PATICULATE MATTERS RELATED TO RESPIRATORY AND ALLERGIC SYMPTOMS IN LIBRARY STAFFS AND ADMINISTRATIVE OFFICERS AT CHULALONGKORN UNIVERSITY BANGKOK THAILAND

Mr. Pathai Chullasuk

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Public Health Program in Public Health
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ฝุ่นละอองขนาดเล็กกับกลุ่มอาการโรคระบบทางเดินหายใจและภูมิแพ้ในเจ้าหน้าที่ห้องสมุดและพนักงานในจุฬาลงกรณ์มหาวิทยาลัย กรุงเทพมหานคร ประเทศไทย

นายผาไท จุลสุข

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต
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Thesis Title	PATICULATE MATTERS RELATED TO RESPIRATORY AND ALLERGIC SYMPTOMS IN LIBRARY STAFFS AND ADMINISTRATIVE OFFICERS AT CHULALONGKORN UNIVERSITY BANGKOK THAILAND
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ผาไท จุลสุข : ฝุ่นละอองขนาดเล็กกับกลุ่มอาการโรคระบบทางเดินหายใจและภูมิแพ้ ในเจ้าหน้าที่ห้องสมุดและพนักงานในจุฬาลงกรณ์มหาวิทยาลัย กรุงเทพมหานคร ประเทศไทย (PATICULATE MATTERS RELATED TO RESPIRATORY AND ALLERGIC SYMPTOMS IN LIBRARY STAFFS AND ADMINISTRATIVE OFFICERS AT CHULALONGKORN UNIVERSITY BANGKOK THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: นพ. โรเบิร์ท เอส. แชบเม็น, 102 หน้า.

วัตถุประสงค์ของการศึกษาครั้งนี้เพื่อหาความสัมพันธ์ระหว่างฝุ่นละอองขนาดเล็กกับอาการโรคระบบทางเดินหายใจ และอาการของภูมิแพ้ของเจ้าหน้าที่ห้องสมุด และพนักงานของจุฬาลงกรณ์มหาวิทยาลัย กลุ่มประชากรศึกษารวมทั้งสิ้น 193 คน โดยแบ่งกลุ่มการศึกษาเป็น 2 กลุ่มประกอบด้วย กลุ่มรับสัมผัสฝุ่น คือ เจ้าหน้าที่ห้องสมุด (119 คน) และกลุ่มไม่สัมผัสฝุ่น คือ พนักงานทั่วไป (74 คน) เก็บข้อมูลโดยการสัมภาษณ์แบบตัวต่อตัวด้วยแบบสอบถามเกี่ยวกับ ลักษณะประชากรทั่วไป ลักษณะการทำงาน ลักษณะสถานที่ทำงาน และกลุ่มอาการโรคระบบทางเดินหายใจและภูมิแพ้ พร้อมหาความเข้มข้นการรับสัมผัสฝุ่นละอองขนาดเล็กขนาดเส้นผ่าศูนย์กลางไม่เกิน 10 ไมครอน (PM_{10}) ด้วยเครื่องเก็บตัวอย่างอากาศ ชนิดติดตามตัวบุคคล โดยวิธีการดังกล่าวเป็นไปตามมาตรฐาน NIOSH method 0600 จากนั้นวิเคราะห์ความสัมพันธ์ด้วยสถิติไค-สแคว์ (Chi-square), การทดสอบของพิชเชอร์ (Fisher's Exact Test) และการวิเคราะห์การถดถอยโลจีสติกแบบหลายตัวแปร (multivariate logistic regression) จากผลการศึกษาพบว่า ลักษณะกลุ่มประชากรตัวอย่างของเจ้าหน้าที่ห้องสมุดส่วนใหญ่เป็นผู้หญิง (79.8%) ไม่สูบบุหรี่ (96.6%) แตกต่างจากกลุ่มพนักงานทั่วไปอย่างมีนัยสำคัญ นอกจากนี้กลุ่มเจ้าหน้าที่ห้องสมุดมีอายุเฉลี่ยระหว่าง 51-60 ปี ในขณะที่กลุ่มพนักงานทั่วไปอายุอยู่ระหว่าง 31-40 ปี ($p < 0.001$) ผลการตรวจวัดฝุ่นละอองพบว่า เจ้าหน้าที่ห้องสมุด ได้รับสัมผัสฝุ่นละอองขนาดเล็กขนาดเส้นผ่าศูนย์กลางไม่เกิน 10 ไมครอน ค่าความเข้มข้นระหว่าง 9.89 – 1298.70 ไมโครกรัมต่อลูกบาศก์เมตร (ค่าเฉลี่ยเท่ากับ 202.81 $\mu g/m^3$) ซึ่งสูงกว่าอย่างมีนัยสำคัญกับกลุ่มพนักงานทั่วไป ที่สัมผัสฝุ่นละอองขนาดเล็กขนาดเส้นผ่าศูนย์กลางไม่เกิน 10 ไมครอน ค่าความเข้มข้นระหว่าง 9.88 - 515.53 ไมโครกรัมต่อลูกบาศก์เมตร (ค่าเฉลี่ย = 102.95 $\mu g/m^3$) ทั้งนี้การรับสัมผัสฝุ่นดังกล่าวอยู่ในเกณฑ์มาตรฐานที่กำหนด นอกจากนี้ พบว่าความชุกของกลุ่มอาการของโรคระบบทางเดินหายใจและภูมิแพ้ เกิดขึ้นในเจ้าหน้าที่ห้องสมุดมากกว่าพนักงานทั่วไปอย่างไม่มีนัยสำคัญ ($p > 0.05$) และเมื่อวิเคราะห์หาความสัมพันธ์ระหว่างฝุ่นละอองขนาดเล็กกับกลุ่มอาการโรคระบบทางเดินหายใจและภูมิแพ้พบว่า ความเข้มข้นการรับสัมผัสฝุ่นละอองขนาดเล็กขนาดไม่เกิน 10 ไมครอน (PM_{10}) มีความสัมพันธ์อย่างมีนัยสำคัญ กับอาการโรคหายใจมีเสียงหวีด (Wheezing) และผื่นผิวหนัง (Skin rash) โดยมีค่า OR=1.005 และ OR=1.004 ตามลำดับ ทั้งนี้ กลุ่มอาการโรคระบบทางเดินหายใจและภูมิแพ้ในเจ้าหน้าที่ดังกล่าว อาจมีสาเหตุจากปัจจัยเสี่ยงด้านอื่น เช่น โรคประจำตัว ได้แก่ โรคระบบทางเดินหายใจและโรคภูมิแพ้, เพศ, ประวัติการทำงานที่ได้รับสัมผัสฝุ่นละอองและสารเคมี, การสัมผัสฝุ่นจากการเผาไม้ในที่โล่ง, ควันธูป และการจราจร, ลักษณะพาหนะสำหรับใช้ในการเดินทางมาทำงาน, การปรับปรุงสถานที่ทำงาน และการใช้ยาฆ่าแมลงในบ้าน เป็นต้น

สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2557 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

5778815153 : MAJOR PUBLIC HEALTH
KEYWORDS: PATICULATE MATTER / RESPIRATORY SYMPTOMS / ALLERGIC SYMPTOMS / LIBRARY STAFFS

PATHAI CHULLASUK: PATICULATE MATTERS RELATED TO RESPIRATORY AND ALLERGIC SYMPTOMS IN LIBRARY STAFFS AND ADMINISTRATIVE OFFICERS AT CHULALONGKORN UNIVERSITY BANGKOK THAILAND. ADVISOR: ROBERT S. CHAPMAN, M.D.,MPH, 102 pp.

The objective of this research was to find association between particulate matter with respiratory and allergic symptom in libraries staffs and administrative officers of Chulalongkorn University. Respondents in this studied were 193 persons separated in 119 exposed group (Libraries staffs) and 74 unexposed group (Administrative officers). Face to face interview was used to ask about socio-demographic, work characteristic, workplace characteristic, respiration and allergic symptoms also with particulate matter exposure measurement with personal equipment followed to NIOSH method (0600). Statistic for analyzed data and association were Chi-square test, Fisher's Exact test and logistic regression. The results from this studied shown that most of libraries staffs were woman (79.8%) and smoke (96.6%), this difference to administrative office significantly (p = 0.002). Nevertheless the libraries staffs had highly in age between 51-60 years old while administrative officers were 31 – 40 years old (p < 0.001). The particulate matter diameter less than 10 micron (PM_{10}) exposure of libraries staff (9.89 – 1298.70 μg/m^3, Mean = 202.81 μg/m^3) was significantly higher than administrative officers (9.88 – 515.53 μg/m^3, Mean = 102.95 μg/m^3) but PM_{10} exposure was not exceed to standard (OSHA: 5000 μg/m3) also with prevalence of respiratory and allergic symptoms in libraries staffs insignificantly higher than administrative officers. However, the data shown that PM_{10} exposure significant association to wheezing (OR=1.005, p = 0.05) and skin rash (OR=1.004, p = 0.041). There were other factors which significantly association to the symptoms such as respiratory and allergic disease, gender, work history with exposure to dust, daily smoke exposure from incent smoke or open burning, transportation to work by bus, renew workplace by re-painting and set up wall paper and pesticide used in household.

Field of Study: Public Health Student's Signature .....

Academic Year: 2014 Advisor's Signature .....

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WHO	World Health Organization
VOCs	Volatile Organic Compounds
PM_{10}	Particulate matter diameter less than 10 micrometer
$PM_{2.5}$	Particulate matter diameter less than 2.5 micrometer
OSHA	Occupational Safety and Health Administration
NIOSH	National Institute of Occupation Safety and Health
mg/m^3	Milligram per cubic meter
$\mu g/m^3$	Microgram per cubic meter

CHAPTER I
INTRODUCTION

1.1 Background and Rationale

In recent years, Thailand is facing with high development in any ways, Industrial dimension, social dimension and life style dimension, that make situation of environment had changed in a problem. Environment had changed in worse situations included; increase waste water from many industry, problem from soil pollution in agricultural area , contaminated with Particle matters less than 10 microgram (PM10) in the air or volatile organic compound (VOCs) in atmosphere etc. that could be the risk factors for health to people stayed in besides or in that area. Especially the problem from air pollution, it had been the first priority of pollution problem in Thailand. From the number of public complained with all pollution data in Thailand project to air pollution, in case of particulate matter is mostly priorities highest complained from people in every years. In 2012 pollution that causes to complain by people was air pollutions (bad odor and particle matter) 65%, by the way a particulate matter was 25% of air pollution complained. Nevertheless, In 2013 pollution that lead to people complained was air pollutions (bad odor and particle matter) 64% , there was the particulate matter about 24%(1). At the same time, in 2013, WHO's International Agency for Research on Cancer (IARC) had some reports about human carcinogen, lung cancer and urinary tract/bladder cancer associated to particulate matters component which contaminated in outdoor air pollutions. More than these WHO reports that in 2012 ambient air pollution that contaminated with a small particulate matters of 10 microns or less in diameter (PM_{10}) caused to adult deaths about 3.7 million in any countries per year and the death could be both urban and rural areas with respiratory disease cardiovascular and cancers too(2).

In Thailand, ambient air pollution with particulate matters was the pollution that causes to people health. The Pollution Control Department (PCD) is the firstly authorities of government who responsible the problem with implementation the prevention project, determined laws or regulation also threshold level of pollution

to control them. In other hand, don't forget that air pollution had two part included; ambient air pollution and indoor air pollution. Especially indoor air pollution, we found from data of WHO that in many countries of the world indoor air pollution problem can be causes of disease related in childhood burden of death, pneumonia (3) and allergic but in Thailand did not have an any authorities from government to concentrated in manner of prevention this problem anymore.

Indoor air pollution mostly included particulate matters, gases or fungi contaminated within inadequate ventilation. Poor ventilation can increase indoor air pollutant levels because a problem in air exchange between indoor and outdoor that mean indoor air pollutant were still contaminated in any area all over the time and cannot released them out from the place. Nevertheless temperature and humidity levels were influenced to concentrations of pollutants by the way health effects from indoor air pollutants can be show in immediately and long term effect (4).

Furthermore, the reports from WHO shown the people around 4.3 million who lives in household died from the exposure to air pollution, particulate matters or fuel gases, from any activities in their home. The reason was three billions of people were cooking and heat their homes by use solid fuels (i.e. charcoal, wood, coal, dung, crop wastes) with traditional stoves without chimney. Inefficient of cooking and heating process, it made a spread out of pollutants contaminated in the house such as fine particles and carbon monoxide (5). For example about this, Pakistan had situation of childhood death burdens and pneumonia. The main cause related to this disease due to indoor air pollution from solid fuel use, wood biomass fuels, with significantly (3).

Nevertheless, In 2012 WHO reported that almost in low and middle income countries, there were people deaths related to household air pollution. The South East Asian and Western Pacific regions were the highest burden of death with 1.69 and 1.62 million deaths respectively and the other region that have burden of deaths attributable from household air pollution or indoor air pollution were Africa region, Eastern Mediterranean region and America respectively. Beside this, the disease caused to deaths which related to indoor air pollution were Stoke (34%) Ischemic Heart disease (26%) COPD (22%) Acute lower respiratory disease (12%) and Lung cancer (6%) (6).

On other hand, even if mostly of indoor air which affected to people health came from household or building air pollutants such as particulate matters, fuel gas, pesticide, incent smoke or smoking but this pollutants can contaminate to other areas where closely to that place so. For example, areas which approach to indoor air pollutants were general offices, department store, classroom or universities. Especially school and universities, there are many of children or students also the lecturer who stayed at that places all day contacted to each indoor air pollutants. This situation consistent to previous studied of J. M. Daisey et al who found that the school had poor ventilation and there was high concentration of CO_2, TVOCs (Total Volatile Organic compounds), Formaldehyde and macrobiotics such as dust fungi and bacteria which causes to asthma, allergic and respiratory symptoms in children and teachers (7). They are exposed to indoor air pollutant all the time but they did not know, maybe in classroom with poor ventilation, re-paint or renew the buildings all of this situations maybe contaminated to the library too. The libraries are the places where there are student and people come to find out some books, document or any information all day but nobody know about pollutants contaminated here. From other countries study, Wlazło A et al (8) and Helen Lloyd et al (9), they found that books and documents especially the old books had high concentration of dust and it was contaminated in the air of library and it will contaminated in the air of library also the temperature and humidity were influenced to increase the accumulation of dust. From the studied above, there were only few studied related to particulate matter associate with respiratory or allergic symptoms in library while in Thailand did not have study about particulate matters exposure associated to the symptoms of workers who worked in the library so we still did not have baseline of pollutants situation in this area.

For this reason researcher have a question in mind about particulate matter concentration contaminated in workplace like a library where maybe have higher risk from his pollutants and affected to the worker and customers. Nonetheless there is some interesting about the symptoms related and the difference to particulate matter exposure with other officers. To find the results of this question, the researcher decide to study about particulate matters concentration associated with the symptoms

in library staffs compare to general officers. This study work in Chulalongkorn University because this place is the no.1 of universities in Thailand so there are many students are studying here and the university have many libraries supported for all of the students also general people that mean Chulalongkorn University is the place where have high risk of particulate matter exposure in library and compare to general office. The results from this study will be the baseline of indoor air quality especially PM concentration related to health of worker who worked for long period of day. It is useful for another researcher or authority organization for use this result for policy planning to control indoor air quality in the building and lead to improvement and re-management of the workplace appropriated to worker and other people too.

1.2 Objectives of the study

1.2.1 General objective

To explore an association between particulate matter exposure with respiratory and allergic symptoms difference between libraries staffs and administrative officers at Chulalongkorn University.

1.2.2 Specific objectives

1. To estimate the prevalence of respiratory and allergic symptoms in libraries staffs (Exposed group) and administrative officers (Unexposed group) at Chulalongkorn University.

2. To measure particulate matters exposure concentration in libraries staffs (Exposed group) and administrative officers (Unexposed group) at Chulalongkorn University.

3. To compare the particulate matter exposure in libraries staffs (Exposed group) and administrative officers (Unexposed group) at Chulalongkorn University.

1.3 Research question

1. What is the prevalence of respiratory and allergic symptoms related to particulate matter exposure in libraries staffs (Exposed group) and administrative officers (Unexposed group) at Chulalongkorn University?

2. Are there any differences of respiratory and allergic symptoms between libraries staffs (Exposed group) and administrative officers (Unexposed group) at Chulalongkorn University?

3. Does particulate matter exposure associate with respiratory and allergic symptoms?

1.4 Statistic Hypotheses

Hypotheses 1

- Null hypothesis (H_0): There are no difference of symptoms between libraries staffs and administrative officers at Chulalongkorn University.

- Alternative hypothesis (H_1): There are difference of symptoms between libraries staffs and administrative officers at Chulalongkorn University.

Hypotheses 2

- Null hypothesis (H_0): The particulate matter concentration does not associate with respiratory and allergic symptoms in libraries staffs and administrative officers at Chulalongkorn University.

- Alternative hypothesis (H_1): The particulate matter concentration associate with respiratory and allergic symptoms in libraries staffs and administrative officers at Chulalongkorn University.

1.5 Expected benefit & application

1. To show situation of particulate matters exposure in the libraries staffs compare to administrative officers at Chulalongkorn University.

2. To present the prevalence of respiratory and allergic symptoms between libraries and administrative officers at Chulalongkorn University.

3. To inform the personal health promotion in the workers for protect the symptoms which come from particulate matter exposure also to plan about clean schedule program also improvement of air ventilation system in workplace with appropriate for each of libraries and administrative offices

1.6 Conceptual framework

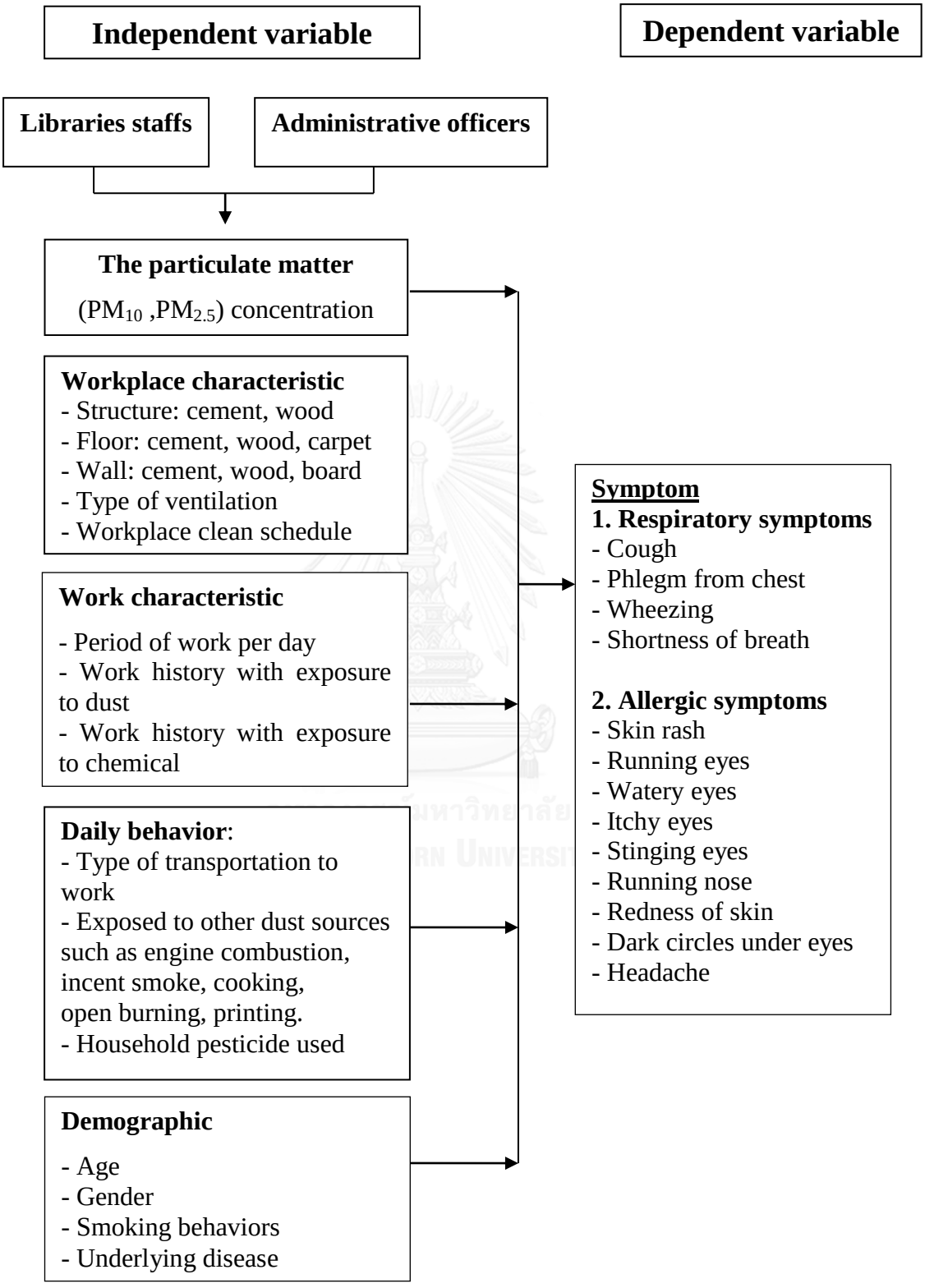

Figure 1 Conceptual Framework

1.7 Operational definition

Age refer to age of adult (23-60 years old) who are working in library and administrative offices of Chulalongkorn University.

Gender defines to male or female of subject in this study

Duration of work per day defines to period of time to work of the subject in this study, mostly 8 hours per day.

Smoke behavior refers to smoke behavior such as current smoke or not smoke.

Underlying disease refers to personal historical of disease such as allergic, asthma heart disease, high pressure deficiency etc.

Particulate matter means particulate matter diameter less than 10 and 2.5 microgram per qubicmeter (PM_{10} and $PM_{2.5}$ respectively).

Structures refer to type of structure in workplace such as cement, wood etc.

Floors refer to type of floor in workplace such as carpet, cement, wood etc.

Wall of workplace refer to type of wall in workplace such as cement, wood or board

Amount of books refer to amount of books, journal and research papers summary together not classify them.

Type of ventilation refer to Type of ventilation used in each library.

Workplace clean schedule refer to frequency of cleaning in workplace.

Renew workplace refers to type of renew situation in workplace.

Work transportation refers to type of transportation of worker such as cars, motorcycle, bus, BTS or walk etc.

Exposed to dust sources refers to other source of dust where the participants usually exposed such as engine combustion, incense smoke, open burning, printing etc.

Respiratory symptoms refers to the symptom of respiratory tract the officers that occur during work analyzed by related question.

Allergic symptoms refers to the symptom of allergic in the officers that occur during work analyzed by related question.

Libraries staffs define to the officers who work in libraries at Chulalongkorn University**.**

Administrative officers refer to the officers who work in administrative offices of Chulalongkorn University and they did not exposed to particulate matter from books or papers work.

CHAPTER II
REVIEW OF LITERATURE

2.1 Indoor air quality

After energy crisis in 1970, many building had to use strategies to save energy by save energy and increased efficiency from air condition so they decided to reduce natural light and protected ambient air pass to the building. These strategies was good to save energy of building but it was caused to poor indoor air quality because ventilation insufficient and contaminated of pollutants in the air inside those building. Furthermore people who lived or worked in the building start to sick and feeling uncomfortable and developed to sick building syndrome (10).

Nevertheless, from the AirAdvice State of Our Indoor Air Report 2007 found that 90% of American people's homes had indoor air quality problem. The factors affected to indoor air problem come from particulate matter, chemical substance, CO_2, temperature, relative humidity and CO respectively. The details can show like the graph below (10).

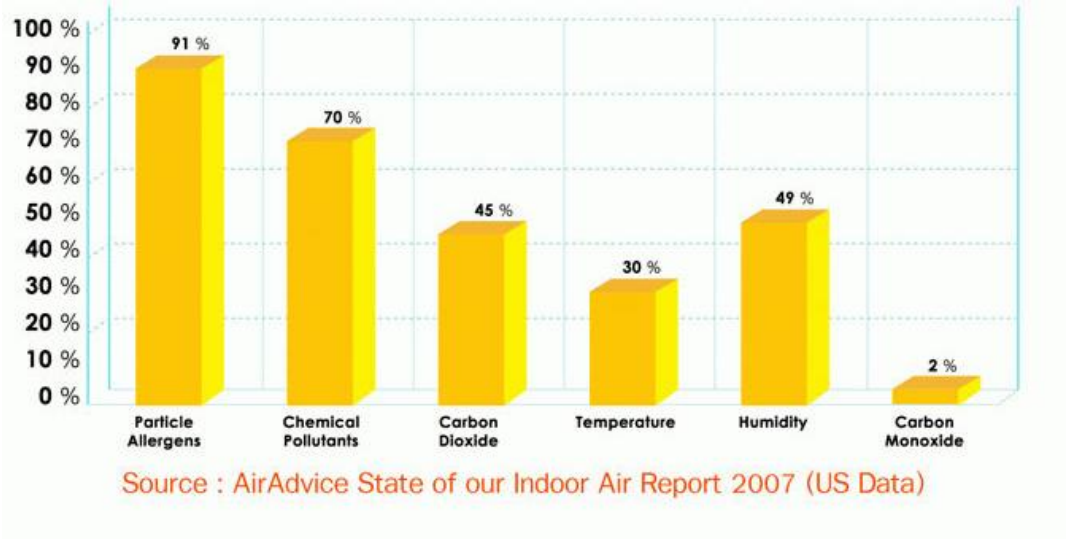

Figure 2 Indoor air report 2007 in United State of America

In general indoor air pollution came from chemical gases, dust, fungi or pathogens contaminated in the air and circulate in the room with poor ventilation. Poor ventilation, humidity and temperature are caused to increase pollutant in the air more than the building where good ventilation(11). Many people work and stayed in the building where always close with poor ventilation exchange from internal and external air more over 8 hours, it made people in that place have a problem in health or illness from the pollutants which we cannot see with our eyes such as fine particles, bacteria, chemicals and fungi. For examples of health problem with indoor air quality including(12).

- Multiple Chemical Sensitivity (MCS) or Environmental Illness (EI): The symptom occurred from always exposure to chemicals or continues stay in bad indoor air quality with pollutants such as dust or particle, smoking, pesticide, curtain, new furniture, perfume spray until lead to body of some people are sensitized and caused to uncomfortable feeling, sick, poor healthy. The kind of symptoms are not specific but they are combine together with headache, sneezing, sore throat, fatigue, dizziness, nausea, chest pain, skin itching, trouble to breathing, muscle pain, rash, confusion, problem to concentration, memory problems, and emotion changes (13).

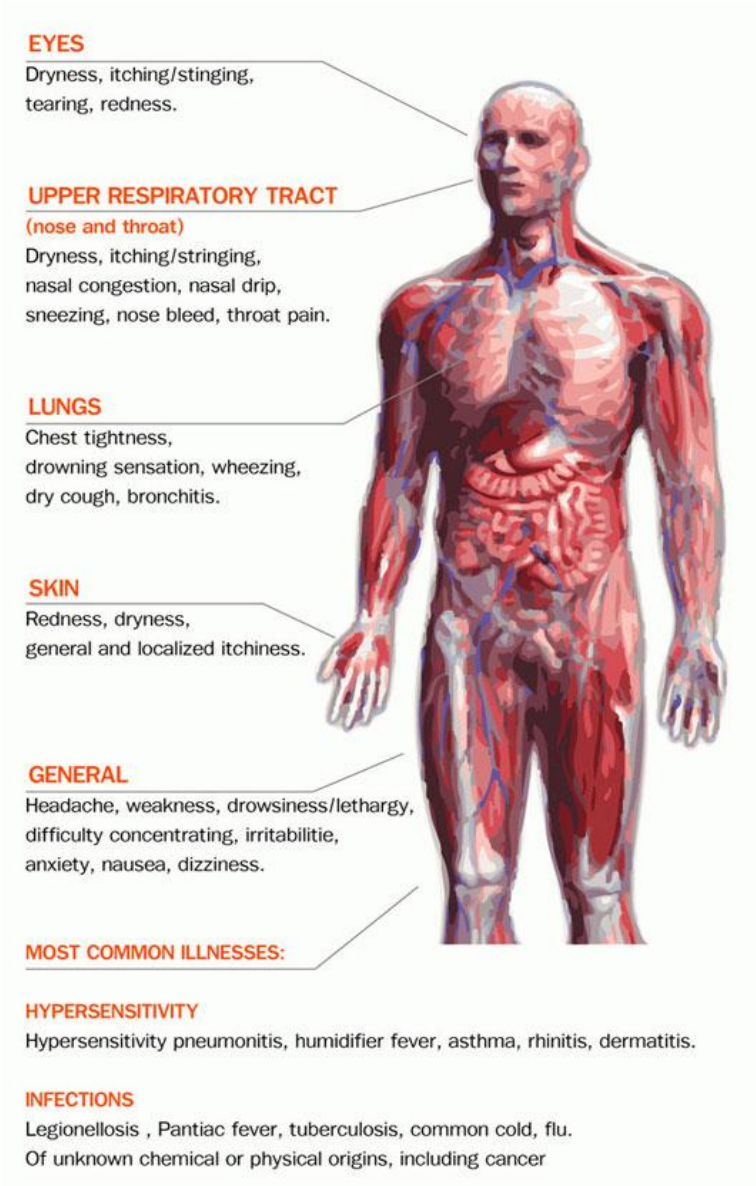

Figure 3 The symptom in human organ related to chemical exposure

2.2 Type of particulate matter

Particulate matters or can call “particle pollution” (PM), is the component of a small particles like liquid droplets also with organic substance, metals solid and fine soil or dust particles. Nevertheless, particulate matter mixture with any chemical such as Nitrate, Sulfate, Ammonium, inorganic ion, heavy metal also with bacteria of fungi (14). The size of these particles related to difference causes of health problems. Environment Protective Agency in United States (U.S.EPA) classifies particle matter two items included (4).

2.2.1 Inhalable coarse particles or respiratory dust is the particle in size diameter between larger than 2.5 micrometers and smaller than 10 micrometers, PM_{10}, for examples are dusts, pollen, mold or particles from the road and industries. PM_{10} can get into the lower respiratory tract until lungs.

2.2.2 Fine particles is the particle in size diameter equal or less than 2.5 micrometers, $PM_{2.5}$, sometime can call fine particulate matter, for examples are forest fires, combustion particle, particles mix with gases exhaust from power plants or automobiles. $PM_{2.5}$ can get into lower respiratory tract until pulmonary alveoli and blood stream.

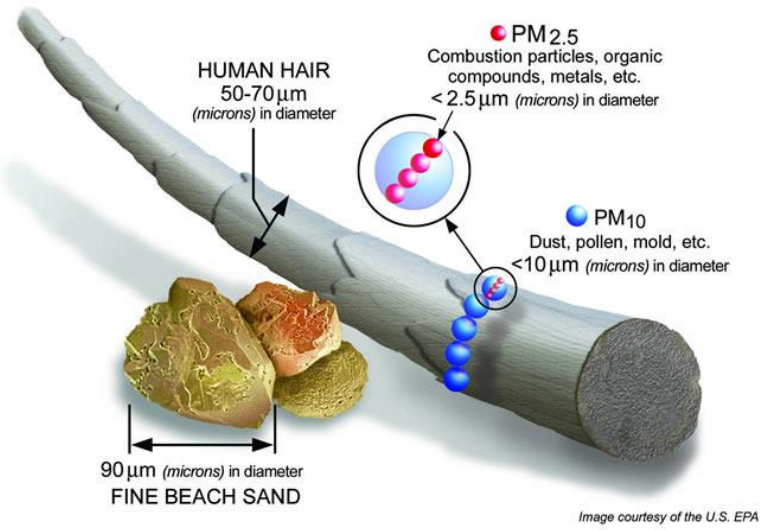

Figure 4 Particulate matter diameter less than 10 micron and 2.5 micron

2.3 Source of particulate matter

Particulate matter comes from many sources and they are many mixture substances in the physical particles both with biological substance, chemical substance depended on source of them. Source of particulate matter can separate in two types like this (15).

1. Natural source are the source of particulate matter that cannot control. It can occur all the time and always make the severity problem to human and environment such as natural wind, volcano, pollens, seasoning, wildfire and geographic area etc.

2. Manmade source are the important source of particulate matter because it can occur in every time and continuous. For example about manmade source particulate matter including.

- Industries or company such as Cement industries, Garment Company, Milling industries, fuel combustion process and metal rub etc.

- Agricultural

- Mining: Particulate matters are occurred in the process such as mine drilling, transportation and grinding.

- Building or structure construction: Construction is caused of particulate matter from pounding, structure pull down, cement mixture, floor scrubbing and transport.

- Transportation and Vehicle:

- Waste disposal: Particle matter come from the first step of preparing areas until disposal processing also waste transport and dumping on land.

2.4 The factor affected to particulate matter concentration

The factors related to concentration of particle matter contaminated to indoor air quality including (15, 16).

2.4.1 Emission concentration from source: particulate matter from outside can come into inside areas of building and contaminated in the air so if there are high concentration of particulate matter from outside, it can make high concentration of particulate matter to indoor air too.

2.4.2 Areas decoration: Many workplace or building decorated area between contamination area and clean area such as smoking area, processing area or official area. If they have not good management in any area, the particulate matter from another area can contaminate to clean area with high concentration of pollutant.

2.4.3 Ventilation system: Ventilation in the place especially workplace or household is important to reduce particulate matter. Building should to develop the ventilation system that appropriate to own building and should decide follow to amount of worker/people, size of area, ambient air and air exchanged rate.

2.4.4 Cleaning program: If workplace or household have more frequency to cleaning place and any area in the building, it can reduce concentration of particulate matter, More than this, they should to rearrangement workplace to clear of the objects or books or paper used for reduce accumulate of particles too.

2.4.5 Geographic area: Geographic is a factor affect to particulate concentration, there are differences in seasoning, high pressure, mountain surrounding for example in North of Thailand always have a problem from respiratory dust because there are high pressure and almost of area surrounding with many mountain so it make high concentration of dust that effect to respiratory problem of people there.

2.5 Effect from particulate matter

Particulate matter is caused of many problems including (17).

2.5.1 Effect to ambient air: When ambient air have more humidity and high pressure, particulate matter will settle and make high concentration then it make fog in the ambient. Furthermore high concentration of particulate matter is caused to poor visibility for people and transportation that lead to accidents.

2.5.2 Effect to objects and structure: Particulate matter can make a dirty surface of object and building structure and some type of particulate matter (sand dust, salt dust) can destroy the structure such as sculpture, ancient building, galvanized iron and metal fence.

2.5.3 Effect to human health: Particulate matter is caused to health of people especially to people who are weak and poor health. Health problem from particulate

matter can separate in term of acute effect and chronic effect that will show the detail in next topic.

2.6 Health effect from particulate matters

From WHO data found that cardiopulmonary and lung cancer was attributable to particulate matter about three percent and five percent respectively. Nevertheless they found that particulate matter caused to increase death rate DALYs and decrease life expectancy of the people too (14).

Usually 99% of particulate matter that is diameter more than 100 micrometer can screening out from human body in upper respiratory trace and cannot get through lower respiratory tract. In the other hand, particulate matter like PM_{10} and $PM_{2.5}$ can get into the lower respiratory tract and alveoli (18). When the particle matters were collected high concentration in alveoli, it makes a problem to air exchange, short breath and hard work in a heart, until to be lung disease and heart disease finally. $PM_{2.5}$ can be caused to mortality than PM_{10} especially mortality for cardiovascular disease (14). So we can classify health effect with particulate matter in short term and long term effects including (4):

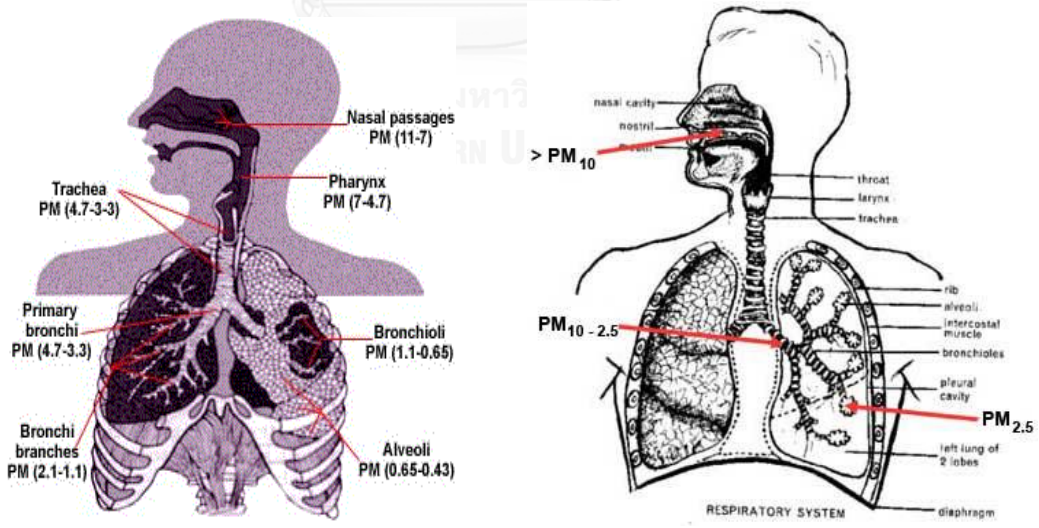

Figure 5 Target organs related to particulate matter exposure

2.6.1 Short term or acute effect: Acute effect from particulate matter will occur very fast in minute or hour until a day. For example of acute effect including.

- Respiratory symptom
- Eyes, nose
- Throat irritation
- Sneezing
- Running nose
- coughing
- Hard to breathing
- Addition the worse of Asthma symptoms (19)

2.6.2 Long term or chronic effect: Chronic effect from particulate matter will occur slowly in a month and some people effects occur in a year or more. For example of chronic effect including.

- Early death in people with heart disease
- Lung disease

-Nonfatal heart attacks,

-Irregular heartbeat,

-Aggravated asthma,

-Decreased lung function

2.6.3 Susceptible groups

The diseases from particulate matter affected in many people but there are difference severity or harmful to health of people depend on (14, 15).

1. Age, children and elderly are the vulnerable group that high risk to be diseases and severity than other age group.
2. Smoking
3. Asthma persons
4. AIDs/HIV
5. COPD (Chronic Obstructive Pulmonary disease)
6. Cancer
7. Existing disease such as Chronic obstruction lung disease, infection disease etc.

2.7 Respiratory symptom related to particulate matter

From the studied of Janneane F. Gent (20) and Hafiz Omer AHMED and Abdelridha A. ABDULLAH (21) found that the people who exposed to particulate matter will have respiratory symptom including:

- Cough
- Phlegm from chest
- Wheeze
- Shortness of breath
- Chest tightness

2.8 Allergic symptom

Allergy occurred from allergen such as pollen, dust, chemical substance, mite, latex etc. the symptom from exposed to allergen was difference according to route or pathway through the human body for example skin, respiration and mount. The mechanism of allergy was started from allergen interrupt the immunization of immune system when human exposed to high concentration of allergen, body immune will release histamine chemical to inhibited allergen that was allergy symptom occurred. Allergy symptom that always met were list below (22).

- Headache
- Sneezing
- Red and stinging eyes
- Itchy and watery eyes
- Running nose
- Skin rash and redness
- Dark circle under eyes

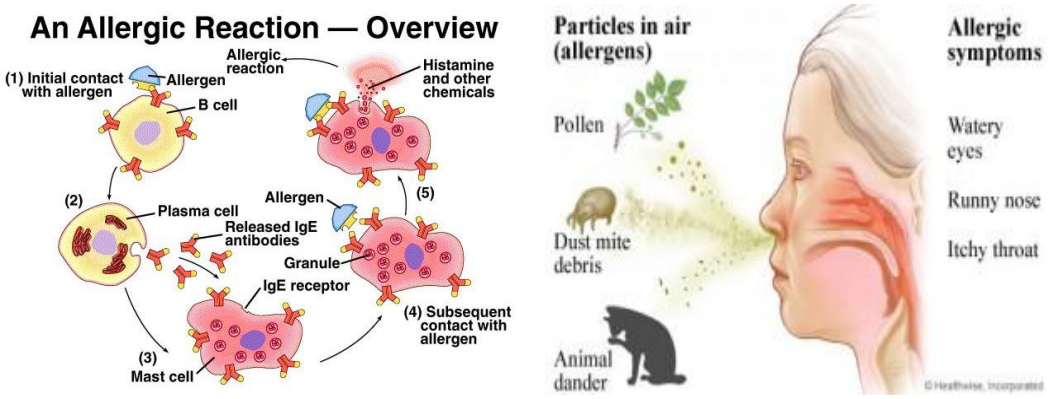

Figure 6 Allergy reaction and allergy symptom

2.9 Particulate matter measurement

Technique to monitor particulate matter separated in two types, firstly particulate matter in ambient air second is particulate matter in exposure monitoring. There are different in the device to sample collection such as flow rate, filter size and time duration show in table 1.

Table 1 Particulate matter measurement technique between ambient and exposure

Particle matter measurement technique	
Ambient air monitoring (23)	**Exposure monitoring (24)**
1. The objective is to investigate level of particulate matter in ambient air that can affect to people who lived in the area where contaminated with particulate matter.	2. The objective is to investigate the exposure of particulate matter to people who lived or work in household or work place where specific people approach to particulate matter directly.
2. Duration time to monitor about 24 hour per sample	2. Duration time to monitor about 8 hour per sample (full time of worker)
3. Device is stated field free in the place where the open area and do not have barrier from buildings or trees.	3. Device is stated in personal mobile in indoor area or workplace all the time to monitoring

Particle matter measurement technique	
Ambient air monitoring (23)	**Exposure monitoring (24)**
4. Use gravimetric method to sampling particulate matter with 8 x 10 inch diameter glass fiber filter	4. Gravimetric method to sampling PM with 37 mm diameter, 2.0 μm PVC filter in dust separator.
5. Analyzed data by weighing the filter before and after sampling then calculate to find out particulate matter concentration.	5. Analyzed data by weighing the filter before and after sampling then calculate to find out particulate matter concentration.

2.10 Regulation of particulate matter

2.10.1 WHO Air Quality Guideline (AQG) identify about particulate matter guideline in ambient air like this (14):

Table 2 Particulate matter guideline from WHO

Type of particles	Duration	Standard
Particulate Matter diameter less than 2.5 micrometer ($PM_{2.5}$)	Annual average	10 $\mu g/m^3$
	24 hour	25 $\mu g/m^3$
Particulate Matter diameter less than 10 micrometer (PM_{10})	Annual average	20 $\mu g/m^3$
	24 hour	50 $\mu g/m^3$

2.10.2 Thailand pollution regulation: Pollution Control Department set up the particulate matter guideline in ambient air like this (25).

Table 3 Particulate matter regulation in Thailand

Type of particles	Duration	Standard
Particulate Matter diameter less than 2.5 micrometer ($PM_{2.5}$)	Annual average	0.025 mg/m^3
	24 hour	0.05 mg/m^3
Particulate Matter diameter less than 10 micrometer (PM_{10})	Annual average	0.05 mg/m^3
	24 hour	0.12 mg/m^3

2.10.3 From ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineering) Addenda: Ventilation for Acceptable Indoor Air Quality. There are data about indoor particles regulation from any organization that related to particulate matter including (26):

2.10.3.1 OSHA (Occupational Safety and Health Administration) (27). This standard was established to the regulation with enforceable.

Table 4 Particulate matter regulation from OSHA

Type of particles	Standard
Particulate Matter diameter less than 2.5 micrometer ($PM_{2.5}$): Respiratory dust	5 mg/m^3
Total dust: Permissible Exposure Limit (PEL-TWA)	15 mg/m^3

2.10.3.2 MAK (Recommended maximum exposures for industrial environments developed by the Deutsche Forschungs Gemeinschaft, a German institution) (26). This standard was established to the regulation with enforceable.

Table 5 Particulate matter regulation from MAK

Type of particles	Standard
Particulate Matter diameter less than 2.5 micrometer ($PM_{2.5}$)	1.5 mg/m^3 for PM less than 4 micrometer
Particulate Matter diameter less than 10 micrometer (PM_{10})	4 mg/m^3

2.10.3.3 Canadians (Recommended maximum exposures for residences developed in 1987 and reaffirmed in 1995**)** (26). This value was established to the guideline or recommendation, not for enforceable.

Table 6 Particulate matter guideline from Canadians

Type of particles	Duration	Standard
Particulate Matter diameter less than 2.5 micrometer ($PM_{2.5}$)	1 hour	0.1 mg/m^3
	Long term	0.04 mg/m^3

2.10.3.4 ACGIH (American Conference of Governmental Industrial Hygienists) (28, 29). This value was established to the guideline or recommendation, not for enforceable.

Table 7 Particulate matter guideline from ACGIH

Type of particles	Duration	Standard
Particulate Matter diameter less than 2.5 micrometer ($PM_{2.5}$): Respiratory dust	TLV-Ceiling	3 mg/m^3
Particulate Matter diameter less than 10 micrometer (PM_{10}): total dust	TLV-Ceiling	10 mg/m^3

2.10.3.5 Comparison of regulation/guideline for particulate matter in workplace and indoor air

Table 8 Particulate matter guideline compare between organizations

Regulation from	Particulate matter (PM)	
	Diameter less than 2.5 micrometer ($PM_{2.5}$)	**Diameter less than 10 micrometer (PM_{10})**
OSHA	5 mg/m^3	-
MAK	1.5 mg/m^3	4 mg/m^3
Canadians	1) 0.1 mg/m^3 (1 hr) 2) 0.04 mg/m^3 (Long term)	-
ACGIH	3 mg/m^3 (TLV-C)	10 mg/m^3 (TLV-C)

In Thailand, did not have regulation about indoor air quality related to particulate matter but they used regulation from other regulation such as ASHARE, OSHA or NIOSH.

2.11 Review related literature

1. Wlazło A, Górny RL, Złotkowska R, Lawniczek A, Ludzeń-Izbińska B, Harkawy AS and Anczyk E concluded with their studies that there are high concentration of house dust mite allergens contaminated in libraries and the level of dust related to air condition system and ventilation in the libraries, if library have good ventilation it can reduced the particles level in libraries. Exposed to particles allergens and mold can causes to allergic effects (8).

2. Helen Lloyd, Caroline Bendix, Peter Brimblecombe and David Thickett interested in dust in historic libraries. They found that the libraries always have dust settle in gap or space between shelves and each books. Dust was cumulative in library when time goes by and did not clean up. For long time of libraries service, the dust will adhesion like a cemented fixed in front of the cover of many books with bacteria. From the research they found that relative humidity was the main causes to adhesion of dust if the libraries could control of relative humidity in the room it can reduce amount of dust in these area (9).

3. Janneane F. Gent with colleague studied about associate between ozone and fine particles causes to respiratory symptoms in children who was asthma**.** They found that asthmatic children who staying with rehabilitation medical were related to ozone, with adjusted with fine particles, at levels below EPA standards (20).

4. Hafiz Omer AHMED and Abdelridha A. ABDULLAH were studied about cement dust related to respiratory symptom in worker who exposed and unexposed to cement dust. The studied area was cement factory in the United Arab Emirates with 227 participants separated in 149 exposed to cement dust and 78 unexposed to cement dust. They found that worker who exposed to cement duct risk higher to have respiratory symptom than worker unexposed. For respiratory symptom, they found that cement dust related directly to cough and phlegm both in exposed and unexposed worker and specifically chronic bronchitis found in the worker who smoking. Furthermore worker who used personal protective equipment like specific mask could reduce risk to have respiratory symptom (21).

5. Paufler P, Gebel T, Dunkelberg H. said that .The house dust mites are important sources of indoor allergens. They caused to any disease such as asthma bronchial, rhinitis, and conjunctivitis. House dust mite could be exposed to indoor air when people were cleaning with close the door and lack of good ventilation so dust mite were still settle in the room . Assessing allergens contaminated to ambient air is the representative of people exposures (30).

6. Nikasinovic L, Just J, Sahraoui F, Seta N, Grimfeld A, Momas I.J Allergy Clin Immunol (2006) concluded that indoor air pollutants especially particles matter less than 2.5 ($PM_{2.5}$) are induced the severe effects through respiratory tract such as nasal inflammation and related to allergic asthma and rhinitis in children (31).

7. Wang Y, Xiong L and other found that house dust mite allergens always met in the bed and pillows with high concentration. More than this house dust mites allergens associated with the harmful of upper respiratory tract itching such as nasal too (32).

8. FENG C.TSAI and group research said that particles matter exposure monitoring in ambient condition could predicted indoor air and there were useful to study relation between health effect and particle matter too. Furthermore indoor air condition like bed room and shopping center had high concentration with fine particle

matter more than ambient air but there were difference in Netherland that had research show that concentration of ambient condition relation to health effect of people and they always use ambient data to predicted this effects than indoor air data (33).

9. P. Bakke, G.E. Eide, R. Hanoa and A. Gulsvik found that respiratory symptom related to people who had been worked in workplace where exposed to dust and gas (OR = 1.6-1.9). Especially men had more respiratory symptom more than woman except breathlessness always met in women than men. Respiratory symptom related to dust exposure included cough, phlegm, breathlessness, wheezing and asthma (34).

10. Phayong Theppaksorn, et al. studied about association between respiratory symptom and respiratory function of worker, only male, who exposed cement dust of roof fiber cement companies in the south of Thailand. The result shown that cement dust related to shortness of breath in worker who exposed cement dust while working (OR = 2.19, 95%CI = 1.08 – 4.43) but not significant with other respiratory symptom such as cough, chest tightness and wheeze. Furthermore the respiratory symptom from exposed cement dust not significant with pulmonary dysfunction in these worker because duration of worker exposed to this pollutant were not much (average = 6.3 years) to shown the effect of respiratory function (35).

11. Pitchaya Phakthongsuk, et al. found that the worker who worked in sewing unit ofhospital were exposed to fabric dust and leaded to respiratory symptom such as phlegm, chest tightness and eye irritation than worker who did not expose to fabric dust. More than this they investigated level of dust contaminated in workplace found that although total dust and respiratory dust did not more than ACGIH guideline (10 mg/m^3 and 3 mg/m^3 respectively) but the specific monitoring only fabric dust found that organic fabric dust in sewing unit higher than ACGIH guideline (0.2 mg/m^3) that means respiratory symptom were related specific to fabric dust (36).

12. P. Sripaiboonkij, et al. studied about respiratory symptoms and lung disorder related to worker who worked in milk powder factory in Thailand compared to general officer who worked in other area where not exposed to milk powder. They found that the worker who worked in contaminated with milk powder had prevalence of respiratory symptom more than general office especially wheezing, breathlessness and nasal

symptom. Although this factory had good air pollution control system but the worker who exposed to milk powder while they were working have risk to be had respiratory symptom and lung disorder. The recommendation for this study was the factory should have surveillance program related to health problem in workers (37).

CHAPTER III
METHODOLOGY

3.1 Research Design

The study was cross-sectional study designed to identify workplace particulate matter concentrations related to respiratory and allergic symptoms from work among, library staffs in Chulalongkorn University library (exposed group) compared to administrative officers in Chulalongkorn University (unexposed group).

3.2 Study Area

Study area was Chulalongkorn University because Chulalongkorn University was the number 1 university in Thailand ranking by Center for World University Rankings (CWUR) in 2014 (38). There were 36 libraries in Chulalongkorn University supported for student and general customers that means there were many officers who work in these libraries for serviced all people.

3.3 Study Population

3.3.1 Libraries staffs group (exposed group)

This group consists of the officers working in Chulalongkorn University libraries. There are 257 officers in 36 libraries where are the member of Chulalongkorn University library and information networking that statement in boundaries of any faculties, colleges and institutes of Chulalongkorn University.

3.3.2Administrative officers group (unexposed group)

This group consists of the officers working in administrative offices of Chulalongkorn University.

3.4 Sampling technique

3.4.1 Sampling technique for libraries staffs group used purposive sampling technique to selected libraries of Chulalongkorn University where have amount of staffs more than 10 persons (the libraries where there were staffs more than 10 persons, it mean of the libraries where accumulated many of books than other libraries). The researcher found 6 libraries where selected including

1. Center of Academic Resources
2. Humanities Information Center (Faculty of Arts Library)
3. Faculty of Education Library
4. Faculty of Law library
5. Faculty of Medicine Library
6. Faculty of Political Science Library

3.4.2 Sampling technique for administrative officers group used purposive sampling technique to selection the officers who are working in the office of Chulalongkorn University. Administrative officers had not to expose to particulate matter from books or paper works. Researcher found that 4 offices in Chulalongkorn University reached the criteria of unexposed group named as:

1. Chulalongkorn University Sport Center (Service officers)
2. Chulalongkorn University Broadcastinging station (IT officer, picture and sound control, Disc jockey)
3. Scientific and Technological Research Equipment center (Equipment laboratory)
4. Chulalongkorn University Health Service Center (Service officer)

From sampling technique above, researcher approached to the participants by making the formal letter from College of Public Health to head of libraries and head of administrative office to as a permission to conduct the research with their staffs and officers. Head of libraries and head of offices helps to manage and distribute authority to the participants in their responsibility.

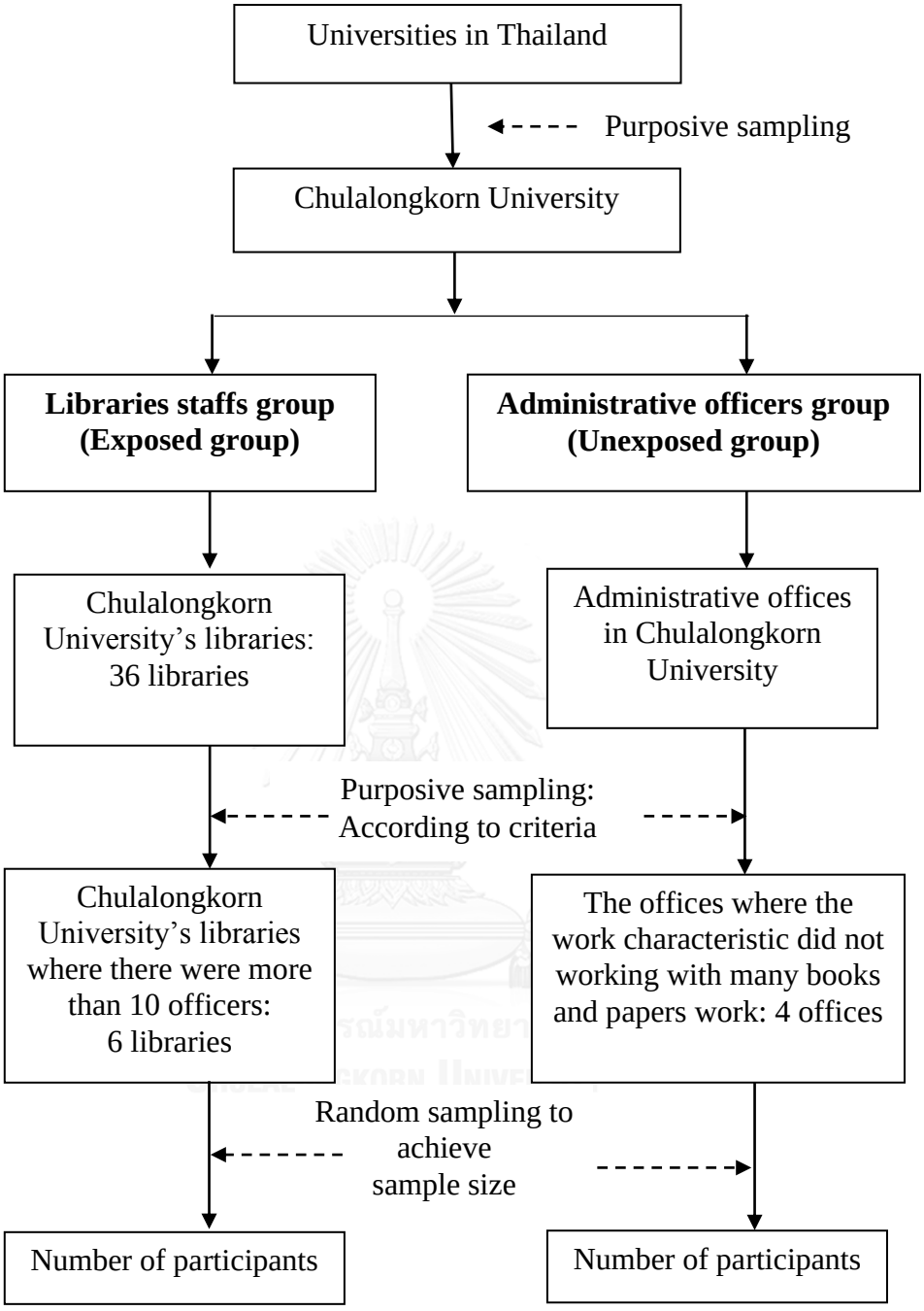

Figure 7 Sampling technique procedure

3.5 Sample & Sample size

3.5.1 The researcher calculated prevalence of respiratory symptom in workers who worked in the indoor air workplace included exposed and unexposed to dust or particulate matter from previous studies which similarly method to this study and calculated the average prevalence of respiratory symptom, shown in table below.

Table 9 Sample size calculation with prevalence of respiratory symptom

Author	**Article related**	**Respiratory symptom prevalence (%)**	
		Exposed group	**Control group**
P. Bakke, et al. (34)	Occupational dust or gas exposure and prevalences of respiratory symptoms and asthma in a general population. (Indoor air studied)	25.1	17.3
P. Phakthongsuk, et al. (36)	Work related respiratory symptoms among cotton-fabric sewing workers. (Indoor air studied)	59.1	18.2
P. Sripaiboonkij, et al. (37)	Respiratory effects of occupational exposures in a milk powder factory. (Indoor air studied)	41.3	31.6
	Average	42	22

3.5.2 Used program Epi info™ 7.1.4 distributed by CDC to calculate sample size. Also used the power in 80% and confidence interval is 95% and average prevalence of respiratory symptom in exposed group , 42%, and control group, 22%, from previously studied. The sample size for this study was 132 of library staff group and 74 of general office group. This research used random sampling with name list of staffs and administrative officers for these sample size.

3.5.3 Random sampling 50% in both libraries staffs group and administrative officers group for conducting personal PM_{10} measurement. So the PM_{10} measurement was set in 66 persons of libraries staffs and 37 persons of administrative officers. This research used random sampling with selected participants by head of each office in libraries and administrative offices for PM_{10} measurement. They were shown in the figure below.

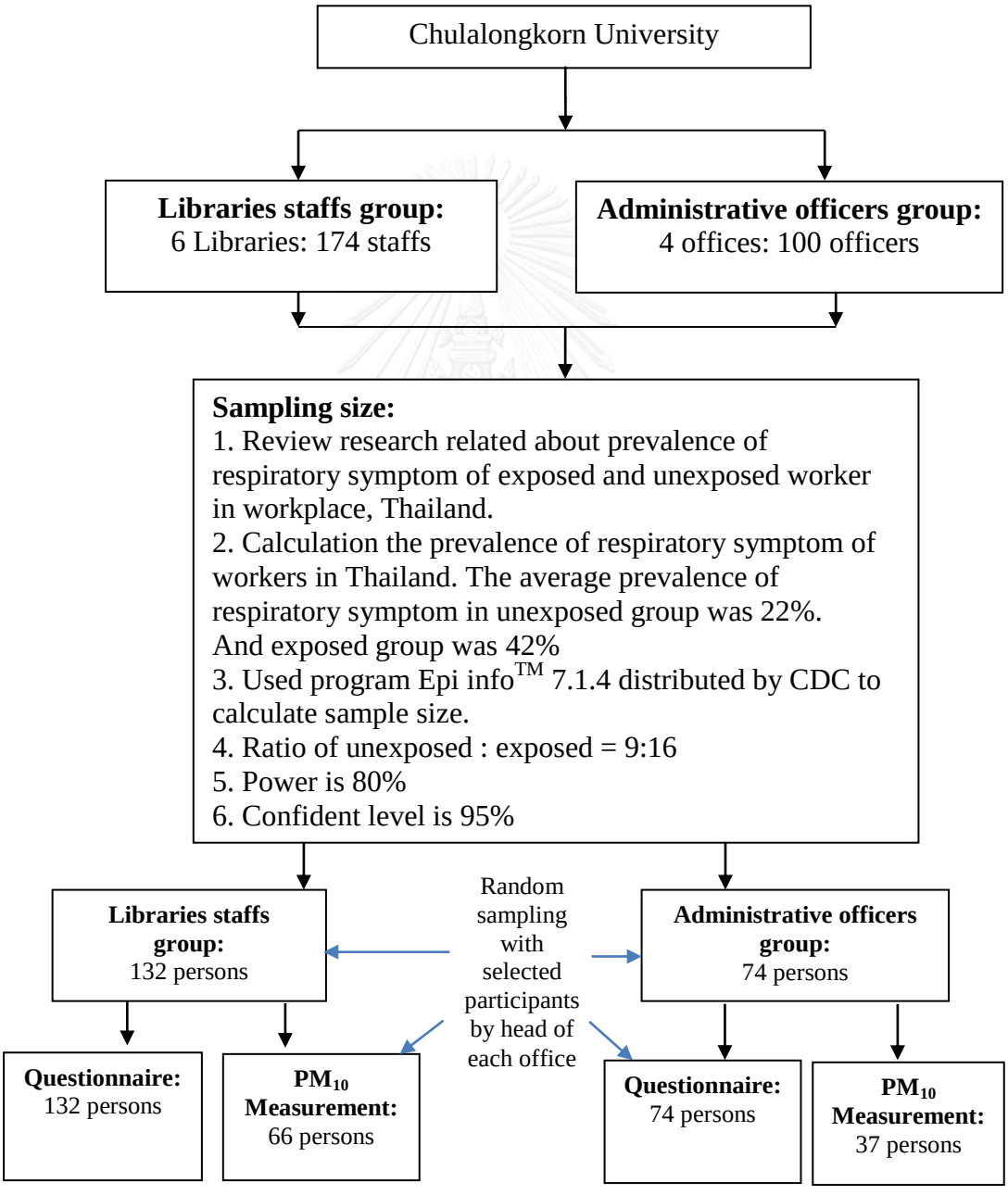

Figure 8 Sample size calculation procedure

3.6 Measurement Tools

1. Questionnaire

Structured questionnaire was developed from The American Thoracic Society Division of Lung Disease questionnaire for Adult (ATS-DLD-78-A) was used for assess respiratory symptoms (39) which followed to the standardized questionnaire on respiratory symptoms of British Medical Research Council Committee on the Aetiology of Chronic Bronchitis (BMRC) (40). The respiratory symptom related to particulate matter classified base on literature review (studied of Janneane F. Gent with colleague (20) and studied of Hafiz Omer AHMED and Abdelridha A. ABDULLAH (21)). The four pages of questionnaire divided in 3 parts consists of

Part 1: There were 13 questions related to personal characteristics such as personal profiles which include age, sex, duration of work per day, work history with exposure to dust and chemical, smoking behaviors, underlying disease, work transportation and pesticide used in household.

Part 2: There were 10 questions related to workplace characterization such as such as type of workplace construct included floor and wall, type of ventilation and cleaned of workplace schedule.

Part 3: Respiratory and allergic symptoms related to particulate matter exposure in the workplace

3.1 Respiratory symptom

3.1.1 Cough symptom

There were 3 questions related to characterization of cough symptom such as cough frequency and duration of cough.

3.1.2 Phlegm from chest symptoms

There were 3 questions related to characterization of phlegm symptom such as phlegm frequency, duration to have phlegm and phlegm characteristic.

3.1.3 Wheezing symptoms

There were 3 questions related to characterization of wheezing symptom such as history and duration of wheezing also wheezing characteristic.

3.1.5 Shortness of breath symptoms

There were 3 questions related to characterization of shortness of breath symptom.

3.2 Allergic symptom

There were 9 questions ask about history of allergic symptom in 3 months ago such as skin rash, running eyes, watery eyes, itchy eyes, stinging eyes, running nose, redness of skin, dark circles under eyes and headache.

Validity and reliability of questionnaire

The validity and reliability tested for questionnaire, First of all validity was reviewed by 3 experts in related field then calculated the IOC score. The secondary test reliability with the draft of questionnaire is pretested with 30 subjects in the libraries and administrative offices at Ministry of Public Health before data collection period. The internal consistency of rating scale was performed by Cronbach's alpha coefficient for an analysis of respiratory and allergic symptom in order to get at least more than 0.80 of alpha.

2. Particulate matter measurement

The particulate matter was collected by separate in 2 method follow two type of particulate matter including

2.1 Particulate matter diameter less than 10 micrometer (PM_{10}): National Institute for Occupational Safety and Health (NIOSH, 1998) guideline was used in this study. The personal air pump was continuously collected particulate matter in librarian during work (fill time about 7-8 hours) on a work day (Monday to Friday). The equipment for particulate matter sampling including personal pump, air flow calibrator, cellulose filter, 37 mm diameter, PVC filter, and personal environmental monitor (PEM): personal impaction sampling device for PM_{10}. The particulate sampling used gravimetric analysis, particulate can settable on the filter with own gravity. Before sampling, filter should to release humidity in desiccators more than 24 hours then pre-weight of filter is done before place in the filter cassette. After the end of sampling period, all of filters are taken into the desiccators again for

release humidity about 24 hours, then post-weight. After that calculation the particulate matter concentration with equation and data evaluation.

Figure 9 PM_{10} personal monitor equipment

2.2 Particulate matter less than 2.5 micrometer ($PM_{2.5}$): Handheld mass particle counter /dust monitor was used to investigate level of $PM_{2.5}$ that contaminated in the library. This device can counts the particles by using scattered laser light and calculates the equivalent mass concentration.

Figure 10 $PM_{2.5}$ ambient monitor equipment

3.7 Data Collection

1. Two research assistants were trained about PM equipment personal set up, PM laboratory preparation and the details of questionnaire for this research.

2. Set up all equipment including pump calibration, pre-post weighting filter and assembling the set of separator.

3. PM_{10} exposure concentration measurement worked by personal particulate matter equipment included personal pump, filter and PM_{10} separator. The procedure started with set up personal equipment on participant's body and clipped the set of separator with filter on the respiratory area of body, closely to nasal. The measurement were assessed in full time of the officers working about 8 hours (start at 8 - 12 a.m. and 1 - 5 p.m.). When finished the collection data, post weighting filter for dust concentration calculator.

4. For $PM_{2.5}$, the researcher set up the equipment in the central of the workplace to be representative of $PM_{2.5}$ exposure and the measurement was assessed in full time of the officers working about 8 hours so. After finished memorized the levels of $PM_{2.5}$ that shown on the screen.

5. Face to face interview for the participants after finished particulate matter measurement (use time for questionnaire about 15 minutes)

Figure 11 $PM_{2.5}$ and personal PM_{10} exposure measurement

3.8 Data Analysis

1. Concentration of particulate matter

The calculation of particulate matter concentration is modified from NIOSH 006 method (NIOSH, 1998). The equation is shown as following

$$C = \frac{(W_1 - W_2)}{V\ (L)} \times 1000\ ,\ mg/m^3$$

Details: C = concentration of particulate matter (mg/m^3)

W_1 = Pre-weight of filter before sampling (mg)

W_2 = Post-weight of filter before sampling (mg)

V = Air volume as sampled at flow (m^3)

Personal PM_{10} measurements were not obtained from all study participants. To enable inclusion of all subjects in analysis of PM_{10} level with symptoms prevalence, the mean of PM_{10} measurements in each workplace was calculated. The workplace specific mean PM_{10} level was assigned to each participant in that workplace.

2. Statistical analysis

Analysis focused on the relationship between particulate matter levels and the symptoms from work prevalence, with appropriate adjustment for other independent variables. Prevalence is dichotomous data, and appropriate statistics will was used for this Data analysis has 2 phases including

2.1 Normality distribution test for chose the appropriate statistical analysis the data files.

2.2 Descriptive statistics to described variable levels bivariate analysis, examining one independent variable at a time. Chi-square and Fisher's Exact test were used for categorical independent variables to compared symptoms prevalence between libraries staff and administrative officers.

2.3 T-test for compared mean of particulate matter levels between libraries staff and administrative officers.

2.4 Used 20 independent variables in bivariate analysis with each respiratory and allergic symptom including (Table 10)

Table 10 Independent and dependent variables used in bivariate analysis

Independent variables	Dependent variables
1. PM_{10} exposure level	**Respiratory symptoms**
2. Age	1. Cough
3. Sex	2. Phlegm from chest
4. Respiratory and allergic disease	3. Wheezing
5. Smoke behavior	4. Shortness of breath
6. Work transportation	
7. Daily dust exposed	**Allergic symptoms**
8. Source of daily dust exposed	1. Skin rash
9. Pesticide use in household	2. Running eyes
10. Period time of work	3. Watery eyes
11. Work history with exposure to dust	4. Itchy eyes
12. Work history with exposure to chemical	5. Stinging eyes
13. Period of time per day (work hour)	6. Running nose
14. Type of floor in workplace	7. Redness of skin
15. Type of wall in workplace	8. Dark circles under eyes
16. Type of ventilation	9. Headache
17. Floor clean schedule	
18. Air conditioner clean schedule	
19. Renew workplace	
20. Type of renew workplace	

2.5 Multivariable analysis, starting with a preliminary logistic regression model, for each dependent variable, that includes the workplace PM_{10} level an all other independent variables for which *p*-values < 0.2 in bivariate analysis. Variables with unduly large standard error (>5000) were omitted from subsequent models. Then a stepwise produce was followed, in which variables for which *p*-values > 0.2 were omitted. This was continued until all independent variables in the model for an outcome had *p*-values < 0.2. Different numbers of steps were required for different dependent variable. Workplace PM_{10} level was kept in all models.

3.9 Ethical Consideration

Ethical Consent from the Ethical Review Committee for Research Involving Human Research Subject, Public Health Program, Chulalongkorn University was obtained prior to beginning the study. The ethical approved number for this study was 092/2558 at April 29, 2015.

The participants were informed the objectives and the process of this study. Inform consent and information sheets will be distributed to the target group. Written consent from participants will be taken before conducting the research.

CHAPTER IV
RESULT

4.1 Socio-Demographic

This study had 193 participants separated in 119 exposed groups (libraries staff) and 74 unexposed groups (administrative officers). The libraries staffs mostly are women than men about 79.8 % and 20.2 % respectively this is similarly to administrative officers that woman more than men at 59.5% and 40.5% respectively. The mean of age in libraries staff was significantly higher than administrative officers, 45 and 37 years old respectively ($p < 0.001$). Most of worker both in libraries staff (89.9%) and administrative officers (89.2%) do not have respiratory and allergic disease but in term of the workers who have respiratory and allergic disease, we found that libraries staffs had respiratory and allergic disease lower than administrative officers with non-significantly, 10.1% and 10.8% respectively ($p = 0.872$). For smoke behavior found 3.5% of libraries staff and 12.2% of administrative officers are current and ex-smoke but 96.6% and 87.8% was not smoke respectively. However administrative officers had significantly higher amount of current and ex-smoke than libraries staffs ($p = 0.034$) (Table 11).

Table 11 Demographic in libraries staff compared with administrative officers

Characteristics	Libraries staff (n= 119)	Administrative officers (n= 74)	*p*-Value
Age (year), mean(SD)	44.9 (10.61)	37.3 (9.73)	<0.001[a]
Age interval (%)			<0.001[b]
- 20 – 30 years	14 (11.8)	20 (27.0)	
- 31 – 40 years	30 (25.2)	30 (40.5)	
- 41 – 50 years	31 (26.1)	16 (21.6)	
- 51 – 60 years	44 (37.0)	8 (10.8)	
Sex (%)			0.002[b]
- Male	24 (20.2)	30 (40.5)	
- Female	95 (79.8)	44 (59.5)	

Characteristics	Libraries staff (n= 119)	Administrative officers (n= 74)	*p*-Value
Respiratory and allergic disease (%)			0.872[b]
- Yes	12 (10.1)	8 (10.8)	
- No	107 (89.9)	66(89.2)	
Smoke behavior (%)			0.034[f]
- Smoke : current and Ex-smoke	4 (3.4)	9 (12.2)	
- Never smoke	115 (96.6)	65 (87.8)	

Analyzed with [a] Independent sample t-test, [b] Chi-square test, [f] Fisher's Exact test.

4.2 Daily behavior

For daily behavior, found that libraries staffs came to workplace with many vehicles including private car (48.7%), bus (44.5%), BTS (21%) motorcycle (14.3%), walk (3.4%) and bicycle (1.7%) respectively and administrative officers came to workplace with many BTS (29.7%), bus (28.4%), private car (27.0%), walk (16.2%), motorcycle (14.9%) and bicycles (5.4%) respectively. So from the result above mostly of libraries staff come to work with private car and bus significantly higher than administrative officers (p = 0.003 and *p* = 0.014 respectively) while administrative officers mostly come to work by BTS, walk, motorcycle and bicycle higher than libraries staffs but significantly in walk (p = 0.002) and was non-significantly in BTS (*p* = 0.170) motorcycle (*p* = 0.912) and bicycle (*p* = 0.206). Beside this administrative officers exposed to daily dust significantly higher than libraries staffs, 79.7% and 60.5% respectively, (*p* = 0.005). Nevertheless, 90.5% administrative officers exposed to daily dust from traffic that was non-significantly higher than libraries staffs (81.5%) (*p* = 0.088). Both of them not difference to exposed to other dust besides from the workplace including cleaning house, printing, cooking, incent smoke and open burning respectively (*p*>0.05). Libraries staffs used pesticide in household non-significantly higher than administrative offers, 42.9% and 37.8% respectively (*p* = 0.490) (Table 12).

Table 12 Daily behaviors in libraries staff compared with administrative officers

Characteristics	Libraries staff (n= 119)	Administrative officers (n= 74)	*p*-Value
Work transportation (%)			
- Bicycle	2 (1.7)	4 (5.4)	0.206[f]
- Motorcycle	17 (14.3)	11 (14.9)	0.912[b]
- Private car	58 (48.7)	20 (27.0)	0.003[b]
- Bus without air conditioner	21 (17.6)	4 (5.4)	0.014[b]
- Bus with air conditioner	32 (26.9)	17 (23.0)	0.543[b]
- BTS	25 (21.0)	22 (29.7)	0.170[b]
- Walk	4 (3.4)	12 (16.2)	0.002[b]
Daily dust exposure (%)			0.005[b]
- Yes	72 (60.5)	59 (79.7)	
- No	47 (39.5)	15 (20.3)	
Source of daily dust exposed (%)			
- Incent smoke	18 (15.1)	10 (13.5)	0.757[b]
- Cooking	39 (32.8)	21 (28.4)	0.521[b]
- Traffic	97 (81.5)	67 (90.5)	0.088[b]
- Open burning	14 (11.8)	9 (12.2)	0.093[b]
- Cleaning house	84 (70.6)	54 (73.0)	0.721[b]
- Printing	74 (62.2)	36 (48.6)	0.065[b]
Pesticide used in household (%)			0.490[b]
- Yes	51 (42.9)	28 (37.8)	
- No	68 (57.1)	46 (62.2)	

Analyzed with [b] Chi-square test, [f] Fisher's Exact test.

4.3 Work characteristic

The period time of work, 74.3 % of administrative officers and 41.2% of libraries staffs worked in the current position less than 10 years ($p < 0.001$). Work history with exposure to dust in the past, found that libraries staffs had significantly

lower than administrative officers, 3.4% and 12.2% respectively (p = 0.034). The example of work history with exposure to dust in libraries staff were building construction, medicine processing, cumulative of paper's room and wood decoration. In the other hands, the examples of administrative officers were farmer, building construction, engine maintenance, herb processing, packaging, wood decoration and private company. At the same time, work history of chemical exposure in administrative officers was non-significantly higher than libraries staffs, 9.5% and 3.4% respectively (p = 0.109). Both of them had been exposed to chemical in work such as paining, agriculture, fabric factory, laboratory officer, engine maintenance, wood decoration and pesticide companies. In current position, mostly of libraries staffs and administrative officers has been working in their workplace between 7–8 hours per day also administrative officers was non-significantly higher in period of work per day than libraries staffs, 48.6% and 46.2% respectively (p = 0.581) (Table 13).

Table 13 Work characteristic in libraries staff compared with administrative officers

Characteristics	**Libraries staff (n= 119)**	**Administrative officers (n= 74)**	***p*-Value**
Period time of work (%)			<0.001[b]
- Less than 10 years	49 (41.2)	55 (74.3)	
- 11 – 20 years	27 (22.7)	7 (9.5)	
- 21 – 30 years	22 (18.5)	7 (9.5)	
- More than 30	21 (17.6)	5 (6.8)	
Work history with exposure to dust (%)			0.034[f]
- Yes	4 (3.4)	9 (12.2)	
- No	115 (96.6)	65 (87.8)	
Work history with exposure to chemical (%)			0.109[f]
- Yes	4 (3.4)	7 (9.5)	
- No	115 (96.6)	67 (90.5)	

Characteristics	Libraries staff (n= 119)	Administrative officers (n= 74)	*p*-Value
Period of work per days (%)			0.581[b]
- 5 -7 hours	13 (10.9)	11 (14.9)	
- More than 7 – 8 hours	55 (46.2)	36 (48.6)	
- More than 8 hours	51 (42.9)	27 (36.5)	

Analyzed with [b] Chi-square test, [f] Fisher's Exact test.

4.4 Workplace characteristic

The structure of workplace, administrative officers worked in workplace where structure was cement non-significantly higher than libraries staffs, 95.5% and 93.3% respectively (p = 0.536). In workplace of libraries staffs had floor material including cement (61.3%), rubber (30.3%) and other material: wood, laminate or carpet (8.4%). While administrative officers, floor material was used from cement (64.9%), rubber (21.6%) and other material: wood, laminate or carpet (13.5%). Mostly of floor material used in workplace of libraries staffs and administrative offers was cement, 61.3% and 64.9% respectively with non-significantly higher in administrative officers than libraries staffs (p = 0.286). Wall material of administrative officers (94.6%) made from cement significantly higher than libraries staffs (79.0%) (p = 0.003). The ventilation material in workplace of libraries staffs was air conditioners significantly higher than administrative officers, 97.5% and 87.8% respectively (p = 0.012). In the workplace there was cleaning schedule in floor and air conditioners including floor cleaning in workplace. The libraries cleaned floor nearly in everyday significantly higher than administrative offices (p<0.001) similarly to air conditioner clean schedule most of libraries cleaned air conditioners 1 times per month (69.7%) while administrative offices cleaned their air conditioner about 4 times per year (p<0.001). More than this the workplace of 2 groups had been renewed such as changed floor, set up wallpaper, decoration areas, polish floor or painted. Libraries staffs (82.4%) had renewed in the workplace significantly higher than administrative officers (64.9%) (p = 0.006). The first type of renewed workplace in both 2 groups was polished floor, libraries staffs (64.7%) had polished floor in workplace

significantly higher than administrative officers (47.3%) (p = 0.017). In case of libraries found that the shelf of books were cleaned mostly in everyday (39.5%) and some place were cleaned for 1times/week (26.1%) also 2-3 time/week (24.4%) respectively (Table 14).

Table 14 Workplace characteristic in libraries compared with administrative offices

Characteristics	**Libraries (n= 119)**	**Administrative offices (n= 74)**	***p*-Value**
Structure of workplace (%)			0.536[f]
- Cement	111 (93.3)	71 (95.5)	
- Other : Wood , future board or mixed structure	8 (6.7)	3 (4.1)	
Type of floor (%)			0.286[b]
- Cement	73 (61.3)	48 (64.9)	
- rubber	36 (30.3)	16 (21.6)	
- Other : Wood, laminate, tile, carpet	10 (8.4)	10 (13.5)	
Type of wall (%)			0.003[b]
- Cement	94 (79.0)	70 (94.6)	
- Other: Wood, mirror, board	25 (21.0)	4 (5.4)	
Ventilation material (%).			0.012[f]
- Air conditioner	116 (97.5)	65 (87.8)	
- Other : Fan Natural ventilation	3 (2.5)	9 (12.2)	
Floor Cleaned (%)			<0.001[b]
- Everyday	115 (96.6)	53 (71.6)	
- Not more than 3 times/week	4 (3.4)	21 (28.4)	
Air conditioner Cleaned (%).			<0.001[b]
- Never	12 (10.1)	9 (12.2)	
- Everyday	3 (2.5)	6 (8.1)	
- 1 times per month	83 (69.7)	29 (39.2)	
- Other: 1-4 times per years	21 (17.6)	30 (40.5)	

Characteristics	Libraries (n= 119)	Administrative offices (n= 74)	*p*-Value
Renew workplace (%).			0.006[b]
- Yes	98 (82.4)	48 (64.9)	
- No	21 (17.6)	26 (35.1)	
Type of renew workplace (%)			
- Floor renew	51 (42.9)	10 (13.5)	<0.001[b]
- Set up wallpaper	7 (5.9)	1 (1.4)	0.157[f]
- Renovated areas	48 (40.3)	6 (8.1)	<0.001[b]
- Polished floor	77 (64.7)	35 (47.3)	0.017[b]
- Re-paint	54 (45.4)	12 (16.2)	<0.001[b]
Clean shelf of books (%)[d] : In case of libraries			
- Never cleaned	12 (10.1)	-	-
- Clean everyday	47 (39.5)	-	-
- 1 time/week	31 (26.1)	-	-
- 2-3 times/week	29 (24.4)	-	-

Analyzed with [b] Chi-square test, [d] Descriptive frequency, [f] Fisher's Exact test.

4.5 Particulate Matter exposure

This study was measurement particulate matters mainly in particulate matters diameter less than 10 micrometer (PM_{10}). The result shown that libraries staff exposed to PM_{10} significantly higher than administrative officers, 202.81 and 102.95 $\mu g/m^3$ respectively ($p < 0.001$). Range of PM_{10} exposure in libraries staffs was 9.89 – 1298.7 $\mu g/m^3$ while in administrative officers was 9.88 – 515.53 $\mu g/m^3$ (Table 15).

The $PM_{2.5}$ concentration in libraries (1.00 – 11.0 $\mu g/m^3$) higher than administrative offices (1.00 – 4.00 $\mu g/m^3$) also Mean of $PM_{2.5}$ in libraries was higher than administrative offices, 4.06 $\mu g/m^3$ and 2.54 $\mu g/m^3$ respectively (Table 16)

Comparing findings in tables 14 and 15 shows that measured PM_{10} levels were quite plausible and consistent with other studies. Levels of $PM_{2.5}$, however, were very low, far lower than levels of PM_{10}. Specifically, measured $PM_{2.5}$ levels were only

about 2 - 3 % of measured PM_{10} levels in both libraries staffs and administrative officers. This percentage is far lower than we have seen in other studies, and does not seem plausible. Therefore, we chose not to analyze associations between $PM_{2.5}$ levels and symptoms prevalence.

Table 15 PM_{10} exposure of libraries staff compared with administrative officers

Characteristics	**Libraries staff (n= 119)**	**Administrative officers (n= 74)**	***p*-Value**
Particulate matters diameter less than 10 micrometer (PM_{10}) exposure in workplace ($\mu g/m^3$) : Mean (SD).	202.81(176.9)	102.95(69.5)	<0.001
Particulate matters diameter less than 10 micrometer (PM_{10}) exposure: ($\mu g/m^3$)			
- Minimum	9.89	9.88	
- Maximum	1298.7	515.53	

Analyzed with independent sample t-test.

Table 16 $PM_{2.5}$ concentration in libraries compared with administrative offices

Characteristics	Libraries	Administrative offices	*p*-Value
Particulate matters diameter less than 2.5 micrometer ($PM_{2.5}$) concentration ($\mu g/m^3$): Mean (SD).	4.06 (2.975)	2.54 (1.196)	<0.001
Particulate matters diameter less than 2.5 micrometer ($PM_{2.5}$) concentration ($\mu g/m^3$) - Minimum - Maximum	 1.0 11.0	 1.0 4.0	

Analyzed with Independent sample t-test.

However if we separated PM_{10} exposure between workplace we found that highest mean of PM_{10} exposure was Faculty of Law library (370.60 $\mu g/m^3$) and lowest in Scientific and Technological Research Equipment Center (42.89 $\mu g/m^3$). Mostly of PM_{10} exposure was higher in libraries than administrative offices (Table 17).

Table 17 PM_{10} average exposure separated between workplace

Workplace	PM_{10} exposure ($\mu g/m^3$)		
	Mean	Minimum	Maximum
Faculty of Law Library	370.60	9.89	878.46
Faculty of Education Library	314.68	18.78	1298.7
Faculty of Arts Library	250	89.29	565.48
Center of Academic Resources	191.80	9.91	783.32
CU Sport Center	140.12	29.78	515.53
Faculty of Medicine Library	120.78	29.75	248.11
CU Broadcasting Station	117.07	9.88	189.13

Workplace	PM_{10} exposure ($\mu g/m^3$)		
	Mean	Minimum	Maximum
IT of CPHS (Instead of CU Health Service Center)	79.32	9.88	188.38
Faculty of Political Science Library	72.52	19.82	158.15
Scientific and Technological Research Equipment Center	42.89	19.77	69.18

4.6 Prevalence of respiratory symptoms

In this study the prevalence of respiratory symptoms highest for shortness of breath (33.2%), wheezing (18.1%), cough (14.5%) and phlegm from chest (15.5%) respectively so if separated into libraries group and administrative group we found that the libraries staffs had prevalence of respiratory symptoms non-significantly higher than administrative officers including shortness of breath (OR = 1.76,p = 0.082), wheezing (OR = 1.06, p = 0.872), cough (OR = 1.55, p = 0.307) and phlegm from chest (OR = 2.33, p = 0.140) respectively too (Table 18).

Table 18 Unadjusted prevalences of respiratory symptoms in libraries staff compared with administrative officers

Characteristics	Total prevalence (n=193)	Libraries staffs (n= 119)	Administrative officers (n= 74)	OR[b]	*p*-value[b]
Respiratory symptoms (%)					
- Cough	30 (15.5)	21 (17.6)	9 (12.2)	1.55	0.307
- Phlegm from chest	28 (14.5)	14 (11.8)	4 (5.4)	2.33	0.140
- Wheezing	35 (18.1)	22 (18.5)	13 (17.6)	1.06	0.872
- Shortness of breath	64 (33.2)	45 (37.8)	19(25.7)	1.76	0.082

Analyzed with [b] Chi-square test.

4.7 Prevalence of allergic symptoms

In this study the overall prevalence of allergic symptoms highest in itchy eyes (50.3%), headache (44.6%), running nose (35.2%), stinging eyes (33.7%), skin rash (31.6%), running eyes (24.9%), redness (19.2%), watery eyes (19.2%) and dark circle under eyes (17.1%) respectively.

From the result we found that libraries staffs had prevalence of allergic symptoms insignificant higher than administrative officers including itchy eyes (OR = 1.73, p = 0.067), headache (OR = 1.56, p = 0.138), stinging eyes (OR = 1.34, p = 0.360), skin rash (OR = 1.76, p = 0.086), running eyes (OR = 1.18, p = 0.631), watery eyes (OR = 1.19, p = 0.655), redness (OR = 1.60, p = 0.231) and dark cycle under eyes (OR = 2.19, p = 0.067) respectively but administrative officers had risk to be running nose symptom non-significantly higher than libraries staff (OR = 0.83, p = 0.055) (Table 19).

Table 19 Unadjusted prevalences of allergic symptoms in libraries staff compared with administrative officers

Characteristics	**Total prevalence (n=193)**	**Libraries staff (n= 119)**	**Administrative officers (n= 74)**	**OR[b]**	***p*-value[b]**
Allergic symptoms (%)					
- Skin rash	61 (31.6)	43 (36.1)	18 (24.3)	1.76	0.086
- Running eyes	48 (24.9)	31 (26.1)	17 (23.0)	1.18	0.631
- Watery eyes	37 (19.2)	24 (20.2)	13 (17.6)	1.19	0.655
- Itchy eyes	97 (50.3)	66 (55.5)	31 (41.9)	1.73	0.067
- Stinging eyes	65 (33.7)	43 (36.1)	22 (29.7)	1.34	0.360
- Running nose	68 (35.2)	40 (33.6)	28 (37.8)	0.83	0.550
- Redness of	37 (19.2)	26 (21.8)	11 (14.9)	1.60	0.231
skin	33 (17.1)	25 (21.0)	8 (10.8)	2.19	0.067
- Dark circle					
under eyes	86 (44.6)	58 (48.7)	28 (37.8)	1.56	0.138
- Headache					

Analyzed with [b] Chi-square test.

4.8 PM_{10} exposure associated to respiratory and allergic symptoms

This studied used bivariate analysis in the first step for guidance regarding selection of variables to include to logistic regression models. The steps taken in specifying final models are described in the method section. This section presents final model results for each dependent variable.

4.8.1 PM_{10} exposure association with cough

From the logistic regression model between PM_{10} and cough symptoms, we found that PM_{10} was weak positive association to cough (OR= 1.003, p = 0.273) when adjust with sex, respiratory and allergic disease, bicycle used, and pesticide used in household (Table 20).

Table 20 Final model result for cough

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.003	0.002	0.273	1.003	0.998	1.007
	Female	-0.648	0.454	0.154	0.523	0.215	1.274
	Respiratory and allergic disease	1.211	0.559	0.030	3.358	1.122	10.047
	Transport by bicycle	1.505	0.915	0.100	4.506	0.750	27.069
	Pesticide used	0.570	0.415	0.170	1.769	0.784	3.990
	Constant	-1.560	0.877	0.075	0.210		

4.8.2 PM_{10} exposure association with phlegm from chest

From the logistic regression model between PM_{10} and phlegm symptoms, we found that PM_{10} was weak negative non-significantly association to phlegm (OR= 0.999, p = 0.770) when adjust with group of dust exposure, sex, transport to work by bus without air conditioner, pesticide used in household and painted the workplace (Table 21).

Table 21 Final model result for phlegm

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	-0.001	0.004	0.770	0.999	0.991	1.006
	Library group	1.548	0.775	0.046	4.702	1.029	21.486
	Female	-1.524	0.576	0.008	0.218	0.070	0.674
	Transport by bus without air	0.959	0.632	0.129	2.608	0.756	8.996
	Pesticide used	1.011	0.554	0.068	2.749	0.928	8.146
	Painting workplace	-1.759	0.737	0.017	0.172	0.041	0.729
	Constant	-0.935	1.064	0.379	0.392		

4.8.3 PM_{10} exposure association with wheezing

From the logistic regression model between PM_{10} and wheezing symptoms, we found that PM_{10} was weak positive significantly association to wheezing (OR=1.005, p = 0.05) when adjust with sex, respiratory and allergic disease, incent smoke exposure, smoke from traffic exposure, bicycle used and pesticide used in household (Table 22).

Table 22 Final model result for wheezing

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.005	0.003	0.050	1.005	1.000	1.011
	Female	-0.922	0.455	0.043	0.398	0.163	0.970
	Respiratory and allergic disease	1.368	0.587	0.020	3.928	1.244	12.408
	Incent smoke exposed	-2.807	1.153	0.015	0.060	0.006	0.579
	Smoke From traffic exposed	1.583	0.816	0.052	4.870	0.984	24.092
	Transport by bicycle	1.884	1.153	0.102	6.582	0.687	63086
	Pesticide used	0.769	0.416	0.065	2.157	0.954	4.877
	Constant	-2.670	1.188	0.025	0.069		

4.8.4 PM_{10} exposure association with shortness of breath

From the logistic regression model between PM_{10} and shortness of breath symptoms, we found that PM_{10} was weak positive non-significantly association to shortness of breath (OR= 1.003, p = 0.167) when adjust with open burning exposure, pesticide used in household and clean floor period (Table 23).

Table 23 Final model result for shortness of breath

	Variables	**B**	**S.E.**	***p*-value**	**OR**	**95% CI**	
						Lower	**Upper**
Step 1(a)	PM_{10} level	0.003	0.002	0.167	1.003	0.999	1.006
	Smoke from open burning exposed	1.242	0.481	0.010	3.464	1.348	8.899
	Pesticide used	0.595	0.322	0.065	1.813	0.964	3.411
	Dust from clean floor exposed	1.042	0.588	0.076	2.836	0.896	8.980
	Constant	-3.534	1.149	0.002	0.029		

4.8.5 PM_{10} exposure association with skin rash

From the logistic regression model between PM_{10} and skin rash symptoms, we found that PM_{10} was weak positive significantly association to skin rash (OR= 1.004, p = 0.041) when adjust with sex, open burning exposure and pesticide used in household and clean floor period (Table 24).

Table 24 Final model result for skin rash

	Variables	**B**	**S.E.**	***p*-value**	**OR**	**95% CI**	
						Lower	**Upper**
Step 1(a)	PM_{10} level	0.004	0.002	0.041	1.004	1.000	1.008
	Female	0.507	0.375	0.177	1.660	0.796	3.4614
	Smoke from open burning exposed	0.866	0.468	0.064	2.377	0.949	5.953
	Pesticide used	0.481	0.322	0.135	1.617	0.861	3.039
	Constant	-2.619	0.773	0.001	0.0729		

4.8.6 PM_{10} exposure association with running eyes

From the logistic regression model between PM_{10} and running eyes symptoms, we found that PM_{10} was weak positive non-significantly association to running eyes (OR=1.002, p = 0.434) when adjust with sex, respiratory and allergic disease, work history with exposure to chemical, smoke from printing, transport to work by motorcycle and bus with air conditioner and cleaned air conditioner (Table 25).

Table 25 Final model result for running eyes

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.002	0.002	0.443	1.002	0.998	1.006
	Female	0.880	0.477	0.065	2.411	0.947	6.139
	Respiratory and allergic disease	1.389	0.526	0.008	4.010	1.430	11.247
	Work history with exposure to chemical	2.184	0.803	0.007	8.886	1.841	42.895
	Smoke from printing exposed	0.586	0.394	0.137	1.796	0.830	3.890
	Transport by motorcycle	-1.000	0.700	0.153	0.368	0.093	1.451
	Transport by bus with air	0.819	0.407	0.044	2.269	1.021	5.042
	Cleaned air conditioner	0.782	0.376	0.038	2.186	1.045	4.572
	Constant	-4.849	1.132	0.000	0.008		

4.8.7 PM_{10} exposure association to watery eyes

From the logistic regression model between PM_{10} and watery eyes symptoms, we found that PM_{10} was non-significantly association to watery eyes (OR= 1.00003, p = 0.991) when adjust with underlying disease, floor polished and painted workplace (Table 26).

Table 26 Final model result for watery eyes

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.000	0.002	0.991	1.00003	0.996	1.004
	Work history with exposure to chemical	1.944	0.622	0.002	6.984	2.064	23.630
	Type of floor	-0.789	0.436	0.070	0.454	0.193	1.067
	Painting workplace	0.940	0.399	0.019	2.559	1.170	5.598
	Constant	-0.965	0.682	0.157	0.381		

4.8.8 PM_{10} exposure association with itchy eyes

From the logistic regression model between PM_{10} and itchy eyes symptoms, we found that PM_{10} was weak positive non-significantly association to itchy eyes (OR=1.002, p = 0.198) when adjust with respiratory and allergic disease, transport to work by motorcycle and pesticide used in household (Table 27).

Table 27 Final model result for itchy eyes

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.002	0.002	0.198	1.002	0.999	1.006
	Respiratory and allergic disease	1.917	0.655	0.003	6.802	1.884	24.552
	Transport by motorcycle	-0.699	0.447	0.117	0.497	0.207	1.192
	Pesticide used	0.742	0.311	0.017	2.101	1.143	3.863
	Constant	-0.742	0.367	0.043	0.476		

4.8.9 PM_{10} exposure association with stinging eyes

From the logistic regression model between PM_{10} and stinging eyes symptoms, we found that PM_{10} was weak positive non-significantly association to stinging eyes (OR=1.001, p = 0.808) when adjust with work history with exposure to dust, pesticide used in household, cleaning ventilation and set wallpaper in workplace (Table 28).

Table 28 Final model result for stinging eyes

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.000	0.002	0.808	1.001	0.997	1.004
	Work history with exposure to dust	1.112	0.625	0.075	3.039	0.893	10.339
	Pesticide used	0.977	0.327	0.003	2.657	1.400	5.042
	Cleaned air conditioner	0.715	0.332	0.031	2.045	1.067	3.918
	Set up wallpaper	1.969	0.878	0.025	7.166	1.281	40.084
	Constant	-2.359	0.616	0.000	0.095		

4.8.10 PM_{10} exposure association with running nose

From the logistic regression model between PM_{10} and running nose symptoms, we found that PM_{10} was weak positive non-significantly association to running nose (OR= 1.001, p = 0.687) when adjust with respiratory and allergic disease, work hour per day, incent smoke exposure, transport to work by bus without air, pesticide used in household, cleaned air conditioner and set wallpaper in workplace (Table 29).

Table 29 Final model result for running nose

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.001	0.002	0.687	1.001	0.997	1.005
	Respiratory and allergic disease	2.630	0.734	0.0001	13.869	3.290	58.464
	Work hour per day	-0.523	0.258	0.042	0.593	0.357	0.982
	Incent smoke exposed	1.219	0.501	0.015	3.382	1.268	9.023
	Transport by bus without air	-1.433	0.658	0.029	0.239	0.066	0.867
	Transport by bus with air	-0.869	0.463	0.061	0.419	0.169	1.040
	Pesticide used	1.466	0.382	0.0001	4.333	2.049	9.166
	Cleaned air conditioner	0.539	0.366	0.140	1.715	0.837	3.511
	Set up wall paper	1.420	1.005	0.157	4.138	0.578	29.639
	Constant	-0.589	1.072	0.583	0.555		

4.8.11 PM_{10} exposure association with redness of skin

From the logistic regression model between PM_{10} and redness symptoms, we found that PM_{10} was weak positive non-significantly association to redness (OR=1.001, p = 0.590) when adjust with respiratory and allergic disease, cooking smoke exposure and pesticide used in household (Table 30).

Table 30 Final model result for redness of skin

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.001	0.002	0.590	1.001	0.997	1.006
	Respiratory and allergic disease	0.966	0.519	0.062	2.628	0.951	7.261
	Smoke from cook exposed	0.554	0.387	0.152	1.740	0.815	3.714
	Pesticide used	0.535	0.375	0.154	1.707	0.819	3.560
	Constant	-2.196	0.483	0.0001	0.111		

4.8.12 PM_{10} exposure association with dark circles under eyes

From the logistic regression model between PM_{10} and dark cycle under eyes symptoms, we found that PM_{10} exposure was weak negative non-significantly association to dark circles under eyes (OR= 0.999, p = 0.860) when adjust with libraries group, respiratory and allergic disease, smoke from printing, transport to work by bus without air conditioner, pesticide used in household and floor polished in workplace (Table 31).

Table 31 Final model result for dark circles under eyes

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.000	0.003	0.860	0.999	0.993	1.006
	Library group	0.887	0.548	0.105	2.427	0.830	7.098
	Respiratory and allergic disease	1.388	0.559	0.013	4.005	1.340	11.971
	Smoke from printing exposed	0.900	0.472	0.057	2.461	0.975	6.212
	Transport by bus without air	-2.158	1.075	0.045	0.116	0.014	0.951
	Pesticide used	1.076	0.424	0.011	2.933	1.277	6.738
	Floor polished	0.619	0.456	0.175	1.857	0.760	4.539
	Constant	-3.594	0.690	0.0001	0.027		

4.8.13 PM_{10} exposure association with headache

From the logistic regression model between PM_{10} and headache symptoms, we found that PM_{10} was weak positive non-significantly association to headache (OR= 1.001, p = 0.759) when adjust with sex, respiratory and allergic disease, incent smoke exposure, smoke from printing, walk to work, cleaned air conditioner and set up wallpaper in workplace (Table 32).

Table 32 Final model result for headache

	Variables	B	S.E.	*p*-value	OR	95% CI	
						Lower	Upper
Step 1(a)	PM_{10} level	0.001	0.002	0.759	1.001	0.997	1.004
	Female	1.087	0.372	0.003	2.966	1.430	6.513
	Respiratory and allergic disease	0.750	0.546	0.169	2.116	0.727	6.165
	Incent smoke exposed	0.786	0.460	0.088	2.195	0.890	5.409
	Smoke from printing exposed	0.484	0.328	0.140	1.623	0.853	3.089
	Transport by walk to work	-1.340	0.715	0.061	0.262	0.064	1.064
	Cleaned air conditioner	0.423	0.324	0.191	1.527	0.810	2.881
	Set up wall paper	1.313	0.917	0.152	3.716	0.616	22.434
	Constant	-3.224	0.880	0.0001	0.040		

4.9 Summary model of PM_{10} exposure associated to respiratory symptoms.

Section 4.8 above presents logistic model estimates for dependent variables. This section presents the same information, but organized according to independent variable, not dependent variable. This alternate presentation was done in an effort to evaluate the general relative importance of the independent variables.

The studied show that particulate matter diameters less than 10 micrometer (PM_{10}), μg/m3, was not strong non-significantly association to respiratory symptoms including cough (OR=1.003, p = 0.273), phlegm from chest (OR=0.999, p = 0.770) and shortness of breath (OR=1.003, p = 0.167). In other hand PM_{10} significantly association with wheezing (OR=1.005, p = 0.05). It means that PM_{10} can predict the symptom of wheezing in the workers (Table 33).

Table 33 Model of association between PM_{10} level and respiratory symptoms

Characteristics	Coefficient (B)	S.E.	OR	*p*-value	95% CI
Respiratory symptoms					
- Cough	0.003	0.002	1.003	0.273	0.998-1.007
- Phlegm from chest	-0.001	0.004	0.999	0.770	0.991-1.006
- Wheezing	0.005	0.003	1.005	0.050	1.000-1.011
- Shortness of breath	0.003	0.002	1.003	0.167	0.999-1.006

4.10 Summary of PM_{10} exposure associated to allergic symptoms.

The particulate matter diameters less than 10 micrometer (PM_{10}) positive significantly association to skin rash (OR=1.004, p= 0.041) but it was not strong non-significantly association to running eyes (OR=1.002, p = 0.443), watery eyes (OR=1.00003, p = 0.991), itchy eyes (OR=1.002, p = 0.198), stinging eyes (OR=1.0005, p = 0.808), running nose (OR=1.001, p = 0.687), redness (OR=1.001, p = 0.590), dark circle under eyes (OR=0.999, p = 0.860) and headache (OR=1.001, p = 0.759) (Table 34). It means that PM_{10} can predict the symptom of skin rash in the workers.

Table 34 Model of association between PM_{10} level and allergic symptoms

Characteristics	Coefficient (B)	S.E.	OR	*p*-value	95% CI
Allergic symptoms					
- Skin rash	0.004	0.002	1.004	0.041	1.000 – 1.008
- Running eyes	0.002	0.002	1.002	0.443	0.998 – 1.006
- Watery eyes	0.0000257	0.002	1.00003	0.991	0.996 – 1.004
- Itchy eyes	0.002	0.002	1.002	0.198	0.999 – 1.006
- Stinging eyes	0.0005	0.002	1.0005	0.808	0.997 – 1.004
- Running nose	0.001	0.002	1.001	0.687	0.997 - 1.005
- Redness	0.001	0.002	1.001	0.590	0.997 – 1.006
- Dark circles under eyes	0.0005	0.003	0.999	0.860	0.993 – 1.006
- Headache	0.001	0.002	1.001	0.759	0.997 - 1.004

4.11 Other factors associated to respiratory and allergic symptoms

Nevertheless from Table 20 – 32, the studied shown that PM_{10} was not strong association to respiratory and allergic symptoms any more. It was possible that there were other factors that related or causes to both symptoms in libraries staffs and administrative officers such as sex in term of female to male, respiratory and allergic disease, exposed to smoke from incent, traffic or open burning etc. we can explain like table below (Table 35).

1. Cough symptoms: The person who had respiratory and allergic disease will risk to be cough higher than other one who did not have underlying disease (about 3.4 times).

2. Phlegm from chest symptoms: Female had less risk to be phlegm from chest than male and the person who was libraries group had higher risk to be phlegm from chest about 4.7 times. Also this, renew by re-painting workplace was related to this symptoms too.

3. Wheezing symptom: Apart PM_{10} exposure that associated to wheezing we found that female had less risk to be wheezing than male. The person who was respiratory and allergic disease had higher risk than other who was not be this disease (about 3.9 times) and female had less risk to be wheezing than male. Nevertheless the person who exposed to incent smoke was association to wheezing as well.

4. Shortness of breath: Exposure to smoke from open burning was one factor which related to shortness of breath higher than the person who did not exposed (about 3.5 times).

5. Skin rash: The person who were libraries staffs have risk to be skin rash than other one (about 1 time)

6. Running eyes symptoms: There were few factors which related to running nose in the workers including the person who exposed to chemical from previous worked also had respiratory and allergic disease will have higher risk to be running eyes than the person who did not have these conditions (about 8.9 and 4.0 times respectively). Also the person who transportation to workplace by bus with air conditioner had higher risk to be running eyes than the person who used other type of transportation (about 2.3 times). The workplaces where cleaned air conditioner schedule about less than 1 time per month had higher risk to running eyes than the workplace where cleaned air conditioner more than 1 time per month (about 2.2 times).

7. Watery eyes symptoms: We found that the person who had ever worked in the place where exposure to dust will have higher risk to watery eyes than the person who did not work in that condition (about 7.0 times). More than this the person who working in the re-painting workplace had higher risk to be watery eye than other one who did not work in this place (About 2.6 times).

8. Itchy eyes symptoms: The person who was respiratory and allergic disease had higher risk to itchy eyes than other one who was not be this disease (about 6.8 times). More than this the person who used pesticide in their household have higher risk to be itchy eyes than other one who did not used (about 2.0 times).

9. Stinging eyes symptoms: The person who used pesticide in their household have higher risk to be itchy eyes than other one who did not used (about 2.7 times). Similar like the person who worked in the place where set up wallpaper higher risk to stinging eyes than other one who did not worked there place (about 7.2 times). Also the workplace where cleaned air conditioner less than 1 time per month had higher risk to running eyes than the workplace where cleaned air conditioner more than 1 time per month (about 2 times)

10. Running nose symptoms: The person who was respiratory and allergic disease had higher risk than other one who was not be disease (about 13.9 times) and pesticide used in household was higher risk to be running nose than someone who did not used about 4 times. Besides this the person who exposed to incent smoke higher risk to be risk of running nose than the person who did not exposed about 3.4 times. Nevertheless transportation to workplace by bus without air conditioner had less risk of running nose than the person who used other type of transportation. Work hour per day was the factor which associated to running nose as well.

11. Redness of skin: There was not statistically significantly with any independent variables.

12. Dark circle under eyes symptoms: The person who was respiratory and allergic disease had higher risk to be dark circle under eyes than other one who was not be this disease (about 4 times) and the person who used pesticide in household had higher risk of dark cycle under eyes than other one who did not used (about 3 times) also someone who transport to work by bus without air conditioner had less risk to dark cycle under eyes than other type of transportation.

13. Headache symptoms: Sex was the one factor of headache that was female has higher risk to headache than male (about 3 times).

Table 35 Independent variables statistically significantly associated with respiratory and allergic prevalence

No.	Symptoms	Other factors	OR	*p*-value
1	Cough	1. Respiratory and allergic disease	3.358	0.03
2	Phlegm from chest	1. libraries group 2. Sex (Female vs. male) 3. Re-painting workplace	4.702 0.398 0.172	0.046 0.043 0.017
3	Wheezing	1. PM_{10} level 2. Respiratory and allergic disease 3. Sex (Female vs. male) 4. Incent smoke exposed	1.005 3.928 0.398 0.060	0.050 0.020 0.043 0.015
4	Shortness of breath	1. Smoke from open burning exposed	3.464	0.010
5	Skin rash	1. PM_{10} level	1.004	0.041
6	Running eyes	1. Work history with exposure to chemical 2. Respiratory and allergic disease 3.Transportation by bus with air 4. Cleaned air conditioner	8.886 4.010 2.269 2.186	0.007 0.008 0.044 0.038
7	Watery eyes	1.Work history with exposure to dust 2. Re-painting workplace	6.984 2.559	0.002 0.019
8	Itchy eyes	1. Respiratory and allergic disease 2. Pesticide used in household	6.802 2.101	0.003 0.017

No.	Symptoms	Other factors	OR	*p*-value
9	Stinging eyes	1.Set up wallpaper in workplace	7.166	0.025
		2.Pesticide used in household	2.657	0.003
		3. Cleaned air conditioner	2.045	0.031
10	Running nose	1. Respiratory and allergic disease	13.869	0.0001
		2. Pesticide used in household	4.124	0.0002
		3.Incent smoke exposure	3.382	0.015
		4.Transportation by bus without air	0.239	0.029
		5. Work hour per day	0.593	0.042
11	Redness of skin	Not statistically significantly with independent variables	-	-
12	Dark circles under eyes	1. Respiratory and allergic disease	4.005	0.013
		2.Pesticide used in household	2.993	0.011
		3.Transportation by bus without air	0.116	0.045
13	Headache	1.Sex (Female vs. male)	2.966	0.003

CHAPTER V
DISCUSSION

The objective of this study was to know about the particulate matters exposure in libraries where there are many books that are causes to dust accumulated in the air of workplace. Chulalongkorn University was the sample area for projected this study, it could be the base line of data about dust in the libraries associated to respiratory and allergic symptom in Thailand. The participants in this studied are 193 persons separated in 2 group are exposed group, libraries staff, 119 persons and unexposed group, administrative officers, 74 persons.

5.1 Socio-Demographic

From the result of the study, we found that mostly of libraries staffs are woman that consistent to Sanwa, S. (2012) (41) and Maitawthong, T. (2014) (42) were found the libraries staff mostly were woman, 86.0% and 56.5% respectively. More than this age of these groups were interval between 51 – 60 years old similarly to Maitawthong, T. (2014) (42) was found that mostly of librarian had age more than 41 years old (34.8%). Also this about 97% of the libraries staff did not smoke that different to administrative officers who mostly had age between 31 – 40 years old and equal in amount of men and women officers so the smoker (12.2%) in administrative officers were higher than libraries staff (3.4%). In other hand, libraries staff had respiratory and allergic disease similar like administrative officers.

5.2 Daily behavior

This study found that participants both in libraries staffs and administrative officers most of them exposed to daily dust besides dust from their workplace but there was difference in administrative officers have higher rate in exposed to daily dust than libraries staff ($p = 0.005$). More than this, both of two groups were exposed to daily dust from the similar source including road traffic, cleaning house, cooking, incent smoke and open burning respectively ($p > 0.05$). Road traffic was high prevalence of source of daily dust which they were exposed so

we could see that both of them had similar decided come to with air conditioner bus, BTS, motorcycle and bicycle ($p > 0.05$). While there were difference in private car, bus without air conditioner and walk because libraries staff came to work by private car and bus without air conditioner higher than the administrative offices accepted walk. For the pesticide used in household both 2 groups did not difference to use it ($p > 0.05$).

5.3 Work characteristic

Work characteristic in this study found that many of libraries staff worked in current position more than 10 years and it was difference to administrative officers which most of them worked in their current position less than 10 years this consistent to past studied from Sanwa, S. (2012) (41) was found about period of work in librarians position more than 10 years (71.6%). This conformed to age of the officers because the libraries staff mostly age interval between 51 -60 years old so they had period of life work higher than administrative officers who had mostly age between 31 – 40 years old. In similarly both of them had worked in their workplace about 7 – 8 hours or more than 8 hours in someone who should to work over time. Nevertheless before they worked in current position, most of them had exposed to dust from works such as farmer, building construction, engine maintenance or packaging but many of libraries staff exposed to dust from the past higher than administrative officer ($p < 0.05$) while they were no difference in experience to work with chemical such as medical process, farmer, wood decoration or painting from works in the past ($p > 0.05$).

5.4 Workplace characteristic

Main structure of both 2 groups was cement ($p = 0.0.536$) also floor that made from cement and rubber ($p = 0.286$) which was cleaned in everyday in libraries but for administrative offices somewhere was cleaned in everyday and somewhere just only 3 times per week ($p < 0.001$). Wall of workplace were difference because administrative offices mostly were cement but libraries had variety wall from wood, mirror, and future board too ($p = 0.003$). Ventilation material of libraries was air

conditioner (p = 0.012) which mostly cleaned 1 time per month (p < 0.001) while administrative office had air conditioner which mostly in 1 - 4 times per years also with some place were fan or natural ventilation like a windows and doors. More than this many libraries had renew workplace such as polished or changed floor, re-paint and decoration areas higher than administrative offices done (p = 0.006).

5.5 Particulate matters exposure

Library staffs exposed to particulate matters diameter less than 10 micrometer (PM_{10}) higher than administrative officers (Mean = 202.81 and 102.95 $\mu g/m^3$ respectively) It was possible because in libraries had accumulated of books mostly between 50,001-150,000 books and some libraries had more than 200,000 books. Nearly 100% of libraries were air condition workplace so particulate matter were circulated and accumulated in the air higher than the offices of administrative where did not have many of books

In other hand, PM_{10} exposure in both of libraries (9.89 - 1298.70 $\mu g/m^3$) and administrative offices (9.88 - 515.53 $\mu g/m^3$) did not exceed than regulation or standard values (OSHA: Occupation Safety and Health Administration establish respiratory dust not over 5 mg/m^3 or 5000 $\mu g/m^3$ for TWA) (6).

For $PM_{2.5}$ concentration in libraries (1.00 - 11.0 $\mu g/m^3$) higher than administrative offices (1.00 – 4.00 $\mu g/m^3$) also Mean of $PM_{2.5}$ in libraries was higher than administrative offices, 4.06 $\mu g/m^3$ and 2.54 $\mu g/m^3$ respectively. However, the levels of $PM_{2.5}$ in this study was very low than levels of PM_{10} (About 2%) so it was not seem plausible because there was difference to other studies such as Jeffrey R. Brook (2011) (43) found that $PM_{2.5}$ concentration average from 19 location in Canada was lower than PM_{10} concentration about 49% this similar to the studied in Chili of Javier Garcia (2005) (44) that shown about mean of $PM_{2.5}$ in urban areas less than PM_{10} about 47.8%. More than this from studied of B.Peckey (2010) (45) found that $PM_{2.5}$ concentration in indoor air lower than PM_{10} about 67.5% in summer and 42.9% in winter.

The reason why $PM_{2.5}$ concentration was far lower than PM_{10} in this studied possible because $PM_{2.5}$ monitoring was direct reading technique with light scattering so it will be detected for current dust in all over the air that was difference to PM_{10} technique which used filler to collected accumulate dust all over work hours with set up on personal exposure. For this reason it possible to make $PM_{2.5}$ very less than PM_{10} concentration so we chose not to analyze associations between $PM_{2.5}$ levels and symptoms prevalence.

5.6 Respiratory and allergic symptom

The library staffs had prevalence of respiratory symptom was non-significantly higher than administrative officers for cough, phlegm, wheezing and shortness of breath ($p > 0.05$). Nevertheless the prevalence of allergic symptoms such as itchy eyes, headache, stinging eyes, skin rash, running eyes, redness, dark circle under eyes and watery eyes occurred in libraries staff was non-significantly higher than administrative officers accepted running nose ($p > 0.05$). Overall, both respiratory and allergic symptoms prevalence were consistently higher in the library group than the administrative group, but not significantly so.

From the result, the symptoms both respiratory and allergic symptoms higher in libraries staff than administrative officer ($p < 0.05$), accepted to running nose, maybe because of any factor such as sex, age, daily behavior and particulate matter concentration (PM_{10}). Especially PM_{10} that higher in libraries than administrative offices about 2 times ($p < 0.05$) this result can causes to the symptoms. It was consistent to the previous studied of Tepakson, P. (2012) (35) who found that the prevalence of respiratory symptom in cement dust exposed group was non-significantly higher than unexposed group ($p > 0.05$).

5.7 Associated between particulate matters with respiratory and allergic symptoms

PM_{10} level were generally positively associated with respiratory and allergic symptoms prevalence, but not significantly so. The only two symptoms that showed significant positive associations were wheezing (OR = 1.005, $p = 0.05$) and skin rash

(OR = 1.004, p = 0.041). So we can predict the wheezing and skin rash by PM_{10} exposure in the workplace. This consistent to the studied of P. Bakke (1991) about wheezing associated to pollutants contaminated in workplace so if the workers contacted to pollutants they can be the symptoms like a wheezing (46) and the studied of Huang MJ (2012) found that skin rash association with dust cloud from World Trade Center situation in 9-11 (47). In another hand, other symptoms both respiratory and allergic symptoms was non-significantly associated with PM_{10} maybe because of several factors. Firstly there were other risk factors which could be causes to the symptoms apart from PM_{10} exposure were

1. Respiratory and allergic disease strongly significant association to cough, wheezing, running eyes, itchy eyes, running nose and dark circle under eyes.

2. Gender statistically significant association to phlegm from chest, wheezing and headache.

3. Work history with exposure to dust significant association to watery eyes.

4. Work history with exposure to chemical significant association to running eyes.

5. Libraries group significant association to phlegm from chest.

6. Work hour per day significant association to running nose.

7. Exposure to incent smoke significant association to wheezing and running nose.

8. Exposure to smoke from open burning significant association to shortness of breath.

9. Transportation to work by bus with air conditioner significant association to running eyes.

10. Transportation to work by bus without air conditioner significant association to running nose and dark circle under eyes.

11. Pesticide used in household significant association to itchy eyes, stinging eyes, running nose and dark circle under eyes.

12. Cleaned air conditioner in workplace significant association to running eyes and stinging eyes.

13. Set up wallpaper in workplace significant association to stinging eyes.

14. Re-painting workplace significant association to phlegm from chest and watery eyes.

Secondary, because of PM_{10} concentration was very lower than the standard value of OSHA (5000 $\mu g/m^3$) maybe because there had clean schedule in the workplace such as cleaned floor, air conditioner and shelves of books mostly in everyday so it possible to reduce amount of PM_{10} in the workplace.

However it was possible that respiratory and allergic symptoms in libraries staff and administrative officers came from indoor air pollutants other than PM_{10} such as Benzene, CO_2, PAHs, NO_2 which established by WHO guideline for indoor air quality (6) also the previous study of Wlazlo, A. et al.(8) found that libraries staff could be respiratory and allergic symptoms from dust mite allergen and microorganism such as fungi, virus or bacteria in the air also consistent to the studied of Lerdkarnkasuk, N. (2011) (48) who found that headache in the bus ticket worker associated to concentration of CO and CO_2 also followed to previous studied of J. M. Daisey et al who found that CO_2, fungi, bacteria, VOCs and Formaldehyde were contaminated in the classroom and caused to asthma, respiratory and allergic symptoms of children (7).

CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

This study was cross-sectional study to estimate the prevalence of respiratory and allergic symptoms in the libraries staffs of Chulalongkorn University (119 persons) compared with the administrative officers of Chulalongkorn University (74 persons) who worked in the offices where did not have many books and paper such as IT officer, trainer, service officer, laboratory staffs and public relation. Nevertheless the researcher explored the association between the symptoms and particulate matter exposure in those workers so. The statistical analysis used in this study were descriptive statistics, T-test analysis, Chi-square test, Fisher's Exact test and multiple logistic regression to find the association between dependent variables (respiratory and allergic symptoms) and independent variables (PM_{10} levels and generally independent variables). Data collected with face to face interview by standardize questionnaire asked about socio-demographic, daily behavior, work characteristic, workplace characteristic also the respiratory and allergic symptoms. More than this particulate matters measurement that followed to respiratory dust standard method from NIOSH in the representative participants.

The conclusion of the study was the libraries where there were many books had particulate matters (PM_{10} and $PM_{2.5}$) contaminated in the air higher than administrative offices ($p < 0.05$) but the concentration of PM_{10} exposure in libraries staffs and administrative officers (Mean of PM_{10} exposure were 202.81 and 102.95 $\mu g/m^3$ respectively) did not exceed to respiratory dust standard (OSHA = 5 mg/m^3 or 5000 $\mu g/m^3$) that was rarely safe for workers health when they worked in their workplaces. The factors which made PM concentration possible were frequency of cleaned workplace, floor, air conditioner and shelf of books.

More than this, the libraries staff had the respiratory symptoms such as cough, phlegm from chest, wheezing and shortness of breath also allergic symptoms such as skin rash, itchy eyes, stinging eyes, watery eyes and headache generally higher than administrative officers accepted running nose but was not significantly ($p > 0.05$).

Nevertheless PM_{10} exposure concentration was significantly associated to wheezing and skin rash ($p < 0.05$) so we could conclude that the libraries had risk of wheezing and skin rash from PM_{10} more than administrative offices.

However there are many symptoms that were not significantly associated with PM_{10} exposure that was possible from other factors which promotes the symptoms such as respiratory and allergic disease, gender, work history with exposure to chemical and dust, work hour per day, daily smoke exposure from incent smoke, open burning, transportation to work by bus, renew workplace by re-painting and set up wall paper, cleaned air conditioner schedule, and pesticide used in household. More than this the symptoms in the worker there were come from dust mite allergen, microorganism such as fungi, virus or bacteria, CO_2, NO_2, VOCs, Benzene, Formaldehyde and PAHs which contaminated in the air of workplace too.

6.2 Recommendation and future study

According to the conclusion, PM_{10} exposure both in libraries and administrative offices were less than the standard and PM_{10} level was generally positively associated with symptoms prevalence but was significantly associated only with wheezing and skin rash prevalence. The recommendation to prevent workers in each office from symptom which result from particulate matter is health promotion for them by dissemination knowledge on personal health care such as 6 steps of hand washing or the person who was respiratory and allergic disease should to use masks when they arrange or keep books on the shelves for decrease risk of symptoms from particulate matter.

This study had objective to find out the association between particulate matters with respiratory and allergic symptoms in libraries staffs compare to administrative officers but in the future should to have study about other factors affected to the symptoms such as fungi or mold, bacteria also any chemicals which contaminated in the workplace such as Benzene, Nitrogen dioxide and Formaldehyde because this chemical rarely found in the building and cause to sick building syndrome.

Finally, it should be noted that the method used to assign PM_{10} levels to individual participants probably does not fully accurately represent their actual PM_{10} exposure. Also, as noted above, the $PM_{2.5}$ measurements were too low to be trustworthy. The researcher believes that these findings raise suspicion that indoor PM maybe a risk factor, perhaps even a cause, of one or more of the symptoms studied. In this studied. It was not feasible in this study to obtain personal and area PM_{10} and $PM_{2.5}$ measurement for all participants. With additional resources and time, indoor PM may yet emerge as a clear risk factor for the symptoms studied, in similar study opulent. Further research in this area is clearly needed.

6.3 Limitation of the study

6.3.1 $PM_{2.5}$ measurement should to have specific equipment such as specific laboratory where can control of temperature, pressure and humidity to constant the $PM_{2.5}$ concentration. So the researcher had to choose the ambient air direct reading equipment instead.

6.3.2 Limitation for budgets and time schedule to provided PM_{10} equipment to measure PM_{10} exposure in all participants. So the researcher decided to measure in some of the participants who available for this study (only half of participants).

6.3.3 Some of sample area did not permission for researcher to collection data so researcher should to change the area that made the period of time schedules were changed.

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APPENDIX

APPENDIX A

Questionnaire English version

Date and times……. Participant serial No…….

Interviewer…….. House number……..

Particulate matters related to respiratory and allergic symptoms in libraries staffs and administrative officers at Chulalongkorn University Bangkok Thailand

Description

Part 1: Personal characteristics, in this part have 13 questions (question 1-13) to ask participants about their personal profiles which include gender, age, education, duration of work per day, duration of work per weeks, smoking behaviors, chemicals exposed and allergic history.

Part 2: Workplace characterization, in this part have 10 questions (question 1-10) to ask participants in characterization of workplace such as size, construction, customers per day, type and amount of books, type of ventilation, type of floor, frequency of cleaning.

Part 3: The symptoms from work

3.1 Respiratory symptom: The question in this part are 12 questions (question 1.1-1.12) related to respiratory symptoms such as cough phlegm wheezing and shortness of breath

3.2 Allergic symptoms: The question in this part are 9 questions (question 2.1-2.9) ask about history of allergic symptom in workers.

…….

Please answer the following questions or mark (/) in front of your responses.

Part 1: Personal characteristics

1. Age …….years

2. Gender ( ) 1.Male ( ) 2.Female

3. Do you have underlying disease?

( ) 1.No ( ) 2.Yes ……

4. How long did you work in current workplace? ……

5. Have you ever worked for a year or more in any dusty job?

( ) 1.No ( ) 2.Yes…….

6. Have you ever worked for a year or more in gas or chemical fumes in your work?

( ) 1.No ( ) 2.Yes……...

7. How long did you work in this library per day?

( ) 1.Less than 5 hours ( ) 2.5-7 hours

( ) 3.More than 7 -8 hours ( ) 4.More than 8 hours

8. If you are working in library what is your work responsibility?

( ) 1.Collect books on shelf ( ) 2.Reserve and borrow book

( ) 3.Classify book system on shelf ( ) 4.Other…….

9. If you are working in other offices what is your work responsibility?

( ) 1.Service ( ) 2.Broadcasting

( ) 3.Typing ( ) 4.Laboratory

10. How about your smoke behavior?

( ) 1.Non smoke ( ) 2.Smoked but stop now

( ) 3.Current smoke amount……

11. Have you usually exposed to dust in the situation below?

( ) 1. Second hand smoke

( ) 2. Incense smoke

( ) 3. Smoke from cooking

( ) 4. Smoke from car engine on traffic

( ) 5.Smoke from open burning

( ) 6. Dust from house cleaning

( ) 7. Dust from paper

( ) 8. Dust from printing

( ) 9. Other……..

12. At present, what is your transportation to work in everyday?

( ) 1. Bicycle

( ) 2. Motorcycle or Hired Motorcycle

( ) 3. Personal car or Taxi

( ) 4. Public transportation without air conditioner

( ) 5. Public transportation with air conditioner

( ) 6. BTS/MRT

( ) 7. Walk

13. Did you usually use household pesticide such as mosquitoes repellent?

( ) 1.No ( ) 2.Yes

Part 2: Workplace characterization

1. What is the main type of your workplace construction?

( ) 1.Wood

( ) 2.Cement

( ) 3. Artificial object such as mirror or future board etc.

( ) 4.Other ……

2. What is the main type of your workplace floor?

( ) 1. Wood

( ) 2. Cement

( ) 3. Carpet

( ) 4. Other ……

3. What is the main type of your workplace wall?

( ) 1. Wood

( ) 2. Cement

( ) 3. Wallpaper

( ) 4. Mirror

( ) 5. Other ……

4. What is the type of ventilation in this library?

( ) 1. Fans ( ) 2. Air condition

( ) 3. Windows or doors ( ) 4. Other ……

5. How often do the office cleaning floor?

( ) 1. Never ( ) 2. Everyday

( ) 3. 1 times /week ( ) 4. 2-3 times /week

6. How often do the office cleaning air conditioner system?

( ) 1. Never ( ) 2. Everyday

( ) 3. 1 time per month ( ) 4. Other…….

7. In the past 1 year, your workplace had reconstruction below?

( ) 1. Never ( ) 2. floor improvement

( ) 3. Wallpaper ( ) 4. Other decoration

( ) 5. Floor polished ( ) 6. Painting

( ) 7. Other …….

8. How tall about ceiling from the floor?……

If you worked in libraries please fill up the marker on the question 9-10

9. How often do the office cleaning books shelf?

( ) 1. Never ( ) 2. Everyday

( ) 3. 1 time/ week ( ) 4. 2-3 times /week

10. If your workplace is library, how many books does it have?

( ) 1. 5,000 – 10,000 ( ) 2. 10,001 – 15,000

( ) 3. 15,001 – 20,000 ( ) 4. More than 20,000

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Part 3: Respiratory and Allergic symptoms

1. The respiratory symptoms

Cough

1.1 Do you usually cough at all on getting up or first thing in the morning?

( ) 1. No ( ) 2. Yes

1.2 Do you usually cough like this on most days 3 consecutive months or more during the year?

( ) No ( ) Yes

1.3 How long did you usually cough in the morning?

( ) 1. Never ( ) 2. Less than 1 year

( ) 3. 1 - 2 years ( ) 4. More than 2 years

Phlegm from chest

1.4 Do you usually bring up phlegm from chest at all on getting up or first thing in the morning? (Do not count phlegm from your nose or throat)

( ) 1. No ( ) 2. Yes

1.5 Do you usually bring up phlegm like this on most days 3 consecutive months or more during the year?

( ) 1. No ( ) 2. Yes

1.6 How long did you get phlegm from chest in the morning (Did not count phlegm from nose and throat)?

( ) 1. Never ( ) 2. Less than 1 year

( ) 3. 1 - 2 years ( ) 4. More than 2 years

Wheezing

1.7 Does your chest wheezing or whistling when you have a cold?

( ) 1. No ( ) 2. Yes

1.8 Does your chest wheezing or whistling most day and night?

( ) 1. No ( ) 2. Yes

1.9 Have you ever had an attack of wheezing that has made you feel short of breath?

( ) 1. No ( ) 2. Yes

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Shortness of breath

1.10 Do you have shortness of breath when hurrying on the level or walking up a slight hill?

( ) 1. No ( ) 2. Yes

1.11 Do you have to walk slower or have to stop for breath than people of your age on the level because of breathlessness?

( ) 1. No ( ) 2. Yes

1.12 Is your breathing absolutely normal between you had shortness of breath?

( ) 1. No ( ) 2. Yes

2. Allergic symptoms

In past 3 months when you are working, did you have the symptoms below?

2.1 Have you had skin rash in the past 3 months?

( ) 1. No ( ) 2. Yes

2.2 Have you had running eyes in the past 3 months?

( ) 1. No ( ) 2. Yes

2.3 Have you had watery eyes in the past 3 months?

( ) 1. No ( ) 2. Yes

2.4 Have you had itchy eyes in the past 3 months?

( ) 1. No ( ) 2. Yes

2.5 Have you had stinging or pain in your eyes in the past 3 months?

( ) 1. No ( ) 2. Yes

2.6 Have you had running nose in the past 3 months?

( ) 1. No ( ) 2. Yes

2.7 Have you had redness in the past 3 months?

( ) 1. No ( ) 2. Yes

2.8 Have you had dark circle under eyes in the past 3 months?

( ) 1. No ( ) 2. Yes

2.9 Have you had headache in the past 3 months?

( ) 1. No ( ) 2. Yes

แบบสอบถามงานวิจัยเรื่อง

ฝุ่นละอองขนาดเล็กกับกลุ่มอาการโรคระบบทางเดินหายใจและภูมิแพ้

ในเจ้าหน้าที่ห้องสมุดและพนักงานในจุฬาลงกรณ์มหาวิทยาลัย

กรุงเทพมหานคร ประเทศไทย

.....

การศึกษาวิจัยเรื่อง ฝุ่นละอองขนาดเล็กกับกลุ่มอาการโรคระบบทางเดินหายใจและภูมิแพ้ ในเจ้าหน้าที่ห้องสมุดและพนักงานในจุฬาลงกรณ์มหาวิทยาลัย กรุงเทพมหานคร ประเทศไทย มีวัตถุประสงค์เพื่อสำรวจข้อมูลการรับสัมผัสฝุ่นละอองในสถานที่ทำงาน และหาความสัมพันธ์ระหว่างความเข้มข้นของฝุ่นละอองขนาดเล็กกับอาการของโรคระบบทางเดินหายใจและภูมิแพ้ในพนักงานที่ปฏิบัติงานในพื้นที่เสี่ยงต่อการปนเปื้อนของฝุ่นละอองขนาดเล็ก ทั้งนี้ผู้วิจัยหวังเป็นอย่างยิ่งว่าจะได้รับความร่วมมือจากท่านเป็นอย่างดี

ส่วนที่ 1 : ข้อมูลทั่วไป ประกอบด้วยข้อคำถาม 13 ข้อ โดยเกี่ยวข้องกับ อายุ เพศ การศึกษา ระยะเวลาปฏิบัติงานต่อวัน พฤติกรรมการสูบบุหรี่ ประวัติการสัมผัสสารเคมี และภาวะโรคประจำตัว และลักษระการเดินทางมาทำงาน

ส่วนที่ 2 : ลักษณะสถานที่ทำงาน ประกอบด้วยข้อคำถาม 10 ข้อ โดยเกี่ยวข้องกับลักษณะโครงสร้างอาคาร ลักษณะพื้น ผนัง จำนวนหนังสือในห้องสมุด รูปแบบการระบายอากาศ ความถี่ในการทำความสะอาดสถานที่ทำงาน ทั้งพื้น เครื่องปรับอากาศ และการปรับปรุงอาคาร

ส่วนที่ 3 : ลักษณะอาการหรือผลกระทบต่อสุขภาพจากการทำงาน แบ่งออกเป็น 2 ประเภทอาการที่มีโอกาสเกิดขึ้นจากการรับสัมผัสฝุ่นละอองขนาดเล็ก

3.1 อาการโรคระบบทางเดินหายใจ ประกอบด้วยข้อคำถามรวมทั้งสิ้น 12 ข้อ ที่มีความสัมพันธ์กับอาการ ไอ มีเสมหะในช่องอก หายใจหอบ และหายใจมีเสียงหวีด

3.2 อาการภูมิแพ้ ประกอบด้วยข้อคำถาม รวมทั้งสิ้น 9 ข้อ

.....

แบบสอบถามสำหรับการศึกษาวิจัย

หน่วยงานที่สังกัด.....

.....

ส่วนที่ 1 ข้อมูลทั่วไป

1. อายุปี.....

2. เพศ ( )1. ชาย ( )2. หญิง

3. ปัจจุบันท่านมีโรคประจำตัวหรือไม่

( ) 1. ไม่มี

( ) 2. มี ระบุ .....

4. ท่านทำงานในสถานที่ทำงานปัจจุบันเป็นระยะเวลานานเท่าไร โปรดระบุ.....(เดือน/ปี)

5. ก่อนท่านทำงานในตำแหน่งปัจจุบัน ท่านเคยทำงานที่ต้องรับสัมผัสฝุ่นละอองจำนวนมาก (เช่น การโม่หิน การกลึงโลหะ การไสไม้ หรือ โรงปูน เป็นต้น) หรือไม่

( ) 1. ไม่เคย ( ) 2. เคย ระบุ.....

6. ก่อนท่านทำงานในตำแหน่งปัจจุบัน ท่านเคยทำงานในสถานที่ทำงานที่ต้องรับสัมผัสสารเคมี หรือไม่

( ) 1. ไม่เคย ( ) 2. เคย ระบุ.....

7. ปัจจุบันท่านทำงานเป็นระยะเวลานานเท่าไรต่อวัน

( ) 1. น้อยกว่า 5 ชั่วโมงต่อวัน ( ) 2. 5 -7 ชั่วโมงต่อวัน

( ) 3. มากกว่า 7 – 8 ชั่วโมงต่อวัน ( ) 4. มากกว่า 8 ชั่วโมงต่อวัน

8. กรณีที่ท่านทำงานในห้องสมุด ปัจจุบันตำแหน่งงานของทำงานในแผนกใด (ถ้าท่านทำงานในหน่วยงานอื่นให้ข้ามไปทำข้อ 9)

( ) 1. จัดเก็บหนังสือเข้าชั้นวาง ( ) 2. ให้ยืม หรือคืนหนังสือ

( ) 3. การจัดระบบหนังสือตามชั้น ( ) 4. อื่น ๆ.....

9. กรณีที่ท่านไม่ได้ทำงานในห้องสมุด ท่านทำงานในแผนกใดต่อไปนี้

( ) 1. แผนกบริการลูกค้า ( ) 2. วิทยุโทรทัศน์

( ) 3. งานเอกสาร งานพิมพ์ ( ) 4. ห้องปฏิบัติการ

( )5. อื่น ๆ ระบุ.....

10. ปัจจุบันท่านสูบบุหรี่หรือไม่

( ) 1. ไม่สูบบุหรี่

( ) 2. เคยสูบบุหรี่แต่ปัจจุบันเลิกแล้ว

( ) 3. สูบบุหรี่เป็นประจำทุกวัน วันละ.....มวน

11. ในแต่ละวันท่าน คิดว่าตัวเองต้องสัมผัสกับฝุ่นละอองจากที่ใดบ้าง ตอบได้มากกว่า)1 ข้อ(

( ) 1. ควันบุหรี่จากบุคคลอื่น

( ) 2. ควันธูป

( ) 3. เขม่าควันจากการประกอบปรุงอาหาร

( ) 4. เขม่าควันรถจากการจราจร

( ) 5. ควันจากการเผาขยะกลางแจ้ง

( ) 6. ฝุ่นละอองจากการทำความสะอาดบ้าน

( ) 7. เอกสารในสถานที่ทำงาน

( ) 8. หมึกพิมพ์ในสถานที่ทำงาน

( ) 9. อื่น ๆ ระบุ.....

( ) 1. จักรยาน

( )2. จักรยานยนต์รับจ้างจักรยานยนต์ส่วนบุคคล/

( )3. รถยนต์ส่วนบุคคลรถยนต์รับจ้าง/

( ) 4. รถประจำทางแบบไม่มีเครื่องปรับอากาศ

( ) 5. รถประจำทางชนิดมีเครื่องปรับอากาศ

( ) 6. BTS/MRT

( ) 7. เดินผ่านทางถนน

13. ปัจจุบันท่านใช้ยากันยุงแบบจุด หรือสเปรย์ฆ่าแมลงในบ้านหรือไม่

( ) 1. ไม่ใช่ ( ) 2. ใช้

ส่วนที่ 2 ลักษณะสถานที่ทำงาน

1. สถานที่ทำงานของท่านโครงสร้างอาคารทำจากวัสดุใดเป็นหลัก

( ) 1. ไม้ ( ) 2. ปูนซีเมนต์

( ) 3. วัสดุทดแทน เช่น กระจก แผ่นฟิวเจอร์บอร์ด หรือ ซิลิโคน เป็นต้น

( ) 4. อื่น ๆ ระบุ.....

2. สถานที่ทำงานของท่านพื้นทำจากวัสดุประเภทใด

( ) 1. ไม้ ( ) 2. ปูนซีเมนต์

( ) 3. พรม ( ) 4. อื่น ๆ ระบุ.....

3. สถานที่ทำงานของท่านผนังห้องส่วนใหญ่ทำจากวัสดุประเภทใด

( ) 1. ไม้ ( ) 2. ปูนซีเมนต์

( ) 3. กระจก ( ) 4. อื่น ๆ ระบุ.....

4. สถานที่ทำงานของท่านมีระบบการระบายอากาศ เป็นแบบใด

( ) 1. พัดลม ( ) 2. เครื่องปรับอากาศ

( ) 3. เปิดหน้าต่างหรือประตูเท่านั้น ( ) 4. อื่น ๆ ระบุ.....

5. สถานที่ทำงานของท่านมีกำหนดการทำงานสะอาดพื้นเป็นแบบใด

( ) 1. ไม่เคยทำความสะอาด ( ) 2. ทำความสะอาดทุกวัน

( ) 3. ทำความสะอาดอาทิตย์ละครั้ง ( ) 4. ทำความสะอาด 2-3 ครั้งต่อสัปดาห์

6. สถานที่ทำงานของท่านมีกำหนดการทำงานสะอาดเครื่องปรับอากาศเป็นแบบใด

( ) 1. ไม่เคยทำความสะอาด ( ) 2. ทำความสะอาดทุกวัน

( ) 3. ทำความสะอาดเดือนละครั้ง ( ) 4. อื่น ๆ ……..

7. ในช่วงปีที่ผ่านมา สถานที่ทำงานของท่านมีการปรับปรุงสถานที่ทำงานใดบ้าง (สามารถตอบได้มากกว่า 1 ข้อ)

( ) 1.ไม่มีการปรับปรุงใด ๆ ( ) 2. ปูพื้นห้องใหม่

( ) 3. ติดวอลเปเปอร์ ( ) 4. ใช้วัสดุตกแต่งเพื่อความสวยงาน

( ) 5. ขัดพื้น ( ) 6. ทาสีผนัง เพดาน

( ) 6. อื่น ๆ ระบุ.....

8. ความสูงจากพื้นห้องถึงเพดานห้องที่ท่านทำงานโดยประมาณเท่าไร ระบุเมตร.....

กรณีที่ทำทำงานในห้องสมุด กรุณาตอบคำถามตามข้อต่อไปนี้ (ข้อ 9 – 10) กรณีไม่ใช่กรุณาข้ามไปส่วนที่ 3

9. สถานที่ทำงานของท่านมีกำหนดการทำงานสะอาดชั้นวางหนังสือเป็นแบบใด

( ) 1. ไม่เคยทำความสะอาด ( ) 2. ทำความสะอาดทุกวัน

( ) 3. ทำความสะอาดอาทิตย์ละครั้ง ( ) 4. ทำความสะอาด 2-3 ครั้งต่อสัปดาห์

10. กรณีที่สถานที่ทำงานของท่านเป็นห้องสมุด ในห้องสมุดของท่านมีจำนวนหนังสือ เอกสารหรือสิ่งพิมพ์ในปริมาณเท่าไร

( ) 1. 5,000 – 10,000 เล่ม ( ) 2. 10,001 – 15,000 เล่ม

( ) 3. 15,001 – 20,000 เล่ม ( ) 3. มากกว่า 20,000 เล่ม

ส่วนที่ 3 : อาการโรคระบบทางเดินหายใจและภูมิแพ้

1.อาการโรคระบบทางเดินหายใจ) Respiratory symptoms)

อาการไอ:ไม่เกี่ยวข้องกับอาการที่เกิดจากไข้หวัด

1.1 โดยปกติท่านมีอาการไอในตอนเช้า ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

1.2 ท่านมีอาการไอเกิดขึ้นเกือบทั้งวันตลอดระยะเวลามากกว่า 3 เดือนต่อปีใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

1.3 ท่านมีอาการไอ ในลักษณะเช่นนี้มานานเท่าไร

( )1. ไม่มีอาการไอ ( )2. มีอาการไอน้อยกว่าหนึ่งปี

( )3. มีอาการไอ 1- 2 ปี ( )4. มีอาการไอมากกว่า 2 ปี

อาการเสมหะในช่องอก: ไม่เกี่ยวข้องกับอาการที่เกิดจากไข้หวัด

1.4 ท่านมีเสมหะในช่องอกเป็นประจำทุกเช้าใช่หรือไม่ (ไม่รวมเสมหะที่มีจากจมูกและช่องคอ)

( )1. ไม่ใช่) (2. ใช่

1.5 ท่านมีเสมหะในช่องอก เกิดขึ้นเกือบทั้งวันตลอดระยะเวลามากกว่า 3 เดือนต่อปีใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

1.6 ท่านมีเสมหะในช่องอก ในลักษณะเช่นนี้มานานเท่าไร

( )1. ไม่มีเสมหะ ( )2. มีเสมหะในช่องอกน้อยกว่าหนึ่งปี

( )3. มีเสมหะในช่องอก 1- 2 ปี ( )4.มีเสมหะในช่องอก มากกว่า 2 ปี

<u>อาการหายใจมีเสียงหวีด: ไม่เกี่ยวข้องกับอาการที่เกิดจากไข้หวัด</u>

1.7โดยปกติท่านมีอาการหายใจมีเสียงหวีดเมื่ออากาศหนาวใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

1.8 ท่านมีอาการหายใจมีเสียงหวีดตลอดเวลาทั้งกลางวันและกลางคืนใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

1.9 ท่านมีอาการหายใจมีเสียงหวีด จนก่อให้เกิดอาการหอบตามมา ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

<u>อาการหอบ: ไม่เกี่ยวข้องกับอาการที่เกิดจากไข้หวัด</u>

1.10 ท่านมีอาการหอบง่าย เมื่อเดินเร็วหรือเดินขึ้นเนินเล็ก ๆ ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

111. ท่านมีอาการหอบทุกครั้ง และต้องหยุดพักหายใจขณะเดินบนพื้นระนาบ เทียบกับบุคคลที่อายุและขนาดตัวเท่ากันใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

1.12 ท่านหายใจได้เป็นปกติ แม้ในช่วงเวลาที่มีอาการหอบเกิดขึ้น ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2. อาการภูมิแพ้)Allergic symptoms(

ในช่วงระยะเวลา 3 เดือนที่ผ่านมา<u>ในระหว่างทำงาน</u> ท่านมีอาการเกี่ยวกับภูมิแพ้เหล่านี้หรือไม่

2.1 ท่านมีอาการผื่นขึ้นบริเวณผิวหนัง ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.2 ท่านมีอาการน้ำตาไหล ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.3 ท่านมีอาการตาแฉะมีขี้ตา ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.4 ท่านมีอาการระคายเคืองตา ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.5 ท่านมีอาการแสบตาหรือเจ็บตา ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.6 ท่านมีอาการน้ำมูกไหล ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.7 ท่านมีอาการผิวหนังแดง ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.8 ท่านมีอาการขอบตาดำคล้ำแบบภูมิแพ้ ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

2.9 ท่านมีอาการปวดศีรษะ ใช่หรือไม่

( )1. ไม่ใช่) (2. ใช่

.....

ขอบคุณที่ให้ความร่วมมือตอบแบบสอบถาม

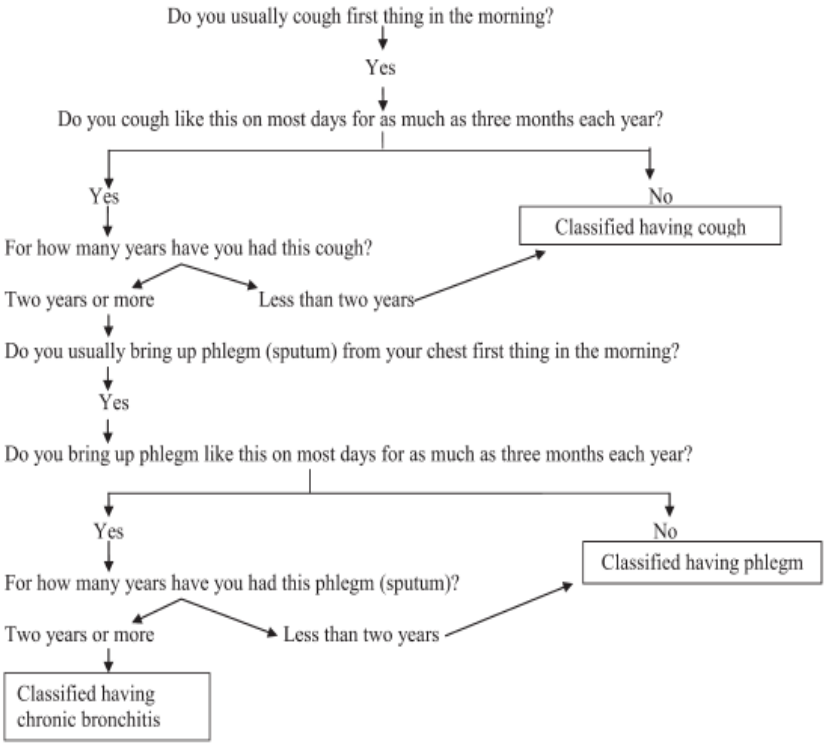
วิทยาลัยวิทยาศาสตร์สาธารณสุข

จุฬาลงกรณ์มหาวิทยาลัย

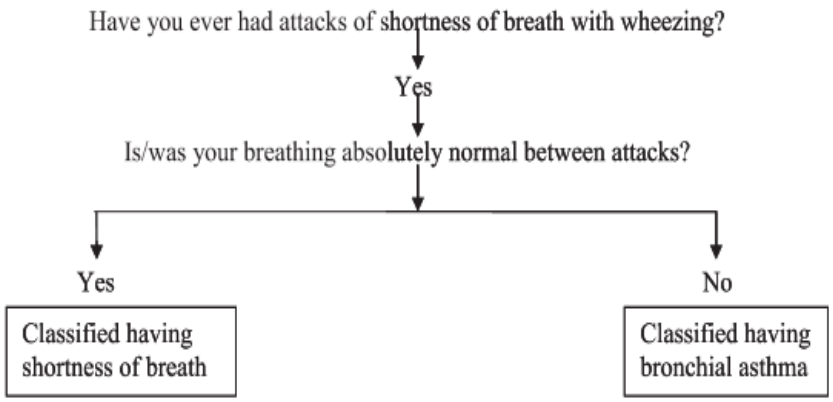
APPENDIX B

Respiratory symptoms classification

1. Cough and Phlegm



2. Shortness of breath



Resource: modified from study of Hafiz Omer AHMED and Abdelridha A. ABDULLAH title: **"Dust Exposure and Respiratory Symptoms among Cement Factory Workers in the United Arab Emirates"**

APPENDIX C

Sample population

1. List of library of Chulalongkorn University

No.	List of library of Chulalongkorn University	No. of officers
1	Library, College of Public Health Sciences	2
2	Center of Academic Resources	101
3	Faculty of Architecture Library	3
4	Humanities Information Center (Faculty of Arts Library)	13
5	Faculty of Commerce & Accountancy Library	7
6	Institute of Asia Studies Library	1
7	Audio Visual Center	1
8	Faculty of Communication Arts Library	2
9	Faculty of Dentistry Library	7
10	Dhrama Centre Library	1
11	Faculty of Education Library	13
12	Energy Research Institute Library	1
13	Faculty of Engineering Library	8
14	Environmental Research Institute Library	2
15	Faculty of Fine & Applied Arts Library	2
16	National Center of Excellence for Environmental and Hazardous Waste Management Library	1
17	International information center	3
18	Institute of Security and International Studies	1
19	Language Institute library	2
20	Faculty of Law library	10

No.	List of library of Chulalongkorn University	No. of officers
21	Faculty of Medicine Library	25
22	Memorial Center Chakrabongse	1
23	Transportation Institute	1
24	Metallurgy and Materials Science Research Institute Library	1
25	Health science library	1
26	Petroleum & Petrochemical College Library	3
27	Faculty of Phamaceutical Science Library	3
28	Faculty of Political Science Library	12
29	Population Information Center, College of Population Studies	2
30	Prajadhipok-Rambhai Barni Library (SASIN)	5
31	Faculty of Science Library	7
32	Social Research Institute Library	1
33	Scientific & Technological Research Equipment Centre Library	1
34	Institute of Thai Studies Library	1
35	Thailand information center	6
36	The Veterinary Library & Information Center	6
	total	257

2. List of general office where there are not exposed to particulate matter from books and papers work.

No.	List of control office	No. of officers
1	Chulalongkorn University Health Service Center (Service officer)	21
2	Chulalongkorn University Sport Center (Training officer, Control and care officer)	37
3	Chulalongkorn University Broadcasting Station (IT officer, picture and sound control, Disc jockey)	30
4	Scientific and Technological Research Equipment Center (Equipment laboratory)	12
	Total	100

APPENDIX D

Sample size

1. List of libraries group

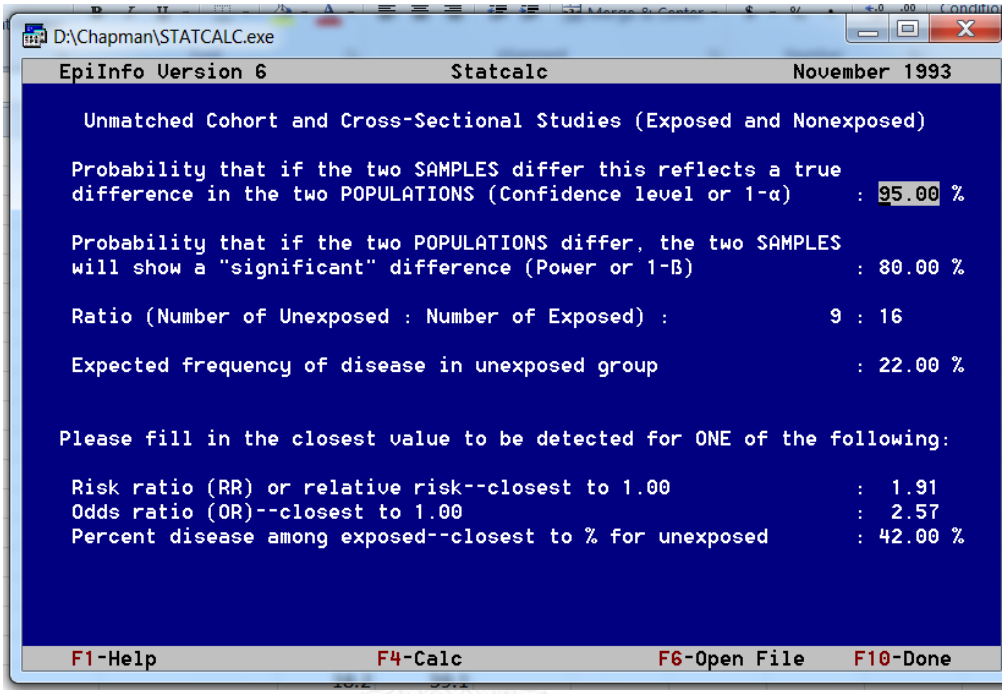
No.	List of library of Chulalongkorn University	No. of officers	Sample size	PM_{10} sample size to measurement
1	Center of Academic Resources	101	76	38
2	Faculty of Arts Library	13	10	5
3	Faculty of Education Library	13	10	5
4	Faculty of Law library	10	8	4
5	Faculty of Medicine Library	25	19	9
6	Faculty of Political Science Library	12	9	5
	Total	174	132	66

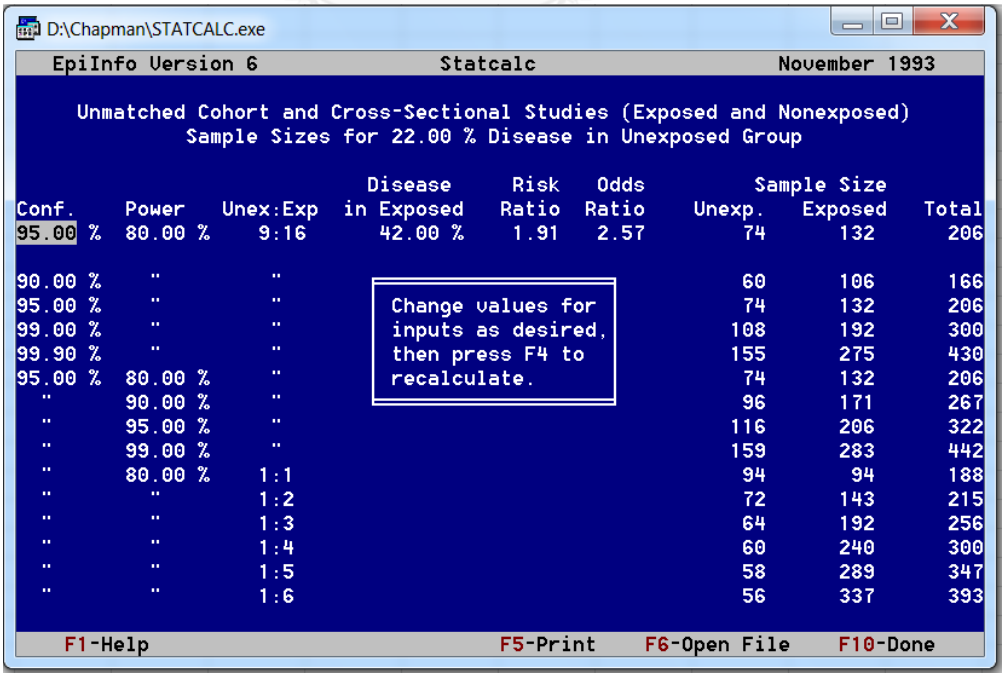
2. List of administrative offices group.

No.	List of control office	No. of officers	Sample size	PM_{10} sample size to measurement
1	Chulalongkorn University Health Service Center (Service officer)	21	16	8
2	Chulalongkorn University Sport Center (Training officer, Control and care)	37	27	13
3	Chulalongkorn University Broadcasting Station (IT officer, picture and sound control, DJ)	30	22	11
4	Scientific and Technological Research Equipment Center (Equipment laboratory)	12	9	5
	Total	100	74	37

APPENDIX E

Sample Size Calculation





APPENDIX F

Administration and Time schedule

Research Project Activities	Period of study								
	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015
1. Determine the topic of study			→						
2. Literature review and data investigation			→	→	→				
3. Write the proposal and tools	←	→	→						
4. Submission of proposal			↔	↔					
5. Proposal examination				↔					
6. Proposal revision				↔	↔				
7. Submission to ethical committee					↔				
8. Tools validity and reliability test					↔				
9. Document permit to study in any library					↔				
10. Data					↔	→			

Research Project Activities	**Period of study**								
	Nov 2014	**Dec 2014**	**Jan 2015**	**Feb 2015**	**Mar 2015**	**Apr 2015**	**May 2015**	**Jun 2015**	**Jul 2015**
collection									
11. Data analysis/ data interpret						←	→		
12. Thesis and article writing					←		→		
13. Thesis final examination								←	→
14. Thesis/ article submission									→

APPENDIX G

Budget

No.	Activities	Price per unit (baht)	Quantity (Unit)	Total price (baht)
1	Area investigation	100 bath/day/ person	5 days/2 persons	1,000
2	Photocopy and Questionnaire	20	200 copy	4,000
3	Data collection -Charge of interviewer -Souvenir for participants -Equipment renting (Used 5 equipment per day) -Laboratory analysis	 300 baht/day/person 30 800 baht/days/ equipment 200 baht/filter	 2 person/30 days 200 persons 5 equipment / 30 days 150 filters	 18,000 6,000 75,000 30,000
4	TPEF Filter (particles filter)	3,500 baht/box/100 pieces	2 boxes/200 pieces	7,000
5	Published cost	9,000	1 report	9,000
Total				**150,000**

VITA

Mr. Pathai Chullasuk was born on the 21 January, 1978, in Lopburi Province, Thailand. He received a Bachelor of Science and Technology in Health science in 1998 from Thammasat University, Thailand. After graduated she worked at Environmental Sanitation Division, Bangkok Metropolitan Administration, 2000. In 2008 he started to work at Bureau of Environmental health, Department of Health, Ministry of Public Health. He continued his study for a Master of Public Health in Occupational and Environmental Health, Chulalongkorn University, Thailand in 2014 and completed the program in 2015.