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RESPIRABLE PARTICLES (PM_{10}) AND ITS ASSOCIATION WITH RESPIRATORY HEALTH OF PRIMARY SCHOOL CHILDREN IN TANJUNG KARANG, SELANGOR

NURUL AIDA BINTI MUHAMAD

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BY

NURUL AIDA BINTI MUHAMAD

Thesis submitted in fulfillment of the requirement for the degree of Bachelor Science (Environmental and Occupational Health) from the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

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ABSTRACT

Introduction: A cross sectional comparative study was carried out on children from a school less than 1km from paddy fields at Tanjung Karang, Selangor Darul Ehsan. **Objective:** The objective of this study was to find the association between respirable particulates (PM_{10}) air concentration and the children respiratory health. **Material and Method:** Seventy seven children from the school located near to paddy fields and exposed to PM_{10} concentration were randomly selected from the class name list as exposed group while 72 children from the school located further away were also selected randomly as a comparison in this study. Questionnaires were given to the parents to obtain the background information on their children and respiratory history. Children's lung functions were measured by Chest Graph Spirometer and the individual PM_{10} levels were measured by Gillian personal air sampler. **Result:** The individual PM_{10} levels showed a significantly higher (64.71 $\mu g/m^3$) in the exposed group than the comparative group (43.14 $\mu g/m^3$) ($p<0.001$). The findings also showed the lung functions; FVC% predicted ($p<0.001$) and FEV_1% predicted ($p<0.001$) in the exposed group were significantly lower than the comparative group. The prevalence of abnormal FVC% predicted among exposed group was 66.8% and the comparative group was 31.2%. The prevalence of abnormal FEV_1% predicted among exposed group was 66.8% and 33.3% for comparative group. There was an inverse correlation between the children's lung function; FVC% predicted ($p<0.001$) and FEV_1% predicted ($p=0.001$) with PM_{10} concentration. Respiratory symptoms such as cough ($p=0.005$), phlegm ($p=0.016$) and wheezing ($p<0.001$) were significantly higher in the exposed group than the comparative group. There were significant relationships between PM_{10} level with cough ($p=0.025$) and wheezing ($p<0.001$).**Conclusion:** From the results, PM_{10} significantly influenced the exposed children's respiratory health in term of the abnormality of lung functions as well as increment of the reported respiratory symptoms.

Keyword: Lung Function, Respirable Particles (PM_{10}), Respiratory Symptoms

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PENDEDAHAN KEPADA PARTIKEL TERNAFAS (PM_{10}) DAN HUBUNGANNYA DENGAN KESIHATAN RESPIRATORI DI KALANGAN KANAK-KANAK SEKOLAH RENDAH DI TANJUNG KARANG, SELANGOR

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ABSTRAK

Pendahuluan: Satu kajian keratan rentas perbandingan telah dijalankan ke atas kanak-kanak yang bersekolah kurang daripada 1 km dari kawasan sawah padi di Tanjung Karang, Selangor Darul Ehsan. **Objektif:** Objektif kajian ini ialah untuk mengkaji hubungan antara kepekatan PM_{10} dengan kesihatan respiratori kanak-kanak tersebut. **Bahan dan Kaedah:** Seramai 77 orang kanak-kanak yang bersekolah berhampiran dengan kawasan sawah padi dan terdedah dengan debu ternafas (PM_{10}) telah dipilih, manakala 72 orang kanak-kanakyang bersekolah jauh dari kawasan sawah padi telah dipilih sebagai perbandingan dalam kajian ini. Borang kaji selidik telah digunakan untuk mendapatkan maklumat latar belakang dan sejarah respiratori dari ibu bapa kanak-kanak terlibat. Fungsi paru-paru kanak-kanak pula diukur menggunakan 'Chest Graph Spirometer' dan kepekatan PM_{10} telah diukur menggunakan 'Gillian personal air sampler'. **Keputusan:** Kepekatan PM_{10} individual dari kawasn terdedah adalah lebih tinggi (64.71 $\mu g/m^3$) berbanding dengan individu dari kawasan perbandingan (43.14 $\mu g/m^3$). Perbezaan kepekatan PM_{10} di antara dua kawasan tersebut adalah signifikan ($p<0.001$). Hasil ujian paru-paru menunjukkan perbezaan yang signifikan di antara fungsi paru-paru kumpulan terdedah dengan kumpulan pernbandingan dari segi FVC% jangkaan ($p<0.001$) dan FEV_1% jangkaan ($p<0.001$). Prevalens kejejasan paru-paru FVC% jangkaan kumpulan terdedah ialah 66.8% dan kumpulan perbandingan ialah 31.2%. Prevalens kejejasan paru-paru FEV_1% jangkaan kumpulan terdedah ialah 66.7% manakala 33.3% untuk kumpulan perbandingan. Terdapat korelasi songsang antara fungsi paru-paru kanak-kanak; FVC% jangkaan ($p<0.001$) dan FEV1% jangkaan ($p=0.001$) dengan kepekatan PM_{10}. Simptom respiratori seperti batuk ($p=0.005$), kahak ($p=0.016$) dan semput ($p<0.001$) adalah lebih tinggi dalam kumpulan terdedah daripada kumpulan perbandingan. Terdapat hubungan yang signifikan antara kepekatan PM_{10} dengan batuk ($p=0.025$) dan semput ($p<0.001$). **Kesimpulan:** Kajian ini menunjukkan PM_{10} mempengaruhi secara signifikan kesihatan respiratori kumpulan terdedah dari segi kejejasan fungsi paru-paru serta pertambahan simptom respiratori.

Kata Kunci: Fungsi paru-paru, partikel ternafas (PM_{10}), simptom respiratori

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LIST OF ABBREVIATION

$\mu g/m^3$	Microgram per meter cubic
ATS	American Thoracic Society
EPA	Environmental Protection Agency
FEV_1	Forced Expiration Volume in 1 second
FVC	Force Vital Capacity
NAAQS	National Ambient Air Quality Standard
PM_{10}	Particulate Matter with a diameter of 10 micrometers or less
SPSS	Statistical Package for Social Science
WHO	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Air pollution is a contamination of indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulfur dioxide. Particulate matter includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Outdoor and indoor air pollution is major environmental risk to health (WHO, 2012).

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Air pollution is a well-known environmental determinant of health, especially among sub-urban populations. This association is probably due to growing industrialization and an increase in the use of motor vehicles. The effects of this process have been shown not only in developed countries but also in small and large cities in the developing world (Villamizar *et al*., 2012).

The common belief is that rural areas are free from air pollution. On the contrary air quality in the rural areas all over the world and particularly in the developing countries may be more polluted than some of the urban areas (Kirkhorn *et al*., 2000). In Malaysia, agriculture is a very diverse industry that includes multiple occupational and environmental exposures and widely varying work practices. Changes in the size of agricultural operations and incursion of nonfarm families who make their homes in the rural setting have also broadened and increased the opportunity for significant respiratory exposure-related health effects in the rural community (Majra, 2011).

Particulate matter suspended in the ambient air is a heterogeneous mixture of inorganic and organic substances, whose composition can vary depending on the source, season, and meteorological conditions (Pavilonis, 2012). One of the major difference between particulate matter in rural compared to sub-urban is agricultural air is assumed to have a larger fraction of organic dust, a mixture of plant and animal matter,

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microorganisms, and bioaerosols (Pavilonis, 2012). Exposure to organic dust can cause a variety of acute or chronic conditions depending on the concentration, duration of exposure and the susceptibility of individual (Pavilonis, 2012). Long-term exposure can cause decreased lung function as well as chronic bronchitis, asthma-like syndrome, and wheezing (Pavilonis, 2012).

Through a study conducted by the Arizona Department of Environmental Quality (ADEQ) in 1995, agricultural activities were identified as a source that contributes to the production of particulate matter (PM). PM10 is particulate matter that is 10 micrometers or less in diameter (0.0004 inches or one-seventh the width of a human hair). These particles are very small and can invade the natural defence mechanism of the human respiratory tract, penetrating deep into the lungs. Consequently, PM10 can cause a wide variety of harmful health effects, especially for children, the elderly, and people with pre-existing respiratory or cardiovascular disease. The health-based national air quality standards by EPA for PM10 are $50 \mu g/m^3$ measured as an annual mean and $150 \mu g/m^3$ measures as a daily concentration.

Accordingly, indoor air quality at schools has attracted increasing public attention in recent years because children spent most of their time at school (Sofia *et. al.*, 2012). Study done by Environment Protection Agency (EPA) found that levels of indoor

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air pollutants can be up to 2 to 5 times from ambient air and found that most people including children spend a total of 90% of their time in the house or building (EPA, 2010).

In fact, children represent the largest subgroup of the population susceptible to the effects of air pollution (NRDC, 2012). Over the last ten years, a considerable number of scientific studies have reported adverse health effects associated with air pollution. The effects have ranged from respiratory symptoms and illness, impaired lung function, hospitalization for respiratory and cardiac disease to increases in mortality (NRDC, 2012).

According to National Resource Defense Council (NRDC), children breathe a greater volume of air than adults due to their greater respiratory rates. As a result, children inhale more pollutants per pound of body weight. They also spend more time engaged in vigorous activity than adults. In addition, because of young children's height and play habits they are more likely to be exposed to pollutants that are heavier than air and tend to concentrate in their breathing zone near ground levels. Children's physiological vulnerability to air pollution arises from their narrower airways and the fact that their lungs are still developing. Irritation caused by air pollutants that would produce only a slight response in an adult can result in potentially significant obstruction in the airways of a young child.

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1.2 Problem Statement

Tanjung Karang is located in the district of Kuala Selangor about 15 kilometers away from the town of Kuala Selangor. Malays live in rural areas and performed agricultural activities, particularly rice cultivation. Paddy cultivation has become the identity of the community in the Tanjung Karang vicinity. (North Kuala Selangor Agriculture Office, 2012).

Most people expect that air quality in the countryside should be better than air quality in town and cities (Enviropedia, 2012). Rural areas also suffer from outdoor air pollution as well as indoor air pollution. Major sources of outdoor air are indiscriminate use of pesticides sprays and burning paddy straw. Individuals living in rural areas are potentially exposed to a variety of pollutants including inorganic and organic particulate matter (PM), endotoxin and gasses (Pavilonis, 2012).

Agricultural activities such as soil tillage, seedbed preparation, planting, fertilizing, harvesting, compost spreading, residue burning, and herbicide use causes dust emissions and personal PM exposure (Nordstroma & Hottab, 2004). Nevertheless, the adverse effects of personal PM exposure are not limited to agricultural operators working in the field.

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In Tanjung Karang, the school and housing area are situated near to the paddy fields. Thus the school children tend to expose with the particles produced from the activities in the paddy fields. In agricultural operations, particularly in soil tillage, particulate matters can contain both mineral and organic components. PM_{10} emitted from agriculture field operations such as disking, listing, levelsing, planting and harvesting was first dispersed downwind in the near-field in high concentration plumes and then dispersed in lower concentrations further downwind in the far-field for more than 1 kilometer (Wang *et al.*, 2010).

This study mainly focuses more on the effect of lung function and respiratory symptoms of primary school children from the school located near to the paddy fields exposed to respirable particles (PM_{10}). The concentration and the composition of the particulate matter in the indoor environment have been associated with reported respiratory symptoms in children. Particulate matter in the indoor air may arise from both outdoor and indoor sources. For example, the indoor air pollution sources in the classroom at the school are mainly from the usage of the chalk on the blackboard during the learning session. While, environmental tobacco smoke and usage of mosquito coil are the main the sources of indoor air pollutions the house.

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According to Environmental Protection Agency (EPA) major concerns for human health from exposure to PM_{10} include effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. Health effects from the exposure to indoor air pollutants may be experienced soon after exposure or possibly years later. Immediate effects may become evident after a single or repeated exposure. These include irritation of eyes, headache, dizziness and fatigue. Such immediate effects are usually treatable. Besides that, symptoms of diseases include asthma and hypersensitivity pneumonitis may also appear soon after exposed to indoor air pollutants (EPA, 2006).

The children are especially sensitive to the effects of particulate matter and have the respiratory symptoms include reduce in lung function. This is because they have smaller stature and their breathing zone is lower so they inhale air loaded with more particles. Diameters of their airways are smaller and therefore likely to be affected by inflammation produced by air pollution. Moreover, their lungs are still developing and hence are more vulnerable to airborne insults. The efficiency of detoxification system of the body develops in time-dependent pattern. Plus, their immune defence is immature and less active against inhale pollutants (Mauskar, 2008).

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1.3 Study Justification

Malaysia is a major rice growing country and Tanjung Karang is one of the largest paddy producers after Kedah (Fuad *et al.*, 2012). Respirable particles (PM_{10}) are derived primarily from suspension or re-suspension of dust, soil and include rice straw and other plant parts. Since the schools are located near to the paddy fields, there is a possibility for the school children exposed to respirable particles (PM_{10}).

One of the aims of this study is to measure the PM_{10} levels among the primary school children near to paddy fields and determine its association with the respiratory health. The finding of this study will help the government to be more concern towards the health of the children in the agriculture area by set the standards for safe PM_{10} exposure levels from the agriculture activities nearby.

Thus, it is good opportunity to prevent the problems from getting serious and simultaneously avoid negative impact on the children's development in term of health and well beings. Besides, the appropriate control measures should be taken in order to minimize the exposure of PM_{10} among the school children from the school located near to paddy fields and also to the community nearby.

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Children are precious in their own right and they are the future of the nation. Parents should become more concern about the health effects of the exposure to PM_{10} towards their children's implication of health. This is due to some of previous studies have found significant associations between concentrations of PM_{10} and decrements in pulmonary function test (PFT) values for in children with and without asthma (Kim *et al.*, 2005). From this study, the baseline data and reference can be created for future researchers to study the indoor-outdoor air quality and health implications of respiratory symptoms in the children.

1.4 Conceptual Framework

Figure 1.1 shows the conceptual framework for this study. The aim of this study was to determine the association between respirable particles (PM_{10}) exposure and respiratory health among the primary school children in Tanjung Karang, Selangor.

Basically, this study focused on exposed group from the primary school children from the school located near paddy fields. Since the paddy cultivation is one of the agriculture activities, it sometimes will produce some disadvantages towards the air, soil and also the water. From the paddy field activities, it may pollute the soil with the using of pesticides to control the pest in the crops. Besides, the water pollution can be one of

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the results of agriculture activities. Last but not least, agricultural activities such as soil tillage, seedbed preparation, planting, fertilizing, harvesting, compost spreading, residue burning, and herbicide use causes dust emissions and personal PM exposure. (Nordstroma & Hottab, 2004). In this study, the researcher will focus only the air pollution source which is respirable particles (PM_{10}).

The lung function of primary school children was tested by using the spirometer. The parameters measured are FVC, FEV_1, FEV_1/FVC. Besides, the respiratory symptoms can be identified by using the modified Questionnaires from American Thoracic Society (ATS), 1978.

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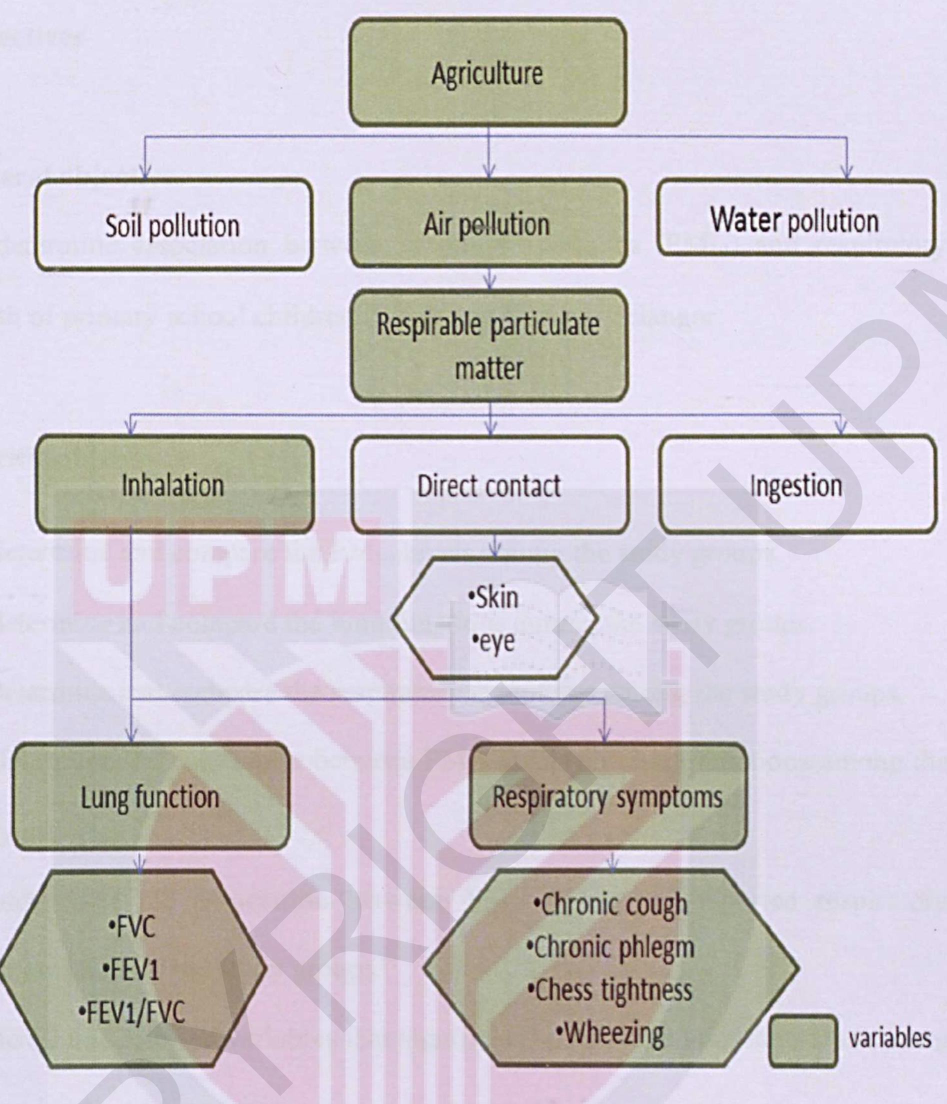

Figure 1.1: Conceptual framework for this study

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1.5 Objectives

1.5.1 General objective

i. To determine association between respirable particles (PM_{10}) and respiratory health of primary school children in Tanjung Karang, Selangor.

1.5.2 Specific objectives

i. To determine and compare the PM_{10} levels among the study groups.

ii. To determine and compare the lung functions among the study groups.

iii. To determine and compare the respiratory symptoms among the study groups.

iv. To determine the correlation between PM_{10} levels and lung functions among the study groups.

v. To determine the association between PM_{10} levels and reported respiratory symptoms among the study groups.

vi. To determine selected variables that significantly influence lung functions among the study groups.

vii. To determine selected variables that significantly influences the reported respiratory symptoms among the study groups.

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1.6 Hypothesis

i. The PM_{10} level among the exposed group is significantly higher than the comparative group.
ii. The lung functions among the exposed group are significantly lower than the comparative group.
iii. The reported respiratory symptoms among the exposed group are significantly higher than the comparative group.
iv. There are significant correlations between PM_{10} level and lung function among the study groups.
v. There are significant associations between PM_{10} levels and reported respiratory symptoms among study groups
vi. PM_{10} levels and mosquito coil use significantly influenced lung functions among the study groups.
vii. PM_{10} levels and family history of asthma significantly influenced reported respiratory symptoms among the study groups.

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1.7 Definition of Term

1.7.1 Conceptual

i. Respirable Particles (PM_{10})

Particles with an aerodynamic diameter smaller than 10µm defined as Respirable Particles (PM_{10}) and the particles can travel deeps into lungs. The lifetime of PM_{10} is from minutes to hours, and its travel distance varies from less than 1km to 10 km (EPA, 1997).

ii. Lung function

Lung function is the ability of the lung to take up air and this amount is compared with other people with same age, height, and sex. It also the function on how much air can blow out from lungs and how fast the individual can do it.

iii. FVC

FVC is the volume delivered during an expiration made as forcefully and completely as possible starting from full inspiration, expressed in litres at BTPS (ATS, 2005).

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iv. FEV_1

FEV_1 is the maximal volume exhaled by time 1 seconds of a forced expiration from a position of full inspiration, expressed in litres at BTPS (ATS, 2005).

v. Respiratory symptoms

Respiratory symptoms can be defined as condition that resulted from a distributed respiratory system by various factors either internal or external factors. The examples of respiratory symptoms are cough, phlegm, wheezing and chest tightness.

vi. Chronic Cough

Have previous symptoms on most days for 3 consecutive months or more during the year (ATS, 1978).

vii. Chronic Phlegm

Having phlegm for at least 4 days in one week for 3 consecutive months during the year (ATS, 1978)

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viii. Wheezing

Wheezing is a high-pitched whistling sound during breathing. The sound of wheezing is most obvious when breathing out but may be heard when taking a breath. Having wheezing associated with breathlessness on most days and nights (ATS, 1978)

ix. Chest tightness

A combination of cough or phlegm or increase of cough and phlegm in cases where the respondents cough or having phlegm continuously (ATS, 1978)

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1.7.2 Operational

i. Respirable Particles (PM_{10})

The PM_{10} levels is measured by personal air sampling pump for 5 hours during school session. The instrument is attached to respondent's breathing zone. The filter paper calculated based on the gravimetric principles in μg/m^3.

ii. Lung Function

The spirometer records the amount and the rate of air that breathe in and out over a period of time. Forced expiratory volume in 1 s (FEV_1) and forced vital capacity (FVC) were measured.

iii. FVC

Force Vital Capacity (FVC) is the maximal volume of air exhaled with maximally forced effort from a position of maximal inspiration and it was measured using Chest Graph Spirometer Model and expressed in litres (ATS, 1978).

Expected value of FVC% = FVC (spirometer) / FVC (FVC expected value) x 100

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iv. **FEV_1**

FEV_1 is measured for the volume of air exhaled during the 1 second with Chest Graph Spirometer Model and expressed in litres (ATS, 1978)

Expected value of $FEV_1\%$ = FEV_1 (spirometer) / FEV_1 (FEV_1 expected value) x 100

v. **Respiratory symptoms**

Occurrence and intensity of respiratory symptoms is evaluated using modified questionnaire which developed from American Thoracic Society (ATS-DLD-78-Children Questionnaire). Symptoms evaluated are cough, phlegm, wheezing and chest tightness.

vi. **Chronic Cough**

Chronic cough is determined from the study questionnaire modified from ATS (1978).

vii. **Chronic Phlegm**

Chronic Phlegm is determined from the study questionnaire modified from American Thoracic Society (ATS, 1978).

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viii. Wheezing

Wheezing is determined from the study questionnaire modified from American Thoracic Society (ATS, 1978).

ix. Chest tightness

Chest tightness is determine from the study questionnaire modified from American Thoracic Society (ATS, 1978)

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CHAPTER 2

LITERATURE REVIEW

2.1 Particulate Matter (PM_{10})

In Malaysia, PM_{10} is one of the major air pollutants and is decisive in the computation of Malaysian Air Pollution Index (MAPI). PM_{10} are particles with an aerodynamic diameter smaller than 10 μm. Ten micrometers are about one-seventh the diameter of a human hair. These particles are respirable and 80% or more will deposit somewhere in the respiratory system.These particles can be formed by evaporation of sprays and suspension of dust. Major sources include fugitive dust from roads, industry, wind-blown dust from geological material such as agriculture and fly ash from fossil fuel combustion. The lifetime of PM_{10} is from minutes to hours, and its travel distance varies from <1km to 10 km (Juneng *et al*., 2011).

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According to Environmental Protection Agency (EPA) 2010, there are several ranges of particle sizes of concerns for air emission evaluation. Particulate matter represents broad class of chemically and physically diverse substances. Particles can be described by size, formation mechanism, origin, chemical composition, atmospheric behavior and method of measurement. The concentration of particles in the air varies across space and time, and it is related to the source of the particles and the transformations that occur in the atmosphere. EPA has defined four terms of categorizing particles of different sizes. Table 2.1 shows the EPA terminology for particles sizes.

Table 2.1: EPA terminology for particle sizes

EPA description	Particle sizes
PM_{10} Super coarse	>10μm
$PM_{10-2.5}$ (Coarse)	2.5 μm – 10 μm
$PM_{2.5}$ Fine	0.1 μm – 2.5 μm
Ultrafine	<0.1 μm

Source: EPA, 2010

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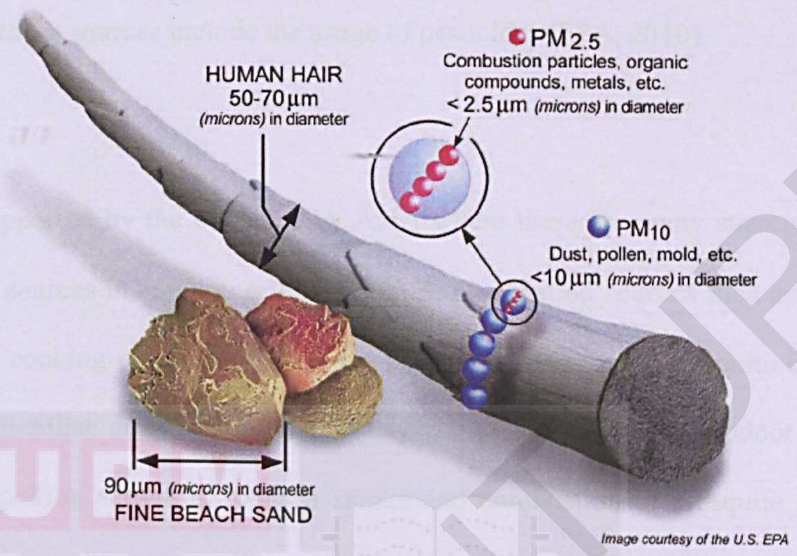

Figure 2.1: Particulate matter size (Source: EPA, 2010)

2.2 Indoor Air Pollutant

According to Environmental Protection Agency (EPA), indoor air pollutant sources that release gases or particles into the air are the primary cause of indoor air quality problems in homes. Inadequate ventilation can increase indoor air pollutant levels by not bringing enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutant out from the house. High temperature and humidity levels can also increase concentrations of some pollutants. There are many sources of indoor air pollution in any home. These include combustion sources such as oil, gas,

tobacco products, building materials like usage of carpet and furniture made from wood products and the outdoor sources include the usage of pesticides (EPA, 2010).

This was supported by the evidence by Azizi where there are many sources of indoor air pollutant sources in any home. These include combustion sources such as oil, gas, coal, wood for cooking purpose, tobacco smoke and combustion of mosquito coil. There are several familiar activities among Malaysian that contribute to indoor air pollution such as cooking activities, tobacco smoke and combustion of mosquito coil (Azizi, 1990).

Other than that, the quality of air inside homes, offices, schools or other private and public buildings is an essential determinant of healthy life and people's well-being (WHO, 2010). The IAQ in school buildings is expected to be a key role player in the assessment of the effects of the children personal exposure to air pollution as children spend at least a third of their time inside school buildings, that is, approximately seven or more hours a day in school (Freitas *et al.*, 2007). Poor IAQ can affect scholarly performance and attendance (Freitas *et al.*, 2007).

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Indoor Air Quality problems in schools may be even more serious than in other categories of buildings, due to higher occupant density and insufficient outside air supply, aggravated by frequent poor construction and or maintenance of school buildings (Pegas *et al.*, 2010). Schools are seen as particularly likely to have environmental deficiencies because chronic shortages of funding contribute to inadequate operation and maintenance of facilities (Freitas *et al.*, 2007).

2.3 Respirable Particles (PM_{10}) and paddy fields

Agricultural activities such soil tillage, seedbed preparation, planting, fertilizing, harvesting, compost spreading, residue burning, and herbicide use cause dust emissions and personal PM exposure (Nordstroma & Hottab, 2004). When the natural soil structure is manipulated or disturbed by tillage, animals, weather, or vehicular traffic, the structure can be broken apart from larger pieces, or clods, into smaller pieces. This process significantly increases the potential for soil particles to become suspended in the air. Further manipulation of the soil increases the chance for smaller particles to become PM_{10}.

Nevertheless, the adverse effects of personal PM exposure are not limited to agricultural operators working in the field. In many countries in Asia, open burning for agricultural land clearing is commonly practiced. In particular, open burning of rice

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straw after harvesting in Southeast Asia is intensive during the dry season, which may contribute significantly to the ambient air pollution. Open burning of rice straw in the field is incomplete combustion in nature hence a large amount of pollutants are emitted, including and fine or inhalable particles (Tipayarom, 2004).

One of the major differences between PM in rural airsheds compared to urban is agricultural air is assumed to have a larger fraction of organic dust, a mixture of plant and animal matter, microorganisms, and bioaerosols (Kirkhorn & Garry, 2000). Exposure to organic dust can cause a variety of acute or chronic conditions depending on the concentration, duration of exposure, and the individual. Long-term exposure can cause decreased lung function as well as chronic bronchitis, asthma-like syndrome, and wheezing (Schenker, 1998).

Adverse health effects have also been linked to populations environmentally exposed to organic dust. Additionally, Schwartz (1999) concluded that environmental exposure to organic dust among rural populations is one of the most important exposures in the progression of childhood asthma.

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According to study by Hiroyuki (2004), in the process of drying the rice during the harvesting season, a large amount of dust is released into the air. Rice husk dust can be absorbed through the skin or swallowed but most frequently inhaled irritating the portal of entry and leading to various obstructive lung diseases (Sukhjinder *et al.*, 2011).

2.4 Respirable Particles (PM_{10}) and Respiratory Health (lung function and respiratory symptoms)

The air contains many small particles that are invisible to the human eye. Once inhaled, the particles can travel deep into the lungs, enter the bloodstream, and penetrate into cells. Smaller particles can penetrate deepest, causing the greatest harm. Health effects can result from both short-term and long-term exposure to PM pollution. Exposure to particulate pollution is linked to increased frequency and severity of asthma attacks. Exposure to PM can also trigger heart attacks and cause premature death in people with pre-existing cardiac or respiratory disease.

Lungs must inhale and exhale an adequate volume of air to remove carbon dioxide and replenish oxygen to maintain health, but studies show that even brief exposure to pollutants can result in impairment of lung function. Breathing polluted air increases a person's chances for respiratory illness. Epidemiological studies show a

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significant correlation between exposure to air pollution and the frequency of respiratory symptoms ranging from cough symptoms to hospital admission (NRDC, 1997).

Lung function test is one of the tests used by health care specialist and facilities to measure the ability of the lung function by using spirometer. The World Health Organization (WHO) has assessed that the exposure to indoor air pollution has been linked to a variety of health effects, including respiratory health problems and exacerbation of childhood asthma. According to the study by Engku Aminatul (2004), indoor PM_{10} levels showed as significant inverse relationship with FVC% predicted (and FEV_1 % predicted among children in Kota Bharu, Kelantan.

In a number of studies, there have been observed an increased incidence of respiratory diseases in association with PM_{10} air pollution. For example, in a study conducted in the United Kingdom by Atkinson (1999), an association between emergency hospital admissions for respiratory and cardiovascular disease and PM_{10} was found. Another study conducted in Seattle, Washington, demonstrated association with emergency room visits for asthmatics and PM_{10} air pollution (Schwartz, 1993). According to the study done by Atkinson (1999), PM_{10} was associated with an increase in hospital admission of the elderly for COPD and asthma and lower respiratory tract infections including bronchitis and pneumonia. Other than that, persons with asthma,

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especially children are more susceptible to PM air pollution and the relationship between PM_{10} air pollution and asthma is stronger than for $PM_{2.5}$. Moreover, a series of analyses children demonstrated that respirable particles was associated with increased respiratory symptoms, including cough, wheeze and shortness of breath.

2.5 Respirable Particles (PM_{10}) and children's health.

Several recent studies have documented associations between the day to day variations of air pollution by particulate matter and acute health effects on children, including increased respiratory symptoms and decreased lung function (Nicole *et al.*, 1997). Measurements of personal exposure are considered to be a more accurate estimate of the subject's true exposure. Children's personal exposures to particles have rarely been studied (Janssen *et al.*, 1997). Children constitute a sensitive group with higher risk than adults because children are particularly vulnerable to pollutants due to their undeveloped airways (Sofia *et al.*, 2012).

Moreover, children have greater susceptibility to some environmental pollutants than adults, because they breathe higher volumes of air relative to their body weights and their tissues are actively growing (Mendell & Heath, 2005). This means that their

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respiratory rate is proportionately greater and they breathe in much more air pollution in relation to their body weight than an adult in similar circumstances. Also, their bodies are still developing and the effect of an environmental insult can interfere with that development.

Study done by Gilliland (1999) found that children generally spend more time and also more active outdoors than the adults. They are active outdoors during midday when air pollution levels tend to be higher. They also have significantly higher oxygen demands so their respiration rates are higher than adults. Other than that, because of their smaller stature, their breathing zone is lower, so they inhale air loaded with more particles. Their diameter airways are smaller and therefore more likely to be affected by inflammation produced by air pollution.

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CHAPTER 3

METHODOLOGY

3.1 Study Location

This research was conducted at Sekolah Kebangsaan Sawah Sempadan (SKSS) which is located near paddy fields (<500m) as an exposed group while Sekolah Kebangsaan Integrasi Dato' Manan located further away from paddy fields (>3km) as a comparative group. Both of this national school located in the same sub district which is in Kampung Sawah Sempadan Tanjung Karang, Selangor. Global Positioning System (GPS) coordinates this area at 3.730467° N, 101.029567° E. The paddy fields at Kampung Sawah Sempadan spans an area approximately 2,300 hectares of Tanjung Karang sub district (Fuad *et al.*, 2012)

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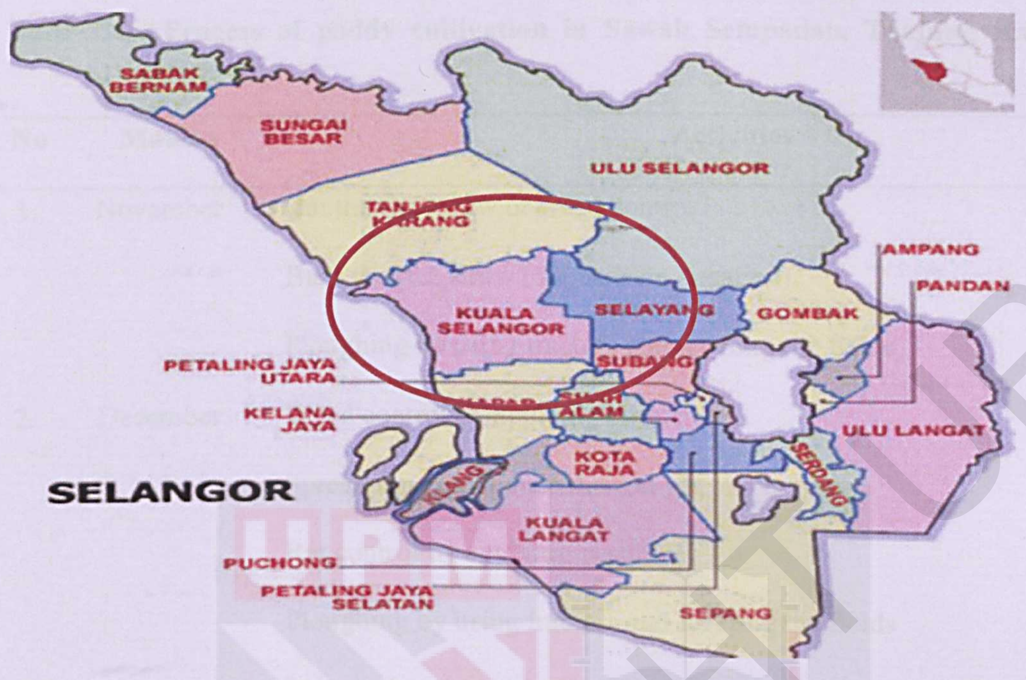

Figure 3.1: Study location in Tanjung Karang, Selangor

3.1.1 Process of Paddy Cultivation

Paddy cultivation process will be carried out twice a year which every cycle takes about 6 months to produce the product. The process in paddy fields was shown in Table 3.1 below.

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Table 3.1: Process of paddy cultivation in Sawah Sempadan, Tanjung Karang Selangor

No	Months	Activities
1.	November	Cut the rice straw or weed control
		Burn the rice straw (depends on situation)
		Ploughing by using tractors and leveling the fields
2.	December	Weed control by applying herbicide
		Spread lime to balance the soil pH
		Rat control by applying pesticides
		Ploughing by using tractors and leveling the fields
3.	January	Irrigate the paddy block
		Remove water from paddy block
		Sow the seed uniformly by using blower
		Fertilizing
4.	February and March	Fertilizing, maintaining, and pest controlling
		Many type of pesticide used in this phase: herbicide, insecticide, mollucide.
5.	April	Ripening of paddy
6.	Mei	Harvesting

(Source: North Kuala Selangor Agriculture Office, 2012)

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3.2 Study Design

This was a cross-sectional comparative design to study respirable particles (PM_{10}) and its association with the respiratory health of primary school children in Tanjung Karang, Selangor.

3.3 Sampling

3.3.1 Study Population

The exposed group was selected from the primary school children from the school located near to the paddy fields (<500m)while the comparative group, the primary school children were chosen from the school located further away from paddy fields (>3km) or non-agriculture area in Tanjung Karang, Selangor.

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3.3.2 Sample Frame

The sampling frame of this study was obtained from the name lists of primary school children from the selected school. The students from standard 2 and 3 were chosen as the study groups. They were given parents' consent form prior the study conducted. The students with the parents' permission were then selected to be involved in this study.

3.3.3 Sample Unit

For sampling unit for this study, only those primary school children fulfill the inclusion criteria were included in the study.

i. Inclusion criteria

The primary school children must be in the range of 8 to 9 years old studied at the school near the paddy fields which was in rural area for exposed group and the primary school children further away from the paddy fields or in non- agriculture area as the comparative group. School children without chronic medical history were chosen as the respondents for this study.

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3.3.4 Sampling Method

In this study, the sampling method used was the simple random sampling. This is because, the respondents were chosen after they had matched and fulfill the inclusive criteria. Respondents were chosen randomly to participate in this study after they got the permission from their parents. There are two study groups involved which are exposed and comparative group.

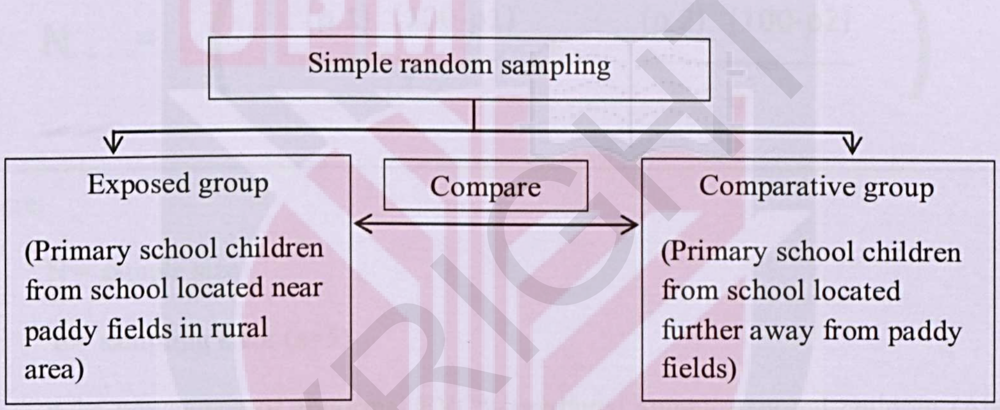

Figure 3.2: Comparison between exposed group and comparative group

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3.3.5 **Sample Size**

The sample size in this study consists of 86 primary school children from the school near paddy fields and 86 primary school children from the school located further away from paddy fields or in non-agriculture area. The sample size was calculated by using Kirwood, 1988.

$$N = \left(\frac{(p\,1)\ (100\text{-}p1)}{e^2} + \frac{(p\,2)\ (100\text{-}p2)}{e^2} \right)$$

Where:

N = sample size

e = sampling error (e=5)

p 1= prevalence of abnormal FVC% predicted among exposed children (Abdul Mujid *et al.*, 2003)

= 82.4 %

p 2= prevalence of abnormal FVC% predicted among unexposed children (Abdul Mujid *et al.*, 2003)

= 5.4 %

Therefore, the sample size for each exposed and comparative group was calculated as follow:

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$$N = \left(\frac{(82.4)\quad(100\text{-}82.4)}{5^2} + \frac{(5.4)\quad(100\text{-}5.4)}{5^2} \right)$$

$$\approx \quad 78$$

Additional by 10% to the calculation of sample size are ≈ 8

The number of respondents for exposed group was 86 primary school children near paddy fields and another 86 primary school children will be from the school located further away from the paddy fields. Thus, the total number of respondents will be selected in this study are 172 primary school children.

3.4 Instrumentation and Data Collection Techniques

3.4.1 Approval letter

Parents Consent Letter, Respondents Consent Form and Information Sheet were distributed among the listed primary school children. Prior the study conducted, consent from their legal guardian and parents was obtained and the students with the parents'

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permission were then selected to be involved in this study. The respondents were fully informed about the procedure and objectives of the study.

3.4.2 Questionnaire

The take home questionnaire was one of the tools to get information from the primary school children. The questionnaire used in this study was based on the valid question by American Thoracic Society (1978), 'Questionnaire ATS-DD-78-C WHO (1982)'. The questionnaire determines the demographic background, exposure history and reported respiratory symptoms among respondents. The questionnaire was translated into Malay version so that the parents of the respondents easily understood. The questionnaire was pre-tested to ensure the parents understand the questions. The pre-test was conducted on 10% of the total respondents to ensure the reliability and validity of the questionnaire (α=0.7).

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3.4.3 SECA Body Meter

This SECA Body meter was used to measure the height of respondents. They stand right at the wall where this equipment was set up on it. The height of respondents was recorded.

Figure 3.3: SECA Body Meter (Source: Med Shop website, 2012)

3.4.4 SECA Weighing Scale

This equipment was used to measure the weight of the respondents. The result was recorded.

Figure 3.4: SECA body weight (Source: Fitness Body Equipment Website, 2012)

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3.4.5 Lung Function Test

3.4.5.1 Spirometer

Children's lung functions were measured by Chest Graph Spirometer. It was used to measure the volume of air in the lungs and how much total air that a person can breathe out in one second. This instrument also used to determine the normality and abnormality of lung function. Three lung function parameter such as FVC, FEV_1, FEV_1/FVC were obtained from this test. Abnormality of lung function can be divided into two which are obstructive and restrictive. The indicators to determine obstructive respiratory problems are FEV_1 less than 80% or FEV_1/FVC ratio less than 75%. Meanwhile, restrictive respiratory problems are characterized by reduced total lung capacity (TLC) where Force Volume Capacity (FVC) value less than 80% of predicted value.

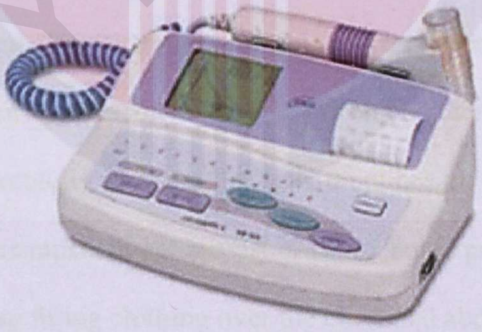

Figure 3.5: Spirometer – chest graph (Source: Spirolab website, 2012)

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3.4.5.1.1 Calibration

Spirometer was calibrated before used. Three liter (3l) of air was injected in the syringe into the spirometer. The error allowed is 3% or 50ml of air. The 3 parameter obtained from this test are Force Vital capacity (FVC) Predicted, Forced Expired Volume in 1 second (FEV_1) Predicted and FEV_1/ FVC Predicted.

3.4.5.1.2 Pre sampling

a) The spirometer was checked to ensure it is well function prior the lung function test. Then, the spirometer was calibrated and clean mouthpiece was prepared to be used by the respondents.
b) The briefing was given to all the respondents before the test conducted. The age, gender, race, height and weight were measured and recorded.
c) Explanation and demonstration on doing the proper and right techniques were performed. The respondents took a deep breath after a signal was given and exhaled forcefully and completely without hesitation for a long period.
d) The respondents must not eat heavily within 2 hours prior the test.
e) They wear loose fitting clothing over the chest and abdominal area.
f) The respondents was given the chance to practice breathing into the mouthpiece before they performs the real test for their lung function.

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3.4.5.1.3 During sampling

a) For accurate results, the FVC maneuver was performed with maximum effort and followed with the maximum inspiration. It should have a rapid start so that the spirogram and flow-volume curve be smooth continuous curve.

b) The respondents was instructed to:
   i. Seal his lips around the mouthpiece.
   ii. They should fully inhale and then immediately exhale the air with maximum effort.
   iii. These procedures were repeated for at least 3 times.

3.4.5.1.4 Post sampling

The print out result was used to interpret the result of respondent's lung function. Spirometer test interpretation process will be made by comparing the observed and expected test score to determine lung function abnormalities among the respondents. FVC and FEV_1 readings are directly aligned to the unit BTPS (Body Temperature and Pressure Saturated).

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3.4.5.2 Evaluation of Lung Function Test

The evaluation of lung function test was performed by comparing the obtained value with normal values (standards value). Based on the study conducted by Azizi (1994), predicted value was calculated from the predicted equation as shown in Table 3.2. Meanwhile, the evaluation of lung function was done based on American Thoracic Society (1991) as shown in Table 3.3.

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Table 3.2: Normal value of lung function parameters among children in Malaysia

Lung Function Test	Boy	Girl
FVC	$4.1120 \times 10^{-6} H^{2.6421}$	$6.0777 \times 10^{-7} H^{3.0112}$
FEV_1	$6.2523 \times 10^{-6} H^{2.5388}$	$5.7588 \times 10^{-7} H^{3.0067}$

H = Height
FVC = Force Vital Capacity
FEV_1 = Forced Expiratory Capacity in 1 second

Source: Azizi and Henry (1994)

Table 3.3: Evaluation of lung function

Obstructive disease	**% predicted FEV_1**
Normal	≥80
Mild	70-79
Severe	60-69
Very severe	<60
Restrictive disease	**% predicted FVC**
Normal	≥80
Mild	70-79
Severe	60-69
Very severe	<60

Source: Azizi and Henry (1994)

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3.4.6 Individual Particulate Matter (PM_{10}) Monitoring

3.4.6.1 Gillian personal air sampler

This pump was used for the monitoring of individual PM_{10} levels among the primary school children near paddy fields during their school session. The duration for the individual PM_{10} monitoring began right after they start the school session which was at 8.00 a.m and ended at 1.00 pm. Besides, the monitoring for individual PM_{10} levels was taken once only for each respondents.

Respirable particles (PM_{10}) will be collected by using Gillian Air Pump model with a flow rate at 1.7 l/min. Cyclone was used to separate large particles from the respirable particles (PM_{10}), where PM_{10} were collected on the filter paper type Cellulose Nitrate Membrane with diameter 47 mm 0.45μm air pore size. The cyclone and cassette holder were attached to the sampling pump. The PM_{10} levels was determined by using gravimetric method and calculated using the following formula.

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$$\text{Concentration PM 10 } (\mu g/m^3) = \frac{[W_2 - W_1] - [B_2 - B_1]}{\text{Flow rates (L/min) x Time (min)}} \text{ X 1000}$$

Where,

W_2 = Final Weight (mg)
W_1 = Initial Weight (mg)
B_2 = Final Blank (mg)
B_1 = Initial Blank (mg)

Source: NAM 0600

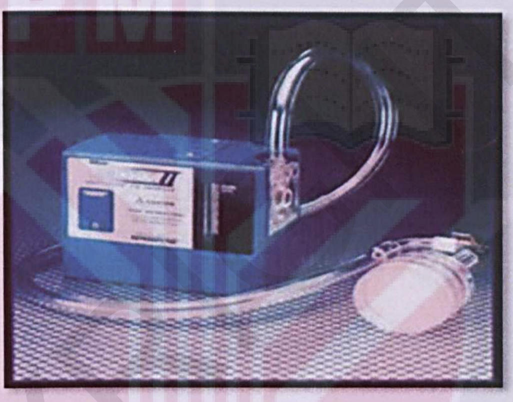

Figure 3.6: Gillian Air Sampling Pumps (Source: Gillian website, 2012)

3.4.6.2 Preparation before sampling

a) Firstly, the cassette was washed with soap detergent and rinsed thoroughly under running water. After that, the filter cassettes were soaked in 50 %

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nitric acid for 24 hours. Then, it was rinsed thoroughly by using distilled water and left it for dry.

b) Then, the filter paper was dried in the oven at 40 °C for 2 hours to remove the water vapour. Subsequently, the filter paper was cooled down in desiccator and to remove any moisture for at least one hour.

c) The filter papers were weighed with a micro-scale device that can measure up to the fifth decimal places and the readings were recorded.

d) Each filter paper was dried, weighed, and recorded the weight according to the procedure.

e) Electrostatic brush was used to eliminate electrostatic biases on the filter paper.

3.4.6.3 During sampling

a) Each personal sampling pump was calibrated to the appropriate flow rate with a representative sampler in line.

b) The sampling pump equipment was placed in the bag and carried by the primary school children with the filter cassette was attached to the shirt collar or as close as practical to their breathing zone. The inlet should always be in a downwards vertical position to avoid gross contamination.

c) Sampling time taken along the school session (5hours).

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d) The pump was turned on and the sampling time was recorded.

e) The respondents were observed from time to time to make sure the sampling equipment operates correctly.

3.4.6.4 Post sampling

a) The flow rate at the end of the sampling period was checked to ensure the rotameter ball is still at the calibrated mark. If not, the reading of position of rotameter ball was recorded.

b) Then, the pump was turn off and the time was recorded.

c) The cassette (collection device) was removed from the pump and sealed it as soon as possible. The seal should be attached across the sample inlet and outlet.

d) The final weight was recorded. The weighing procedures repeated three times.

3.5 Data Analysis

All data obtain from this study will be statistically analyze by using 'Statistical Package for Social Sciences (SPSS) software 21. The univariate and bivariate analysis will be performed. The significant levels in this study set at <0.05. Univariate analysis

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will be carried out to determine mean, range and standard deviation. While, for illustrate the respondents' background, bivariate analysis, t-test, chi-square will be used to differentiate and correlate between the variables in this study.

Table 3.4: Statistical analysis used in this study

NO.	OBJECTIVE	NON-PARAMETRIC
1	To determine the PM_{10} levels, lung function and respiratory symptoms among study groups.	Descriptive
2	To compare the difference between PM_{10} levels, lung function and respiratory symptoms among study groups.	Man Whitney-U/chi-square
3	To identify the correlation between PM_{10} levels and lung function among the study groups.	Spearman- Rho Correlation
4	To identify the relationship between PM_{10} levels and reported respiratory symptoms among the study groups.	Chi-square test
5	To determine selected variables that significantly influenced lung function among the study groups.	Multiple Linear Regression
6	To determine selected variables that significantly influenced the reported respiratory symptoms among study groups.	Multiple Linear Regression

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3.6 Quality Control

To ensure data collection was reliable and valid, quality control on the instrument and procedures during data collection were taken as following:

3.6.1 Questionnaire

A pre-test of questionnaire was conducted for 10% of sample size prior data collection process. This is to ensure all the questions in the questionnaires understood by respondent's parents. The questionnaire was pre-tested to ensure the parents understand the questions. The pre-test was conducted on 10% of the total respondents to ensure the reliability and validity of the questionnaire (α=0.7). The questionnaire used in this study was based on the valid question by American Thoracic Society (1978), 'Questionnaire ATS-DD-78-C WHO (1982)'. The questionnaire determines the demographic background, exposure history and reported respiratory symptoms among respondents.

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3.6.2 Lung function test

American Thoracic Society recommended a number of quality control methods to use spirometer. These included the respondents should loosen tight clothing and are in place and stand erect and removes dentures if any before start the test. Information testing procedures was given to the respondents and the technique of drawing breath was demonstrated to help the respondents fulfill the criteria given by American Thoracic Society (ATS). Besides, spirometer was calibrated before used. Three liter (3l) of air was injected in the syringe into the spirometer based on the recommended method by ATS Standardization of Spirometry (2004).

3.6.3 Individual respirable particles (PM_{10}) monitoring

Before conduct the monitoring, NIOSH analytical Method (NAM 0600) was fully understand and all the recommended methods were followed. Other than that, the pumps were fully charged and in good condition prior go to the site for monitoring purpose. Other than that, the pump was calibrated to the appropriate volumetric flow rate and verification of the flow rate during the sampling period was very important. The flow rate was adjusted to achieve desire flow rate which is at 1.7 L/min.

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3.7 Study Limitation

This study design was a cross sectional and thus it has some limitation as the factor and outcome will be determined at the same specific period of time. Besides, the difficulty in getting cooperation from respondents due to young age will become one of the limitations in this study. Next, it is also due to time constrained since long duration is needed for each test to be conducted. Other than that, apart from PM_{10}, there are many other types of indoor air contaminants such as $PM_{2.5}$, NO, radon, CO^2 and CO, but these were not measured in this study.

3.8 Ethical Consideration

This study was approved by Ethics Committee of Faculty of Medicine and Health Sciences, UPM. The identities of the respondents including their personal information were remained confidential and were not stated in any parts of the study. Respondents' information sheets were given to their parents prior the study conducted and the respondents with parents' consent were invited to participate in this study.

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CHAPTER 4

RESULTS

4.1 Study location

This study was conducted at Sawah Sempadan, Tanjung Karang, Selangor. For exposed group, the school children from Sekolah Rendah Sawah Sempadan were chosen since the school situated near to paddy fields (<500 meters from paddy fields) while the comparative group involved the school children from Sekolah Kebangsaan Dato' Manan (Integrasi), located further away from paddy fields.

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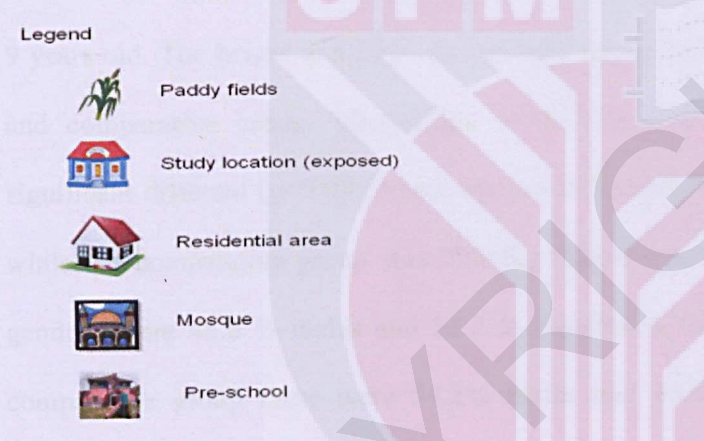
Figure 4.1: Study location for exposed group



This study was carried out to determine the PM_{10} levels among primary school children near paddy fields. This is due to agricultural activities such as soil tillage, seedbed preparation, planting, fertilizing, harvesting, residue burning, and herbicide use caused dust emissions and personal PM exposure (Nordstroma & Hottab 2004). Nevertheless, the adverse effects of personal PM exposure are not limited to agricultural operators working in the field but also affect the nearby community include primary school children.

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4.2 Socio-Demographic Data of Study groups

A total of 149 Malay school children were involved in this study. They were chosen randomly based on several inclusion criteria that have been stated in Chapter 3. Table 4.1 shows the socio demographic data of respondents. The data for age, height, weight, BMI, gender and total household income were not normally distributed. Hence, non-parametric test were conducted to obtain the findings. There was no significant different for age between study groups (p> 0.05) and the ranges of age were from 8 and 9 years old. The height and BMI also showed no significant different between exposed and comparative group. Meanwhile, weight for this two study groups shows no significant different (p>0.05) where median of weight for exposed group was 27.00kg, while the comparative group was 28.00kg. There was no significant different for the gender where 46.8 % males and 53.2 % females in the exposed group while for the comparative group there were 54.2% males and 45.8% females. Thus, confounder factors such as age, gender and height had been matched between these two study groups.

Majority of the exposed group comes from an intermediate family with household income in the range of RM500–RM1500, while the comparative group have high total household income (>RM2000). For total household income, it showed that there was a significant different (p=0.005) between exposed and comparative group.

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Table 4.1 Socio-Demographic Study groups in Tanjung Karang, Selangor

Variables	Exposed	Comparative	Z	p
	Median (IQR)			
Age	9 (1.0)	8 (1.0)	-1.847	0.065
Height	127.50 (9.5)	126.00(12.0)	-0.810	0.418
Weight	27.00 (12.0)	28.00 (11.7)	-0.554	0.579
BMI	15.36 (6.4)	17.31 (4.8)	-1.368	0.171

Variables	Exposed n (%)	Comparative n (%)	χ^2	p
Gender				
Male	36 (46.8%)	39 (54.2%)	0.818	0.366
Female	41 (53.2%)	33 (45.8%)		
Total Household Income				
<RM 500	12 (15.6%)	5 (6.9%)		
RM 500 – RM 1000	25 (32.5%)	10 (13.9%)	23.036	<0.001**
RM 1001 – RM 1500	24 (31.17%)	20 (27.8%)		
RM 1501 – RM 2000	9 (11.7%)	8 (11.1%)		
> RM 2000	7 (9.09%)	29 (40.3%)		

N=149
Z=Mann-Whitney U Test
χ^2= Chi-Square Test
***Significant at $p<0.001$*

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4.3 Parental Educational Levels among Study groups

The parental educational levels were recognized from UPSR until degree/Master/PhD. Majority of fathers' educational levels (42.9 %) and mothers' educational levels (57.1%) of exposed group were at SPM levels. While for comparative group, majority of their father had STPM as their highest educational levels (27.8%). In contrast, mothers' educational levels for comparative group (40.3%) were at SPM levels. There was a significant difference (p=0.003) for fathers' educational levels between the two-study group.

Table 4.2: Parental Educational Levels among Study groups

Variables	Exposed n (%)	Comparative n (%)	χ^2	p
Father's educational levels				
Primary school	15 (19.5)	8 (11.1)	16.17	0.003*
PMR/SRP	16 (20.8)	14 (19.4)		
SPM	33 (42.9)	17 (23.6)		
STPM	9 (11.7)	20 (27.8)		
Degree/Master/PhD	4 (5.2)	13 (18.1)		
Mother's educational levels				
Primary school	5 (6.5)	7 (9.7)	4.167	0.384
PMR/SRP	16 (20.8)	19 (26.4)		
SPM	44 (57.1)	29 (40.3)		
STPM	9 (11.7)	13 (18.1)		
Degree/Master/PhD	3 (3.9)	4 (5.6)		

N=149
χ^2=Chi-Square Test
**Significant at p<0.05*

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4.4 Parental Occupation among Study groups

The table below shows that majority of the father of exposed group worked as farmers (68.8%). For the comparative groups, majority of their father (48.6%) worked as general worker or normal staff. There was a significant different (p=0.016) between exposed and comparative group. Besides that, majority of exposed (61%) and comparative groups' mothers (58.3%) were housewives.

Table 4.3: Parental Occupation among Study groups

Variables	Exposed n (%)	Comparative n (%)	χ^2	p
Father's occupation				
Professional/Specialist/Expert	3 (3.9)	5 (6.9)	12.18	0.016*
Pre-specialist/Officer	4 (5.2)	7 (9.7)		
General worker/Normal staff	16 (20.8)	35 (48.6)		
Self-employed/farmers	53 (68.8)	20 (27.8)		
Pension/Jobless	1 (1.3)	5 (6.9)		
Mother's occupation				
Professional/Specialist/Expert	2 (2.6)	3 (4.2)	0.657	0.957
Pre-specialist/Officer	2 (2.6)	3 (4.2)		
General worker/Normal staff	15 (19.5)	13 (18.1)		
Self-employed/farmers	11 (14.3)	11 (15.3)		
Housewife	47 (61.0)	42 (58.3)		

N=149
χ^2=Chi-Square Test
Significant at $p < 0.05$

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4.5 Distribution of house's outdoor information among Study groups

The Table 4.4 illustrates that most of the exposed group (36.4%) currently living in the house made up from the wood and cement building materials. Meanwhile, majority of the home building materials for comparative group (54.2%) were made from concrete and cement. There was a significant different ($p=0.002$) for types of building materials between exposed and comparative group.

The distance of house from paddy fields, factories and main roads were assessed because there are potential sources of respirable particles PM_{10} emitted in the air. In exposed group, there were only 5 children lived in proximity of the main road (<100 meter-500 meter), no children lived in proximity of factory (<500 meter) and majority of them lived in proximity of paddy fields (<500 meter). Meanwhile for the comparative group majority (68.0 %) of them lived far (>3km) from paddy fields. There was a significant difference for distance of house from main road ($p=0.024$) and paddy fields ($p<0.001$) between the exposed and the comparative group.

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Table 4.4: Distribution of house's outdoor information among Study groups

Variables	Exposed n (%)	Comparative n (%)	χ^2	p
Home building materials				
Cement/concrete	24 (31.2)	39 (54.2)		
Wood and cement	28 (36.4)	25 (34.7)	12.35	0.002*
Wood	25 (32.4)	8 (11.1)		
Distance from the main road				
<100 m from the main road	5 (6.5)	3 (4.2)		
>100-500 m from the main road	23 (29.9)	13 (18.1)	9.45	0.024*
>500-1000 m from the main road	30 (39.0)	21 (29.2)		
>1000 m from the main road	19 (24.7)	35 (48.6)		
Distance from factory				
>3 km from factory	77 (100.0)	72 (100.0)	-	-
Distance from paddy fields				
<500 m from paddy fields	58 (75.3)	3 (4.2)		
>1 - 1.5 km from paddy fields	17 (22.1)	8(11.1)	108.93	<0.001**
>1.5 -3 km from paddy fields	2 (2.6)	12 (16.7)		
>3 km from paddy fields	-	49 (68.0)		

N= 149
χ^2=Chi-Square Test
**Significant at p<0.05*
*** Significant at p<0.001*

4.6 Distribution of Indoor Air Pollutant Sources in house among Study Groups

Table 4.5 shows the exposure of indoor air pollutant sources for the study groups. The findings indicate that majority of the family of exposed group, 77 (100%) and comparative group, 72 (100%) used gas as fuel for cooking. The finding also

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showed that 42 (54.5%) of family of exposed group smoke in their house and 29 (40.3%) for comparative group. Meanwhile, for usage of mosquito coil, there were 41 (53.2%) family of the exposed group used mosquito coil and it was higher than the comparative group 29 (40.3%). However, there were no significant difference between exposed and comparative group for usage of gas, usage of mosquito coil and smoker in house between this two study groups.

Table 4.5: Distribution of Indoor Air Pollutant Sources in House among Study Group

Variables	Exposed n (%)	Comparative n (%)	χ^2	p
Fuel for cooking				
Gas	77 (100.0)	72 (100.0)	-	-
Electric	-	-		
Mosquito coil usage				
No	6 (7.8)	2 (2.8)	6.420	0.093
Mosquito coil	42 (54.5)	29 (40.3)		
Aerosol	20 (26.0)	30 (41.7)		
Electric	9 (11.7)	11 (15.3)		
Smoker in house				
Yes	42 (54.5)	29 (40.3)	3.036	0.081
No	35 (45.5)	43 (59.7)		

N= 149
χ^2=Chi-Square Test

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4.7 Comparison of PM_{10} Levels between the Study groups

The finding was based on the first study objective. The PM_{10} levels' data were not normally distributed. Hence, the findings were obtained by using non-parametric test. From the Table 4.6, it shows that the median of PM_{10} levels for exposed group (64.71(29.41) μg/m^3) were higher than comparative group (43.14 (7.35) μg/m^3). There was a significant different ($p<0.001$) for PM_{10} levels between exposed and comparative group.

Table 4.6: Comparison of PM_{10} Levels between the Study groups

Variables	Exposed	Comparative	Z	p
	Median (IQR)			
PM_{10} μg/m^3	64.71(29.41)	43.14 (7.35)	-6.432	<0.001**

N=149
Z=Mann-Whitney U Test
*** Significant at p<0.001*

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4.8 Comparison of Lung Function between the Study groups

The result from Table 4.7 was based on the second study objective. After run the normality test, all the variables which are FVC (liter), FEV_1 (liter), FVC % predicted, FEV_1% predicted and FEV_1/ FVC % predicted, were not normally distributed ($p>0.05$) and then the data were analyzed by using non-parametric test which is Mann-Whitney U to obtain the Z and p-value.

The median for FVC (liter) and FEV_1 (liter) for exposed group were 1.05 (0.35) and1.04 (0.37) respectively. For comparative group, the median for FVC (liter) was 1.20 (0.49) and the median for FEV_1 (liter) was 1.20 (0.26). For FVC % predicted among exposed and comparative group, the median were 76.87 (5.37) and 82.18 (3.31) respectively. Whereas, FEV_1% predicted of exposed group and comparative group showed the median were 80.40 (6.37) and 84.82 (5.56) respectively. The median for FEV_1/ FVC % predicted of exposed group was 104.41 (2.90) while for the comparative group was 104.13 (2.93). The FVC (liter), FEV_1 (liter), FVC % predicted and FEV_1% predicted were lower ($p<0.05$) among exposed group than comparative group. However, FEV_1/ FVC % predicted was higher among exposed group than the comparative group. There were significant difference ($p<0.05$) in all the of lung function test between the two-study groups.

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Table 4.7: Comparison of Lung Function between the Study groups

Variables	Exposed n(%)	Comparative n(%)	Z	p
	Median (IQR)			
FVC (liter)	1.05 (0.35)	1.20 (0.49)	-2.431	0.015*
FEV_1 (liter)	1.04 (0.37)	1.20 (0.26)	-1.992	0.046*
FVC % predicted	76.87 (5.37)	82.18 (3.31)	-6.059	<0.001**
FEV_1% predicted	80.40 (6.37)	84.82 (5.56)	-4.753	<0.001**
FEV_1/ FVC % predicted	104.41 (2.90)	104.13 (2.93)	-2.000	0.045*

N=149
Z=Mann-Whitney U Test
**Significant at $p \leq 0.05$*
***Significant at $p \leq 0.001$*

The evaluation of lung function test was performed by comparing the obtained value with normal values (standards value) based on the study conducted by Azizi (1994). Those with lung function value ≥80, categorized as normal and <80, categorized as abnormal lung function. Table 4.8 below shows that the prevalence of lung function abnormality include FVC % predicted, FEV_1% predicted and FEV_1/FVC % predicted among the exposed and comparative group. The number of exposed group having abnormal FVC % predicted and FEV_1% predicted were higher than comparative group. There are significant difference for FVC % predicted and FEV_1% predicted between two study groups. However, both groups showed normal FEV_1/FVC% predicted.

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Table 4.8 Prevalence of Lung Function Abnormality among Study Groups

Lung Function	Status	Exposed n(%)	Comparative n(%)	χ^2	p
FVC % predicted	Abnormal	33(68.8)	15(31.2)	8.265	0.004*
	Normal	44(43.6)	57(56.4)		
FEV_1% predicted	Abnormal	34(66.7)	17(33.3)	6.976	0.008*
	Normal	43(43.9)	55 (56.1)		
FEV_1/FVC% predicted	Abnormal	0	0	-	-
	Normal	77(100.0)	72(100.0)		

N=149
χ^2=Chi-Square Test
**Significant at p < 0.05*
*** Significant at p<0.001*

There are several factors that influenced the abnormality of the lung function which include exposure to home indoor air pollutants. The Table 4.9 shows the common sources of indoor air pollutant that were released from familiar activities among Malaysian in their house (Azizi, 1990). Chi-square Test was conducted to test the association between the prevalence of lung function abnormality and indoor pollutant sources. There was a significant association in the use of mosquito coil (χ^2=11.83, p=0.001) with FVC predicted. However, usage of gas for cooking and passive smoker did not showed any significant relationship with FVC abnormality among the study groups.

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Table 4.9: Association between Prevalence of Lung Function Abnormality (FVC Predicted) and Indoor Air Pollutant Sources in House among Study groups

Variables	FVC predicted		χ^2	p	OR	95% CI
	Abnormal n (%)	Normal n (%)				
Usage of mosquito coil						
Yes	44(62.0)	27(38.0)	11.83	0.001*	3.497	0.121-0.479
No	22(28.2)	56(71.8)				
Usage of gas for cooking						
High	40(47.6)	44(52.4)	0.862	0.353	0.733	0.381-1.412
Low	26(40.0)	39(60.0)				
Passive smoker						
Yes	37(52.1)	34(47.9)	3.359	0.067	0.544	0.283-1.046
No	29(37.2)	49(62.8)				

N=149
χ^2=Chi-Square Test
**Significant at p < 0.05*
*** Significant at p<0.001*

Table 4.10 shows the association between the prevalence of lung function abnormality for FEV_1 predicted and indoor pollutant sources in house. There was a significant relationship between FEV_1 abnormality and usage of mosquito coil (χ^2=18.23, p<0.001). Meanwhile, there were no significant relationship between FEV_1 abnormality with passive smoker and usage of gas for cooking.

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Table 4.10: Association between Prevalence of Lung Function Abnormality (FEV_1 predicted) and Indoor Air Pollutant Sources in House among Study groups

Variables	FEV_1 predicted		χ^2	p	OR	95% CI
	Abnormal n (%)	Normal n (%)				
Usage of mosquito coil						
Yes	48(67.6)	23(32.4)	18.23	<0.001**	4.757	0.098-0.578
No	8(10.3)	70(89.7)				
Usage of gas for cooking						
High	18(21.4)	66(78.6)	0.045	0.831	0.917	0.412-2.041
Low	13(20.0)	52(80.0)				
Passive smoker						
Yes	19(26.8)	52(73.2)	2.919	0.088	0.498	0.222-1.117
No	12(15.4)	66(84.6)				

N=149
χ^2=Chi-Square Test
**Significant at p<0.05*
*** Significant at p<0.001*

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4.9 Reported Respiratory Health Symptoms among Study groups

The result in the Table 4.11 below was based on the third study objective. There are several variables of respiratory symptoms which includes cough, phlegm, wheezing and chest tightness had been evaluated among exposed and comparative group. There were significant difference between the exposed and the comparative group for cough (χ^2=7.814, p=0.005), phlegm (χ^2=5.833, p=0.016) and wheezing (χ^2=20.072, p<0.001). Figure 4.12 shows the graph of reported respiratory symptoms among study groups. Based on the graph, it clearly shows that the exposed group had higher reported respiratory symptoms such as cough, phlegm, wheezing and chest pain than comparative group.

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Table 4.11: Prevalence of Reported Respiratory Symptoms among Study groups

Variables	Exposed n(%)	Comparative n(%)	χ^2	p	OR	95% CI
Cough						
Yes	35 (45.5)	17 (23.6)	7.814	0.005*	2.696	1.332-5.456
No	42(54.5)	55 (76.4)				
Phlegm						
Yes	22(28.6)	9 (12.5)	5.833	0.016*	2.800	1.190-6.589
No	55 (71.3)	63 (87.5)				
Wheezing						
Yes	34 (44.2)	8 (11.1)	20.072	<0.001*	6.326	2.672-14.974
No	43(55.8)	64 (88.9)				
Chest tightness						
Yes	11(14.3)	5 (6.9)	5.846	0.150	2.233	0.736-6.780
No	66 (85.7)	67 (93.1)				

N=149
χ^2=Chi-Square Test
*** Significant at p<0.001*
**Significant at p < 0.05*

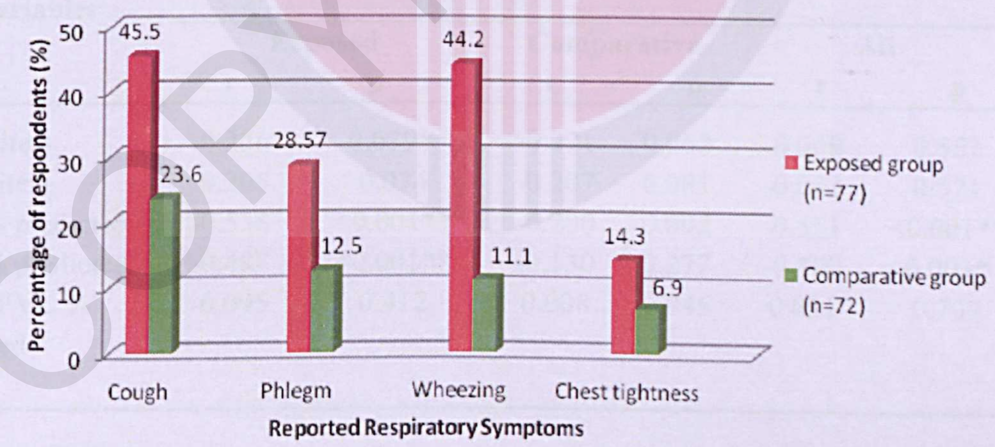

Figure 4.2: Reported Respiratory Symptoms among Study groups

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4.10 Correlation of PM_{10} Levels with Lung Function among Study groups

The table below shows the result based on the fourth study objectives. Since the data was not normally distributed, Sperman-Rho Test was used to correlate PM_{10} levels and lung function. The result shows that for exposed group, FVC (liter) ($r=-0.236$, $p=0.039$) FVC % predicted ($r=-0.538$, $p<0.001$) and FEV_1 % predicted ($r=-0.487$, $p=0.007$) showed significant inverse correlation with PM_{10} levels. Meanwhile, the comparative group showed no significant inverse correlation between all the variables and PM_{10} levels. Amongst the total number of respondents (N=149), there were significant inverse correlation between FVC % predicted ($p<0.001$) and FEV_1 % redicted ($p=0.007$) with PM_{10} levels.

Table 4.12: Correlation of PM_{10} Levels and Lung Function among Study groups

Variables	Respirable particles (PM_{10})					
	Exposed		Comparative		All	
	r	p	r	p	r	p
FVC (liter)	-0.236	0.039*	-0.221	0.062	-0.049	0.552
FEV (liter)	-0.205	0.074	-0.207	0.081	-0.053	0.521
FVC % predicted	-0.538	<0.001**	-0.200	0.092	-0.561	<0.001**
FEV_1% predicted	-0.487	<0.001**	-0.130	0.277	-0.500	0.001*
FEV_1/ FVC % predicted	-0.095	0.412	0.008	0.945	0.031	0.707

N= 149
r=Spearman Correlation
Significant at $p<0.05$
** *Significant at $p<0.001$*

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4.11 Association between PM_{10} Levels and respiratory symptoms among study groups

The result in the table below was based on the fifth study objectives. There are several variables of respiratory symptoms which include cough, phlegm, wheezing and chest tightness that had been evaluated in this study among study groups exposed to high levels of PM_{10} ($\geq 53\mu g/m^3$) and low levels of PM_{10} ($< 53\mu g/m^3$). There were significant association between high PM_{10} levels and low PM_{10} levels for cough ($\chi^2 = 5.046$, $p=0.025$) and wheezing ($\chi^2 = 19.529$, $p<0.001$). Meanwhile, phlegm and chest tightness showed no significant relationship between high PM_{10} levels and low PM_{10} levels.

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Table 4.13: Association between PM_{10} Levels and Respiratory Symptoms among Study groups

Variables	High PM_{10} levels ($\geq 53 \mu g/m^3$)	Low PM_{10} levels ($< 53 \mu g/m^3$)	χ^2	p	OR	95% CI
Cough						
Yes	24 (47.1)	28 (28.6)	5.046	0.025*	2.222	1.100-4.489
No	27 (52.9)	70 (71.4)				
Phlegm						
Yes	19 (45.2)	23 (23.5)	3.149	0.076	1.936	0.928-4.038
No	32 (57.8)	75 (76.5)				
Wheezing						
Yes	21 (41.2)	10 (10.2)	19.529	<0.001**	6.160	2.608-14.550
No	30 (58.8)	88 (89.8)				
Chest tightness						
Yes	7 (12.1)	9 (9.2)	0.722	0.396	1.573	0.550-4.503
No	51 (87.9)	89 (90.8)				

N=149
χ^2=Chi-Square Test
** *Significant at p<0.001*
**Significant at p < 0.05*

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4.12 Selected Variables That Influenced Lung Function among Study groups After Control All Confounders

This analysis was based on the sixth study objective. Logistic regression was used to determine the selected variables that influenced FVC predicted among study groups after controlling all the confounders which include total household income, distance of house from paddy fields, usage of mosquito coil, passive smoker and PM_{10} levels. Based on the Table 4.14, it showed that PM10 levels and mosquito coil usage in home were significantly influenced FVC Predicted among study groups.

Table 4.14: Selected Variables Influenced FVC Predicted among Study groups

Independent variables	β	S.E	*p*	OR	95%CI
Constant	-2.641	0.645	<0.001		
Total household income	-0.637	0.510	0.212	0.529	0.195-1.437
Distance of house from paddy fields	0.441	0.504	0.382	1.554	0.578-4.176
Usage of mosquito coil	1.147	4.95	0.031*	2.954	1.193-8.300
Passive smoker	0.027	0.477	0.956	1.027	0.403-2.617
PM_{10} levels	3.390	0.597	<0.001**	6.166	9.200-24.440

N=149
95%CI=95% Confidence Interval
β=Regression Coefficient
S.E=Standard Error
Negelkerke R^2 value = 0.589
**Significant at $p < 0.05$*
*** Significant at $p<0.001$*

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4.13 The Selected Variables That Influenced Respiratory Symptoms among Study groups After Control All the Confounders

This analysis was based on the seventh study objective. Logistic regression were used to determine selected variables that influenced cough and wheezing among study groups after controlling all the confounders which include total household income, distance of house from paddy fields, usage of mosquito coil, passive smoker, family history of asthma and PM_{10} levels. Based on the Table 4.15, it shows that family history of asthma was significantly influenced reported cough among study groups. Meanwhile, Table 4.16 shows that both family history of asthma and PM_{10} levels were significantly influenced reported wheezing among study groups.

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Table 4.15: Selected Variables That Influenced Cough among Study groups

Independent variables	β	S.E	*p*	OR	95%CI
Constant	-1.862	0.559	0.001		
Total household income	-0.028	0.406	0.946	2.131	0.438-2.157
Distance of house from paddy fields	0.757	0.444	0.089	1.106	0.892-5.092
Usage of mosquito coil	0.100	0.407	0.805	1.796	0.498-2.452
Passive smoker	0.586	0.377	0.120	2.725	0.858-3.761
Family history of asthma	1.002	0.379	0.008*	1.151	1.297-5.725
PM_{10} levels	0.141	0.450	0.754	0.477	0.477-2.779

N=149
95%CI=95% Confidence Interval
β=Regression Coefficient
S.E=Standard Error
Negelkerke R^2 value = 0.606
**Significant at $p < 0.05$*
*** Significant at $p<0.001$*

Table 4.16: Selected Variables Influenced Wheezing among Study groups

Independent variables	β	S.E	*p*	OR	95%CI
Constant	-3.083	0.797	<0.001		
Total household income	-0.107	0.540	0.842	0.898	0.312-2.589
Distance of house from paddy fields	0.478	0.635	0.452	1.613	0.465-5.596
Usage of mosquito coil	-0.868	0.576	0.131	0.420	0.136-1.297
Passive smoker	0.169	0.502	0.737	1.184	0.443-3.167
Family history of asthma	2.099	0.503	<0.001**	8.155	3.045-21.841
PM_{10} levels	1.714	0.581	0.003*	5.549	1.777-17.330

N=149
95%CI=95% Confidence Interval
β=Regression Coefficient
S.E=Standard Error
Negelkerke R^2 value = 0.375
**Significant at $p < 0.05$*
*** Significant at $p<0.001$*

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CHAPTER 5

DISCUSSION, CONCLUSION, RECOMMENDATION

5.1 Discussion

5.1.1 Socio demographic data of study groups

This study was done at Sawah Sempadan, Tanjung Karang Selangor to determine respirable particles (PM_{10}) exposure and its association with respiratory health of primary school children. The study groups involved in this study includes the primary school children from standard 2 and 3. The total of students in standard 2 and 3 in both study location were 216 students. Since the sample size in this study required 86 primary school children for each group, a total of 172 parents consent letter were distributed among them prior the study conducted and the students were randomly

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selected after they got their parents' permission. There were 149 children allowed to be involved in this study. Therefore, response rate for this study was 86.6% which indicates that most of the parents understand the objective of this study from the given information sheet and concern about their children's health. In this study, there were 77 respondents for exposed group from Sekolah Kebangsaan Sawah Sempadan which is located near to paddy fields. Meanwhile, for comparative group there were 72 respondents involved from Sekolah Kebangsaan Dato'Manan (Integrasi) in Tanjung Karang and located away from paddy fields.

Information on the socio-demographic, economic status and homes' environment of the study group was obtained from self administered questionnaires. The questionnaires were completed by the parents. The questionnaires were valid from American Thoracic Society (1978), 'Questionnaire ATS-DD-78-C WHO (1982)'.The entire study groups involved in this study was Malay since majority of the community in Tanjung Karang were Malays. The different for the age, height, weight and BMI between exposed and comparative group was not statistically significant ($p>0.005$). Besides, the difference in gender of the study groups also shows no statistically significant ($p > 0.05$) where the total of male of exposed and comparative group were 36 (46.8%) and 39 (54.2%) respectively while there are 41 (53.2%) female in exposed group and 33 (45.8%) of comparative group.

The total household incomes of the parents have been categorized into 4 categories based on the study done by Zailina *et al*., (2004). This is because some of the study groups of the previous study were from the rural area. Hence, the category for the total household was suitable to be applied in this study. The household income in Table 4.1 shows that the respondents in exposed group were in high class socioeconomic (>RM 2000) while the children in comparative group were in the middle class socioeconomic (RM 1001–RM 1500). The difference in their parents' total household incomes was statistically significant. Socio-economic factors such as total household income influenced the increase risk in respiratory problems due to lack of proper medical treatment especially in children from low total household income compared with high total household income.

This was due to majority of the fathers of exposed group work as farmers or self-employed (68.8%) while in comparative group, most of their farther work as general worker or office worker (48.6%). There was a significant different between exposed and comparative group for father's occupation. Majority of the mothers in exposed group (61.0%) and in comparative group (58.3%) are housewives. Besides, the highest educational levels of the parents of exposed group was at SPM levels (42.9%) followed by PMR or SRP (20.8%) while in comparative group, most of the parents had SPM (27.8%) and degree or master or PHD (18.1%). The difference in their parents' educational levels was not statistically significant.

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5.1.2 Distribution of house's outdoor information among Study groups

There are several types of study groups' home building materials which are wood, combination of wood and cement and also cement or concrete. Most of the exposed group lives in home made by wood and cement (36.4%) while 54.2% of the comparative group lives in home made by cements. Study done by Juliana (2002) found that there were significant differences for home building materials with air pollutant sources.

The distance of house from the main road, factory and paddy fields were evaluated to identify the possible sources of outdoor air pollutant that may indirectly affect the respiratory health of the respondents. Major outdoor air pollutant sources include fugitive dust from roads, industry, wind-blown dust from geological material such as agriculture, and fly ash from fossil fuel combustion.

Based on Table 4.4, most of the exposed group (73.5%) living near to paddy fields which is less than 500 meters whereas the comparative group (68.0%) was living away (>3km) from the paddy fields. That was why mostly of the fathers in exposed group work as farmers and self-employed. According to Nordstroma & Hottab, (2004)

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agricultural activities such as soil tillage, seedbed preparation, planting, fertilizing, harvesting compost spreading, residue burning, and herbicide used cause dust emissions and personal particulate matter (PM) exposure.

The distances from home to factories for study groups (100%) were more than 3km which indicates that their homes were away from the factories. Whereas the distances from house to main road (>3km) for exposed group (24.7%) was lower than comparative group (48.6%). The lifetime of PM_{10} is from minutes to hours, and its travel distance varies from <1km to 10 km.

5.1.3 Distribution of Exposure Indoor Air Pollutant Sources in House among Study Groups

The usage of gas as the fuel for cooking was common among the exposed (100%) and comparative group (100%) and it indicates that there was no significant different for usage of gas for cooking purposes between this two study groups. Based on the study by Azizi (1990), the finding showed that there were several sources of indoor air pollution in homes such as oil, gas, coal and wood for cooking purpose. However, nowadays there was no more usage of wood for cooking purposes.

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The usage mosquito coil among exposed group (54.5%) was higher than comparative group (40.3%). According to Azizi (1990), one of the common activities among Malaysian that contribute to indoor air pollutant was the combustion of mosquito coil. However, the difference for the usage of mosquito coil between the two study groups was not statistically significant. While study done by Juliana (2004) found that exposure to combustion of mosquito coil can cause increasing risk towards the respiratory health of exposed children. Usually the exposure occurred for 6-8 hours per night. Thus, the children will breathe in the air that was contaminated with the smoke of mosquito coil since it was placed near to bed of the children while they sleep.

Another source of home's indoor air pollutant comes from the smoke from the cigarette. Basically, the children expose to the smoke were called passive smoker. Based on Table 4.5 it shows that for both group, there was no significant different for passive smoker. Study by Azizi (1991) found that passive smoking children tend to be one of the significant risks for the respiratory illness such as chest tightness. Other than that, passive smoker more intensely occurred among children who share rooms with smoking parents than in children who had their own rooms (Azizi, 1991). Thus, this findings support that respiratory health of the passive smoker affected from the burning of the cigarettes.

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5.1.4 Comparison PM_{10} Levels between the Study Groups

Median for PM_{10} levels among exposed group, 64.71(29.41) $\mu g/m^3$ was higher than comparative group, 43.14 (7.35) $\mu g/m^3$. As for the average of PM_{10} exposed by the study groups was 53$\mu g/m^3$. There was a significant different ($p<0.001$) for PM_{10} levels between exposed and comparative group. However, PM_{10} levels in this area are still below the allowable health-based national air quality standards by EPA for PM_{10} which are 50$\mu g/m^3$ (measured as an annual mean) and 150$\mu g/m^3$ (measures as a daily concentration).

The PM_{10} levels was higher in exposed group because the location of the school nearby to the paddy fields. According to Nordstroma & Hottab (2004), agricultural activities such as soil tillage, seedbed preparation, planting, fertilizing, harvesting, compost spreading, residue burning, and herbicide used caused dust emissions and personal PM exposure. Study by Gaffney & Yu (2003) found that in the process of drying the rice during the harvesting season, a large amount of dust (PM_{10}) is released into the air. Meanwhile, according to Arslan *et al.*, 2010, the respirable particles sources may be organic or inorganic in agricultural field operations. The source of personal PM exposure during tillage, for instance, is mainly inorganic with some organic particulate matters mixed in the soil while PM source during harvest is basically organic. PM_{10}

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concentration was quite low in fertilizing compared to other applications. The greatest levels of personal PM_{10} exposure occurred during rotary tilling (25000 μg m-3) followed by planting (11000 μg m-3).

There is also common practice in agriculture such as openly burn agricultural residues in fields after harvesting crops in order to get rid of stubble left out after the harvest. The contribution of the burning to PM_{10} concentration appeared to be around 100-200 μg/m3 (Parmod and Surrender, 2010). According to Mastura & Haslina (2012), practise of burning rice straws usually causes air pollution within the vicinity of the paddy fields in Alor Setar, Kedah. This is shown by hourly Air Pollutant Index (API) readings of exceed 70 $\mu g/m^3$. Thus, it showed that (PM_{10}) emitted into the air were also increased during the burning period.

PM_{10} emitted from agriculture field operations is first dispersed downwind in the near-field in high concentration plumes and then dispersed in lower concentrations further downwind in the far-field for more than 1 kilometer (Wang *et al.*, 2010). According to Maynard& Howard (1999), PM_{10} is not as long-lived as $PM_{2.5}$, with a life-time of some 7±30 days, as the latter is less efficient removal by gravitational settling or scavenging by rain. Since the school's distance from the paddy fields was less than 500 meters, the concentrations levels of indoor pollutant also increased. Hence, the

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concentration of PM_{10} levels exposed by the exposed groups was higher than comparative group. Through the researcher's observation, fans were used to ventilate the air in the school especially in the classroom. The study from Kildeso (1999) found that there was 2 times increase of particulate levels when the fan was not used to flow the air inside the buildings. According M. Ismail *et al.*, (2010), age of building, types of flooring, presence of curtains, shelf area, dust from blackboard and fans were found to be the determinants in the PM_{10} classrooms

Hypothesis one was failed to be rejected because result from this study showed that the PM_{10} exposure levels among exposed group was significantly higher compared to comparative group. One of the major difference between Particulate matter in rural compared to sub-urban is agricultural air is assumed to have a larger fraction of organic dust, a mixture of plant and animal matter, microorganisms, and bioaerosols (Pavilonis, 2012).

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5.1.5 Comparison of Lung Function between the Study groups

Lung function test was performed among the exposed and comparative group. The procedure for this test was adopted from the recommended procedures by American Thoracic Society (ATS), 1991. The lung function status among the study groups evaluated based on FVC (liter), FEV_1 (liter), FVC % predicted, FEV_1% predicted and FEV_1/ FVC % predicted. Since the study groups from this study were children, normal value of lung function parameters among children in Malaysia by Azizi and Henry (1994) was used to calculate the FVC and FEV_1 predicted.

Table 4.7 shows the comparison of lung function between exposed and comparative group. The findings shows that all the variables which were FVC (liter), FEV_1 (liter), FVC % predicted FEV_1% predicted and FEV_1/ FVC % had significant difference ($p<0.05$) between exposed and comparative group.

Table 4.8 shows that the prevalence of abnormality of lung function which include FVC % predicted, FEV_1% predicted and FEV_1/FVC %predicted among exposed and comparative group. The result showed that exposed group had higher abnormal FVC% predicted and FEV_1% predicted than comparative group. The exposed groups are eight times likely to get abnormal FVC% predicted and six time likely to get abnormal

FEV_1% predicted compared to comparative group. However, for FEV_1/FVC % predicted, both groups had normal result.

Hence, hypothesis two was failed to be rejected because this study showed that the lung function of exposed group was significantly lower compared to comparative group. There are several factors that influenced the abnormality of the lung function include exposure to home's indoor air pollutant. There were common sources of indoor air pollutant that were released from familiar activities among Malaysian (Azizi, 1990) such as usage of mosquito coil, usage of gas during cooking and passive smoker.

Based on Table 4.9, there was a significant association (χ^2=11.83, p=0.001) between abnormality of FVC predicted and usage of mosquito coil. However, usage of gas for cooking and passive smoker did not showed any significant association with abnormal FVC predicted among the study groups. Meanwhile, Table 4.10 shows that there was a significant association between abnormal FEV_1 predicted and mosquito coil usage (χ^2=18.23, p<0.001) with exposed group are four times likely to get abnormal FEV_1 predicted. Meanwhile no significant association was found between FEV_1 abnormality and passive smoking and gas usage for cooking.

Study by Juliana, 2004 found that exposure to combustion of mosquito coil may cause increasing risk towards respiratory health among children. This is due to exposure of smoke from combustion of mosquito coil for almost 6-7 hours at night. Besides, the

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ventilation at night also influenced the risk of exposure to mosquito coil usage since all the windows and doors were closed. The poor ventilation condition with no functioning fan or mechanical ventilation increases the dose of exposure by the children.

5.1.6 Reported Respiratory Symptoms among Study groups

There were four parameters of chronic respiratory symptoms evaluated in this study which were identified by using Questionnaire ATS-DLD-78-C-WHO (1982). The differences in prevalence of respiratory symptoms between exposed and comparative group was presented in Table 4.11. The statistical analysis shows that prevalence of reported cough was significantly higher among exposed group (45.5%) and 2 times likely to get cough compared to comparative group (23.6%). For phlegm, exposed group (28.6%) 2 time likely to get that symptom than comparative group (12.5%) and 6 times likely to get wheezing (44.2%) compared to comparative group (11.1%).

In this study, hypothesis three was fail to be rejected since the reported respiratory symptom among exposed group was higher compared to comparative group. Exposure to organic dust can cause acute or chronic conditions depending on the concentration, duration of exposure and the susceptibility of individual. Findings from

Pavilonis (2012) showed that long-term exposure can cause decreased lung function as well as chronic bronchitis, asthma-like syndrome, and wheezing.

Respiratory symptoms such as cough are the indicator of airway irritant stimuli to air pollutants. Cough was an early response to irritant receptor in the airway to enhanced secretion of mucus by the gland lining in the airway because of ineffective clearance o airways mucus by a damage mucociliary system (David and Foster, 1999).

There are several factors that influenced the reported respiratory symptoms include exposure to home's indoor air pollutant. Study done by Azizi and Henry (1991) found that prolonged exposure to combustion of mosquito coil and side stream tobacco smoke could cause respiratory symptoms. According to Aridvidya (2000), the children who were passive smoker had significant association with phlegm. Plus, the previous study done by Spengler and Sexton (1983) also found significant relationship for passive smoker with respiratory disease among children.

Meanwhile, Ayana and Sarah (1991) found that trend of a higher frequency of reported respiratory conditions among schoolchildren whose fathers or mothers are smokers compared with children whose parents do not smoke. The excess in respiratory

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symptoms among children exposed to smoking fathers is statistically significant for cough with cold, cough accompanied by sputum and wheezing with and without cold, and for wheezing accompanied by shortness of breath ($p = 0.0626$).

5.1.7 Correlation of PM_{10} Levels and Lung Function among Study groups

The correlation between the PM_{10} levels and lung function was presented in Table 4.12. The findings show that for exposed group, there were significant inverse correlation between FVC (liter) ($r=-0.236$, $p=0.039$), FVC % predicted ($r = -0.538$, $p<0.001$), and FEV_1 % predicted ($r = -0.487$, $p<0.001$) but no significant inverse correlation for FEV_1 (liter) and FEV_1/ FVC % predicted and PM_{10} levels. Meanwhile, for control group there was no significant inverse correlation between PM_{10} levels and lung function. Meanwhile, the finding shows for total study groups only two variables which were FVC % predicted ($r =-0.561$, $p=<0.001$) and FEV_1 % predicted ($r =-0.500$, $p=0.001$) had significant inverse correlation with PM_{10} levels.

Hypothesis four in this study was failed to be rejected since there was a significant correlation between individual PM_{10} levels and lung function among study groups. High exposure levels of PM_{10} will decrease in lung function among study

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groups. This study was supported by the study by Majra (2011) where the size of agricultural operations increased the opportunity for significant respiratory exposure-related health effects in the rural community. According to the study done by Hiroyuki (2004), in the process of drying the rice during the harvesting season, a large amount of dust (PM_{10}) is released into the air. Rice husk dust can be absorbed through the skin or swallowed but most frequently inhaled irritating the portal of entry and leading to various obstructive lung diseases (Sukhjinder *et al.*, 2011).

According to EPA, 2010, the exposure to PM_{10} can cause reduction of lung function among children. The findings was supported by the study done by Hoeak (2000) where he found that decreasing lung function among children in range of age between 8 and 11 years old in Austria has significant with increasing PM_{10} exposure levels. It was supported by another research by Abdul *et. al.*, 2003, concluded that PM_{10} affected exposed children's respiratory system in term of lung functions abnormality and also increases their respiratory symptoms.

If the respondents have an obstructive disease, the amount of air in the lungs will not be readily exhaled because of physical obstruction and airway collapse during exhalation due to loss of elastic recoil of the lungs. The air volume of lung will be more slowly expelled and will be a smaller volume over the time course of the FVC test than would be expected in a normal, healthy individual. While, respondents with restrictive lung disease, the FVC will be smaller because the amount of air that can be forcefully

inhaled or exhaled from the lungs is smaller to start with because of disease such as asthma or emphysema.

5.1.8 Association Between PM_{10} Levels and Reported Respiratory Symptoms among Study groups

Table 4.13 shows the association between PM_{10} levels and reported respiratory symptoms. There were significant relationship between PM_{10} levels and cough ($\chi^2=5.046$, $p=0.025$) and wheezing ($\chi^2=19.529$, $p<0.001$). The statistical analysis shows that prevalence of reported respiratory symptoms for cough was significantly higher among respondents exposed to high PM_{10} levels (47.1%) than respondents exposed to low PM_{10} levels (28.6%) and exposed groups 2 times likely to get cough. For wheezing, study groups exposed to high PM_{10} levels (41.18%) 6 times likely to get wheezing compared to respondents exposed to low PM_{10} levels (10.20%).

Hypothesis five in this study was failed to be rejected since there is a significant association between PM_{10} levels and reported respiratory symptoms among study groups. This study showed that even though the PM_{10} levels is below the allowable standard ($150\mu g/m^3$), the children still have the risk to get the respiratory problems.

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Besides that, numerous local studies repeatedly found an association between the presence of acute respiratory symptoms and short term reduction of pulmonary function with exposure to particulate matter. This result was supported by Aridvidya (2000) which found a significant association of concentration of PM_{10} with the prevalence of chronic respiratory symptoms. Plus, according to Atkinson (1999), a series of analyses children demonstrated that PM_{10} was associated with increased respiratory symptoms, including cough, wheeze and shortness of breath. Exposure to PM also was associated with increased respiratory symptoms and decreased lung function (Nicole *et al.*, 1997). Other than that, bronchitis and chronic obstructive airways disease are associated with inorganic PM generated in agricultural field applications (Baker et al 2005).

5.1.9 Selected Variables That Influenced Abnormality of Lung Function (FVC% Predicted) among Study groups

Based on the Table 4.14, FVC% predicted among study group has a statistically significant relationship with mosquito coil usage and PM_{10} levels with adjusted R^2 value is 58.9%. According to the study by Engku Aminatul (2004), indoor PM_{10} levels showed as significant inverse relationship with FVC% predicted (and FEV_1 % predicted among children in Kota Bharu, Kelantan. This finding is in line with the study by Abdul *et. al.*,

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2003 where PM_{10} affected exposed children's respiratory system in term of lung functions abnormality and also increases their respiratory symptoms.

While study done by Juliana (2004) found that exposure to combustion of mosquito coil can cause increasing risk towards the respiratory health of exposed children. Usually the exposure occurred for 6-8 hours per night. Thus, the children will breathe in the air that was contaminated with the smoke of mosquito coil since it was placed near to bed of the children while they sleep.

5.1.10 Selected Variables That Influences Respiratory Symptoms (Cough and Wheezing) among Study groups

The Table 4.15 shows cough have a significant relationship with family history of asthma (adjusted R^2= 60.6%) after controlling all confounders by using logistic regression test. For wheezing, there was a statistically significant relationship (adjusted R^2=37.5%) with family history of asthma and PM_{10} concentration when all the other confounding factors are controlled (Table 4.16). Therefore, the last hypothesis in this study was failed to be rejected. This was supported with the findings by Aridvidya (2000) which found a significant association of concentration of PM_{10} with the prevalence of chronic respiratory symptoms. This finding was supported by Zailina et

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al., 2004, where the atmospheric pollutants such as respirable particles (PM_{10}) and gases are foreign materials that can promote and increase the overall bronchioles repetitively by causing mucuosal edema.

Family history of asthma was one of the selected variables that influenced reported cough and wheezing. In Malaysia, number of studies conducted locally showed that air pollutants can worsen childhood asthma even at low concentration (Abdul *et. al.,* 2003). Study by Junaidah *et. al.*, 2012, found association between PM_{10} concentrations and asthma severity among respondents.

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5.2 Conclusion

From the findings above it can be concluded that PM_{10} levels was higher in the exposed group than comparative group and cause the abnormality in lung function and increased reported respiratory symptoms. High PM_{10} sources were comes from the agriculture activities nearby such as burning of paddy straw, pesticide spray and plant ploughing which contribute to air pollution and led to the lung function impairment.

The result of PM_{10} levels had a significant correlation with lung function (FVC% predicted and FEV_1% predicted) and significant association with reported respiratory symptoms (cough and wheezing). From this study, it shows that exposure to PM_{10} especially from agricultural activities and indoor air pollutant sources such as usage of mosquito coil influenced the abnormality of lung function and increase the reported respiratory health symptoms.

From the logistic regression, PM_{10} levels and mosquito coil usage had significant association with abnormal FVC% predicted. While, history of asthma and PM_{10} levels were significant influenced in increased reported cough and wheezing among study groups.

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5.3 Recommendation

In many cities air pollution is reaching levels that threaten people's health. From this study, the exposure to PM_{10} in the agriculture area caused reduction in lung function and increased reported respiratory symptoms among primary school children from the school located near paddy fields. The school management should prioritize the classroom cleanliness in the school to reduce the respirable dust. They can educate the students to periodically clean their classroom.

Meanwhile, further study can be done for ambient PM_{10} using real time monitoring equipments such as dust-trak at the school. Other than that, to strengthen the study, personal PM_{10} monitoring for 24 hours can be conducted at respondent's house to identify indoor air pollutant sources that may release PM_{10}. Besides that, further study should be conducted with the different target group. It is to identify the exposure levels of PM_{10} and its association with respiratory health among the community nearby paddy fields includes adults and elderly.

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References

Abdul Mujid, A., Zailina, H., Juliana, J. and Shamsul Bahri. M. T. 2003. Partikel Ternafas (PM10) dan hubungannya dengan sistem respiratori di kalangan kanak-kanak sekolah Sungai Siput Utara, Perak. *Malaysian Journal Public Health Med*., 3: 23-32

Aridvidya (2001). Concentration of Indoor PM_{10} in Schoos and at Homes and the Prevalence of Acute and Chronic Respiratory Symptoms among Primary School Children in Serdang, Selangor. B.Sc. (Kesihatan Persekitaran dan Pekerjaan) UPM

Arizona Department of Environmental Quality (ADEQ) (1995). Guide to Agricultural PM10 Best Management Practices. Retrieved from www.azdeq.gov/environ/air/index.html

Arizona Department of Environmental Quality (ADEQ) (1995). Guide to Agricultural PM10 Best Management Practices. Retrieved from www.azdeq.gov/environ/air/index.html

Arslan, S., Aybek, A., & Hasan C., E. (2010). Measurement of Personal PM10, PM2.5 and PM1 Exposures in Tractor and Combine Operations and Evaluation of Health Disturbances of Operators. *Journal of Agricultural Sciences* .104-115.

Ashmore, M. R., & Dimitroulopoulou, C. (2009). Personal exposure of children to air pollution. *Atmospheric Environment, 43*(1), 128-141. doi: 10.1016/j.atmosenv.2008.09.024

Atkinson, R., Bremner, S., Anderson, H., Strachan, D. and Bland, J. M. (1999). Short-term Association between Emergency Hospital Admissions for Respiratory and Cardiovascular Disease and Outdoor Air Pollution in London. *Arch Environ health*; 54(6): 399-411

ATS (1978) Recommended Respiratory Disease Questionnaires for Use with Adults and Children in Epidemiological Research. Retrieved from http://www.thoracic.org/statements/resources/archive/rrdquacer.pdf

Ayana, I. G., & Sarah, H.(1991) Passive Smoking among Schoolchildren in Israel. *Environmental Health Perspectives*. Vol. 96, pp. 203-211

© COPYRIGHT UPM

Azizi, B. H., & Henry, R. L. (1990).Effect of Indoor Air Pollution on Lung Function od Primary School Children in Kuala Lumpur. *PediatricPulmonol* 9(1), 9-24

Azizi, B. H., & Henry, R. L. (1991).Effect of Indoor Environment Factors on Respiratory Illness in Primary School Children in Kuala Lumpur. *International Journal of Epidemiology* 20, 144-150

Canha, N., Martinho, M., Silva, M. A.,Freitas, M. D. C., Almeida, S. M.,Pegas, P.,… Contreiras, T. (2007). Indoor air quality in primary schools. *Kos Greece*, 312-316

Center for Disease Control and Prevention (CDC). (2012).Bronchitis (Chest Cold). Retrieved from http://www.cdc.gov/getsmart/antibiotic-use/uri/bronchitis.html

Department of Environment (DOE), Malaysia. (2010). *MALAYSIA Environmental Quality Report.*

El-Fadel, M., & Massoud, M. (2000). Particulate matter in sub-urban areas: Health-based economic assessment. *Science of the Total Environment, 257*(2–3), 133-146. doi: 10.1016/S0048-9697(00)00503-9

Environment Protection Agency (EPA). (2008). Children's Environmental Health 2006 Reports. Retrieved fromhttp://yosemite.epa.gov/ochp/ochpweb.nsf/content/2008_highlights.htm/file/OCHP_2008_Highlights_508.pdf

Environment Protection Agency (EPA). (2012). Particulate Matter (PM10). Retrieved from http://www.epa.gov/airtrends/aqtrnd95/pm10.html

Enviropedia. (2012). Rural Air Quality. Retrived from http://www.enviropedia.org.uk/Air_Quality/Rural_Air_Quality.php

Epton, M. J., Dawson, R. D., Brooks, W. M., Kingham, S., Aberkane, T., Cavanagh, J. E.,… Brown, L. (2008). The effect of ambient air pollution on respiratory health of schoolchildren: a panel study.*Environmental Health*, 7:16 doi:10.1186/1476-069X-7-16

Fierro, M. (2000).Particulate Matter. Retrieved from http://www.airinfonow.org/pdf/Particulate_Matter.pdf

Freitas, M. D. C. et al.(2007). Advanced Topics in Environmental Health and Air Pollution Case Studies.Indoor Air Quality in Primary Schools. *InstitutoTecnológico e Nuclear (ITN), Portugal*. 361-384

© COPYRIGHT UPM

Fuad, M. J., Junaidi, A. B., Habibah, A., Hamzah, J., Toriman, M. E., Lyndon, N.,... Selvad. (2012). The impact of pesticides on paddy farmers and ecosystem. *The free library*. Retrived September 29, 2012

Gaffin, J.M., Shotola, N. L., Martin, T. R, & Phipatanakul, W. (2010). Clinically Useful Spirometry in Preschool-Aged Children: Evaluation of the 2007. *American Thoracic Society GuidelinesJ Asthma* 47(7): 762–767. doi:10.3109/02770903.2010.485664

Gaffney, P. & H. Yu (2003). Computing Agricultural PM_{10} Fugitive Dust Emissions Using Process Specific Emission Rates and GIS Poster. California Air Resources Board. Presented at EPA 12th International Emission Inventory Conference April 2003.

Gillian Air Sampler (2012, October), Respirable Dust Specified in NIOSH Respirable Dust Methods. Retrieved from http://www.Gillianinc.com/pumps/224-52.asp

Heinrich, J., & Slama, R. (2007). Fine particles, a major threat to children. *International Journal of Hygiene and Environmental Health, 210*(5), 617-622. doi: 10.1016/j.ijheh.2007.07.012

Ismail. M., NurZafirah, M. S., AhmadMakmon, A. EnvironmentAsia 3(special issue) (2010) 103-108. Retrieved from www.tshe.org/EA

Janssen,N. A. H., Hoek, G., Brunekreef, B.,Harssema, H.,Mensink, I., & Zuidhof, A. (1998). Personal Sampling of Particles in Adults: Relation among Personal, Indoor,and Outdoor Air Concentrations. *American Journal of Epidemiology 147 (6),533-547*

Juliana, J., Zailina, H., Nasir, M. T., Syarif, H.,L. & Jamal, J. J.(2002). Perbandingan pengaruh persekitran kediaman terhadap serangan asma di antara kanak-kanak Kuala Lumpur dengan Terengganu, Malaysia. *Jurnal Kesihatan Masyarakat*. Jilid 18.

Junaidah, Z., Lye, M. S. and Zailina, H. (2012). Asthma Severity and Environmental Health Risk Factor among Asthmatic Primary Shool Children in Selected Areas. *American Journal Applied Sciences*., 9(10) : 1553-1560

Juneng, L., Latif, M. T., & Tangang, F. (2011). Factors influencing the variations of PM10 aerosol dust in Klang Valley, Malaysia during the summer. *Atmospheric Environment*45, 4370-4378. doi:10.1016/j.atmosenv.2011.05.045

Kakooei, H., & Marioryad,H. (2005). Exposure to Inhalable Flour Dust and Respiratory Symptoms of Workers in a Flour Mill in Iran Iranian. *Journal Environmental Health Sciences English,* 2(1), 50-55

Kerrebijn K. F., & Mourmans, A. R. M. (1975). Study on relationship of air pollutant to respiratory disease in schoolchildren. *Environmental Research* 10, 14-28

Kildeso, J., Tornvig, L., Skov, P. and Schneider, T. (1998) An intervention study of the effect of improved cleaning methods on dust concentration and on dust composition. Indoor Air. 8, 12-22.

Kim, J. H., Lim, D. H., Kim, J. K., Jcong, S. J., & Son, B. K (2006) Effects of Particulate Matter (PM10) on The Pulmonary Function of Middle-School Children. *Journal Korean Medical Sciences* 20, 42-5

Kirkhorn, S. R., & Garry, V. F. (2000). Agricultural lung diseases. *Environmental Health Perspectives*, 108-4

Koenig, J. Q., Larson, T. V., Hanley, Q. S., Rebolledo, V., Dumler, K., Checkoway, H.,… Pierson, W. E. (1993). Pulmonary function changes in children associated with fine particulate matter. *Environmental Research, 63*(1), 26-38. doi: 10.1006/enrs.1993.1123

Langkulsen, U., Jinsart, W., Karita, K., & Yano, E. (2006). Health effects of respirable particulate matter in bangkok schoolchildren. *International Congress Series, 1294*(0), 197-200. doi: 10.1016/j.ics.2006.03.019

Latif, M. T., Baharudin, N. H., Mohamad, Z., & Mokhtar, N. M. (2011). Lead in PM10 and in Indoor Dust Around Schools and Preschools in Selangor, Malaysia. *Indoor Built Environment,* 20(3):346–353. doi: 10.1177/1420326X11402433

Lee, Y. L., Wang, W., Lu, C., Lin, Y., & Hwang, B. (2011). Effects of ambient air pollution on pulmonary function among schoolchildren. *International Journal of Hygiene and Environmental Health, 214*(5), 369-375. doi: 10.1016/j.ijheh.2011.05.004

Majra J. P. (2012). Air Quality in Rural Areas.*InTech*, 619-638

Mastura, M., & Siti Haslina, M,S. (2012). Perbandingan kualiti udara antara tahun 2002 dan 2003 di kawasan padi sewaktu pembakaran jerami di Mergong, Kedah. *GEOGRAFIA OnlineTM Malaysia Journal of Society and Space,* 8 issue 3 (33 - 42)

Mauskar, J. M. (2008). Study on Ambient Air Quality, Respiratory Symptoms and Lung Function of Children in Delhi. *Environmental Health Series*, 25-32

Maynard, R., L. & Howard, C., V. (1999). Particulate matter: Properties and effects on health. Garland Publishing.

McCormack, M. C., Breysse, P. N., Hansel, N. N., Matsui, E. C., Tonorezos, E. S., Curtin-Brosnan, J., Diette, G. B. (2008). Common household activities are associated with elevated particulate matter concentrations in bedrooms of inner-city baltimore pre-school children. *Environmental Research, 106*(2), 148-155. doi: 10.1016/j.envres.2007.08.012

Merkus P. J. F. M. and. Hislop A. A. Lung development from infancy to adulthood *Respiratory Diseases in Infants and Children July 1, 2010 1:8-21*

Monn, C., Fuchs, A., Högger, D., Junker, M., Kogelschatz, D., Roth, N., & Wanner, H. (1997). Particulate matter less than 10 µm (PM10) and fine particles less than 2.5 µm (PM2.5): Relationships between indoor, outdoor and personal concentrations. *Science of the Total Environment, 208*(1–2), 15-21. doi: 10.1016/S0048-9697(97)00271-4

Musa, R., Naing, L., Ahmad, Z., & Kamarul, Y. (2000). Respiratory Health of Rice Millers in Kelantan,Malaysia.*Southeast Asian J Trop Med Public Health.*31(3):575-8

NIOSH Manual Analytical Methods (NMAM) (2012). Particles not otherwise regulated, respirable 0600. Retrieved from http://www.cdc.gov/niosh/docs/2003-154/pdfs/0600.pdf

Nordstroma, K., F. & Hottab S (2004). Wind erosion from cropland in the USA: a review of problems, solutions and prospects. *Geoderma* 121: 157-167

NRCD (2012). The Five Worst Environmental Threats to Their Health. Retrieved from http://www.nrdc.org/health/kids/ocar/chap4.asp

Oanh, N. T. K.,Bicha, T. L.,Tipayaroma, D., Manadhara, B. R., Prapata, P.,Simpsonb, C. D., &Liub, L. J. S. (2001).Characterization of Particulate Matter Emission from Open Burning of Rice Straw. *Atmos Environ* 45(2): 493–502. doi:10.1016/j.atmosenv.2010.09.023.

Parmod, K., & Surender, Kumar., (2010). Valuing the Health Effects of Air Pollution from Agricultural Residue Burning. *Institute for Social and Economic Change (ISEC).* 1-33.

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Pavilonis, B. T.(2012). Rural air quality and respiratory health.*Iowa Research Online*,1-103

Pegas, P. N., Evtyugina, M. G., Alves, C. A., Nunes, T., Cerquirea, M., Pio, M. F. C.(2010). Outdoor/Indoor Air Quality in Primary Schools in Lisbon: A Preliminary Study.*Quim. Nova, 33(5),* 1145-1149

Pejabat Pertanian Kuala Selangor Utara (2009). Aktiviti-AktivitiPenanamanPadiKawasanTanjongKarang.. Retrieved from http://padiksu.blogspot.com/2009/01/laporan-padi-selangor.html

Polichetti, G., Cocco, S., Spinali, A., Trimarco, V., &Nunziata, A. (2009). Effects of particulate matter (PM10, PM2.5 and PM1) on the cardiovascular system. *Toxicology, 261*(1–2), 1-8. doi: 10.1016/j.tox.2009.04.035

Prado, G. F., Zanetta, D. M. T., Arbex, M. A., Braga, A. L., Pereira, L. A. A., de Marchi, M. R. R., de Paula Santos, U. (2012). Burnt sugarcane harvesting: Particulate matter exposure and the effects on lung function, oxidative stress, and urinary 1-hydroxypyrene. *Science of the Total Environment, 437*(0), 200-208. doi: 10.1016/j.scitotenv.2012.07.069

Salvi, S. (2007). Health effects of ambient air pollution in children.*Paediatric Respiratory Reviews, 8*(4), 275-280. doi: 10.1016/j.prrv.2007.08.008

Scapellato, M. L., Canova, C., de Simone, A., Carrieri, M., Maestrelli, P., Simonato, L., & Bartolucci, G. B. (2009). Personal PM10 exposure in asthmatic adults in padova, italy: Seasonal variability and factors affecting individual concentrations of particulate matter. *International Journal of Hygiene and Environmental Health, 212*(6), 626-636. doi: 10.1016/j.ijheh.2009.06.001

Schenker M, Christiani D, Cormier Y, Dimich-Ward H, Doekes G, Dosman J, et al. American thoracic society: Respiratory health hazards in agriculture. Am J Respir Crit Care Med. 1998;158(suppl 4):S1-S76.

Schwartz DA. Etiology and pathogenesis of airway disease in children and adults from rural communities. Environ Health Perspect. 1999;107(Suppl 3):393. SECA Body Meter.(2012, October). Retrieved from http://www.medshop.co.nz/seca-206-body-meter-scale

Schwartz J, et. Al. Particulate Air Pollution and Hospital Emergency Room Visits for Asthma in Seattle. Am Rev Respir Dis 1993; 147: 826-831.

SECA Body Weight.(2012, October). Retrieved from http://www.fitnessbodyequipment.com/ specialty/ personal/seca_762_personal_scale.html

Shendell, D. G., Therkorn, J. H., Yamamoto, N., Meng, Q., Kelly, S. W., & Foster, C. A. (2012). Outdoor near-roadway, community and residential pollen, carbon dioxide and particulate matter measurements in the sub-urban core of an agricultural region in central CA. *Atmospheric Environment, 50*(0), 103-111. doi: 10.1016/j.atmosenv.2011.12.056

Smith, K. R., Samet, J. M.,Romieu, I., & Bruce, N.(2000).Indoor air pollution in developing countries andacute lower respiratory infections in children.*Thorax*55:518–532

Sofia, I. V., Catarina, F., Maria, C. M. A., Luisa, G. V., Agostinho, J. M., & Fernando, G. M. (2012). Indoor air pollution on nurseries and primary schools: impact on childhood asthma – study protocol. *BMC Public Health* 12:435

Spirolab II Model. (2012, October). Retrieved from http://www.sdidiagnostics.com/spirometers/ spirolab.php

Tang, C., Chang, L., Lee, H., & Chan, C. (2007). Effects of personal particulate matter on peak expiratory flow rate of asthmatic children. *Science of the Total Environment, 382*(1), 43-51. doi: 10.1016/j.scitotenv.2007.04.016

Tipayarom, D. (2004) Development of a management program to reduce impacts of open agro-residue burning on air quality. M. Eng. Thesis, Asian Institute of Technology, Thailand, August 2002.

U.S. National Library of Medicine.(2012). Wheezing and breathlessness.*National Institutes of Health*. Retrieve from http://www.nlm.nih.gov/medlineplus/ency/article/003070.htm

Villamizar, L. A. R., Ortiz, H.C., & Serrano, J. J. R. (2012). The effects of air pollution on respiratory health in susceptible populations: a multilevels study in Bucaramanga, Colombia.Cad.SaúdePública, Rio de Janeiro, 28(4):749-757.

Wallner, P., Kundi, M., Moshammer, H., Piegler, K., Hohenblum, P., Scharf, S., & Hutter, H. (2012). Indoor air in schools and lung function of austrian school children. *Journal of Environmental Monitoring, 14*(7), 1976-1982.

Wang, J., Sammis, T. W., Miller, D. R., Hiscox, A. L., Granucci, D., Holmen, B., Kasumba, J., &Shukla, M. K.(2010) Simulate PM10 Transport from Agricultural Tilling Operations Using Hysplit4. Transactions of the ASABE 51(5): 1763-1774.

WHO (2010) Guidelines for Indoor Air Quality. In Selected Pollutants, World Health. Retrieved from http://www.who.int/mediacentre/factsheets/fs313/en/index.html

Yip, F. Y., Keeler, G. J., Dvonch, J. T., Robins, T. G., Parker, E. A., Israel, B. A., & Brakefield-Caldwell, W. (2004). Personal exposures to particulate matter among children with asthma in detroit, michigan. Atmospheric Environment, 38(31), 5227-5236. doi: 10.1016/j.atmosenv.2004.06.006

Zailina, H., Juliana, J.,& Jamal, H. H. (2004). Comparison of Lung Functions Among Asthamatic Chidren in Malaysia. *Pertanika J. Sci. & Technol*. Vol.12 No, 1.

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APPENDIX 1

Gantt chart

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PLANNING/MONTH	2012				2013				
	SEPT	OCT	NOV	DEC	JAN	FEB	MAC	APR	MAY
Propose title for the project									
Submit the proposal									
Title presentation									
Attach Supervisor									
Permission letter to selected school									
Submission on methodology									
Proposal presentation									
Pre-test questionnaire									
Resubmission of proposal									
Ethical approval									
Receive approval letter from the selected school									
Visit the study location									
Give and collect the consent letter from respondents									
Collect data									
Analyse data									
Preparing the complete thesis									
Submission of final thesis									

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APPENDIX 2

Subject Information Sheet, Parents Consent Letter and Respondents Consent Form

(Bahasa Melayu)

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FAKULTI PERUBATAN DAN SAINS KESIHATAN
FACULTY OF MEDICINE AND HEALTH SCIENCES
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR, MALAYSIA

HELAIAN PENERANGAN RESPODEN

Sila baca maklumat berikut dengan teliti, sila bertanya untuk membincangkan apa-apa soalan yang anda ada dengan penyelidik anda.

TAJUK KAJIAN

Pendedahan kepada partikel ternafas (PM 10) dan hubungannya dengan fungsi paru-paru dalam kalangan kanak-kanak sekolah rendah di Tanjung Karang, Selangor.

PENGENALAN

Kajian ini dijalankan bagi mengenalpasti hubungan di antara pendedahan kepada partikel ternafas (PM 10) dengan fungsi paru-paru dalam kalangan kanak-kanak sekolah rendah berhampiran sawah padi dan kumpulan perbandingan. Kanak-kanak sekolah rendah berhampiran sawah padi terdedah dengan debu yang dihasilkan daripada aktiviti-aktiviti di sawah padi berhampiran seperti membajak tanah, membaja dan menuai. Manakala, kanak-kanak sekolah rendah yang bersekolah jauh dari kawasan sawah padi tetapi di daerah yang sama telah dipilih sebagai kumpulan perbandingan.

APAKAH YANG PERLU ANDA LAKUKAN?

Responden akan diberi borang soal selidik dan dikehendaki menjawab dengan jujur. Selain itu, responden juga akan dipasangkan dengan pam persampelan udara individu bagi mengukur kualiti udara yang disedut oleh setiap individu. Ujian tahap fungsi paru-paru pula akan dilakukan kepada semua responden dengan menggunakan spirometer.

SIAPA YANG SEPATUTNYA TIDAK MENYERTAI KAJIAN INI?

Antara yang tidak dibenarkan untuk mengambil bahagian dalam kajian ini adalah kanak-kanak sekolah yang mempunyai masalah kesihatan fizikal dan kanak-kanak yang berumur 12 tahun yang akan menduduki peperiksaan Ujian Penilaian Sekolah Rendah (UPSR).

APAKAH FAEDAH MENYERTAI KAJIAN INI:

(a) KEPADA ANDA SEBAGAI PESERTA?

Kajian ini akan menjelaskan samada pendedahan kepada partikel ternafas (PM 10) boleh mengakibatkan masalah kepada paru-paru atau tidak kepada kanak-kanak sekolah rendah. Andainya kepekatan partikel ternafas (PM 10) adalah tinggi dan memberi kesan kepada responden, maklumat kajian ini berguna untuk tindakan selanjutnya. Melalui kajian ini juga, responden dapat menentukan samada mengalami masalah sistem pernafasan atau tidak tanpa dikenakan sebarang bayaran dan berfaedah untuk responden.

b) KEPADA PENYELIDIK?

Penyelidik dapat mengetahui cara-cara penggunaan alat dengan betul dan menjadikan penyelidik mahir dalam penggunaannya. Selain itu, penyelidik juga dapat melakukan pengajaran kesihatan (health education) kepada responden. Data yang diperolehi daripada kajian ini dapat digunakan bagi melengkapkan projek ilmiah tahun akhir.

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ADAKAH IA BERISIKO?

Ianya tidak berisiko kepada responden

APAKAH PILIHAN UNTUK MENARIK DIRI DARIPADA PENYELIDIKAN INI?

Kajian ini melibatkan anda secara sukarela. Oleh itu, responden mempunyai hak untuk menarik diri daripada penyertaan dalam kajian ini pada bila-bila masa sekiranya peserta merasa tidak selesa untuk memberikan maklumat kepada penyelidik.

ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Semua maklumat yang diberikan oleh responden di dalam borang kaji selidik adalah dijamin sulit. Tiada huraian berkaitan individu akan dibuat pada mana-mana bahagian di dalam kajian atau penerbitan.

SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEMASA MENGIKUTI PENYELIDIKAN INI?

Sekiranya anda mempunyai sebarang kemusykilan, pengkaji akan membantu untuk memberi maklumat yang selanjutya.

Terima kasih atas kerjasama dan bantuan anda.

NURUL AIDA BINTI MUHAMAD
Pelajar Tahun Akhir
Bacelor Sains Kesihatan Persekitaran dan Pekerjaan

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BORANG PERSETUJUAN (IBU BAPA/PENJAGA)

TAJUK KAJIAN :

PENDEDAHAN KEPADA PARTIKEL TERNAFAS (PM 10) DAN HUBUNGANNYA DENGAN FUNGSI PARU-PARU DALAM KALANGAN KANAK-KANAK SEKOLAH RENDAH DI TANJUNG KARANG, SELANGOR.

PENYELIDIK :

NURUL AIDA BINTI MUHAMAD

Saya ....No. Kad Pengenalan..
beralamat...
.... Dengan ini secara sukarela bersetuju anak/ anak jagaan* saya untuk mengambil bahagian dalam penyelidikan klinikal * (pengajian klinikal / pengajian soal selidik / percubaan ubat-ubatan) yang dinyatakan di atas.

Saya telah diberi penjelasan secara menyeluruh mengenai dasar penyelidikan klinikal dari segi metadologi, risiko dan komplikasi (dirujuk pada Helaian Kepada Responden). Saya memahami bahawa anak/ anak jagaan * saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan. Saya juga memahami bahawa sebarang maklumat berkaitan identiti anak/anak jagaan* saya akan dirahsiakan.

Saya berminat/ tidak berminat* untuk mengetahui keputusan ujian yang dijalankan ke atas sampel anak/anak jagaan* saya.

* potong yang tidak berkenaan

Tandatangan .... (*Ibu bapa/ Penjaga*)

Tarikh :...

Tandatangan .... (*Saksi*)

Nama :...

No. K/P: ....

Saya mengesahkan bahawa saya telah menerangkan kepada Ibu bapa/penjaga sifat dan tujuan penyelidikan klinikal tersebut di atas.

Tarikh ....

Tandatangan .... (Penyelidik)

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BORANG PERSETUJUAN (RESPONDEN)

TAJUK KAJIAN :

PENDEDAHAN KEPADA PARTIKEL TERNAFAS (PM 10) DAN HUBUNGANNYA DENGAN FUNGSI PARU-PARU DALAM KALANGAN KANAK-KANAK SEKOLAH RENDAH DI TANJUNG KARANG, SELANGOR.

PENYELIDIK :

NURUL AIDA BINTI MUHAMAD

Saya ....No. Kad Pengenalan.......................................
beralamat...
.... Dengan ini secara sukarela bersetuju untuk mengambil bahagian dalam penyelidikan klinikal * (pengajian klinikal / pengajian soal selidik / percubaan ubat-ubatan) yang dinyatakan di atas

Saya telah diberi penjelasan secara menyeluruh mengenai dasar penyelidikan klinikal dari segi metadologi, risiko dan komplikasi (dirujuk pada Helaian Kepada Responden). Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan. Saya juga memahami bahawa sebarang maklumat berkaitan identiti saya akan dirahsiakan.

Saya berminat/ tidak berminat* untuk mengetahui keputusan ujian yang dijalankan ke atas sampel saya.

* potong yang tidak berkenaan

Tandatangan ....
(*Responden*)

Tarikh :..

Tandatangan ....
(*Saksi*)

Nama :..

No. K/P: ....

Saya mengesahkan bahawa saya telah menerangkan kepada responden sifat dan tujuan penyelidikan klinikal tersebut di atas.

Tarikh ....

Tandatangan ....
(Penyelidik)

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APPENDIX 3

Questionnaire (Bahasa Melayu)

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SELANGOR, MALAYSIA

Pendedahan kepada partikel ternafas (PM 10) dan hubungannya dengan fungsi paru-paru dalam kalangan kanak-kanak sekolah rendah di Tanjung Karang, Selangor.

Dengan ini sukacita dimaklumkan bahawa anda telah disenaraikan sebagai salah seorang responden dalam satu kajian penyelidikan yang mengkaji hubungan antara pendedahan kepada partikel ternafas (PM 10) dan hubungannya dengan fungsi paru-paru. Oleh yang demikian saya memohon jasa baik anda untuk menjawab soalan-soalan yang terdapat dalam borang selidik ini secara tepat dan jujur. Segala maklumat kajian yang diterima akan dirahsiakan. Kerjasama dari pihak anda amatlah dihargai.

No Responden : | | | | | | |

Tarikh : | | | | | | |

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A. MAKLUMAT PERIBADI KANAK-KANAK DAN KELUARGA

1. No.responden: ☐☐☐

2. Tinggi kanak-kanak: ____________cm Berat kanak-kanak: ____________kg

3. Umur: ________tahun

4. Tarikh lahir: __________hari ___________bulan________tahun

5. Bilangan adik-beradik:__________(orang)

6. Tahun Persekolahan:_____________

7. Nama sekolah: ____

8. Jantina: ☐ Lelaki ☐ Perempuan

9. Bangsa: ☐ Melayu ☐ Cina ☐ India ☐ Lain-lain

10. Tahap pendidikan bapa:

☐ Sekolah rendah ☐ PMR/SRP ☐ SPM ☐ STPM/Diploma

☐ Ijazah/Master/PHD

11. Tahap pendidikan ibu:

☐ Sekolah rendah ☐ PMR/SRP ☐ SPM ☐ STPM/Diploma

☐ Ijazah/Master/PHD

12. Pekerjaan bapa:____

13. Pekerjaan ibu:____

14. Pendapatan bapa: RM________________

15. Pendapatan ibu: RM_________________

16. Pendapatan isi rumah: RM_______.____sebulan

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17. Tempat di mana kanak-kanak di lahirkan. Bandar:_____________ Negeri: ___________

18. Sudah berapa lama kanak-kanak tinggal di alamat sekarang:_______tahun________bulan

19. Sila senaraikan tempat-tempat dimana kanak-kanak ini pernah tinggal selama 6 bulan atau lebih sejak lahir hingga sekarang

a) ____

b) ____

B. MAKLUMAT PERSEKITARAN DALAM RUMAH

1. Berapa buah bilikkah yang terdapat di dalam rumah ini? ________bilik

2. Berapa orangkan yang tinggal di dalam rumah ini? _______orang

3. Kanak-kanak ini tidur/tinggal di dalam bilik

☐ Sendiri ☐ berkongsi dengan 2 orang

☐ Berkongsi dengan 3 orang ☐ berkongsi dengan ≥4orang

4. Apakan bahan api yang digunakan untuk memasak?

☐ Elektrik ☐ Minyak tanah ☐ Kayu api ☐ Gas ☐ Arang

5. Berapa kali dalam sehari anda gunakan untuk memasak? ______kali sehari

6. Semasa anda memasak, adakah anda membuka tingkap atau pintu untuk membenarkan pengaliran udara di dalam rumah?

☐ Ya ☐ Tidak

7. Alat apakah yang digunakan untuk menyejukkan udara di dalam rumah?

☐ Penyaman udara ☐ kipas ☐ lain-lain _________(sila nyatakan)

8. Adakah anda mempunyai binatang peliharaan di dalam rumah?

☐ Ya ☐ Tidak

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9. Jika 'Ya', sila nyatakan: _______________

10. Adakah anda menggunakan bahan tertentu untuk mengelakkan serangan nyamuk?

☐ Ya ☐ Tidak

10a. Jika 'Ya' jenis apakah yang selalu digunakan?

☐ Lingkaran biasa ☐ Semburan aerosol ☐ Elektrik

☐ lain-lain:_______________(sila nyatakan)

10b. Berapa kerapkah anda menggunakannya dalam seminggu? _________kali seminggu

10c. Dimanakah ianya ditempatkan di dalam rumah?

☐ Di ruang tamu sahaja ☐ Di bilik tidur ☐ Di bilik tidur dan ruang tamu

11. Adakah terdapat sesiapa/ahli keluarga anda yang merokok di persekitaran dalam rumah? (bermaksud sekurang-kurangnya 1 batang rokok sehari atau 1 aun tembakau dalam masa sebulan) Jika TIDAK teruskan ke no.14

☐ Ya ☐ Tidak

12. Senaraikan individu yang merokok di dalam rumah

☐ Bapa ☐ Bapa saudara ☐ Abang ☐ Datuk

☐ Lain-lain:__________(sila nyatakan)

13. Berapa batang rokokkah yang dihisap oleh individu di atas (di persekitaran di dalam rumah anda sahaja)? ___________batang sehari

14. Apakah alat yang digunakan untuk membersihkan rumah anda? Sila nyatakan:_____________________________

15. Berapa kerapkah dalam seminggu anda membersihkan rumah anda? ______________kali seminggu

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16. Adakah anda menggunakan karpet di kediaman anda?

☐ Ya ☐ Tidak

C. MAKLUMAT PERSEKITARAN LUAR RUMAH

1. Bahan binaan rumah kanak-kanak

☐ Batu/simen ☐ Kayu/papan ☐ Lain/lain:____________(sial nyatakan)

2. Lokasi rumah dari jalan raya

☐ <100 meter dari jalan raya

☐ >100-500 meter dari jalan raya

☐ >500-1000 meter dari jalan raya

☐ >1000 meter dari jalan raya

3. Lokasi rumah dari kilang

☐ <500 meter dari kilang

☐ >1-1.5 kilometer dari kilang

☐ > 1.5-3 kilometer dari kilang

☐ > 3 kilometer dari kilang

5. Lokasi rumah dari kawasan sawah padi

☐ <500 meter dari sawah padi

☐ >1-1.5 kilometer dari sawah padi

☐ > 1.5-3 kilometer dari sawah padi

☐ > 3 kilometer dari sawah padi

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6. Apakah pendapat anda mengenai persekitaran sekolah anda?

- [ ] Sangat berhabuk
- [ ] Sederhana berhabuk
- [ ] Kurang berhabuk

7. Apakah kenderaan yang digunakan oleh anak anda untuk ke sekolah?

[ ] Kereta [ ] Basikal [ ] Berjalan kaki [ ] Bas [ ] Motosikal

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Soalan-soalan berikut merupakan soalan-soalan mengenai taraf kesihatan di bahagian dada anak anda, sila berikan jawapan sama ada **'YA' atau 'TIDAK'** jika anda tahu jawapannya. Jika didapati soalan tersebut tidak merujuk pada anak tuan, sila tandakan pada bahagian tidak berkenaan.jika sekiranya anda ragu-ragu sama ada jawapannya 'YA' atau 'TIDAK' sila tandakan 'TIDAK'.

D. MAKLUMAT TARAF KESIHATAN KANAK-KANAK

BATUK/*COUGH*

		YA	TIDAK
1.	Adakah anak anda selalu mengalami batuk beserta selsema?		
2.	Adakah anak anda mengalami batuk sahaja?		
	2a. Jika YA (soalan 1&2), adakah dia batuk pada keseluruhan hari (4 hari atau lebih dalam masa seminggu atau selama 3 bulan berturut-turut dalam masa setahun)		
	2b. Sudah berapa tahunkah anak anda mengalami batuk seperti ini? ______________________tahun		

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KAHAK/*PHLEGM*

		YA	TIDAK
1.	Adakah anak anda selalu mengalami kesesakan nafas serta mengeluarkan kahak dan mengalami selsema?		
	1a. Jika YA (soalan1&2), adakah anak anda mengalami kesesakan nafas dan mengeluarkan kahak pada keseluruhan hari (4 hari atau lebih dalam masa seminggu atau selama 3 bulan berturut-turut dalam masa setahun)		
	1b. Sudah berapa lamakah anak anda mengalami masalah seperti ini? ______________bulan/tahun		
2.	Adakah anak anda pernah mengalami serangan batuk,kesesakan nafas atau berkahak dalam masa seminggu atau lebih dalam masa setahun?		
	2a. Jika YA (soalan di atas), sudah berapa lamakah masalah ini berlaku? __________bulan/tahun		

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DADA BERBUNYI/*WHEEZING*

1.	Adakah anak anda selalu mengalami masalah pernafasan berbunyi di bahagian dada?	**YA**	**TIDAK**
	1a. Apabila anak anda mengalami selsema?		
	1b. kadangkala walaupun tidak mengalami selsema		
	1c. Hampir setiap hari (waktu siang dan juga malam)		
	1d. Jika YA (soalan di atas), sudah berapa lamakah anak anda mengalami masalah ini (dada berbunyi) ________________ bulan/tahun		
2.	Adakah anak anda pernah mengalami serangan dada berbunyi yang menyebabkan anak anda mengalami masalah kesesakan nafas?		
3.	Adakah anak anda mengalami masalah ini setelah anak anda melakukan aktiviti seperti senaman atau latihan?		

KESAKITAN DADA/*CHEST PAIN*

		YA	**TIDAK**
1.	Sejak 3 tahun lepas, adakah anak anda pernak mengalami kesesakan bahagian dada yang menghalang anak anda daripada melakukan aktiviti biasa selama 3 hari? **Jika YA sila jawab soalan seterusnya.**		
	1a. Adakah anak anda mengeluarkan kahak atau mengalami kesesakan nafas lain daripada keadaan biasa selain dari mengalami penyakit ini?		

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2.	Adakah anak anda pernah dimasukkan ke hospital kerana mengalami masalah jangkitan di dada yang serius sebelum berumur 2 tahun?		

E. PENYAKIT-PENYAKIT LAIN

		YA	TIDAK
1.	Adakah doktor pernak mengatakan bahawa anak anda mengalami 'eczema' (gatal kulit) sebelum berumur 2 tahun?		
2.	Adakah doktor pernah mengatakan bahawa anak anda menghidap asma?		
3.	Adakah anak anda mempunyai penyakit-penyakit seperti berikut? Jika YA, pada umur berapakah ia didiagnoskan mengalami penyakit berikut?		

		YA	TIDAK	(Umur didiagnoskan)
a)	Campak			
b)	Bronkitis			
c)	Emfisema			
d)	Asma (lelah)			
e)	Pneumonia (Jangkitan paru-paru)			
f)	Lain-lain			

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ALERGI/ALAHAN

	YA	TIDAK
1. Adakah doktor pernak mengatakan bahawa anak anda mengalami alahan kepada makanan atau ubatan tertentu?		
1a. YA, kepada makanan tertentu sahaja. Nyatakan:_____________		
1b. YA, kepada ubatan tertentu sahaja. Nyatakan:_____________		
1c. YA, kepada makanan dan ubatan tertentu sahaja. Nyatakan:____________		
2. Adakah doktor pernaH mengatakan bahawa anak anda mengalami alahan kepada debu?		
3. Adakah doktor pernak mengatakan bahawa kulit anak anda mengalami alahan kepada detergen atau bahan kimia tertentu?		
4. Adakah ia mengambil suntikan untuk mengurangkan masalah alahan tersebut?		

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F. SEJARAH KESIHATAN KELUARGA

Adakah ahli keluarga seperti ibu bapa, adik beradik atau keluarga mengalami masalah-masalah berikut:

	YA	TIDAK
1. Bronkitis kronik		
2. Emfisema		
3. Asma		
4. Barah paru-paru		
5. Lain-lain penyakit ______________________		

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APPENDIX 4

Ethic, Ministry of Education and Selangor Education Department Approval Letter

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APPENDIX 5

Pictures during Data Collection

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Studied children with personal air pump

Studied children perform spirometry test