.06 | 0.808 |
| Sore throat without cold | 41 | 49.4 | 28 | 40.6 | 1.18 | 0.277 |

**4.3 Multiple logistic regressions of respiratory symptoms in respondents**

Final multiple logistic regression model of cough with or without colds in respondents is given in table 27. Members in household, education, windows in house, incense use, windows open during cooking and household member current smoking were included in semi final model but they were not included in final model because of p>0.15. Respondent age, rooms in house and mosquito coil use were included in semifinal model and final model and significantly associated with cough symptoms. Mosquito coil use had significantly association with cough with or without colds (OR=1.84, 95% CI=1.02 to 3.33, p=0.045).

**Table 27. Cough with or without colds in respondents, final multiple logistic regression model** ($X^2$ for model=30.54, df=5, p<0.001).

| Independent variable | Modeled odds ratio | 95% C.I. | Wald $X^2$ | p-value |
|---|---|---|---|---|
| Mosquito coil use | 1.84 | 1.02 to 3.33 | 4.03 | 0.045 |
| Respondent age | | | 5.83* | 0.054* |
| 17-30 vs. >40 | 0.55 | 0.28 to 1.12 | 2.71 | 0.100 |
| 31-39 vs. >40 | 1.14 | 0.54 to 2.42 | 0.11 | 0.736 |
| Rooms in house | | | 8.18* | 0.017* |
| 1 vs. >2 | 0.57 | 0.26 to 1.23 | 2.07 | 0.150 |
| 2 vs. >2 | 1.49 | 0.68 to 3.27 | 0.98 | 0.323 |

* Wald and p-value for factor as a whole, not for any individual independent variable.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

Final multiple logistic regression model of phlegm with or without colds in respondents is given in table 28. Windows in house and incense use were included in semi final model but they were not included in final model because of p>0.15. Respondent age, rooms in house, mosquito coil use, main type of cooking fuel and household member current smoking were included in semifinal model and final model. Almost all the variables had significant relationship with phlegm symptoms except main type of cooking fuel and household member current smoking. Mosquito coil use had significantly association with phlegm with or without colds (OR=2.02, 95% CI=1.28 to 3.19, p=0.003).

**Table 28. Phlegm with or without colds in respondents, final multiple logistic regression model** ($X^2$ for model=36.25, df=8, p<0.001).

| Independent variable | Modeled odds ratio | 95% C.I. | Wald $X^2$ | p-value |
|---|---|---|---|---|
| Mosquito coil use | 2.02 | 1.28 to 3.19 | 9.12 | 0.003 |
| Respondent age | | | 11.65* | 0.003* |
| 17-30 vs. >40 | 0.70 | 0.41 to 1.19 | 1.76 | 0.185 |
| 31-39 vs. >40 | 1.62 | 0.97 to 2.71 | 3.35 | 0.067 |
| Rooms in house | | | 12.46* | 0.002* |
| 1 vs. >2 | 1.31 | 0.70 to 2.46 | 0.74 | 0.390 |
| 2 vs. >2 | 0.53 | 0.31 to 0.91 | 5.29 | 0.021 |
| Main type of cooking fuel | 1.63 | 0.91 to 2.89 | 2.73 | 0.098 |
| Household member current smoking (per day) | | | 4.05* | 0.132* |
| Never vs. ≥5 sticks | 0.54 | 0.28 to 1.04 | 3.43 | 0.064 |
| <5 sticks vs. ≥ 5 sticks | 0.75 | 0.39 to 1.43 | 0.77 | 0.380 |

* Wald and p-value for factor as a whole, not for any individual independent variable.

Final multiple logistic regression model of wheeze with or without colds in respondents is presented in table 29. Members in household, windows open during cooking and main type of cooking fuel were included in semi final model but they were not included in final model because of p>0.15. Respondent age, education, windows in house and mosquito coil use were included in semifinal model and final model. All the variables had significant relationship with wheeze symptoms. Mosquito coil use had significantly association with wheeze with or without colds (OR=2.47, 95% CI=1.52 to 4.00, p<0.001).

**Table 29. Wheeze with or without colds in respondents, final multiple logistic regression model** ($X^2$ for model=51.26, df=7, p<0.001).

| Independent variable | Modeled odds ratio | 95% C.I. | Wald $X^2$ | p-value |
|---|---|---|---|---|
| Mosquito coil use | 2.47 | 1.52 to 4.00 | 13.48 | <0.001 |
| Respondent age | | | 6.65* | 0.036* |
| 17-30 vs. >40 | 0.54 | 0.31 to 0.93 | 4.90 | 0.027 |
| 31-39 vs. >40 | 0.53 | 0.31 to 0.89 | 5.61 | 0.018 |
| Respondent education | | | 22.88* | <0.001* |
| Never go to school vs. secondary and above | 0.25 | 0.14 to 0.44 | 22.87 | <0.001 |
| Primary vs. secondary and above | 0.43 | 0.25 to 0.74 | 9.34 | 0.002 |
| Windows in house | | | 14.06* | 0.001* |
| None vs. ≥2 | 2.49 | 1.33 to 4.70 | 8.02 | 0.005 |
| 1 vs. ≥2 | 0.95 | 0.55 to 1.64 | 0.04 | 0.846 |

* Wald and p-value for factor as a whole, not for any individual independent variable.

Final multiple logistic regression model of cough with or without colds in children is given in table 30. Main fuel use was included in semi final model but it was not included in final model because of p>0.15. Rooms in house, mosquito coil use and household member current smoking were included in semifinal model and final model. Rooms in house was significantly associated with cough prevalences and household member current smoking had marginal significant association with cough prevalences. Mosquito coil use had significantly association with cough with or without colds (OR=2.85, 95% CI=0.99 to 8.22, p=0.052).

**Table 30. Cough with or without colds in children, final multiple logistic regression model** ($X^2$ for model=16.64, df=4, p=0.002).

| Independent variable | Modeled odds ratio | 95% C.I. | Wald $X^2$ | p-value |
|---|---|---|---|---|
| Mosquito coil use | 2.85 | 0.99 to 8.22 | 3.77 | 0.052 |
| Rooms in house | | | 7.32* | 0.026* |
| 1 vs. >2 | 0.38 | 0.10 to 1.41 | 2.09 | 0.148 |
| 2 vs. >2 | 1.95 | 0.47 to 8.08 | 0.85 | 0.357 |
| Household member current smoking (yes vs. no) | 0.37 | 0.13 to 1.05 | 3.47 | 0.062 |

* Wald and p-value for factor as a whole, not for any individual independent variable.

Final multiple logistic regression model of wheeze with or without colds in children is presented in table 31. Rooms in house, mosquito coil use and windows open during cooking were included in semifinal model and final model. Rooms in house and windows open during cooking were significantly associated with wheeze symptoms. Mosquito coil use was included in the model although p value was not less than 0.15 and it was not significantly associated with wheeze symptoms in children (OR=1.70, 95% CI=0.80 to 3.61, p=0.171).

**Table 31. Wheeze with or without colds in children, final multiple logistic regression model** ($X^2$ for model=15.92, df=4, p=0.003).

| Independent variable | Modeled odds ratio | 95% C.I. | Wald $X^2$ | p-value |
|---|---|---|---|---|
| Mosquito coil use | 1.70 | 0.80 to 3.61 | 1.87 | 0.171 |
| Rooms in house | | | 6.96* | 0.031* |
| 1 vs. >2 | 0.22 | 0.07 to 0.68 | 6.91 | 0.009 |
| 2 vs. >2 | 0.48 | 0.19 to 1.24 | 2.30 | 0.129 |
| Windows open during cooking | 0.24 | 0.11 to 0.58 | 10.41 | 0.001 |

* Wald and p-value for factor as a whole, not for any individual independent variable.

Final multiple logistic regression model of rhinitis in children is presented in table 32. Children age, type of house, windows in house and windows open during cooking were included in semifinal model but they were not included in final model because of p>0.15. Rooms in house, mosquito coil use and meals cooking per day were included in semifinal and final model. Rooms in house and meals cooking per day were significantly associated with rhinitis. Mosquito coil use was included in the model although p value was not less than 0.15 and it was not significantly associated with rhinitis in children (OR=1.74, 95% CI=0.75 to 4.01, p=0.197).

**Table 32. Rhinitis in children, final multiple logistic regression model** ($X^2$ for model=20.37, df=5, p=0.001).

| Independent variable | Modeled odds ratio | 95% C.I. | Wald $X^2$ | p-value |
|---|---|---|---|---|
| Mosquito coil use | 1.74 | 0.75 to 4.01 | 1.67 | 0.197 |
| Rooms in house | | | 7.46* | 0.024* |
| 1 vs. >2 | 0.24 | 0.08 to 0.73 | 6.34 | 0.012 |
| 2 vs. >2 | 0.58 | 0.20 to 1.66 | 1.04 | 0.309 |
| Meals cooking per day | | | 6.84* | 0.033* |
| 1 vs. ≥3 | 0.28 | 0.07 to 1.22 | 2.87 | 0.090 |
| 2 vs. ≥3 | 1.38 | 0.54 to 3.54 | 0.45 | 0.504 |

* Wald and p-value for factor as a whole, not for any individual independent variable.

Final multiple logistic regression model of eye irritation at home in children is presented in table 33. Rooms in house, mosquito coil use and main type of cooking fuel were included in semifinal and final model. Rooms in house were significantly associated with eye irritation. Mosquito coil use and main type of cooking fuel were not significantly associated with eye irritation. Mosquito coil use was included in the model although p value was not less than 0.15 and it was not significantly associated with eye irritation in children (OR=1.61, 95% CI=0.73 to 3.57, p=0.238).

**Table 33.Eye irritation at home in children, final multiple logistic regression model** ($X^2$ for model=10.70, df=4, p=0.030).

| Independent variable | Modeled odds ratio | 95% C.I. | Wald $X^2$ | p-value |
|---|---|---|---|---|
| Mosquito coil use | 1.61 | 0.73 to 3.57 | 1.39 | 0.238 |
| Rooms in house | | | 6.22* | 0.045* |
| 1 vs. >2 | 0.54 | 0.20 to 1.46 | 1.47 | 0.225 |
| 2 vs. >2 | 0.32 | 0.13 to 0.79 | 6.21 | 0.013 |
| Main type of cooking fuel | 1.87 | 0.78 to 4.47 | 1.99 | 0.158 |

* Wald and p-value for factor as a whole, not for any individual independent variable.

# CHAPTER V
# DISCUSSION, RECOMMENDATION AND CONCLUSIONS

## 5.1 Discussion

The main objective of this study was to find out whether indoor air pollution from household burning of mosquito coils is associated with increased risk of respiratory problems in Myanmar migrant workers in Tak Province, Thailand. The researcher hypothesized that there were associations between exposure to mosquito coil smokes, socio-demographic factors, environmental factors (cooking fuels and incense burning), behavioral factors (passive smoking and cooking habits) and risk of respiratory symptom prevalences. Seven respiratory symptoms (cough with or without colds, phlegm with or without colds, wheeze with or without colds, shortness of breath, sore throat without cold, rhinitis and eye irritation at home) in respondents and 6 respiratory symptoms (cough with or without colds, phlegm with or without colds, wheeze with or without colds, sore throat without cold, rhinitis and eye irritation at home) in children were analyzed. Doctor diagnosed asthma, bronchitis and pneumonia in respondents and children were asked in questions but there were too few cases to analyze meaningfully. We did not learn about mosquito coil smoke effects in males.

In this study, respiratory symptoms questions were not specified by time period (for example, only asked, “Do you usually have a cough when you have a cold or you do not have a cold?”, and not specify duration of symptoms). So there may be uncertainty in finding of respiratory symptoms. But the questions used in this study were based on American Thoracic Society Respiratory questionnaires which have served as models for about the last 30 years. The study also evaluated a lot of independent variables which were not associated with respiratory symptoms. So we expected that the results related to the effects of indoor air pollution including mosquito coil smoke and respiratory symptoms would be relevant.

**5.1.1 Association between mosquito coil use and respiratory symptom prevalences in respondents**.

Mosquito coil use was positively associated with all the respiratory symptoms except shortness of breath. Mosquito coil use was significantly associated with cough with or without colds ($p<0.001$) and phlegm with or without colds ($p=0.011$). Wheeze with or without colds had positive association with mosquito coil use and it was marginally significant ($p=0.091$). The higher symptom rates were usually found with higher frequency of mosquito coil use. In final multiple logistic regression models, after adjustment of other confounding factor, mosquito coil use was still positively significantly associated with cough with or without cold (OR=1.84, 95% CI= 1.02 to 3.33, $p=0.045$) and phlegm with or without colds (OR=2.02, 95% CI=1.28 to 3.19,$p=0.003$). Wheeze with or without colds became significantly associated with mosquito coil use (OR=2.47, 95% CI=1.52 to 4.00, $p<0.001$) in logistic regression model. This fact was consistent with the study of Hu and Wong (1999) in which mosquito coil use was significantly associated with respiratory health of non-smoking women in Hong Kong.

**5.1.2 Association between mosquito coil use and respiratory symptom prevalences in children.**

Mosquito coil use was positively associated with all the respiratory symptoms except phlegm with or without colds and eye irritation. Mosquito coil use was significantly associated with cough with or without colds ($p=0.007$) and rhinitis ($p=0.042$). Wheeze with or without colds ($p=0.126$) was not significantly associated with mosquito coil use. In final multiple logistic regression models, after adjustment of other confounding factor, mosquito coil use was not significantly associated with all the above respiratory symptoms. In logistic regression model, mosquito coil use had significantly association with cough with or without colds (OR=2.85, 95% CI=0.99 to 8.22, $p=0.052$), wheeze with or without colds (OR=1.70, 95% CI=0.80 to 3.61, $p=0.171$) and rhinitis in children (OR=1.74, 95% CI=0.75 to 4.01, $p=0.197$). This fact was consistent with the study of Azizi and Henry (1991) in which mosquito coil use was significantly associated with chronic cough/phlegm (OR= 1.6, 95% CI= 1.1 to 2.4, $p<0.05$) and persistent wheeze (OR=1.4, 95% CI=1.1 to 1.8, $p<0.01$).

Association between mosquito coil use and eye irritation was not statically significant (OR=1.61, 95% CI=0.73 to 3.57, p=0.238).

**5.1.3 Association between socio-demographic characteristics and respiratory symptom prevalences in respondents.**

Regarding to socio-demographic characteristics, the finding of this study confirmed that there were associations between age and education of the respondent. Generally, as increased, there were higher prevalences of respiratory symptoms. The highest symptom rates were usually found in age 31-40 years. Age was significantly associated with almost all respiratory symptoms except rhinitis and eye irritation. In multivariate analysis, age was statically significant with cough, phlegm and wheeze symptoms. Some of the symptom rates were lower with higher education level. This may be due to the awareness for health care as the respondents" education become higher. In bivariate analysis, respondent education was significantly negatively associated with wheeze with or without cold. The number of household members was negatively and significantly associated with wheeze with or without cold and shortness of breath in respondent.

**5.1.4 Association between general characteristics of children and their respiratory symptom prevalences.**

Female had higher prevalence rate of rhinitis than male and it was positively associated with rhinitis but not statically significant (p=0.148). Children age between 5-7 years old had higher tendency of sore throat without cold than those age under 4 years old. Age was positively statistically significantly associated with sore throat without cold (p=0.007).

**5.1.5 Association between environmental factors and respiratory symptom prevalences in respondents.**

The environmental factors included in analysis were incense use, type of house, rooms in house, windows in house and cooking fuel type. Incense use in the house was positively associated with cough with or without colds (p=0.101), phlegm with or without colds (p=0.082), rhinitis (p=0.003) and eye irritation (p=0.148). Wheeze with or without colds, shortness of breath and sore throat were negatively associated with incense use. People lived in wood housing had higher tendency to get sore throat without cold than those who lived in other housing. Rooms in house was

negatively associated with cough with or without colds, phlegm with or without colds, shortness of breath and positively associated with sore throat without colds. In final multiple logistic regression model, rooms in house was statically significantly associated with cough with or without colds (p=0.017) and phlegm with or without cold (p=0.002).

Number of windows in the house was negatively associated with cough with or without cold, phlegm with or without cold, rhinitis and positively associated with wheeze with or without cold and shortness of breath. In final multiple logistic regression models, windows in house had significant relationship with wheeze with or without cold (p=0.001). Wood fuel use had positive significant association with sore throat without cold (p=0.030). Cooking fuel type was positively, and marginally significantly, associated with risk of phlegm with or without colds in respondents (OR= 1.63, 95% CI= 0.91 to 2.89, p=0.098).

**5.1.6 Association between environmental factors and respiratory symptom prevalences in children.**

The environmental factors included in analysis were incense use, type of house, rooms in house, windows in house and cooking fuel type. Generally frequency of incense use was positively associated with symptom prevalences, but not significantly so. The children who lived in wood housing had more tendencies to get respiratory problems than those lived in other housing (bamboo, concrete). Rooms in the house was negatively associated with cough with or without cold (p=0.005), wheeze with or without cold (p=0.152), rhinitis (p=0.002) and eye irritation (p=0.024). In final multiple logistic regression model, rooms in house had significant relationship with cough with or without colds (p=0.026), wheeze with or without colds (p=0.031), rhinitis (p=0.024) and eye irritation (p=0.045). Windows in house was negatively associated with sore throat without cold (p=0.052) and rhinitis (p=0.009). Cooking fuel type was positively associated with cough with or without cold (p=0.028), phlegm with or without cold (p=0.148) and eye irritation (p=0.082). Wood fuel for cooking was not significantly associated with eye irritation in final multiple logistic regression model (p=0.158).

**5.1.7 Association between behavioral factors and respiratory symptom prevalences in respondents.**

The behavioral factors included in analysis were windows open during cooking, meals cooking per day and household member current smoking. Windows open during cooking was negatively significantly associated with cough with or without colds (p=0.023) and; positively significantly associated with wheeze with or without colds (p=0.001), sore throat without cold (p=0.140) and eye irritation (p=0.154). Meals cooking per day was positively associated with shortness of breath but not significant (p=0.101). Household member current smoking was positively associated with cough with or without colds (p=0.066), phlegm with or without colds (p=0.103), shortness of breath (p<0.001) and rhinitis (p=0.118). In final multiple logistic regression model, household member current smoking was independently associated with phlegm with or without cold but not significant (p=0.132).

**5.1.8 Association between behavioral factors and respiratory symptom prevalences in children.**

The behavioral factors included in analysis were windows open during cooking, meals cooking per day and household member current smoking. Windows open during cooking was positively associated with wheeze with or without colds (p=0.056) and negatively associated with rhinitis (p=0.046). Windows open during cooking had significant positive relationship with wheeze with or without colds in multivariate analysis (p=0.001). Meals cooking per day was negatively associated with phlegm with or without colds (p=0.055) and positively associated with rhinitis (p=0.032). Meals cooking per day had significant positive relationship with rhinitis in multivariate analysis (p=0.033). Household member current smoking was positively associated with cough symptoms (p=0.058). In multivariate analysis, household member current smoking was marginally significantly associated with cough symptoms (p=0.062).

**5.2 Conclusion**

Great mobility and geographically scattered distribution of the migrants, unfamiliarity with the migrant community, their working nature and culture, their free times and willingness for interview were major challenges during data collection. To overcome these, ten Myanmar local persons, who are familiar and well experienced with the nature of Myanmar migrant communities, were hired to assist data collection process of the study. It was found that mosquito coil use differs from location and interviewers went specific location and saw higher rate of respiratory symptoms in mosquito coil used area. One area of the village was not covered in data collection. This could conceivably introduce bias, but according to researcher personal observation, there were no difference between that area and others covered in the study. Thus, the researcher is confident that any such bias would have been small.

In conclusion, this study found that exposure to mosquito coil smoke was positively associated with respiratory symptom prevalences. This result provides support for the hypothesis that use of mosquito coil is associated with increased risk of respiratory symptoms in Myanmar migrant workers. Socio-demographic factors such as age and education were positively associated with the prevalences of respiratory symptoms and had significant association with 4 out of 7 symptoms. Also the environmental factors: incense use, wood as main type of cooking fuel and passive smoking had significant positive association with some of the respiratory symptoms. Some of the behavioral factors were significantly associated with respiratory symptoms.

**5.3 Recommendation**

1. Further research should study in other places to ascertain the association between mosquito coil smoke and prevalences of respiratory problems.
2. Risk benefit consideration is required to think whether mosquito coil use can prevent vector borne diseases or not. (For the researcher best knowledge, there was no evidence in the previous studies that burning insecticide containing mosquito coils prevented malaria or dengue or other vector borne diseases and provided evidence that mosquito coils inhibit nuisance biting by various mosquito species.)
3. The risk and benefit of mosquito coil use should be compared to other methods of control mosquito in home.

4. If association between mosquito coil use and respiratory problems is consistently confirmed in other research, find other ways of control mosquito exposure.

5. Available research, including the present study, shows an association between mosquito coil use and increased prevalence of respiratory symptoms. However, this research has not yet confirmed whether this association is causal. If further research demonstrates causal associations, herbal alternatives (eg., lemon grass) to mosquito coil use should be strongly considered, even though such alternatives may be more expensive than mosquito coils. Also, the health risks of these alternative methods should be thoroughly characterized.

6. Investigate long-term health consequences of mosquito coil use, for example chronic lung disease and cancer.

7. Investigate other conditions which could plausibly be associated with mosquito coil use, for example skin rash and upper digestive tract disorders.

**5.4 Limitation**

About mosquito coils usage, the questions did not include how many hours of mosquito coils were used per day, so potential dose-response relationships between coil use and prevalences could not be explored.

A cross-sectional study design measures the exposure and effects at a particular point of time and not over time. This study was done among Myanmar migrant workers in Mae Ku village in Mae Sot district, Tak Province only so that the findings cannot be generalized to the whole Myanmar migrant population.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**5.5 Expected benefit and application**

The researcher can disseminate the results of research to policy maker and other relevant health care provider. The program implementers and health workers can use it to improve the programs in the future by developing appropriate health messages and relevant interventions. The program can use the baseline data for future planning activities and comparisons. Study results may help to create awareness to general public on effects of indoor pollution for taking appropriate steps to prevent respiratory problems due to indoor air pollution.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# REFERENCES


Azizi BH, Henry RL. (1991). The effects of indoor environmental factors on respiratory illness in primary school children in Kuala Lumpur. **Int J Epidemiol** 20: 144-50.

Bruce N, Perez- Padilla R, Albalak R. (2000). Indoor air pollution in developing countries: a major environmental and public health challenge for the new millennium. **Bull World Health Org** 78: 1078- 1092.

Chang J, Lin J. (1998). Aliphatic aldehydes and allethrin in mosquito coil smoke. **Chemosphere** 36(3): 617-624.

Chhabra et al. (2001). Ambient Air Pollution and Chronic Respiratory Morbidity in Delhi. **Arch Environ Health** 56,1: 58-64.

Duki (2003). Effects of Air Pollution on Respiratory Health in Indonesia and its economic cost. **Arch Environ Health**58,3 :135-43.

Environmental Health Perspective**.** (2003). **Illegal Mosquito Coils Still Sold in U.S., Likely Expose Users to Potent Lung Carcinogen.** [online]. Available from: http://www.ehp.niehs.gov/press/illmosquito.htm [2009, November 15].

Ezzati, M., Lopez, A.D., Rodgers, A., Hoorn, S.V. and Murray, C.JL. (2002). Selected major risk factors and global and regional burden of disease. **Lancet** 360, 1347-1360.

Fagbule and Ekanem. (1994). Some environmental risk factors for childhood asthma: a case control study. **Annals of tropical Pediatrics** 14,1: 15-9.

Fang GC, Chang CN et al. (2002). Suspended particulate variations and mass size distributions of incense burning at Tzu Yun Yen temple in Taiwan, Taichung. **Science Total Environment** 299,1-3: 79-87.

Hong (2004). Prevalence of Respiratory Symptom in children and air quality by village in Rural Indonesia. **J Occup Environ Med** 46,11: 1174-9.

Hu and Wong, et al. (2004). Binary latent variable modeling and its application in the study of air pollution in Hong Kong. **Statist. Med** 23:667-684.

Indoor Air Pollution at a glance. (2002, March). [online]. Available from: www.worldbank.org/hnp [2009, October 18].

Ingle (2005). Exposure to vehicular pollution and respiratory impairment of Traffic policeman in Jalgaon City, India. **Industrial health** 43,4: 656-62.

Karita (2001). Respiratory Symptom and Pulmonary function among Traffic Police in Bangkok, Thailand. **Arch Environ Health** 56,5: 467-70

Karita (2004). Effects of working and residential location area on air pollution related Respiratory symptoms in Policeman and their wives in Bangkok, Thailand. **European Journal of public health** 14,1: 24-6.

Krieger RI, Dinoff TM, Zhang X. (2003). Octachlorodipropyl ether (s-2) mosquito coils are inadequately studied for residential use in Asia and illegal in the United States. **Environ Health Perspect** 111: 1439-42.

Kumar (2004). Association of outdoor Air Pollution with chronic respiratory morbidity in industrial town in Northern India. **Archives of environmental health** 59,9: 471-7.

Lahiri and Roy, et al. (2000). Air Pollution in Calcutta elicits adverse pulmonary reaction in children. **Indian journal of medical research** 112: 21-6.

Langkulsen (2006). Respiratory Symptoms and lung function in Bangkok school children. **Eur J Public Health** 16,6: 676-81.

Lee YL, Lin YC, Hsiue TR, Hwang BF, Guo YL. (2003). Indoor and outdoor environmental exposures, parental atopy, and physician-diagnosed asthma in Taiwanese schoolchildren. **Pediatrics** 112: 389–95.

Lin T C and krishnaswamy G et al. (2008). Incense smoke: clinical, structural and molecular effects on airway disease. **Clinical and Molecular Allergy** 6:3doi:10.1186/1476-7961-6-3.

Liu W, Zhang J, Hashim JH, Jalaludin J, Hashim Z, Goldstein BD. (2003). Mosquito coil emissions and health implications. **Environ Health Perspect** 111: 1454-60.

Lukwa N, Chandiwana SK. (1998). Efficacy of mosquito coils containing 0.3% and 0.4% pyrethrins against An.gambiae sensulato mosquitoes. **Cent Afr J Med** 44,4: 104-107.

S.G Ong et al. (1991). Studies on Respiratory Health of primary school children in urban communities of Hong Kong. **The Science of Total Environment** 1; 106,1-2: 121-35.

Samet, J.M., Marbury, Marian C., and Spengler, J.D. (1987). Introduction for health professionals: indoor air pollution. **Health Effects and Sources of Indoor Air Pollution** 136: 1486-1508.

Smith KR. (1987). Biofuels, air pollution, and health. **A global review. New York: Plenum**.

Smith KR. (2002). Indoor air pollution in developing countries: recommendations for research. **Indoor Air** 12: 198-207.

Smith, K.R. (2003). Indoor air pollution and acute respiratory infections. **Indian Paediatrics** 40: 815-819.

Smith, KR., Samet, J.M., Romieu, I., Bruce, N. (2000). Indoor air pollution in developing countries and acute respiratory infections in children. **Throax** 55, 6: 518-32.

Songsore J and McGranahan G. (1998). The Political Economy of Household Environmental Management: Gender, Environment and Epidemiology in the Greater Accra Metropolitan Area. **World Development** 26,3: 395-412.

Tamura. (2003). Particulate Air Pollution and chronic respiratory symptom among Traffic Policeman, Bangkok, Thailand. **Arch of Environ Health** 58,4: 201-7.

US Environmental Protection Agency. (1992). Respiratory health effects of passive smoking: lung cancer and other disorders. Washington, DC: Environmental Protection Agency (publication EPA/600/6-90/006F).

WHO. (1998). Pesticides Evaluation Scheme, Division of Control of Tropical Diseases, Guideline Specifications for Household Insecticide Products.

WHO. (2000). Indoor air pollution in developing countries: a major environmental and public health challenge.

WHO. (2005). Indoor air pollution and child health in Pakistan: report of a seminar held at the Aga Khan University, Karachi, Pakistan.

Wongsurakiat. (1999). Respiratory Symptom and Pulmonary function of Traffic Policeman in Thonburi, Thailand. **J Med Assoc Thai** 82,5: 435-43.

WHO. (2005). Safety of Pyrethroids for Public Health Use.

Yan CY, Chiu JF, Cheng MF, Lin MC. (1997). Effects of indoor environmental factors on respiratory health of children in a subtropical climate. **Environ Res** 75: 49-55.

Zhang and Wei. (2002). Children"s Respiratory Morbidity Prevalence in relation to Air Pollution in 4 Chinese cities. **Environ Health Perspect** 110,9: 961-7.

Zhang et al. (1999). Effects of Air Pollution on Respiratory Health of adults in 3 Chinese cities. **Arch Environ Health** 54,6: 373-81.

Zhang W, Sun J, Chen S, Wu Y, He F. (1991). Levels of exposure and biological monitoring of pyrethroids in spray men. **Br J Ind Med** 48: 82-86.

Chen and Wong et al. (2008). Exposure to Mosquito Coil Smoke may be a risk factor for lung cancer in Taiwan. **J Epidemiol** 18,1: 19-25.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# APPENDICES

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

**APPENDIX A**
**Questionnaires**

Interviewer code number: _____

Household code number: _____ Date: _____

**PLEASE ANSWER ALL THE QUESTIONS FROM PART ONE AND PART TWO. IF ANY CHILDREN (AGE IS SEVEN YEARS OLD OR LESS) LIVE IN THE HOUSE, PLEASE ALSO ANSWER ALL THE QUESTIONS FROM PART THREE FOR EACH CHILDREN.**

PART ONE. QUESTIONS ABOUT THE GENERAL HOUSEHOLD SITUATION.

1. What is the total number of people now living in this household?
_____People

2. In the table below, please write the name, age, sex, education and occupation of every person living in this household. Please start with the oldest person and work to the youngest person living in the household.

| | NAME | AGE | SEX | EDUCATION | OCCUPATION |
|---|---|---|---|---|---|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |

Education: 1. Never go to school _____ 2. Primary school _____
3. Middle School _____ 4.High School and above _____

Occupation: 1. Farmer _____ 2. General worker _____
3. House wife _____ 4. Others (please specify) ____

3. What type of house does your family live in?
1. Concrete Building_____ 2. Wood housing _____

3. Others _____

How many floors in your house?
Only one _____ Two_____
More than two_____

4. How many rooms does the house have? (do not count bathroom) _____

5. How many windows does the house have? _____

6. Does your family burn mosquito coils in the house? YES [ ] NO [ ]

If YES, how often do you burn it in the last month? Check only one.

1. Every day (more than one time per day) _____
2. One to two times per week _____
3. Three to four times per week _____
4. One to two times per month _____
5. Seldom (not often) _____

If NO, what is the reason of not using mosquito coils in the house? (Can check more than one)

1. Use of mosquito nets _____ 2. Can"t effort to buy _____
3. Sensitive to coils smoke _____ 4. Others _____

7. Does your family burn incense stick for religious purpose in your house?

YES [ ] NO [ ]

If YES, how often do you burn it in the last month? Check only one.

1. Every day (more than one time per day) _____
2. One to two times per week _____
3. Three to four times per week _____
4. One to two times per month _____
5. Seldom (not often) _____

8. What is the main type of cooking fuel stove does your family use? Check only one.

Charcoal fuel stove _____ Wood stove _____
Electric stove _____ Others _____

9. Do you ever use other fuels for cooking? Can check more than one.

Charcoal fuel _____ Wood _____

Electricity_____ Others _____

10. Are the windows usually opened during cooking? YES [ ] NO [ ]

11. How many meals are cooked per day on average in your house? Check only one.

1 meal/ day _____ 2 meals /day _____

3 meals or more / day _____

12. Do any household members smoke cigarettes at the present time? YES [ ]

NO [ ]

If YES, how many cigarettes are smoked each day in the home?

1. Less than five sticks _____ 2. Five to ten sticks _____

3. More than ten sticks _____ 4. More than one pack _____

PART TWO. QUESTIONS ABOUT THE RESPIRATORY SYMPTOMS OF MOTHER OR WIFE OR FEMALE GUARDIAN OF THE HOUSEHOLD.

13. COUGH

A. When you have a cold, do you usually have a cough?

YES [ ] NO [ ]

B. When you do not have a cold, do you usually have a cough?

YES [ ] NO [ ]

.

IF "YES" TO QUESTION "A" OR "B", ANSWER FOLLOWING.

You cough like this for about how many months each year? Check only one.

Less than 1 month _____ 1 - 2 months _____

3 months or more _____

14. PHLEGM

A. When you have a cold, do you usually bring up phlegm from your chest?

YES [ ] NO [ ]

B. When you do not have a cold, do you usually bring up phlegm from your chest? YES [ ] NO [ ]

.

IF "YES" TO QUESTION "A" OR "B", ANSWER FOLLOWING.

You bring up phlegm from your chest like this for about how many months each year? Check only one.

Less than 1 month _____ 1 - 2 months _____

3 months or more _____

15. WHEEZING

Does your chest ever sound wheezy or whistling? (May check more than one choice).

1. When you have a cold? _____

2. Occasionally apart from cold? _____

3. Most days or nights? _____

16. Have you ever feel an attack of wheezing that has made you feel shortness of breath?

YES [ ] NO [ ]

17. SORE THROAT AND RHINITIS

Do you ever have a sore throat when you do not have a cold?

YES [ ] NO [ ]

Do you ever have a problem with sneezing, or a runny, or a blocked nose When you do not have a cold? YES [ ] NO [ ]

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

YES [ ] NO [ ]

In the past 12 months, about how many times have you had a cold with a cough or the flu?

Never _____ 1 time _____ 2 times _____ 3 times or more _____

18. ASTHMA

Has a doctor ever said that you have asthma? YES [ ] NO [ ]

19. BRONCHITIS

Has a doctor ever said that you have bronchitis? YES [ ] NO [ ]

20. PNEUMONIA

Has a doctor ever said that you have pneumonia? YES [ ] NO [ ]

PART THREE. QUESTIONS ABOUT RESPIRATORY SYMPTOMS FOR CHILDREN UNDER SEVEN YEARS OLD.

STUDY CHILD NAME…… GENDER……. AGE…….

21. COUGH

A. When the child has a cold, does he/she usually have a cough?

YES [ ] NO [ ]

B. When the child does not have a cold, does he/she usually have a cough?

YES [ ] NO [ ]

. IF "YES" TO QUESTION "A" OR "B", ANSWER FOLLOWING.

He/she coughs like this for about how many months each year? Check only one.

Less than 1 month _____ 1 - 2 months _____

3 months or more _____

22. PHLEGM

A. When the child has a cold, does he/she usually bring up phlegm from his/her chest?

YES [ ] NO [ ]

B. When the child does not have a cold, does he/she usually bring up phlegm from your chest?

YES [ ] NO [ ]

. IF "YES" TO QUESTION "A" OR "B", ANSWER FOLLOWING.

He/she brings up phlegm like this for about how many months each year? Check only one.

Less than 1 month _____ 1 - 2 months _____

3 months or more _____

23. WHEEZING

A. Has the child"s chest ever sounded wheezy or whistling? (may check more than one choice)

1. When he/she has had a cold? _____

2. Occasionally apart from cold? _____

3. Most days or nights? _____

24. SORE THROAT AND RHINITIS

Does the child ever have a sore throat when he/she does not have a cold?

YES [ ] NO [ ]

Does the child ever have a problem with sneezing, or a runny, or a blocked nose

When he/she does not have a cold? YES [ ] NO [ ]

Does his /her eye ever feel sore or itchy or irritated when he/she is at home?

YES [ ] NO [ ]

In the past 12 months, about how many times has the child had a cold with a cough or the flu?

Never _____ 1 time _____ 2 times _____ 3 times or more _____

25. ASTHMA

Has a doctor ever said that he/she has asthma? YES [ ] NO [ ]

26. BRONCHITIS

Has a doctor ever said that he/she has bronchitis? YES [ ] NO [ ]

27. PNEUMONIA

Has a doctor ever said that he or she has pneumonia? YES [ ] NO [ ]

# APPENDIX B

## Time schedules

| Research process | Sep 2009 | Oct 2009 | Nov 2009 | Dec 2009 | Jan 2010 | Feb 2010 | Mar 2010 | Apr 2010 | May 2010 |
|---|---|---|---|---|---|---|---|---|---|
| Literature review | ← | — | → | | | | | | |
| Proposal writing and submission | | | ← | — | → | | | | |
| Ethical consideration | | | | | ← | — | → | | |
| Data collection | | | | | | | ← | — | → |
| Data analysis | | | | | | | ← | — | → |
| Writing report | | | | | | | | ← | → |
| Thesis presentation and final submission | | | | | | | | ← | → |

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# APPENDIX C

## Budget

| No | Activities | Unit | Price (Baht) | Unit (number) | Total Budget (Baht) |
|---|---|---|---|---|---|
| 1. | Pre-testing<br>-travelling expense (Bangkok- Mae Sot)<br>-Accommodation<br>-photocopy and stationery | <br>2 person<br>2 person<br>30 Question sets | <br>1400<br>700/day/person<br>6/set | <br><br>3 day | <br>2800<br>4200<br>1800 |
| 2. | Data Collection<br>-travelling expense (Bangkok-Mae Sot)<br>-Accommodation | <br>2 person<br>2 person | <br>1400<br>700/day/person | <br><br>6 day | <br>2800<br>8400 |
| 3. | Charges of the interviewers | 10 person | 200/day | 6 day | 12000 |
| 4. | Incentives for participants | 422 households | 20 | | 8440 |
| 5. | Printing and Copying expenses | 422 Question sets | 6/set | | 2532 |
| 6. | Preparation and completion of thesis paper | | | | 5000 |
| 7. | Grand Total | | | | 47972 |

# VITAE

| | |
|---|---|
| Name | : Miss Tharaphy |
| Date of Birth | : 5th July 1985. |
| Place of Birth | : Yangon, Myanmar. |
| Education Achievement | : M.B., B.S. (2009)<br>University of Medicine (2), Yangon, Myanmar |
| Work Experience | : Medical Officer (SANPYA Hospital) (2008-2009) |
| Scholarship received | : Thai Fogarty ITREOH Center"s Academic Year 2009 scholarships<br>(Tuition Scholarship for MPH in Public Health) |

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย