UNIVERSITI PUTRA MALAYSIA

THE ASSESSMENT OF ALLERGY AND RESPIRATORY SYMPTOMS AMONG SECONDARY SCHOOL STUDENTS IN KOTA KINABALU: INFLUENCE OF MICROORGANISMS IN SCHOOL ENVIRONMENT

SITI RAIHAN MOHD FUAD

THE ASSESSMENT OF ALLERGY AND RESPIRATORY SYMPTOMS AMONG SECONDARY SCHOOL STUDENTS IN KOTA KINABALU: INFLUENCE OF MICROORGANISMS IN SCHOOL ENVIRONMENT

BY

SITI RAIHAN MOHD FUAD

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

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to the Almighty Allah. With the blessing of Him, I have been able to complete the thesis entitled 'The Assessment of Allergy and Respiratory Symptoms among Secondary Schools Students in Kota Kinabalu: Influence of Microorganisms in School Environment'.

My greatest gratitude goes to my dedicated supervisor, Prof. Dr. Zailina Hashim for her guiding, support and outstanding supervising. Her wide knowledge, experience and unflagging encouragement were instrumental. Special thanks to my co-supervisor, Associate Prof. Dr. Shamsul Bahari Shamsudin, Prof Jamal Hisham Hashim and medical doctors from Universiti Malaysia Sabah for the collaboration and being supportive throughtout the data collection.

I am indebted beyond the words to the all schools and the teachers involved that give a good cooperation in this study. Thank you to all the students and parents for participate in order to complete this study.

ABSTRACT

THE ASSESSMENT OF ALLERGY AND RESPIRATORY SYMPTOMS AMONG SECONDARY SCHOOL STUDENTS IN KOTA KINABALU: INFLUENCE OF MICROORGANISMS IN SCHOOL ENVIRONMENT

SITI RAIHAN MOHD FUAD

Introduction: Recently, a healthy educational building becomes a concern issue because it was related to human health especially among children. Indoor air can be contaminated by multiple pollutants such as tobacco smoke, cooking fumes, furniture, biological sources and from outdoor (vehicle and open burning). Kota Kinabalu often experiencing open burning and it affected the Air Pollutant Index (API). **Objectives:** To determine the relationship between the microorganisms in classroom indoor air with allergy and respiratory symptoms among secondary school students. **Methodology:** A cross sectional study was conducted among 316 students from Form 2 randomly selected from six schools in Kota Kinabalu. Building inspection, environmental sampling and skin prick test were conducted and a set of questionnaire adapted from International Study of Asthma and Allergies in Childhood (ISAAC) was distributed and completed by students with their parent consent. Carbon dioxide, relative air humidity and temperature were measured by using Air Velocity Meter (Model TSI 9565-P) and the bacteria and fungi were collected by using The BUCK Bio-Culture Pump (Model C102285). Skin prick test was performed for common allergens such as house dust mites, cat and mold. The data were analyzed by using SPSS version 21 and STATA statistical package 11.0. **Outcome:** Gram positive bacillus was the most frequently found in this study. The average bacterial and fungal concentrations in indoor air were 44.50 cfu/m^3 and 18.50 cfu/m^3. Findings showed, most of reported respiratory symptoms were associated with house dust mite and cat allergy. **Conclusion:** High prevalence of health symptoms reported by respondents including breathlessness after exercise and on day time, wheezing and whistling in the chest and breathlessness without flu. House dust mite (Derp 1 and Derf) were the highest prevalence reported on the allergy among the students. Parental asthma and family smoking were the risk factors to the reported health symptoms.

Keywords: Microorganisms, allergy, respiratory symptoms, skin prick test

ABSTRAK

PENILAIAN ALAHAN DAN SIMPTOM PERNAFASAN DALAM KALANGAN PELAJAR SEKOLAH MENENGAH DI KOTA KINABALU: PENGARUH MIKROORGANISMA DALAM PERSEKITARAN SEKOLAH

SITI RAIHAN MOHD FUAD

Pengenalan: Baru-baru ini, bangunan pendidikan yang sihat menjadi isu yang membimbangkan kerana ia berkaitan dengan kesihatan manusia terutamanya di kalangan kanak-kanak. Udara dalaman boleh tercemar oleh pelbagai pencemar seperti asap tembakau, asap memasak, perabot, sumber biologi dan dari luar (kenderaan dan pembakaran terbuka). Kota Kinabalu sering mengalami pembakaran terbuka dan ia mempengaruhi Indeks Pencemaran Udara (API). **Objektif:** Objektif kajian ini adalah untuk mengkaji hubungan antara mikroorganisma di dalam udara dalaman kelas dengan alahan dan symptom pernafasan dalam kalangan pelajar sekolah menengah. **Metodologi:** Satu kajian keratin rentas dijalankan dalam kalangan 316 pelajar Tingkatan Dua dipilih secara rawak dari enam buah sekolah di Kota Kinabalu. Pemantauan bangunan, kajian persekiatan dan ujian cucuk kulit (SPT) dijalankan dan satu set borang kajian soal selidik diadaptasi daripada Kajian Antarabangsa Asma dan Alahan dalam Kanak-Kanak (ISAAC) diedarkan dan dijawab oleh pelajar dengan kebenaran ibubapa. Karbon dioksida, kelembapan udara relatif dan suhu diukur menggunakan Air Velocity Meter (Model TSI 9565-P) dan bakteria dan kulat dikumpul menggunakan The BUCK Bio-Culture Pump (Model C102285). Ujian cucuk kulit dilakukan untuk alergen yang biasa seperti hama rumah, kucing dan kulat. Data dianalisis menggunakan pakej statistik untuk sains social (SPSS) versi 21 dan STATA statistic pakej 11.0. **Keputusan:**. Gram positif Bacillus adalah yang paling kerap ditemui dalam kajian ini. Purata kepekatan bakteria dan kulat dalam udara dalaman ialah 44.50 cfu/m^3 dan 18.50 cfu/m^3. Dapatan menunjukkan, kebanyakan gejala pernafasan yang dilaporkan dikaitkan dengan hama habuk rumah dan alahan kucing. **Kesimpulan:** Simptom kesihatan dalam kalangan responden seperti sesak nafas selepas senaman dan pada siang hari, mengiu dan bersiul di dada dan sesak nafas tanpa selesema mencatatkan kadar prevalen yang tinggi. Hama habuk rumah (Derp 1 dan Derf) adalah mencatatkan kadar prevalen tertinggi yang dilaporkan mengenai alahan dalam kalangan pelajar. Ibu bapa yang menghidapi asma dan ahli keluarga yang merokok adalah faktor risiko kepada gejala kesihatan yang dilaporkan.

Keywords: Mikroorganisma, alahan, symptom-simptom pernafasan, ujian cucuk kulit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

<	Less than
>	More than
°C	Degree Celcius
cfu/m^3	Colony forming unit per meter cubic
Der f	*Dermatophagoides farinae* allergen
Derp 1	*Dermatophagoides pteronyssinus* allergen
DOSH	Department of Safety and Health
HDM	House Dust Mite
IAQ	Indoor Air Quality
ICOPAQ	Industrial code of practice on indoor air quality
ISAAC	International Study of Asthma and Allergies in Childhood
MEA	Malt Extract Agar
RH	Relative Humidity
SPT	Skin Prick Test
TSA	Tryptic Soy Agar
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

The issue of healthy educational building is a global concern. The effect of indoor air quality on morbidity and mortality has been well documented among adult and children (Sundell, 2004). Annually, indoor air pollution accountable for death of 1.6 million people throughout the world. Air pollution is associated with substantial increases in medical expenses, morbidity worldwide. A report by Blacksmith Institute has listed that indoor air pollution and urban air quality as two of the world's worst pollution problems (Blacksmith Institute, 2008). The nature of different constitutions of air pollution exposure, dosage and timing give rise to vast variety of adverse health effect to human (Curtis et al,. 2006).

It is increasingly apparent that indoor environment is unique and has significant effect to the health of the occupants. School is a particularly important indoor environment for children and adolescents. The physical, chemical, biological factors and ventilation in school buildings play an important role in establishing good learning environment for children. Improvement on cleanliness and indoor environmental quality will enable children to gain optimum learning opportunity.

Several pollutants have been reported to exist in classrooms (Blacksmith Institute, 2008). These originate from the indoor, outdoor environment or as a result of poor ventilation. The pollutants can be bio-aerosol, volatile and persistent organic compounds as well as micro-particles.

The school environment is an important indoor environment for children. Schools can be contaminated by a mixture of air pollutants including mould, bacteria, allergens, particles, volatile organic compounds (VOC) and formaldehyde (Daisy, Angell, & Apte, 2003; Mendell & Heath, 2005). One review concluded that schools might be an important source of allergen exposure, including cat and dog allergens (Salo, 2009). Around 93% of the world's children under the age of 15 years breathe air that is so polluted it puts their health and development at serious risk (WHO, 2019).

1.2 Problem Statement

Bacteria and fungi are microorganisms that can be found everywhere either in the indoor environment or outdoor and they are not all pathogenic. Normal flora rarely causes human disease although some are hypersensitivity agents, infectious or inflammatory diseases. Previous study stated that, expose to microbe at early age demonstrated a reduction in allergen sensitization in children of farmers and in children raised in day-care centres due to microbial stimulation of the immune system (Hussin et al., 2011). However, in some studies documented expose to

bacterial endotoxins can inflame airways, elicit asthmatic attack and bronchial hypersensitivity in children (Ross et al., 2000).

Under legislations such as the Education Act 1996, the Malaysian Government has taken the lead in planning for the provision of children's services and to safeguard the survival, protection, and development of children. However, up until now there is no establishment of standard and guideline for the level of indoor air pollution exposure at school environment. A good school environment is crucial to achieving the goal of the child friendly school (CFS) model that was issued by UNICEF, 2009. The goal is to move schools and educational systems progressively toward quality standards, addressing all elements that affect the well-being and rights of children as students and key teaching beneficiaries, while improving the functioning of other schools in the process (UNICEF, 2009).

Evidence shows that indoor air quality plays an important part of children life and they spent more time in the classroom (Ferreira & Cardoso, 2014). Children are more vulnerable to environmental pollutants compared to adults since they breathe more relative to their body weight and they also have a lower ability to deal with the toxic chemicals due to their undeveloped airways (Brągoszewska et al., 2018). According World Health Organization (WHO) (2018), children are considered as the population group that deserves the highest level of protection as they are more vulnerable to the effects of air pollutant. In Malaysia, there are guidelines (industry code of practice on indoor air quality 2010) for indoor air quality and exposure

standards to protect workers (DOSH, 2005), but no guidelines have yet been developed that apply specifically to the school environment with susceptible children.

Indoor air quality in a hot and humid climate country is a relatively new issue. Limited data is available on the general understanding of the present indoor air quality in Malaysia especially for school buildings. It is therefore, important that indoor air quality be given more attention and further studies be conducted. Besides, the school building in Malaysia can be very different from those in western countries. The fact that policy development requires solid evidence on deleterious effect of air pollution provides means to further enhance effort to identify indoor air pollutants. Identification of hazard and factors influencing indoor air quality among children will attract interest of all parties and can be translated into a shared effort of exposure prevention at all levels of governmental agencies, private bodies and community.

1.3 Study Justification

Study on various adverse effect of air pollution on children's health and development are one of the important aspects of continuous environmental health management. This study will enable better description of the prevalence and magnitude of indoor air pollutant circulating children among schools. The study outcome will provide essential information in an effort to establishing comprehensive database for monitoring indoor air quality among children. This study result will also provide better understanding and improved ability to identify current

toxic contaminant and recommend effective strategies for reducing indoor air pollution.

The knowledge gathered are intended to address various levels of economic development, cover all relevant population groups, and allow feasible approaches to reducing health risks from exposure to the selected pollutants in various regions of the country. Comprehensive data generated from this study will enable development of readily application of guidelines, standards of indoor air pollutants and provide means to feasible monitoring methods in identifying sources for controls of indoor air pollutants in nationwide scale. Cases of allergies and asthma can be further compared if we have baseline data and sources identifications from these studies. In the future, further intervention and mitigating measures could be formulated to reduce cases of allergies and asthma among school children.

1.4 Definition of Variables

1.4.1 Conceptual definitions

1.4.1.1 Indoor Air Quality

Indoor air pollution is where the outdoor or indoor contaminant enters the building. Pollutant inside the building may contain of biological, chemicals and physicals that affect a building occupant's health'. The parameters to indicate

whether an indoor environment is comfortable and healthy for the occupants include microorganism (bacteria and fungi), relative humidity and temperature.

1.4.1.2 Microorganism

National Park Service U.S. Department of the Interior has defined microorganism as a living thing that is so small it must be viewed with a microscope. Some microorganisms like viruses are so small they can only be seen with special electron microscopes. In this study, the bacteria and fungi colonies were assessed as the parameter. Bacteria and fungi are ubiquitous in all environments and become the indoor biological contaminant that can cause allergic symptoms. Exposure to this microorganism in school building is associated with an increased occurrence of respiratory symptoms and infections among the exposed children (Savilahti et al., 2001).

1.4.1.3 Respiratory symptoms

Respiratory symptoms comprise a vast range of inflammation and discomfort throughout respiratory track. Symptoms that affect the nose, throat and lings are typically considered respiratory symptoms (Meklin et al., 2005). The primary symptoms of respiratory disease are breathlessness, chest pain, wheeze, cough and associated sputum production. However, non-respiratory conditions including anaemia and metabolic acidosis can cause breathlessness, and lung diseases can

cause distant symptoms, for example the non-metastatic manifestations of lung cancer.

1.4.1.4 Allergy

Allergy refers to hypersensitivity reactions which are due to immunological mechanisms, which could be antibody or cell mediated allergy. Typical type of antibody mediated allergy is IgE-mediated allergy which is triggered by IgE isotype. The substances that can trigger allergy are called allergen. Examples include pollens, dust mite, molds, danders, and certain foods (World Allergy Organization, 2016).

1.4.2 Operational definitions

1.4.2.1 Indoor Air Quality

The on-site measurement of air pollutants for each classroom performed for relative humidity and temperature. For equipment to measure relative humidity and temperature, the equipment used was Air Velocity Meter. The level for each indoor air pollutant will be compare with the Industry Code of Practice on Indoor Air Quality (ICOP IAQ 2010), DOSH.

1.4.2.2 Microorganism

In this study, the bacteria and fungi exposure indoors and outdoors of classrooms were quantified with total bacterial count (TBC) and total fungal count (TFC) in unit cfu/m^3, collected using The BUCK Bio-Culture Pump.

1.4.2.2 Respiratory symptoms

This study used questionnaire to collect the information on the respiratory symptoms, allergic health of the children and this questionnaire based on the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. This questionnaire consist of information on socio-economic status (sex, age, education, job), life style (environmental tobacco smoke exposure, dietary habits) and building characteristics of the home, in particular the child's bedroom.

1.4.2.3 Allergy

Assessment of skin allergy was determined by performed skin prick test for relevant common allergens such as house dust mites, pollens and moulds. A small drop of the allergen extract is placed on the arm and with a lancet the skin is pierced and a very small amount of allergen is penetrated the skin. Skin prick test is recommended by the European Academy of Allergy and Clinical immunology (AAACI) as the first choice for allergy testing because of its high safety and easy performance. This test

will be conducted by a qualified medical doctor with cardio-pulmonary medical emergency equipment prepared on site.

1.5 Study Objectives

1.5.1 General objective

a) To determine the relationship between microorganisms in classroom indoor air with allergy and respiratory symptoms among secondary school students.

1.5.2 Specific objectives

a) To determine the socio-demographic factors among the students.
b) To measure the temperature, relative humidity and carbon dioxide inside and outside of the classrooms.
c) To determine the prevalence of allergy and respiratory symptoms among the students.
d) To compare the microorganism colonies (bacteria and fungus) from the classroom indoors and outdoors air as well as between schools.
e) To determine the relationship between allergy and respiratory symptoms with the microorganism colonies in the indoor.

f) To determine the relationship between allergy and respiratory symptoms with allergies among the students.

g) To determine the risk factors that influenced the reported respiratory symptoms and allergy among the students.

1.6 Study Hypothesis

a) There is significant difference between the microorganism colonies (bacteria and fungus) from the classroom indoors and outdoors air as well as between the schools.

b) The microorganism colonies in the indoor and outdoor air are correlated with allergy and respiratory symptoms.

1.7 Conceptual Framework

The indoor air quality in a building can be affected by multi-factors such as building characteristic. Chemical, physical and biological parameters are the main groups of indoor air quality parameter (Department of Occupational Safety and Health, 2010). These parameters can influence the comfort and health of building occupants through inhalation and direct contact. However, only temperature, relative humidity, carbon dioxide and dampness in building are related with the concentrations of bacterial and fungal.

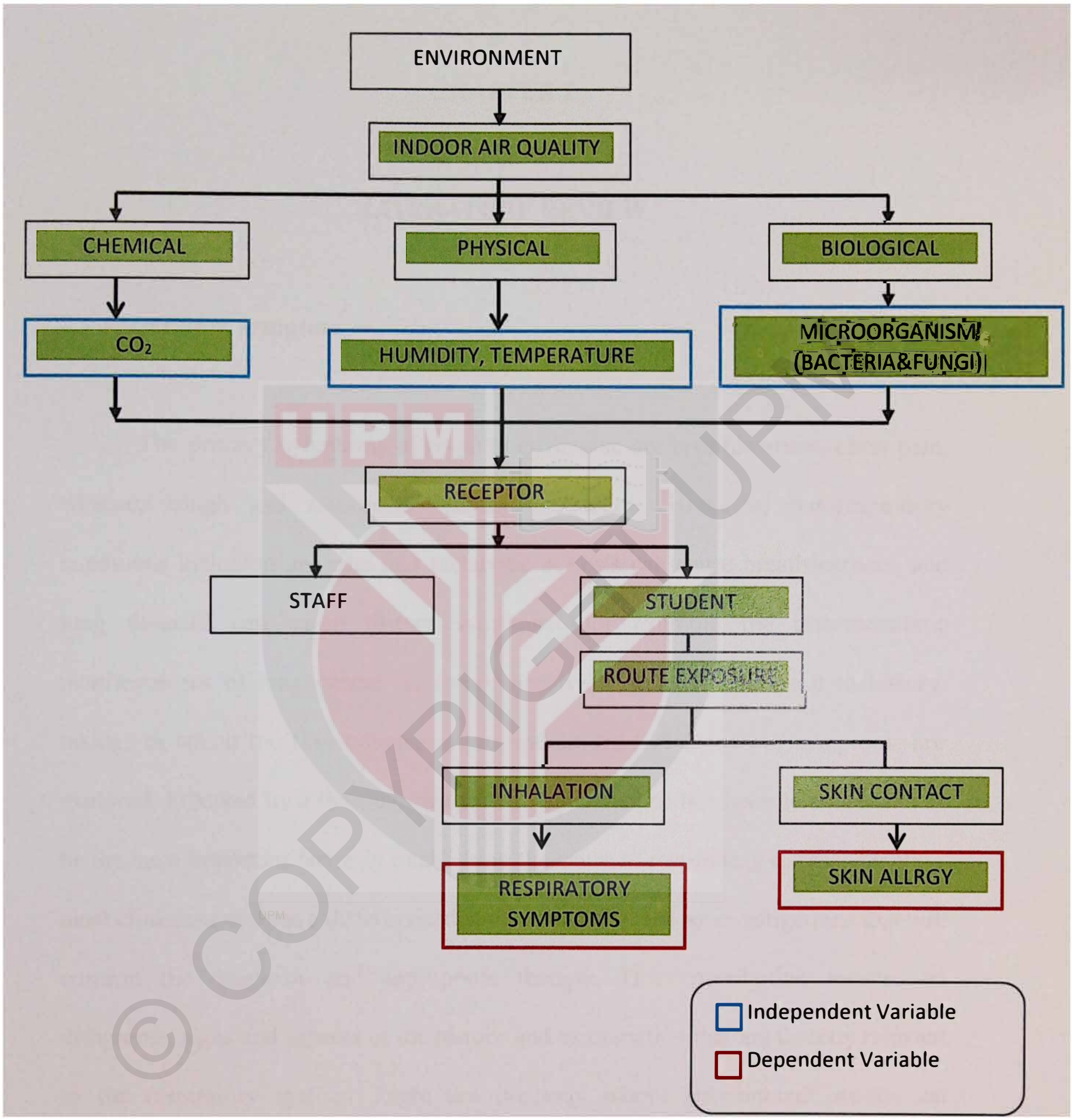

Figure 1.1 Conceptual frameworks of indoor air quality in schools and its relationships with respiratory symptoms and allergy among secondary school students.

CHAPTER 2

LITERATURE REVIEW

2.1 Respiratory symptom

The primary symptoms of respiratory disease are breathlessness, chest pain, wheeze, cough and associated sputum production. However, non-respiratory conditions including anaemia and metabolic acidosis can cause breathlessness, and lung diseases can cause distant symptoms, for example the non-metastatic manifestations of lung cancer. A comprehensive, systematic approach to history-taking, in which the time-course, nature and severity of individual symptoms are explored, followed by a thorough analysis of clinical signs has been demonstrated to be the most important factor in establishing the cause of respiratory disease, enabling most clinicians to form a differential diagnosis and proceed to investigations that will confirm the diagnosis and appropriate therapy. This contribution focuses on symptoms, signs and aspects of the history and examination that are directly relevant to the respiratory system. There are previous school environment studies on association between observed dampness in school and respiratory health (Norback, D. et al., 2017). The study conducted at schools in Penang, Malaysia that focussed on the sign of dampness and fungal DNA in school found that respiratory symptoms were usual among the secondary schools students (Norback, D. et al, 2016).

2.2 Allergy

Allergy refers to hypersensitivity reaction which is due to immunological mechanisms, which could be antibody or cell mediated allergy. Typical type of antibody mediated allergy is IgE-mediated allergy which is triggered bt IgE isotype. Allergic contact dermatitis is an example of cell-mediated allaergy which is mediated by lymphocytes, a type of white blood cell (Johansson, 2004).

2.3 Children's Health

Children are considered as one the most susceptible groups to the effects atmospheric pollution than adults because of their immature immune and respiratory system, inferior body mass index and breathing pattern (Madureira et al., 2015). They actively growing and breathe higher volumes of air relative to their body weights than adults do. The children spend most of their time in indoor environments and therefore are more exposed to pollution indoors than outdoors.

2.4 Indoor air quality

Indoor air is a natural nature about air that can affect human life and health in indoor environment and it is does not achieve a satisfactory level, human health will be affected (Zuraimi et al., 2003). Indoor air is contaminated by multiple pollutants generated by combustion sources, such as tobacco smoke, biological sources (moulds, fungi, bacteria), by gaseous pollutant released from households products, furnishings and building materials, and by entry of pollutants from outdoor air

(Mebi, Samuel, & Ojogba, 2012). Exposure to indoor air pollutants can produce a variety of symptoms depending on the mode of transmission, duration and concentration of exposure (Zuraimi et al., 2003). According to WHO Report 2002, indoor air pollutant is responsible for 2.7% of the global burden of disease.

Exposure to microorganisms may occur through inhalation, dermal contact and ingestion. Among these routes of exposure, inhalation plays the main role of transmission because microorganisms are relatively very small and very light in the term of aerodynamic (AED). It is very easy to become airborne and this will increase the possibility for inhale.

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids and it does include a variety of chemicals that have short and long term adverse health effects. VOCs are emitted by a wide array of products including paints, lacquers, cleaning supply, glues and adhesive. The emissions of VOCs may cause several of symptoms such as headache, eye, nose and throat irritations, dizziness and nausea, difficulty in concentrate and tiredness. Particulate matter in ambient air is an important risk factor for acute and long term adverse effect related to pulmonary and cardiovascular disease, cancer and mortality (Pope & Dockery, 2006).

Indoor air exposure can vary strongly with various factors including outdoor sources, building materials and furnishing, the building air exchange rate (Solomon et.at., 2008). According United State Environmental Protection Agency (USEPA 2018) by creating a healthy indoor air quality in schools, it can promote a healthy

learning environment at school which able to reduce absenteeism, improve the test scores and enhance student productivity. The school environment is an important indoor environment for school children and school can be contaminated by different pollutants such as particles, chemicals, allergens, mould and bacteria (Daisey et al., 2003; Mandell and Health, 2005; Salo et al., 2009). Stafford T. M. (2014) stated that there are many reasons why indoor air pollution is an important issue in general and why improving air quality in schools might lead to improved student health and academic performance. First, according to the American Lung Association, the average American spends approximately 90% of their time indoors. Second, due to changes in building materials and household products, the U.S. Environmental Protection Agency (EPA) estimates that concentrations of some pollutants, such as volatile organic compounds (VOCs), are often 2–5 times greater indoors than outdoors and may be as much as 100 times greater. Third, since the energy crisis in the 1970s, building ventilation rates have decreased in order to conserve energy, which has tended to increase the residence time for indoor pollutants and decrease oxygen levels. This increase in exposure over time has leaded the EPA to consistently rank indoor air pollution among the top five environmental health risks.

2.5 Microorganisms Exposure

According to WHO (2009), people spend a large part of their time each day indoors such as in homes, offices, schools, health care facilities or other private or public buildings. The quality of the air in those buildings is an important determinant of human health and well-being. The inadequate control of indoor air quality therefore creates a considerable health burden. Sources of indoor air pollution can

came from dampness and mould, chemicals and other biological agent. This is a major cause of morbidity and mortality worldwide. About 1.5 million deaths each year are associated with the indoor combustion of solid fuels, the majority of which occur among women and children in low-income countries.

Acknowledging the problem of the microbial and its effect to indoor air quality and subsequently, the health of occupants, World Health Organization (WHO) published a guideline in 2009 on the fungal quality of indoor air, called "WHO guidelines for Indoor Air Quality: Dampness and Mould". The guideline concludes that the most important effects are increased prevalence of respiratory symptoms, allergies and asthma as well as perturbation of the immunological system. In some study, the most frequent species in the microbial samples were Gram-positive cocci in the indoor environment and Gram-positive rod-forming endospores dominated in the outdoor environment. (Bragoszewska, Mainka, Pastuszka, Lizończyk, & Desta, 2018). This finding was consistent with other studies conducted in schools, offices and residential buildings in Europe, Poland, Korea and Turkey as staphylococci are microorganisms that are widespread in nature. However, detection of these microorganisms at a high level would indicate high density occupancy and inadequate ventilation (Hussin et al., 2011).

CHAPTER 3

METHODOLOGY

3.1 Study Design

This study was a cross-sectional study design which aimed to determine the relationships between microorganisms in classroom indoor air with allergy and respiratory symptoms among secondary schools students. This study was conducted the middle of January until middle of February 2019.

3.2 Study Location

There are approximately 219 secondary schools in Kota Kinabalu and six secondary schools were selected which registered under Ministry of Education (MOE). After random sampling has been carried out, the selected schools were labelled as School 1, School 2, School 3, School 4, School 5 and School 6. For study location, Kota Kinabalu was purposely selected as study area due to logistic reasons (easy accessibility). From the six secondary schools randomly selected from Kota Kinabalu, four classes of Form 2 were randomly selected. From each selected class, all students were selected to become the respondents and they were given written consent form.

3.3 Sampling

3.3.1 Sampling Population

14 years old students were selected as these are non-examination class (school principal restricted condition) and these students old enough to fill up the questionnaire with some guidance from the researcher.

3.3.2 Sampling Frame

The sampling frame was from the random selection of 4 classes of Year 2 (Form 2) in the school. From each selected class, all students were selected to become respondents and the students' name list were obtained from the school management.

3.3.3 Sampling Unit

The sampling unit for this study was the students who were obtained written consent from their parents or guardians prior to their participation. A respondent was chosen on the inclusive criteria as listed below:

Inclusive Criteria:

- Consent:

  Written consent of all selected Year 2 (From 2) (non-examination class) students had to be obtained from their parents or guardians in order to participate in the study. All the procedures involved were clearly explained to the respondents.

- Age:

  School children age 14 years (Form 2) was involved in this study. Since these were non-examination class and they were old enough to fill out questionnaires.

- Duration:

  Only school children who were in the same school previously in Year 1 (Form 2) were involved in this study, to indicate that they had been exposed to the same environment for a year. Allergy sometime took a while to develop in young children.

- Nationality:

  Only Malaysian was included in the study.

Exclusive criteria

- Severe medical diseases:

  Individual having chronic diseases such as heart disease, hypertension, severe asthma and congenital physical chest abnormality were not included in the study. Screening was carried out before carrying out data collection by asking the parents using a pre-questionnaire form together with the written consent form before the start of the study.

3.3.4 Sampling Method

3.3.4.1 State

For the selection of the state, purposive sampling was used. The selection considered the accommodation, facilities and the availability of the facility.

3.3.4.2 School

For the selection of the schools simple random sampling was used.

3.3.4.3 Respondents

The respondents were selected at random based on the list name provided by the school management.

3.3.5 Sample Size

A sample size calculation was carried out using the sample size formula of proportion of one group (Lwanga & Lemeshow, 1991)

Formula,

$$n = \frac{Z^2_{1-\alpha/2}\, p(1-P)}{d^2}$$

Where,

$Z_{1-\alpha/2}$ = standard errors associated with confidence intervals,

P = Prevalence of respiratory symptoms, and

d = desired precision

n = (1.96)2 x (0.103) (0.897) / (0.05)2

= 142 + 20% of 142

= 170

According to (Norzila, Haifa, Deng, & Azizi , 2000) the prevalence of childhood asthma in an inner city Malaysian Community is 10.3 %. Thus, the calculated sample size was 142 respondents. 20% from the total sample size which was roughly 28 was added to reduce the likelihood of refusals. Therefore, the final estimation sample size for this study was **170 respondents.**

3.4 Study Instruments and Data Collection

This study was assessed 3 method of data collection. Air containing microbial components from mould and bacteria were sampled inside and outside the classrooms, and were analyzed at designated laboratory. Health related data and home exposure was extracted from a validated questionnaire. Questionnaire was distributed to the children in school and the health assessment conducted concurrently. While, health assessment on skin prick test was carried out on the children. The field data collection was carried out from 14 Jan 2019 till 10 Feb 2019. A written consent form was distributed to each respondent prior to all procedures.

3.4.1 Questionnaire

A set of questionnaires were used to gather information from the selected respondent. The questionnaire used was a researcher's based questionnaire. The questionnaires included:

Part A: Socio demographic characteristics

Part B: Allergy

Part C: Current Health

Part D: Allergy problem among family

Part E: Current surrounding

Part F: Current symptoms

Part A is to identify the socio-demographic characteristics of the respondent background including their name, age and phone number to make it easier to access them. Besides, educational family background and total family income also been asked in this part. Part B discussed on asthma and allergy symptoms. Examples of questions was be asked: Itchy watery eyes and nose, day time breathlessness, night time breathlessness, wheezing or whistling in the chest and breathlessness after exercise. Part C was to identify the current health status of the students. Either the students had been allergy to cat, mould, pollen or food. Part D was to evaluate the allergy problem among family members. This part was analysed the family background about the allergy symptoms. Part E was to study the current surrounding of students. The types of home building materials and some of situations were be asked in this part such as water leakage on walls, floor or ceiling; bubble or yellow discolouration on plastic floor; visible mould growth on indoors walls, floor or ceiling or smell of mould in one or more rooms. Part F was to identify the current symptoms had been feeling by the students the last 3 months.

3.4.2 Indoor Environmental Measurement

The schools were visited and measurements were conducted during the same period as the questionnaire survey and the medical investigations are being carried out. Details on building materials, type of ventilation system, and signs of building dampness or mold growth was recorded in a check list form, following a standardized inspection protocol (DOSH, 2010).

Air Velocity Meter (Model TSI 9565-P, TSI Incorporated, St. Paul, MN, USA) was used to monitor indoor temperature (°C), relative air humidity (%) and carbon dioxide (ppm). The range of detection for this instrument was 0-50°C (temperature), 5-95% (relative air humidity) and 0-500 ppm (carbon dioxide). While microorganisms' samples were collected by using The BUCK Bio-Culture Pump (AP Buck Microbia Sampler) and it was analysed for its gram staining. It was collected by sampling on Petri-dishes.

Figure 3.1 Air Velocity Meter (Model TSI 9565-P)

Figure 3.2 The BUCK Bio-Culture Pump (Model C102285)

The sampling was performed in the four selected classrooms and indoor air parameters such as temperature, relative air humidity and carbon dioxide were measured over 45 minutes while microorganism (bacteria and fungi) were sampled over 10 minutes in petri-dishes by following to NIOSH method 0800. The sampling medium, in plates were prepared at Microbiology Laboratory of Universiti Malaysia Sabah. There were two types of sampling media were used such as Malt Extract Agar (MEA) for fungi culture media and Trypticase Soy Agar (TSA) for bacterial culture media. The medium was prepared and sterilized in an autoclave prior to being poured into the petri dishes. The sampler was sterilized using alcohol swab before and between sampling. The samples were packed and necessary for keeping samples cool

during shipment. The indoor air sampling collection was conducted in the middle of the classroom which approximately 1.5 m above the floor to stimulate the students breathing height. The outdoor air sampling was conducted at the corridor of classroom at height 1-2 m above the ground. The blanks were taken for each class, for quality control purposes. After the sampling, the plates were removed from the sampler and immediately taken to the microbiology laboratory for incubation. The samples were incubated for 24 hours at 36±1◦C (bacteria) which conditions approximately same with human body temperature while 72 hours at 23◦C for fungi. The bacteria and fungi colonies concentration were counted as the number of grown colonies and expressed as colony forming units per cubic (cfu/m^3) using positive-hole correction.

The following formula was used to calculate bacteria and fungi colonies:

Colony-forming units (cfu)/ mL or g = (Number of colonies) / (Dilution X Amount plated)

The microscopic analysis of the collected bacteria and fungi were done based on the Gram stain preparations and on cell, size, shape and appearance of spores (Brągoszewska et al., 2018)

3.4.2.1 Gram Staining

By using a sterile inoculating loop, 1 drop of sterile water was added to the slide. The inoculating loop was brought over the flame and sterilized with alcohol. Then, 1-2 colonies of bacteria on the surface of agar were taken and mixed them well used a sterile inoculating loop. The mixture was smeared to the size of five cent coin in order to get a thin layer of bacterial smear. The inoculating loop was brought over the flame and sterilize with alcohol. The air dried the slide. To heat fixed the slide, pass through the slide several times through a flame (the slide should not become too hot to touch) with the bacterial smear facing up. The bacterial smear was covered with a few drops of Crystal Violet (primary stain) for ½ to 1 min. The slide was washed off gently with slow running water. Few drops of Iodine was added on the bacterial smear for ½ to 1 min and washed with water. After that, the slide was decolorized with a few drops of alcohol. This was the "tricky" step. Stop decolorizing with alcohol as soon as the purple colour has stopped leaching off the slide (time will vary depending on thickness of the smear). The slide was washed with running water. The bacterial smear was covered with Safranin for ½ to 2 min. The slide was blotted with towel tissue and observed the slide with the microscope. The oil immersion was used if using for 100x objective lens (Cappucino, J. G. & Sherman, N., 2010). While for the fungi, only colony forming unit were calculated.

3.4.3 Skin Prick Test

Allergens used in this skin prick test (SPT) included *Dermatophagoides farinae* (Derf), *Dematophagoides pteronyssi*nus (Derp 1), *Felis domesticus* (Cat), *Alternaria alternate* and *Cladosporium herbarum*. SPT kits were 30 HEP (histamine equivalent prick) while concentration of *Felis* allergen was 10 HEP. Normal saline solution was used as positive control and histamine was used as negative control. Positive Control (Histamine) and Negative Control (glycerol-saline). The SPT were carried out by nurses who were trained with the skin prick test. The procedures may cause mild swelling and itching in the area of test if the respondent is allergic. In order to prevent unwanted event, the respondents was screened by medical doctor before SPT carried out and they were not be tested if they had recently taken any medications which interfere with the test response. Besides that, this test was conducted by a qualified and experienced staff nurse with cardio-pulmonary medical emergency equipment prepared on site. Local emergency authorities was notified and requested to be standby in case of medical emergency. Other than that, the respondents who participated in this study were insured.

Before the nurses started the SPT, each of respondents was asked about their recent medication intake. The arm skin was cleaned prior to skin prick testing (this may be contraindicated in cases of extreme dry skin and eczema). Positions for skin pricks were marked by numbers on the skin to identify the allergen and the pricks were made immediately adjacent to the numbers to avoid confusion between allergens. Skin prick tests was be at least 2cm apart to avoid overlapping reactions

and false-positive results. A drop of allergen was applied from the dropper bottle onto the skin prior to pricking the skin. The drop on the tip of the dropper can be touched on the skin to transfer the liquid but the actual tip of the dropper should not touch the skin. A lancet the skin was pierced and a very small amount of allergen was penetrated the skin. The reaction to the histamine positive control was at its maximum size at approximately 10 minutes whereas the allergen reaction reached its maximum at around 15 minutes. After 15 minutes, the reaction was evaluated based on the wheal diameter. A wheal greater than or equal to the diameter of histamine control and at least 3 mm larger than the diameter of negative control which indicate the positive SPT. The diameter or mean diameter of the wheal will be recorded as the primary result of the test (ASCIA Skin Prick Test Manual, 2016). Allergens of the skin prick test were stored in refrigerator at temperature ranging from + 2 °C. to + 8°C. to maintain its stability . Expiration date o the allergen extracts were checked before used. During transportation, the allergens were kept in an ice box with ice packs to preserve allergens at temperature from + 2 °C to + 8°C.

3.5 Data Analysis

The frequency and percentage were used to identify descriptive values. Chi-square test was applied to determine between allergy and respiratory symptoms with the microorganism colonies in the indoor and outdoor air shown in table 3. Statistical significance was set at 5%. The data were analyzed by using Statistical Package for the Social Sciences (SPSS) Version 21 for univariate and bivariate analysis, while STATA statistical package 11.0 was used for multivariate analysis.

Table 3.0: List of statistical analysis

Objectives	Statistical analysis
To measure the temperature, relative humidity and carbon dioxide inside and outside of the classrooms.	Descriptive analysis
To determine the prevalence of allergy and respiratory symptoms among the students.	Descriptive analysis
To determine the microorganism colonies (bacteria and fungi) in the indoor air of classrooms.	Descriptive analysis
To measure the microorganism colonies (bacteria and fungi) from the classroom indoors and outdoors air as well as between schools.	Descriptive analysis
To compare the microorganism colonies (bacteria and fungi) from the classroom indoors and outdoors air as well as between schools.	Kruskal-Wallis Test
To determine the relationship between allergy and respiratory symptoms with the microorganism colonies in the indoor and outdoor air.	Chi-square test
To determine the risk factors that influenced the reported respiratory symptoms and allergy among the students.	Multiple Logistic Regression

3.6 Quality Control

In this study, the questionnaire was translated from English to Malay for students understanding. A pilot study was conducted prior starting data collection in order to test the potential deficiency of the study design, reliability and validity of the questionnaire. The pilot study on validity and reliability was carried out among students. A total of 30 students in secondary schools in Selangor who had similar characteristics with study population were randomly recruited in the validity study. The respondents were aged of 14 years old. The pilot study on the questionnaire was conducted among 30 secondary school students which is 10% from the sample size population. The pilot study will be done to ensure the questionnaire is relevant and can be understood by the students. The questionnaire will be corrected after comments are taken from each of the students. A final version of questionnaire will be used in this study after the pilot questionnaire has been corrected. Face validity was used to assess the clarity of the words and identify unclear words in the questionnaire. The respondents were interviewed in a face-to-face interview regarding questions or wording that was confusing or irrelevant in the questionnaire. Average time to answer the questionnaire was about 15 minutes.

3.7 Ethical Approval

This study was approved from the Ethics Committee for Researches Involving Human Subjects in Universiti Putra Malaysia (UPM) (JKEUPM Ref. No.:

JKEUPM-2018-359) (Appendix I). Written permission from authorities were obtained before starting data collection on the study location (Appendix II). All the respondents gave their witten consents after the researchers' briefing regarding the study objective and procedures (Appendix III and IV). Privacy of information and confidential of respondents had been protected.

CHAPTER 4

RESULTS

4.1 Response Rate

The participation of the respondents in this study was voluntary based with written consent of respondents' parents. A few days before data collection was carried out, the respondents and their parents were informed to participate in this study and the announcements were made by the teachers to invite respondents to participate in this study. At the end, a total 316 students fulfilled the criteria and agreed to participate in this study (95.6%). All of these respondents were required to answer the questionnaire on respiratory symptoms and participated in skin prick test.

4.2 Characteristics of Respondents

4.2.1 Socio-demographic

Table 4.1 shows the distribution of socio-demographic background of the respondents involved in this study. Majority of the respondents were from female (58.5%) of the total respondents (N=316). Among of the respondents, 36.4% were Bajau, Malay were 21.8% and 20.6% were from other ethnicity including Murut,

Suluk, Irannum, Bisaya, Jawa, Kedayan and Bisaya. The data collected described about 55.7% of respondent's father had secondary education, same with respondent's mother 52.1% had secondary education. In term of household income, most of respondents' parents got less than RM 1500 per month (49.7%). Besides that, about 8.5% of respondents were smokers. More than halves, respondents' father were smoker (51.9%). Siblings showed the highest reported of history nasal symptoms and history of eczema which were (14.6%) and (10.4%) respectively.

Table 4.1: Socio-demographic of respondents

Variable	School, n (%)						
	1	2	3	4	5	6	Total
Gender							
Male	12 (38.7)	14 (24.6)	18 (43.9)	24 (34.3)	42 (75.0)	21 (34.4)	131 (41.5)
Female	19 (61.3)	43 (75.4)	23 (56.1)	46 (65.7)	14 (25.0)	40 (65.6)	185 (58.5)
Ethnicity							
Kadazan-Dusun	11 (35.5)	13 (22.8)	3 (7.3)	7 (10.0)	3 (5.4)	9 (14.8)	46 (14.6)
Bajau	5 (16.1)	25 (43.9)	17 (41.5)	19 (27.1)	22 (39.3)	27 (44.3)	115 (36.4)
Bugis	2 (6.5)	1 (1.8)	0 (0.0)	4 (5.7)	9 (16.1)	5 (8.2)	21 (6.6)
Malay	5 (16.1)	4 (7.0)	11 (26.8)	32 (45.7)	11 (19.6)	6 (9.8)	69 (21.8)
Others	8 (25.8)	14 (24.6)	10 (24.4)	8 (11.4)	11 (19.6)	14 (23.0)	65 (20.6)
Height (cm)							
median	154.00	149.00	153.50	154.20	153.45	154.00	153.00
(IQR)	(6.70)	(10.70)	(8.75)	(8.93)	(14.50)	(9.50)	(10.00)
Weight (kg)							
median	46.4	43.50	47.00	49.20	44.70	44.00	46.19
(IQR)	(14.9)	(15.95)	(12.90)	(14.85)	(17.20)	(13.45)	(13.88)
Father's Education							
Not Formal	0 (0.0)	5 (5.3)	1 (2.4)	1 (1.4)	5 (8.9)	2 (3.3)	12(3.8)
Primary	1 (3.2)	10 (17.5)	7 (17.1)	2 (2.9)	5 (8.9)	5 (8.2)	30(9.5)
Secondary	16 (51.6)	37 (64.9)	29 (70.7)	16 (22.9)	38 (67.9)	40 (65.6)	176(55.7)
Diploma	6 (19.4)	37 (64.9)	1 (2.4)	18 (25.7)	2 (3.6)	9 (14.8)	42(13.3)
University	6 (19.4)	3 (5.3)	3 (7.3)	33 (47.1)	6 (10.7)	5 (8.2)	56(17.7)
Mother's Education							
Not Formal	1 (3.2)	5 (8.8)	1 (2.4)	1 (1.4)	8 (14.5)	3 (4.9)	19(6.0)
Primary	3 (9.7)	9 (15.8)	8 (19.5)	0 (0.0)	7 (12.7)	6 (9.8)	33(10.5)
Secondary	8 (25.8)	36 (63.2)	26 (63.4)	23 (32.9)	32 (58.2)	39 (63.9)	164(52.1)
Diploma	6 (19.4)	3 (5.3)	3 (7.3)	18 (25.7)	5 (9.1)	6 (9.8)	41(13.0)
University	13 (41.9)	4 (7.0)	3 (7.3)	28 (40.0)	3 (5.5)	7 (11.5)	58(18.4)
Total	31 (9.8)	57 (18.0)	41 (13.0)	70 (22.2)	56 (17.7)	61 (19.3)	316 (100.0)

N=316

Continued Table 4.1: Socio-demographic of respondents (N=316)

Variable	School, n (%)						
	1	2	3	4	5	6	Total
Smoking Status of respondents							
Smoker	0 (0.0)	4 (7.0)	5 (12.2)	0 (0.0)	14 (25.0)	4 (6.6)	27 (8.5)
Non-smoker	31 (100.0)	53 (93.0)	36 (87.8)	70 (100.0)	42 (75.0)	57 (93.4)	289 (91.5)
Family Member Smoking Status							
Father	14 (45.2)	32 (56.1)	24 (58.5)	28 (40.0)	32 (57.1)	34 (55.7)	164 (51.9)
Mother	0 (0.0)	0 (0.0)	4 (9.8)	1 (1.4)	2 (3.6)	2 (3.3)	9 (2.8)
Siblings	9 (29.0)	20 (35.1)	19 (46.3)	22 (31.4)	33 (58.9)	27 (44.3)	130 (41.1)
Family History Nasal Symptom							
Father	2 (6.5)	4 (7.0)	5 (12.2)	9 (12.9)	4 (7.1)	4 (6.6)	28 (8.9)
Mother	2 (6.5)	4 (7.0)	4 (9.8)	6 (8.6)	4 (7.1)	3 (4.9)	23 (7.3)
Siblings	5 (16.1)	10 (17.5)	6 (14.6)	11 (15.7)	6 (10.7)	8 (13.1)	46 (14.6)
Family History Eczema							
Father	1 (3.2)	4 (7.0)	0 (0.0)	1 (1.4)	0 (0.0)	4 (6.6)	10 (3.2)
Mother	3 (9.7)	3 (5.3)	4 (9.8)	3 (4.3)	3 (5.4)	2 (3.3)	18 (5.7)
Siblings	3 (9.7)	6 (10.5)	8 (19.5)	7 (10.0)	5 (8.9)	4 (6.6)	33 (10.4)
Household Income							
Less than RM1500	12(38.7)	44 (77.2)	20(48.8)	7 (10.0)	36 (64.3)	38 (62.3)	157 (49.7)
RM1501-RM3000	3(9.7)	9 (15.8)	11(26.8)	6 (8.6)	13 (23.2)	11 (18.0)	53 (16.8)
More than RM3000	16(51.6)	4 (7.0)	10(24.4)	57 (81.4)	7 (12.5)	12 (19.7)	106 (33.5)
Total	31 (9.8)	57 (18.0)	41 (13.0)	70 (22.2)	56 (17.7)	61 (19.3)	316 (100.0)

N=316

4.2.2 School Characteristics

All six selected schools were built more than 5 years. The mean age of the school buildings was 37 years (range of 17-52 years). The schools were 2-4 storeys concrete buildings with painted outdoor surfaces and the floor surface consisted of concrete without any paint or floor covering except for School 1 which the floor were covered with tiles. There was no potted plant and carpet in the class, but certain schools had wooden book shelves because of boarding school. About 14 (58.3%) of classrooms out of 24 were found to have sign of water leakage on the ceiling and dampness but none had visible indoor mould growth. None of the schools had mechanical ventilation and the classrooms were equipped with electric fan on the ceiling and the primary sources of building ventilation would be via open windows and doors were kept open during classes. There was on average 30 students per classroom (range of 23-40 students). Smoking was not allowed in the school environment.

4.2.3 School Indoor Environmental Parameters

Table 4.2 shows the mean and standard deviation for normal distributed data, while median and interquartile ranges for not normally distribution data of the school indoor environmental parameters. The median indoor air temperature was 26.3°C (range of 25–33°C), similar as the median outdoor air temperature (26.5°C). The median indoor relative air humidity was 66% (range of 67–88%), slightly different from the median outdoor relative air humidity (64%). The median CO_2 concentration in the classrooms was 459 ppm (range of 408-746 ppm) and 401 ppm outdoors. While for indoor total bacteria count and indoor total fungi count, the median was 44.50 cfu/m^3 and 18.50 cfu/m^3. The median for outdoor total bacteria count and outdoor total fungi count was 26.50 cfu/m^3 and 19.50 cfu/m^3, respectively.

Table 4.2: School Environmental Measurement

Environmental Parameters	Mean(S.D)	Median(IQR)
Indoor Air Temperature (°C)	27.41(2.58)	26.30(4.40)
Indoor Relative Air Humidity (%)	67.64(5.03)	66.25(4.80)
Indoor Total Fungi Count (cfu/m^3)	27.25(17.94)	18.50(33.00)
Indoor Total Bacteria Count (cfu/m^3)	69.71(99.75)	44.50(40.00)
Indoor Carbon Dioxide (ppm)	480.33(81.33)	459.00(121.00)
Outdoor Air Temperature (°C)	28.18(3.68)	26.45(7.00)
Outdoor Relative Air Humidity (%)	65.65(5.85)	64.40(10.70)
Outdoor Total Fungi Count (cfu/m^3)	31.17(24.93)	19.50(35.00)
Outdoor Total Bacteria Count (cfu/m^3)	47.17(58.46)	26.50(71.00)
Outdoor Carbon Dioxide (ppm)	421.18(67.41)	401.00(57.30)

N= 24 for indoor air measurement, N=6 for outdoor air measurement
S.D= Standard Deviation, IQR= Inter Quartile Range

For indoor air parameters, the average for relative air humidity, carbon dioxide concentration, total bacteria and fungi count was within and under acceptable limit suggested by Department of Occupational Safety and Health (DOSH) in ICOPIAQ 2010. The recommended level of air measurement by DOSH in ICOP IAQ 2010 was presented in Table 4.3. However, indoor air temperature (26.3°C) was not within suggested acceptable temperature range in ICOP IAQ, (23-26 °C). In addition, some of the classrooms in School 1 had high indoor relative air humidity (more than 70%), which exceed the maximum acceptable indoor relative air humidity level in ICOPIAQ 2010.

Table 4.3: Indoor air measurement recommended by Department of Occupational Safety and Health (DOSH) in Industry Code of Practice on Indoor Air Quality (ICOPIAQ)

Environmental Parameters	Acceptable Range/Level
Indoor Air Temperature (°C)	23-26 (°C)
Indoor Relative Air Humidity (%)	40-70%
Indoor Carbon Dioxide (ppm)	Below 1000 ppm
Total Bacteria Count (cfu/m^3)	Below 500
Total Fungal Count (cfu/m^3)	Below 1000

(Source: Department of Occupational Health, 2010)

Kruskal-Wallis test was used to test if there was a difference in a measured indoor air parameters between six schools. Based on Table 4.4, relative air humidity ($p=0.031$) and carbon dioxide concentration ($p=0.019$) showed a significant difference among the six schools. When there is a difference, there is need to identify the pair(s) that differs significantly. This was done using Bonferroni. After run

Bonferroni, it showed the significant difference median of CO_2 between School 3 and School 1 (p=0.010). While, for relative air humidity, it showed a significant difference median among School 6 and School 1 (p=0.026). There was no significant difference of total bacteria colonies and total fungi colonies between the six schools (p>0.05).

The microorganisms' colonies (bacteria and fungi) were measured in different classrooms. The microorganisms' colonies were obtained by measuring the bacterial and fungal colony forming unit per cubic meter (cfu/m^3) in the environment. Table 4.5 shows bacteria and fungi colonies in different classrooms. School 3 has highest indoor air bacteria and fungi colonies in the environment. The median for the indoor air bacteria and fungi colonies in all the classrooms were 44.50 cfu/m^3 and 18.50 cfu/m^3, respectively. From Table 4.6, the most common and dominant gram staining that was present in environment was Gram positive bacillus.

Table 4.4: Comparison Indoor Air Parameters between 6 Different Schools

Indoor Air Parameter	Schools, Median (IQR)						N	Median (IQR)	Z-value	p-value
	School 1	School 2	School 3	School 4	School 5	School 6				
Temperature (Real-time Measurement)[a]	26.65 (2.96)	26.05 (0.88)	25.20 (0.80)	25.25 (4.65)	29.65 (4.97)	31.40 (2.08)	23	26.30 (4.30)	10.685	0.058
Relative Air Humidity (Real-time Measurement)[a]	76.55 (1.90)	65.10 (6.50)	65.70 (3.40)	68.70 (3.45)	65.80 (1.65)	61.00 (10.05)	23	66.40 (4.90)	12.305	**0.031***
Carbon dioxide (Real-time Measurement)[a]	540.00 (101.00)	412.00 (408.75)	399.00 (5.00)	400.50 (133.75)	424.50 (37.00)	412.00 (99.75)	23	415.00 (50.00)	13.574	**0.019***
Bacteria Colony (Real-time Measurement)[b]	40.00 (37.00)	46.00 (47.00)	36.00 (380)	56.50 (69.00)	43.50 (118)	50.50 (60.00)	24	44.50 (40.00)	0.833	0.975
Fungi Colony (Real-time Measurement)[b]	14.50 (27.00)	46.50 (37.00)	31.50 (36.00)	16.00 (8.00)	11.50 (7.00)	38.50 (39.00)	24	18.50 (32.50)	8.882	0.114

N=117
Kruskal-Wallis Test
* significant at $p < 0.05$
[a]Real-time Measurement with Air Velocity Meter (Model TSI 9565-P)
[b]Real-time Measurement with The BUCK Bio-Culture Pump (Model C102285)

Table 4.5: Bacteria and Fungi Colonies Count at Classrooms

School	Sampling location	N	Bacteria Colonies Count (cfu/m^3)				Fungi Colonies Count (cfu/m^3)			
			Mean(SD)	Median	Min	Max	Mean(SD)	Median	Min	Max
1	Classrooms	4	42.75(19.62)	40	24	67	20.25(15.65)	14.5	9	43
2	Classrooms	4	50.75(25.08)	46	29	82	39.50(20.92)	46.5	9	56
3	Classrooms	4	194.00(273.68)	39	33	510	41.00(18.52)	40	23	60
4	Classrooms	4	55.00(35.95)	56.5	10	97	16.00(4.16)	16	11	21
5	Classrooms	4	63.00(64.77)	43.5	13	152	13.00(4.08)	11.5	10	19
6	Classrooms	4	60.00(32.77)	50.5	25	104	39.50(19.98)	38.5	18	63
Total	Classrooms	24	69.71(99.75)	44.5	5	510	27.25(17.94)	18.5	9	63

N=24

Table 4.6: Bacteria and Fungi Dominant at Different Sampling Location

School	Sampling location	N	Dominant Gram Staining of Microorganisms Isolated in Environment
1	Classrooms	4	GPB, GPC, GNB
	Outdoor	1	GPC
2	Classrooms	4	GPB, GPC
	Outdoor	1	GPC
3	Classrooms	4	GPB, GPF
	Outdoor	1	GPB
4	Classrooms	4	GPB, GPC
	Outdoor	1	GPB
5	Classrooms	4	GPB
	Outdoor	1	GPCB
6	Classrooms	4	GNB, GPB
	Outdoor	1	GPB

N=30

GPB= Gram Positive Bacillius, GNB= Gram Negative Bacillus, GPC= Gram Positive Cocci, GPCB= Gram Positive Coccobacillus, GPF= Gram Positive Fungus

4.2.4 Home Environmental Factor

The home is an important indoor environment for students. The questionnaire included questions on the indoor environment at home. Table 4.7 shows the current home environment characteristics. Most of the respondents reported that water leakage or water damage in walls or floor is the common current home characteristics in the last 12 months (30.4%) and followed by visible mould growth on indoors walls and floor. About 7.6% of them reported that visible of bubble or yellow discolouration on plastic floor covering. Pet keeping was very common among of the respondents (62%) whereby 53.8% around of them had a cat at home and 30.4% had their home painted indoor in the last 12 months. Around 22.2% of respondents reported their home floor had been changed in the last 12 months.

Table 4.7: Current home environment characteristics of respondents

Current Home Characteristics	Respondent, n (%)
Any home dampness in the last 12 months	
Water leakage or water damage in walls, floor	96 (30.4)
Visible mould growth on indoors walls, floor	46 (14.6)
Bubble or yellow discolouration on plastic floor covering	24 (7.6)
Smell of mould in one or more rooms	13 (4.1)
Indoor home painted in the last 12 months	
Yes	96 (30.4)
No	220 (69.6)
Floor in dwelling been changed in last 12 months	
Yes	70 (22.2)
No	246 (77.8)
Pet keeping at home	
Yes	196 (62)
No	120 (38)

N=316

4.3 Prevalence of Allergy and Respiratory Symptoms of Respondents

4.3.1 Prevalence of Self-reported Allergy Symptoms of Respondents

From Table 4.8, it shows the prevalence of self-reported allergy symptoms among respondents. The questionnaire included questions on the allergy or sensitivity towards some of allergen such as dust, pollen, cat and food allergy. In total, 177 (56.0%) of the respondents had experienced itchy watery eyes and nose. Respondents who were allergic to food showed the highest prevalence (17.7%) as compared to cat (8.2%), dust (6.6%) and pollen (4.1%).

Table 4.8: Prevalence of self-reported allergy symptoms of respondent

Reported Allergy Symptoms	N	Prevalence (%)
Itchy watery eyes and nose	177	56.0
Food allergy	50	17.7
Cat allergy	26	8.2
Dust/mold allergy	21	6.6
Pollen allergy	13	4.1

N=316

4.3.2 Prevalence of Allergy (skin prick test) of Respondents

From Table 4.9, it shows the prevalence of allergy after conducted skin prick test among the respondents. The respondents were tested with different of allergens to determine either they are positive towards those allergen. Respondents who were allergic to HDM showed the highest prevalence. More than half of the respondents were allergic to Derp 1 which is 53.5% and 48.7% of them were positive to Derf. Almost of 14.0% of the respondents were allergic to *Felis domesticus* (cat allergen) and *Cladosporium herbarum* (mold).

Table 4.9: Prevalence of allergy (skin prick test) of the respondents

Allergen	N	Prevalence (%)
House Dust Mite (HDM)		
Dermatophagoides pteronyssinus (Derp 1)	169	53.5
Dermatophagoides farinae (Derf)	154	48.7
Cat		
Felis domesticus	47	14.9
Mold		
Alternaria alternate	15	4.7
Cladosporium herbarum	45	14.2

N=316

4.3.3 Prevalence of Respiratory Symptoms of Respondents

From Table 4.10, it shows that the prevalence of respiratory symptoms of the respondents. 16.8% of the respondents had any day time breathlessness in the last 12 months and 12.0% experienced night time breathlessness. About 36.1% of them had breathlessness after exercise and 13.6% of them had wheeze or whistling in the chest. Daytime attacks of breathlessness occurring after exercise was common (36.1%), and wheezing when did not have flu were less common (3.2%).

Table 4.10: Prevalence of respiratory symptoms of respondents

Respiratory symptoms	N	Prevalence (%)
Breathlessness after exercise	114	36.1
Day time breathlessness	53	16.8
Wheezing or whistling in the chest	43	13.6
Night time breathlessness	38	12.0
Breathlessness during wheezing	22	7.0
Tightness in the chest	19	6.0
Wheezing without flu	10	3.2

N=316

4.3.4 Prevalence of Health Symptoms in the Last 3 Months among Respondents

Referring to Table 4.11, it shows the prevalence of health symptoms in the last 3 months among respondents. The health symptoms were reported through the questionnaire. In general symptoms, headache was the most common symptoms reported by the respondents (77.8%). For muscosal symptoms, 70.6% of them had nasal obstruction or blocked nose, which followed by runny nose (67.4%) and throat dryness (50.6%). Besides that, itches on hands or forearms were the most frequent reported by 35.8 % of respondents for dermal symptoms.

Table 4.11: Prevalence of health symptoms in the last 3 months among respondents

Health Symptoms	N (%)
Dermal	
Rashes on hands or forearms	46 (14.6)
Rashes on the face or neck	25 (7.9)
Skin Redness	41 (13.0)
Itches in the face or on the neck	85 (26.9)
Itches on hands or forearms	113 (35.8)
Mucosal	
Eye irritation	110 (34.8)
Swollen eyelids	51 (16.1)
Runny nose/nasal catarrh	213 (67.4)
Nasal obstruction/blocked nose	223 (70.6)
Throat dryness	160 (50.6)
Sore throat	155 (49.1)
Irritative cough	84 (26.6)
General	
Headache	246 (77.8)
Nausea	99 (31.3)
Feeling tired and out of sort	154 (48.7)

N=316

4.4 Correlation between Indoor Air Parameters in Schools

In order to determine the correlation between each of indoor environmental parameters in schools are showed in Table 4.12. All the parameters were not normally distributed. Therefore, Spearman's Rho correlation was used to determine the correlation between the indoor parameters. Based on the results show indoor air temperature, relative air humidity and carbon dioxide concentration were not correlated with indoor air bacteria and fungi colonies ($p>0.05$).

Table 4.12: Correlation between indoor air parameters in schools

Variables	Bacteria Colonies		Fungi Colonies	
	r-value	p-value	r-value	p-value
Temperature (°C)	-0.400	0.053	0.075	0.726
Relative Humidity (%)	0.090	0.675	-0.171	0.425
Carbon dioxide (ppm)	-0.087	0.684	-0.182	0.394

4.5 Association between Health Variables with Indoor Air Parameters among Respondents

4.5.1 Association between Self-reported Allergy Symptoms of Respondent with the Microorganism Colonies in the Indoor Air and Skin Prick Test

Table 4.13 presents analysis by Chi-Square test for association between self-reported allergy symptoms of respondent with the microorganism colonies in the indoor air. It shows food allergy and itchy watery eyes and nose are significantly associated with the category of bacteria count (p=0.005) and (p=0.043), respectively.

With reference to Table 4.14, Chi-Square test used to analyse the association between self-reported allergy symptoms with the skin prick test. The reported cat allergy among respondents was associated with all allergens except for *Alternaria* (p>0.05). Food allergy was associated with Derp 1 and Derf which is (p=0.047) for both of them. Itchy watery eyes and nose symptoms was significantly associated with Derp 1 (p=0.048) and cat allergen (p=0.015). The students those who had allergy to house dust mite had 1.57 times itchy watery eyes and nose symptoms and had 1.67 allergies to cat.

Table 4.13: Association between self-reported allergy symptoms with the microorganism colonies in the indoor air

Reported Allergies	Category of Bacteria Count				Category of Fungi Count			
	X^2	OR	95%CI	p-value	X^2	OR	95%CI	p-value
Itchy watery eyes and nose	4.085	1.59	1.01-2.48	0.043*	0.934	1.03	0.66-1.61	0.334
Food allergy	7.732	1.97	1.22-3.18	0.005**	0.023	1.31	0.81-2.10	0.870
Cat allergy	0.089	1.82	1.09-3.01	0.766	0.077	0.80	0.49-1.32	0.781
Dust/mold allergy	0.039	1.29	0.82-2.02	0.844	0.483	0.82	0.53-1.29	0.487
Pollen allergy	0.001	1.80	1.12-2.93	0.973	3.602	0.70	0.44-1.13	0.058

#category of bacteria count (Below than 44.50 cfu/m^3, Upper than 44.50); #category of fungi (Below than 18.50 cfu/m^3, Upper than 18.50)
*significant at $p< 0.05$
**significant at $p< 0.01$

Table 4.14: Association between self-reported allergy symptoms with the skin prick test

Reported allergies	Derp 1		Derf		Cladosporium		Alternaria		Cat	
	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value
Itchy watery eyes and nose	1.57 (1.00-2.46)	0.048*	1.54 (0.98-2.41)	0.058	1.35 (0.71-2.58)	0.365	1.19 (0.41-3.42)	0.750	3.30 (1.17-4.56)	0.015*
Food allergy	1.61 (1.01-2.58)	0.047*	1.62 (1.01-2.60)	0.047*	0.99 (0.51-1.93)	0.974	1.34 (0.46-3.87)	0.587	1.75 (0.93-3.28)	0.080
Cat allergy	1.67 (1.02-2.75)	0.042*	1.78 (1.07-2.95)	0.025*	2.13 (1.12-4.11)	0.020*	2.38 (0.835-6.76)	0.096	2.44 (1.29-4.61)	0.005**
Dust/mold allergy	0.68 (0.44-1.07)	0.094	0.79 (0.50-1.23)	0.293	1.14 (0.60-2.15)	0.695	0.93 (0.32-2.67)	0.887	0.76 (0.40-1.44)	0.399
Pollen allergy	1.02 (0.63-1.63)	0.949	0.917 (0.57-1.47)	0.719	1.23 (0.63-2.38)	0.54	1.47 (0.51-4.23)	0.48	1.42 (0.74-2.69)	0.288

*significant at $p < 0.05$
**significant at $p < 0.01$

4.5.2 Association between Respiratory Symptoms of Respondents with the Microorganisms Colonies in the Indoor Air and Skin Prick Test

Chi-Square test was used to determine the association between respiratory symptoms of respondent with the microorganism colonies in the indoor air. In total, all the respiratory symptoms were not significantly associated with the bacteria colonies. While for the association between respiratory symptoms of respondent with the fungi colonies in the indoor air, night time breathlessness was significantly associated with the fungi colonies ($p=0.035$).

Table 4.16 presents the results of association between respiratory symptoms of the respondents with the skin prick test. Students whose were breathlessness when wheezing present were significantly associated with all the allergies ($p<0.05$). Students with wheezing or whistling in the chest and wheezing when did not have flu were significantly associated with all the allergies except for the Cladosporium ($p=0.069$) and ($p=0.596$). Day time breathlessness and breathlessness after exercise were not significantly associated with all the allergies ($p>0.05$). Feeling of tightness in the chest only associated with Derp 1, Derf and Cat allergies, while night time breathlessness only significantly associated with Derf allergies ($p<0.05$).

Table 4.15: Association between respiratory symptoms of respondent with the microorganism colonies in the indoor air

Respiratory symptoms	Category of Bacteria Count				Category of Fungi Count			
	X^2	OR	95%CI	p-value	X^2	OR	95%CI	p-value
Breathlessness after exercise	1.063	1.28	0.80-2.02	0.302	0.030	1.013	0.64-1.61	0.957
Day time breathlessness	0.303	1.18	0.65-2.14	0.582	0.302	1.182	0.65-2.15	0.582
Wheezing or whistling in the chest	1.611	0.66	0.35-1.26	0.204	1.201	1.446	0.75-2.81	0.273
Night time breathlessness	0.388	1.24	0.63-2.47	0.533	4.463	2.187	1.04-4.58	0.035*
Breathlessness during wheezing	1.426	0.59	0.24-1.42	0.232	0.155	1.193	0.50-2.88	0694
Tightness in the chest	0.273	0.78	0.30-1.98	0.601	0.535	1.429	0.55-3.73	0.464
Wheezing without flu	2.225	0.37	0.09-1.44	0.136	0.107	0.811	0.23-2.86	0.744

#category of bacteria count (Below than 44.50 cfu/m^3, Upper than 44.50); #category of fungi (Below than 18.50 cfu/m^3, Upper than 18.50)
*significant at $p < 0.05$

Table 4.16: Association between respiratory symptoms of the respondents with the skin prick test

Respiratory symptoms	Derp 1 (HDM)		Derf (HDM)		Cladosporium		Alternaria		Cat	
	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value
Breathlessness after exercise	1.08 (0.68-1.71)	0.735	1.18 (0.75-1.88)	0.474	0.68 (0.34-1.36)	0.278	1.90 (0.51-7.07)	0.381	1.01 (0.53-1.92)	0.254
Day time breathlessness	0.927 (0.51-1.68)	0.803	1.16 (0.64-2.11)	0.617	2.04 (0.97-4.27)	0.055	1.26 (0.34-4.61)	0.732	0.85 (0.36-2.01)	0.709
Wheezing without flu	4.38 (0.92-20.98)	0.044*	8.21 (1.03-65.61)	0.019*	1.53 (0.31-4.44)	0.596	5.64 (1.09-29.22)	0.021*	9.70 (2.62-35.83)	<0.001***
Night time breathlessness	1.72 (0.86-3.44)	0.121	2.05 (0.99-4.22)	0.049	1.74 (0.74-4.08)	0.200	1.59 (0.56-4.50)	0.331	1.63 (0.70-3.82)	0.988
Breathlessness during wheezing	5.23 (1.73-15.82)	0.001***	6.08 (1.76-20.99)	0.001***	4.96 (1.98-12.43)	<0.001***	5.72 (1.66-19.75)	0.002**	3.74 (1.47-9.49)	0.003**
Tightness in the chest	4.26 (1.38-13.15)	0.007**	3.48 (1.13-10.74)	0.022*	2.30 (0.78-6.72)	0.120	2.57 (0.54-2.32)	0.222	2.88 (1.04-8.01)	0.035*
Wheezing without flu	4.38 (0.92-20.98)	0.044*	8.21 (1.03-65.61)	0.019*	1.53 (0.31-4.44)	0.596	5.64 (1.09-29.22)	0.021*	9.70 (2.62-35.83)	<0.001***

*significant at p<0.05
**significant at p<0.01
**significant at p<0.001

4.5.3 Association between Health Symptoms in the Last 3 Months among Respondents with the Microorganisms Colonies in the Indoor Air and Skin Prick Test

Based on Table 4.17, the result shows no significant difference between the two categories of bacteria concentrations with the health symptoms in the last 3 months. However, analysis on fungi concentrations showed different trend as compared to bacteria concentrations. There were significant differences between 2 categories of fungi concentrations with rashes on the face or neck ($p = 0.016$) and swollen eyelids ($p = 0.105$).

Table 4.18 shows the association between health symptoms the past 3 month with skin prick test. Students who reported rashes on the face or neck, itches in the face or on the neck and itches on hands and forearms were significantly associated with Cladosporium $p=0.040$, $p= 0.032$ and $p=0.047$ respectively. In term of mucosal symptoms, eye irritation was significantly associated with Derp allergies ($p=0.003$) and runny nose/ nasal catarrh was significantly associated with Cat allergies ($p=0.033$). While for general symptoms, feeling tired and out of sort was significantly associated with cat allergen ($p=0.033$).

Table 4.17: Association between health symptoms in the last 3 months with the microorganism colonies in the indoor air

Health symptoms	Category of Bacteria Count				Category of Fungi Count			
	X^2	OR	95%CI	p-value	X^2	OR	95%CI	p-value
Dermal								
Rashes on hands and forearms	1.28	1.44	0.76-2.74	0.257	2.71	1.64	0.86-3.15	0.134
Rashes on the face or neck	2.40	1.97	0.82-4.71	0.121	5.93	0.35	0.15-0.85	0.016*
Skin redness	0.07	0.91	0.47-1.76	0.789	1.27	1.49	0.76-2.93	0.249
Itches in the face or on the neck	0.21	1.12	0.68-1.85	0.645	0.38	0.83	0.51-1.37	0.475
Itches on hands or forearms	0.06	0.94	0.59-1.49	0.800	0.001	0.99	0.62-1.57	0.958
Muscosal								
Eye irritation	1.13	0.78	0.49-1.24	0.289	0.002	0.97	0.61-1.54	0.892
Swollen eyelids	0.07	1.09	0.60-1.98	0.786	0.75	2.21	1.15-4.23	0.015*
Runny nose/ nasal catarrh	2.64	1.48	0.92-2.37	0.104	0.56	0.83	0.51-1.33	0.428
Nasal obstruction/ blocked nose	0.13	1.09	0.67-1.77	0.721	0.02	0.95	0.59-1.55	0.952
Throat dryness	0.44	1.16	0.75-1.81	0.508	0.43	1.16	0.74-1.81	0.512
Sore Throat	0.02	1.03	0.66-1.60	0.893	0.14	1.09	0.70-1.70	0.71
Irritative cough	0.01	1.02	0.62-1.69	0.930	0.69	0.81	0.49-1.33	0.405
General								
Headache	2.85	1.58	0.93-2.70	0.092	0.02	1.04	0.61-1.78	0.882
Nausea	1.70	1.38	0.85-2.23	0.192	0.14	0.91	0.57-1.47	0.712
Feeling tired and out of sort	0.50	1.17	0.75-1.83	0.481	0.90	1.24	0.80-1.93	0.342

#category of bacteria (Below than 44.50 cfu/m3, Upper than 44.50); #category of fungi (Below than 18.50 cfu/m3, Upper than 18.50)
*significant at $p<0.05$

Table 4.18: Association between health symptoms in the last 3 months with skin prick test

Health symptoms	Derp 1 (HDM)		Derf (HDM)		Cladosporium		Alternaria		Cat	
	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value
Dermal										
Rashes on hands and forearms	1.06 (0.57-1.98)	0.853	1.16 (0.62-2.17)	0.655	1.58 (0.70-3.55)	0.264	1.50 (0.41-5.54)	0.54	1.03 (0.43-2.47)	0.943
Rashes on the face or neck	1.64 (0.71-3.77)	0.240	2.38 (0.97-5.88)	0.053	2.59 (1.01-6.61)	0.040*	1.86 (0.40-8.75)	0.425	1.48 (0.53-4.16)	0.453
Skin redness	1.58 (0.81-3.06)	0.178	0.90 (0.47-1.74)	0.756	1.28 (0.53-3.10)	0.578	0.47 (0.60-3.64)	0.456	1.21 (0.50-2.92)	0.671
Itches in the face or on the neck	1.53 (0.93-2.52)	0.950	1.04 (0.63-1.71)	0.891	2.03 (1.05-3.92)	0.032*	0.67 (0.18-2.43)	0.537	1.87 (0.98-3.58)	0.056
Itches on hands or forearms	1.39 (1.09-2.20)	0.164	1.15 (0.73-1.83)	0.546	1.89 (1.00-3.58)	0.047*	0.64 (0.20-2.06)	0.452	1.40 (0.75-2.63)	0.292
Muscosal										
Eye irritation	2.01 (1.26-3.22)	0.003**	1.59 (0.99-2.54)	0.053	1.16 (0.61-2.23)	0.652	1.26 (0.44-3.65)	0.665	1.33 (0.70-2.51)	0.381
Swollen eyelids	1.52 (0.94-2.44)	0.205	0.89 (0.49-1.62)	0.696	1.15 (0.50-2.63)	0.747	1.32 (0.36-4.85)	0.677	1.50 (0.69-3.26)	0.299
Runny nose/ nasal catarrh	1.39 (0.85-2.26)	0.084	1.51 (0.94-2.42)	0.088	2.12 (0.98-4.60)	0.052	0.54 (0.19-1.52)	0.234	2.27 (1.05-4.89)	0.033*
Nasal obstruction/ blocked nose	1.39 (0.85-2.26)	0.189	1.51 (0.93-2.46)	0.095	1.55 (0.73-3.27)	0.252	0.61 (0.21-1.77)	0.357	1.65 (0.78-3.48)	0.184
Throat dryness	0.74 (0.47-1.15)	0.179	0.68 (0.44-1.06)	0.088	1.26 (0.97-2.38)	0.476	0.47 (0.16-1.41)	0.170	0.84 (0.45-1.55)	0.570
Sore throat	0.76 (0.49-1.18)	0.212	0.70 (0.45-1.10)	0.120	1.36 (0.72-2.56)	0.346	0.91 (0.32-2.56)	0.850	1.34 (0.72-2.51)	0.351
Irritative cough	1.07 (0.65-1.77)	0.786	1.15 (0.69-1.89)	0.596	1.65 (0.84-3.22)	0.14	0.68 (0.19-2.47)	0.554	0.94 (0.46-1.91)	0.860

*significant at $p<0.05$

**significant at p<0.01

Continue Table 4.18: Association between health symptoms in the last 3 months with skin prick test

Health symptoms	Derp (HDM)		Derf (HDM)		Cladosporium		Alternaria		Cat	
	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value
General										
Headache	0.65 (0.38-1.11)	0.111	0.66 (0.38-1.13)	0.131	0.66 (0.32-1.33)	0.240	0.41 (0.14-1.18)	0.088	0.70 (0.35-1.42)	0.324
Nausea	0.93 (0.58-1.50)	0.762	1.27 (0.79-2.06)	0.324	1.11 (0.57-2.18)	0.754	0.79 (0.25-2.54)	0.690	1.16 (0.60-2.23)	0.664
Feeling tired and out of sort	1.39 (0.85-2.26)	0.084	1.51 (0.94-2.42)	0.088	2.12 (0.98-4.60)	0.052	0.54 (0.19-1.52)	0.234	2.27 (1.05-4.89)	0.033*

*significant at p<0.05

4.6 Potential Risk Factors of Self-reported Allergy Symptoms, Respiratory Symptoms and Health Symptoms in the Last 3 Months among Respondents

Table 4.19 presents the association between respiratory symptoms and allergy with potential risk factors among respondents analysis by using Chi-Square test. Parental asthma, gender, current smoking, family member smoking and home dampness were independently associated with respiratory symptoms. Respondents whose parental asthma or have family members smoking as significantly associated with wheezing or whistling in the chest, breathless when wheezing present, day time breathlessness and breathlessness after exercise. While, respondents with parental asthma had significantly more feeling of tightness in the chest ($p=0.024$).

Table 4.20 illustrates the associations between the health symptoms and personal factors among the respondents. Parental asthma, gender, current smoking, family smoking and home dampness were independently associated with health symptoms. Family smoking was significantly associated with rashes on hands and forearms ($p = 0.014$) and skin redness ($p=0.014$). Besides that, respondents who smoke were significantly associated with swollen eyelids, throat dryness and irritative cough ($p<0.05$). Home dampness Rashes on hands and forearms ($p=0.013$), eye irritation ($p<0.001$), irritative cough ($p<0.001$) and feeling tired out of sort ($p=0.014$).

Table 4.19: Association between respiratory symptoms and allergy with potential risk factors among respondents

Respiratory symptoms	Parental Asthma		Gender		Current Smoking		Family Smoking		Home dampness	
	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value
Breathlessness after exercise	2.18 (1.06-4.47)	0.030*	1.38 (0.86-2.21)	0.182	1.47 (0.66-3.25)	0.344	1.61 (1.01-2.57)	0.044*	1.32 (0.81-2.17)	0.266
Day time breathlessness	2.32 (1.03-5.19)	0.037*	1.65 (0.88-3.08)	0.117	2.28 (0.94-5.53)	0.062	2.35 (1.25-4.43)	0.007**	1.49 (0.81-2.76)	0.202
Wheezing or whistling in the chest	2.63 (1.13-6.10)	0.021*	1.24 (0.64-2.42)	0.514	0.78 (0.22-2.71)	0.692	2.27 (1.14-4.55)	0.018*	0.87 (0.43-1.78)	0.704
Night time breathlessness	2.59 (1.07-6.22)	0.029*	2.19 (1.02-4.68)	0.039*	2.30 (0.86-6.11)	0.088	1.25 (0.63-2.49)	0.520	1.80 (0.90-3.60)	0.094
Breathless with wheezing	4.62 (1.73-12.30)	0.001***	2.00 (0.76-5.26)	0.153	0.91 (0.88-0.94)	0.137	3.24 (1.17-0.02)	0.018*	0.85 (0.32-2.24)	0.743
Tightness in the chest	3.30 (1.11-9.82)	0.024*	1.60 (0.59-4.32)	0.353	0.91 (0.88-0.94)	0.169	2.62 (0.92-7.45)	0.063	0.594 (0.19-1.84)	0.362
Wheezing without flu	2.14 (0.44-10.52)	0.338	1.70 (0.43-6.70)	0.443	1.20 (0.15-9.82)	0.867	3.67 (0.77-17.58)	0.082	2.36 (0.67-8.36)	0.170

*significant at p<0.05
**significant at p<0.01
**significant at p<0.001

Table 4.20: Association between health symptoms and allergy with potential risk factors among respondents

Health symptoms	Parental Asthma		Gender		Current Smoking		Family Smoking		Home dampness	
	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value
Dermal										
Rashes on hands and forcarms	0.76 (0.26-2.27)	0.625	1.41 (0.74-2.71)	0.298	1.02 (0.34-3.11)	0.968	2.29 (1.17-4.48)	0.014*	2.23 (1.17-4.25)	0.013*
Rashes on the face or neck	0.33 (0.4-2.49)	0.256	1.58 (0.66-3.77)	0.302	1.52 (0.42-5.44)	0.520	2.45 (0.99-6.04)	0.046	1.83 (0.80-4.21)	0.149
Skin redness	1.51 (0.59-9.91)	0.391	0.72 (0.37-1.39)	0.329	3.27 (1.33-8.05)	0.007	2.40 (1.18-4.90)	0.014*	1.41 (0.73-2.72)	0.305
Itches in the face or on the neck	2.08 (0.99-4.33)	0.047*	0.75 (0.45-1.23)	0.248	1.16 (0.49-2.76)	0.738	1.39 (0.84-2.30)	0.197	1.88 (1.14-3.11)	0.013*
Itches on hands or forearms	0.11 (0.54-2.35)	0.750	1.07 (0.67-1.71)	0.775	0.89 (0.39-2.05)	0.783	1.07 (0.68-1.70)	0.763	1.54 (0.97-2.45)	0.067
Muscosal										
Eye irritation	1.36 (0.66-2.80)	0.409	0.84 (0.53-1.34)	0.465	1.32 (0.59-2.95)	0.499	1.65 (1.03-2.64)	0.036*	2.51 (1.56-4.01)	<0.001***
Swollen eyelids	1.40 (0.58-3.42)	0.455	0.94 (0.51-1.71)	0.829	2.94 (1.24-6.98)	0.011*	2.20 (1.16-4.17)	0.014	1.84 (0.99-3.37)	0.048
Runny nose/ nasal catarrh	1.39 (0.62-3.09)	0.420	0.89 (0.55-1.43)	0.622	1.42 (0.58-3.48)	0.439	1.09 (0.68-1.74)	0.730	1.10 (0.68-1.76)	0.702
Nasal obstruction/ blocked nose	1.40 (0.61-3.22)	0.424	0.65 (0.40-1.07)	0.087	1.93 (0.71-5.25)	0.193	1.07 (0.66-1.74)	0.776	1.54 (0.94-2.52)	0.084
Throat dryness	0.97 (0.48-1.98)	0.938	1.16 (0.74-1.81)	0.518	3.78 (1.48-9.63)	0.003**	1.62 (1.04-2.53)	0.033	1.51 (0.97-2.36)	0.068
Sore throat	1.56 (0.76-3.20)	0.228	2.07 (1.31-3.26)	0.002**	2.22 (0.97-5.10)	0.056	1.51 (0.97-2.36)	0.068	1.19 (0.76-1.85)	0.445
Irritative cough	1.59 (0.75-3.38)	0.224	0.88 (0.53-1.46)	0.622	3.37 (1.51-7.51)	0.002**	1.11 (0.67-1.83)	0.682	2.56 (1.53-4.28)	<0.001***

Continue Table 4.20: Association between health symptoms and allergy with potential risk factors among respondents

Health symptoms	Parental Asthma		Gender		Current Smoking		Family Smoking		Home dampness	
	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value
General										
Headache	1.74 (0.65-4.67)	0.268	1.32 (0.78-2.26)	0.302	2.41 (0.71-8.27)	0.149	1.16 (0.68-1.97)	0.588	1.28 (0.75-2.20)	0.364
Nausea	0.77 (0.34-2.72)	0.518	0.96 (0.59-1.56)	0.874	1.57 (0.70-3.52)	0.270	1.04 (0.65-1.68)	0.869	1.21 (0.75-1.95)	0.428
Feeling tired and out of sort	1.38 (0.67-2.82)	0.377	2.13 (1.35-3.37)	0.001***	1.35 (0.61-2.98)	0.458	1.27 (0.81-1.97)	0.298	1.74 (1.12-2.73)	0.014*

N=316
*significant at p<0.05
**significant at p<0.01
**significant at p<0.001

Table 4.21: Association between allergy and respiratory symptoms with potential risk factors and microorganism colonies among respondents

Respiratory symptoms	Parental Asthma		Gender		Family Smoking		Bacteria Concentration		Fungi Concentration	
	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value
Wheezing or whistling in the chest	2.90 (1.19-7.05)	0.019*	1.07 (0.52-2.18)	0.852	2.45 (1.18-5.09)	0.016*	0.99 (0.99-1.00)	0.404	1.02 (0.949-1.0)	0.144
Day time breathlessness	2.34 (0.97-5.65)	0.059	1.48 (0.72-3.02)	0.278	2.46 (1.24-4.90)	0.020*	1.00 (0.99-1.01)	0.333	1.01 (0.99-1.04)	0.425
Night time breathlessness	2.34 (0.97-5.65)	0.044*	1.91 (0.88-4.18)	0.104	1.21 (0.59-2.45)	0.602	1.00 (0.99-1.01)	0.780	1.02 (0.99-1.04)	0.050*
Rashes on the face or neck	0.33 (0.04-2.69)	0.301	1.61 (0.62-4.20)	0.332	2.65 (0.98-7.17)	0.055	1.01 (1.00-1.01)	0.049*	0.97 (0.93-1.00)	0.056
Itches in the face or on the neck	2.16 (1.03-4.54)	0.043	0.70 (0.42-1.18)	0.183	1.49 (0.89-2.50)	0.129	1.00 (0.99-1.00)	0.718	0.99 (0.98-1.01)	0.587
Eye irritation	1.42 (0.68-2.96)	0.353	0.78 (0.48)	0.322	1.77 (1.09-2.67)	0.019*	1.00 (0.99-1.00)	0.658	1.00 (0.99-101)	0.882

Each model consists of age, gender, family smoking and microorganism concentration
Multilevel logistic Regression analysis
*significant at p<0.05, **significant at p<0.01, ***significant at p<0.001

CHAPTER 5

DISCUSSION

5.1 Characteristics of the respondents

Schools, classrooms and students were randomly selected from all secondary schools in Kota Kinabalu, Malaysia and the response rate was high. All samples were analysed after questionnaire data was completed and environmental sampling was conducted the same week as the questionnaire study.

5.1.1 Socio-demographic

From this study, a total of 316 respondents out of 320 participated in questionnaire interview and skin prick test. As summarized in Table 4.1 and 4.2, the majority of the respondents in this study were females among 14 years old. The results were consistent with other study among secondary school students in Malaysia, in which more than 50% of the respondents were females (Norbäck et al., 2014; Leung & Ho, 1994). Among of the respondents, 36.4% were Bajau even though Kadazan Dusun was the largest ethnicity in Sabah. This is because Bajau people are a group living in West Coast, which is Kota Kinabalu is the capital of the West Coast Division of Sabah (Sabah Government, 2019).

In this study, the median of height and weight were 153.00 and 46.19 respectively. High percentages of the study respondents 91.5% were non-smoker which might due to smoke was not allowed in the schools, neither for the students or the teachers (Norbäck et al., 2016). High prevalence of smoking among the student in Kota Kinabalu (8.5%) compared with the study conducted in Penang Malaysia which was 2.7% (Norbäck et al., 2017) and in Johor Bharu about 4.8% (Norbäck et al., 2014). More than halves, respondents' father were smoker (51.9%). Siblings showed the highest reported of history nasal symptoms and history of eczema which were (14.6%) and (10.4%) respectively. Family history was the factor with the strongest association with asthma and allergic symptoms (Leung & Ho, 1994). In term of household income, most of respondents' parents got less than RM 1500 per month (49.7%) because of most of them were fisherman and farmers. Besides that, about 8.5% of respondents were smokers.

5.1.2 School Characteristics

This study was carried out in six selected schools in Kota Kinabalu and the schools were built more than 5 years. The highest building age was School 2 built on 1967. The mean age of the school buildings was 37 years (range of 17-52 years). Most of the schools were 2-4 storeys concrete buildings with painted outdoor surfaces and the floor surface consisted of concrete without any paint or floor covering except for the school 1 which the floor were covered with tiles. The schools

with concrete floor were clearer to see the dust and some of the classrooms had curtain. Curtain is one of the site which the dust volume higher to compare to other. The small size of the classrooms and higher population of the students in classrooms will make the classrooms denser.

5.1.3 School Indoor Environmental Parameters

Most of the indoor air parameters such as indoor air temperature, carbon dioxide concentration, total bacteria count and fungi count were within acceptable range and limits of indoor air quality guidelines (DOSH, 2010) except for indoor relative air humidity was 66% (range of 67–88%), different bit from the median outdoor relative air humidity (64%). The level of CO_2 was low in the classrooms (range 408-746 ppm) and always below the recommended limit of 1000 ppm. This was due to effective natural ventilation since all the classrooms had open window and door on the both side of the classrooms (Norbäck et al., 2014). The median indoor air temperature (26.3°C) in the current study was similar to the thermal comfort temperature suggested by some studies in tropical countries (26°C) (Lim et al., 2015).

5.1.4 Home Environmental Factors

As summarized in Table 4.8, about 30.4% of the respondents had reported that water leakage or water damage in walls or floor is the common current home

characteristics in the last 12 months. The prevalence in the current study was lower than in other previous studies. A cross-sectional study in Penang reported that 34.8% of the respondents had home dampness problem (Norbäck et al., 2017). The World Health Organization 1990 has concluded that there is sufficient evidence to show that the occupants of damp buildings have an increased risk of respiratory symptoms, respiratory infection and exacerbation of asthma.

Around 62% of them had pet keeping at home and cat were the common pet (53.8%) in Asia-Pacific compared to dogs or other animals (Brunekreef et al., 2012). The percentage of indoor home painted in in the last 12 months (30.4%) in current study was comparable with the prevalence from the cross-sectional study performed in Penang, 40.6% (Norbäck et al., 2017). It showed population in Kota Kinabalu has lower prevalence compared to other population in Malaysia.

5.2 Prevalence of Allergy and Respiratory Symptoms of Respondents

5.2.1 Prevalence of Self-reported Allergy Symptoms of Respondents

As summarized in Table 4.11, it had shown the prevalence of self-reported allergy symptoms among respondents. In total, 177 (56.0%) of the respondents had experienced itchy watery eyes and nose. Respondent who were allergic to food showed the highest prevalence (17.7%) as compared to cat (8.2%), dust (6.6%) and pollen (4.1%) meanwhile in other study conducted in Johor Bharu, it showed pollen or furry pet allergy (21.1%) had the highest prevalence in allergy symptoms (Norbäck et al., 2016). It showed reported pollen allergy (4.1%) and cat allergy (8.2%) in Kota Kinabalu has lower prevalence compared to previous study conducted in Johor Bharu (Norbäck et al., 2014). After conducted skin prick test 14.0% of respondents were positive allergic to cat allergen compared with the self-reported allergy, only 8.2% were stated that they have allergy toward cat. It showed that some of them were not diagnosed or familiar with cat allergy. One of the limitations in this study, there was no data on the concentration of cat allergen in the schools and home environment. Although the respondents who are allergic to cats do not own a cat in their home, they may expose to high concentrations of cat allergen because cat allergens can be passively transported through clothing easily, especially if they are living in a community with high level of cat ownership (Arbes et al., 2004). Further studies are needed to study on cat allergy and its health implication in Malaysia.

5.2.2 Prevalence of Allergy (skin prick test) of Respondents

From this study, it shows HDM (Derp 1 and Derf) recorded the highest prevalence of allergies among the respondent in this study. The prevalence of HDM (*D. pteronyssinus)*conducted in this study which was 53.5% compared to previous study conducted in Kota Kinabalu on 1994 was 60.5%, showed the decreasing of prevalence HDM among students in Kota Kinabalu (Leung & Ho, 1994). HDM allergen is one of the major indoor allergen which can trigger respiratory symptoms and clinical study among patients with allergy in Malaysia have revealed HDM allergy and cat allergy were the common allergies among patients (Asha'ari, Yusof, Ismail, & Hussin, 2010). A recent review concluded that schools might be important sources of allergen exposures including cat and dog allergen (Salo, Sever, & Zeldin, 2009). Home environment is the major site of exposure to HDM allergens as HDM mainly live in bed mattresses (Brunetto et al., 2009) and high prevalence and density of *D. pteronyssinus* (average 4 553 mites/g per month) was reported from a home environment study in Malaysia (Mariana, Ho, Sofian-Azirun, & Wong, 2000). HDM might be transported from the home to other places through cloths. While there was a study conducted in 2014, which showed that a low levels of HDM found in a school study of allergens in settled dust (Norbäck et al., 2014). HDM can be found on clothing and automobile seats and proposed both are vehicles in the dispersal of mites(Neal, Arlian, & Morgan, 2002). In tropical areas, indoor levels of house dust mite and tropical mite allergens and moulds are expected to be high due to the warm and humid climate, while ventilation flow can be expected high from natural ventilation (Hussin et al., 2011).

5.2.3 Prevalence of Respiratory Symptoms of Respondents

High prevalence of breathlessness after exercise (31.6%), day time breathlessness (16.8%), wheeze or whistling in the chest (13.6%) and night time breathlessness (12.0%) among the respondents was observed in this study. It same goes with previous study reported high prevalence of breathlessness after exercise (Norbäck et al., 2014). High prevalence of respiratory symptoms in this study may due to the high prevalence of HDM and cat allergies among the students in current study (Brunekreef et al., 2012). Students in Kota Kinabalu reported lower prevalence of day time breathlessness compared to students in Penang for previous study (37.3%). Although prevalence of smokers among the students in Kota Kinabalu higher, but the higher prevalence in day time breathlessness in Penang can be due to others risk factors such as parental smoking or presence of asthma since childhood.

5.3 Correlation between Indoor Air Parameter in Schools

No correlation found between temperature, relative humidity and carbon dioxide concentration with the bacteria and fungi colonies. Previous study stated that the survival of bacteria in air is dependents on a number of factors including relative humidity and temperature (W., 2009). One possible reason could be that there were little variation in room temperature and relative air humidity in this study.

5.4 Association between Health Variables with Indoor Air Parameters among Respondents

5.4.1 Association between Self-reported Allergy Symptoms of Respondents with the Microorganisms Colonies in the Indoor Air and Skin Prick Test

As summarized to Table 4.13 presents analysis by Chi-Square test for association between self-reported allergy symptoms of respondent with the microorganism colonies in the indoor air. It shows food allergy and itchy watery eyes and nose are significantly associated with the category of bacteria count ($p= 0.005$) and ($p=0.043$) respectively. There was study stated that the building da

As summarized to Table 4.14, Chi-Square test used to analyse association between self-reported allergy symptoms reported with the skin prick test. The reported cat allergy among respondents was associated with the all allergen except for Alternaria ($p > 0.05$). Food allergy was associated with Derp and Derf which the p value is 0.047 for both of them. Itchy watery eyes and nose symptoms was significantly associated with Derp 1 ($p = 0.048$) and cat allergen ($p = 0.015$).

5.4.2 Association between Respiratory Symptoms of Respondent with the Microorganisms Colonies in the Indoor Air and Skin Prick Test

This study found that the respiratory symptoms were not significantly associated with bacteria colonies. While for the association between respiratory symptoms of respondent with the fungi exposure in the indoor air, night time breathlessness was significantly associated with fungi exposure ($p=0.035$). In previous study found that, there was an association between fungal exposure and respiratory health effects among school children in a warmer (subtropical) climate.

Students who were breathlessness with the presence of wheezing were significantly associated with allergies ($p<0.05$). Students with wheezing or whistling in the chest and wheezing without flu were significantly associated with all allergies except for the *cladosporium* ($p=0.069$) and ($p=0.596$). Day time breathlessness and breathlessness after exercise were not significantly associated with all the allergies ($p>0.05$). Tightness in the chest was only associated with HDM (Derp 1, Derf) and cat allergies, while night time breathlessness was significantly associated with Derf allergies ($p<0.05$). Students whose reported with itches in the face or on the neck was significantly associated with allergy to *Cladosporium herbarum* (mould) ($p=0.032$). In term of mucosal symptoms, eye irritation was significantly associated with *D. pteronyssinus* (Derp 1) allergies ($p=0.003$) and runny nose/ nasal catarrh was significantly associated with cat allergies ($p=0.033$).

5.4.3 Association between Health Symptoms in the Last 3 Months among Respondents with the Microorganisms Colonies in the Indoor Air and Skin Prick Test

Table 4.18 shows the association between health symptoms the past 3 month with skin prick test. Students whose reported with rashes on the face or neck, itches in the face or on the neck and itches on hands and forearms were significantly associated with *Cladosporium* (p=0.040), (p=0.032) and (p=0.047) respectively. In term of mucosal symptoms, eye irritation was significantly associated with Derp allergies (p=0.003) and runny nose/ nasal catarrh was significantly associated with Cat allergies (p=0.033). While for general symptoms, feeling tired and out of sort was significantly associated with cat allergen (p=0.033). This study found that respondents sensitized to HDM or cat allergen had more health symptoms

5.4 Potential Risk Factors of Self-reported Allergy Symptoms, Respiratory Symptoms and Health Symptoms in the Last 3 Months among Respondents

As summarized Table 4.19 and Table 4.20, presents the association between respiratory symptoms and allergy with potential risk factors among respondents analysis by using Chi-Square test. Parental asthma, gender, current smoking, family member smoking and home dampness were independently associated with respiratory symptoms. Respondents whose parental asthma or have family members smoking as significantly associated with wheezing or whistling in the chest, breathless when wheezing present, day time breathlessness and breathlessness after exercise. While, respondents with parental asthma had significantly more feeling of

tightness in the chest (p = 0.024). Home dampness showed there was no significant association with the respiratory symptoms however, there was study stated that mold exposure in buildings is a risk factors for respiratory symptoms, rhinitis as well as general symptoms such as headache and tiredness (Pei Zam, Emilia, Karmegam, & Mohd Sapuan, 2017).

Table 4.20 illustrates the associations between the health symptoms and personal factors among the respondents. Parental asthma, gender, current smoking, family smoking and home dampness were independently associated with health symptoms. Family smoking was significantly associated with rashes on hands and forearms (p = 0.014) and skin redness (p=0.014). Besides that, respondents who smoke were significantly associated with swollen eyelids, throat dryness and irritative cough (p<0.05). Home dampness Rashes on hands and forearms (p=0.013), eye irritation (p<0.001), irritative cough (p<0.001) and feeling tired out of sort (p=0.014).

In multilevel logistic regression analysis, the result showed students with parental asthma had 2.90 times more wheezing or whistling in the chest (p=0.019) and 2.34 times night time breathlessness (p=0.044). There was positive association between students who have family members smoking with wheezing or whistling in the chest (p=0.016), day times breathlessness (p=0.020) and eye irritation (p=0.019). According to American Lung Association (2019), who with parental asthma, they have three to six times more likely to develop asthma than someone who does not have a parent with asthma.

More than halves, respondents' father were smoker (51.9%) and the children can be the passive smoker if inhaled the smoke. If the parents smoked in home, the smoke or ashes from smoking might flew in the home and can lead to unpleasant odour and discomfort in home (Lim et al., 2015). Previous study stated that children who expose to environmental tobacco smoke (ETS) during childhood was associated with respiratory symptoms in adulthood (Johannessen, Bakke, Hardie, & Eagan, 2012).

CHAPTER 6

STUDY LIMITATIONS, CONCLUSION AND RECOMMENDATIONS

6.1 Study Limitation

This is a prevalence study, which could not differentiate between exacerbation of existing symptoms and new-onset symptoms. The study's limitations include the design of a study that is a cross-sectional study using questionnaires where responses to questions rely on recalled memories by the students or parents, which provide potential biased information where the outcome is only relevant to estimate the prevalence. In addition, other factors that contribute to indoor air pollution such as ventilation rate, classroom size are not measured.

6.2 Conclusion

Gram positive bacillus was the most common types of bacteria staining isolated in school environment. Most bacteria and fungi concentrations were within the acceptable limit recommended for good IAQ by ICOQIAQ 2010. High prevalence of health symptoms reported by respondents within the last 3 months including headache, itches on hands or forearms and nasal obstruction/nose blocked. However, rashes on the face or neck and swollen eyelid were significantly associated with fungi concentration. High prevalence of respiratory symptoms reported by respondents including breathlessness after exercise and on day time, wheezing and

whistling in the chest and breathlessness without flu. House dust mite (Derp 1 and Derf) were the highest prevalence reported on the allergy among the students. Parental asthma and family smoking were the risk factors to the reported health symptoms.

6.3 Recommendations

As the research only study the prevalence of house dust mite, cat and mold allergy such as *D.pteronysinnus* (Derp 1), *D.farinae* (Derf), *Felis domesticus* (cat allergen), *Alternaria alternate* and *Cladosporodium herbarum* allergy among the students, additional types of common allergies could be added in future studies such as another type of dust mites (Blomia tropicallis) and pollen allergens extracts. This could help in better understanding the allergies profile of study group. Besides, it is recommended to study house dust mite (HDM) concentration in the classroom settled dust in relation to respiratory symptoms and allergies (skin prick test) among the students in future studies. It is better to have cohort study on indoor air quality studies in the future in order to study dose-response effect of the indoor environmental parameters towards respiratory health in children.

REFERENCES

American Lung Association. (2019). Lung Health & Diseases. https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/living-with-asthma/managing-asthma/for-parents-of-children-with-asthma.html

Arbes, S. J., Cohn, R. D., Yin, M., Muilenberg, M. L., Friedman, W., & Zeldin, D. C. (2004). Dog allergen (Can f 1) and cat allergen (Fel d 1) in US homes: Results from the National Survey of Lead and Allergens in Housing. *Journal of Allergy and Clinical Immunology*, *114*(1), 111–117. https://doi.org/10.1016/j.jaci.2004.04.036

Arbes, S. J., Cohn, R. D., Yin, M., Muilenberg, M. L., Friedman, W., & Zeldin, D. C. (2004). Dog allergen (Can f 1) and cat allergen (Fel d 1) in US homes: Results from the National Survey of Lead and Allergens in Housing. *Journal of Allergy and Clinical Immunology*, *114*(1), 111–117. https://doi.org/10.1016/j.jaci.2004.04.036

Asha'ari, Z. A., Yusof, S., Ismail, R., & Hussin, C. M. C. (2010). Clinical features of allergic rhinitis and skin prick test analysis based on the ARIA classification: A preliminary study in Malaysia. *Annals of the Academy of Medicine Singapore*, *39*(8), 619–624.

Bragoszewska, E., Mainka, A., Pastuszka, J. S., Lizończyk, K., & Desta, Y. G. (2018). Assessment of bacterial aerosol in a preschool, primary school and high school in Poland. *Atmosphere*, *9*(3), 1–15. https://doi.org/10.3390/atmos9030087

Brunekreef, B., Von Mutius, E., Wong, G., Odhiambo, J., García-Marcos, L., & Foliaki, S. (2012). Exposure to cats and dogs, and symptoms of asthma, rhinoconjunctivitis, and eczema. *Epidemiology*, *23*(5), 742–750. https://doi.org/10.1097/EDE.0b013e318261f040

Brunetto, B., Barletta, B., Brescianini, S., Masciulli, R., Perfetti, L., Moscato, G., … Iacovacci, P. (2009). Differences in the presence of allergens among several types of indoor environments. *Annali Dell'Istituto Superiore Di Sanita*, *45*(4),

409–414. https://doi.org/10.1590/S0021-25712009000400009

Ferreira, A. M. da C., & Cardoso, M. (2014). Indoor air quality and health in schools. *Jornal Brasileiro de Pneumologia : Publicacao Oficial Da Sociedade Brasileira de Pneumologia e Tisilogia*, *40*(3), 259–268. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/25029649%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC4109198

Hussin, N. H. M., Sann, L. M., Shamsudin, M. N., & Hashim, Z. (2011). Characterization of bacteria and fungi bioaerosol in the indoor air of selected primary schools in Malaysia. *Indoor and Built Environment*, *20*(6), 607–617. https://doi.org/10.1177/1420326X11414318

Johansson, R. (2004). has been updated by World Allergy Organization in its publication .A Revised Nomenclature for Allergy for Global Use. *Allergy*, 1–2.

Leung, R., & Ho, P. (1994). Asthma, Allergy and atopy in three South-East Asian populations. *Thorax*, *49*(12), 1205–1210. https://doi.org/10.1136/thx.49.12.1205

Lim, F. L., Hashim, Z., Md Said, S., Than, L. T. L., Hisham Hashim, J., Norbäck, D., & Hisham Hashim, J. (2015). Asthma, Airway Symptoms and Rhinitis in Office Workers in Malaysia: Associations with House Dust Mite (HDM) Allergy, Cat Allergy and Levels of House Dust Mite Allergens in Office Dust. *Plos One*, *10*(4), e0124905. https://doi.org/10.1371/journal.pone.0124905

Lwanga, S., & Lemeshow, S. (1991). Sample Size Determination in Health Studies: A Practical manual, 1991. In *World Health Organization, Geneva*. https://doi.org/10.2307/2290547

Madureira, J., Paciência, I., Ramos, E., Barros, H., Pereira, C., Teixeira, J. P., & De Oliveira Fernandes, E. (2015). Childrens health and indoor air quality in primary schools and homes in Portugal - Study design. *Journal of Toxicology and Environmental Health - Part A: Current Issues*, *78*(13–14), 915–930. https://doi.org/10.1080/15287394.2015.1048926

Mariana, A., Ho, T. M., Sofian-Azirun, M., & Wong, A. L. (2000). House dust mite fauna in the Klang Valley, Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health*, *31*(4), 712–721.

Mebi, G., Samuel, W., & Ojogba, M. (2012). Relationship Between Fungal Contamination of Indoor Air and Health Problems of Some Residents in Jos. *Air Quality - Monitoring and Modeling*. https://doi.org/10.5772/32160

Neal, J. S., Arlian, L. G., & Morgan, M. S. (2002). Relationship among house-dust mites, Der 1, Fel d 1, and Can f 1 on clothing and automobile seats with respect to densities in houses. *Annals of Allergy, Asthma and Immunology*, *88*(4), 410–415. https://doi.org/10.1016/S1081-1206(10)62373-3

Norbäck, D., Hashim, J. H., Hashim, Z., Sooria, V., Ismail, S. A., & Wieslander, G. (2017). Ocular symptoms and tear film break up time (BUT) among junior high school students in Penang, Malaysia – Associations with fungal DNA in school dust. *International Journal of Hygiene and Environmental Health*, *220*(4), 697–703. https://doi.org/10.1016/j.ijheh.2017.01.016

Norbäck, D., Hashim, J. H., Markowicz, P., Cai, G. H., Hashim, Z., Ali, F., & Larsson, L. (2016). Endotoxin, ergosterol, muramic acid and fungal DNA in dust from schools in Johor Bahru, Malaysia - Associations with rhinitis and sick building syndrome (SBS) in junior high school students. *Science of the Total Environment*, *545–546*, 95–103. https://doi.org/10.1016/j.scitotenv.2015.12.072

Norbäck, D., Markowicz, P., Cai, G. H., Hashim, Z., Ali, F., Zheng, Y. W., … Hashim, J. H. (2014). Endotoxin, ergosterol, fungal dna and allergens in dust from schools in johor bahru, malaysia- Associations with asthma and respiratory infections in pupils. *PLoS ONE*, *9*(2). https://doi.org/10.1371/journal.pone.0088303

Norzila, M. Z., Haifa, A. L., Deng, C. T., & Azizi, B. H. (2000). Prevalence of childhood asthma and allergy in an inner city Malaysian community: intra-observer reliability of two translated international questionnaires. *The Medical Journal of Malaysia*, *55*(2), 33–39.

Ross, M. A., Curtis, L., Scheff, P. A., Hryhorczuk, D. O., Ramakrishnan, V., Wadden, R. A., & Persky, V. W. (2000). Association of asthma symptoms and severity with indoor bioaerosols. *Allergy: European Journal of Allergy and Clinical Immunology*, *55*(8), 705–711. https://doi.org/10.1034/j.1398-9995.2000.00551.x

Salo, P. M., Sever, M. L., & Zeldin, D. C. (2009). Indoor allergens in school and day care environments. *Journal of Allergy and Clinical Immunology*, *124*(2). https://doi.org/10.1016/j.jaci.2009.05.012

W., T. J. (2009). The effect of environmental parameters on the survival of airborne infectious agents. *Journal of The Royal Society Interface*, *6*(suppl_6), S737–S746. https://doi.org/10.1098/rsif.2009.0227.focus

World Health Organization. (2018). Air Pollution and Child Health. *American Academy of Prdiatrics*, *113*, 1037–1043. Retrieved from http://pediatrics.aappublications.org/content/113/Supplement_3/1037.full.html

Pope, C. A., & Dockery, D. W. (2006). Health Effects of Fine Particulate Air Pollution: Lines that Connect. *Journal of the Air & Waste Management Association, 56*(6), 709–742. doi:10.1080/10473289.2006.10464485

Rosen, J., & Heseltine, E. (2009). WHO guidelines for indoor air quality: Dampness and mould. Copenhagen: WHO Regional Office for Europe.

Salo, P. M., Sever, M. L., & Zeldin, D. C. (2009). Indoor allergens in school and day care environments. *Journal of Allergy and Clinical Immunology, 124*(2). https://doi.org/10.1016/j.jaci.2009.05.012

Savilahti, R., Uitti, J., Roto, P., Laippala, P., & Husman, T. (2001). Increased prevalence of atopy among children exposed to mold in a school building. *Allergy, 56*(2), 175–179

Stafford, T. M. (2015). Indoor air quality and academic performance. *Journal of Environmental Economics and Management, 70*, 34–50. doi:10.1016/j.jeem.2014.11.002

Sundell, J. (2004). On the history of indoor air quality and health. *Indoor Air, 14(s7),* 51–58. doi:10.1111/j.1600-0668.2004.00273.x

UNICEF (2009). The Child-Friendly Schools Manual. New York: United Nations Children's Fund.

W., T. J. (2009). The effect of environmental parameters on the survival of airborne infectious agents. *Journal of The Royal Society Interface, 6*(suppl_6), S737–

S746. https://doi.org/10.1098/rsif.2009.0227.focus

World Allergy Organization. (2016). *WAO/EAACI allergy definitions.* Retrieved from https://www.worldallergy.org/education-and-programs/education/allergic-disease-resource-center/professionals/ige-in-clinical-allergy-and-allergy-diagnosis

World Health Organization. (2017). Don't Pollute my future! The impact of the environment on children's health. World Health Organization, 30. https://doi.org/10.1021/bi00088a015

World Health Organization. (2018). Air Pollution and Child Health. *American Academy of Prdiatrics*, *113*, 1037–1043. Retrieved from http://pediatrics.aappublications.org/content/113/Supplement_3/1037.full.html

Zuraimi M. S, Tham K. W., & Sekhar S. C. (2003). The effect of ventilation operation in determining contribution at VOCs sources in air conditioned trophical building. *Building and Environment, 38*, pp. 23-32.

Appendix I

Approval Letter (Ethic Committee)

ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA

Research title	:	**The Assessment of Allergy and Respiratory Symptoms Among Secondary School Students in Kota Kinabalu: Influence of Microorganisms in School Environment**
Study Site	:	**Kota Kinabalu, Sabah**
JKEUPM Ref No.	:	**JKEUPM-2018-359**
Researcher	:	**Siti Raihan binti Mohd Fuad**
Supervisor	:	**Prof. Dr. Zailina binti Hashim**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 29/10/2018
2. Respondent Information Sheet & Guardian's/ Parent's Consent (Malay), Version 2 dated 13/12/2018
3. Respondent Information Sheet & Consent (Malay), Version 2 dated 13/12/2018
4. Proposal (English), Version 2 dated 13 /12/2018
5. Questionnaires/ Interviews (Malay), Version 1 dated 29/10/2018
6. Curriculum Vitae of:
    a. Prof. Dr. Zailina binti Hashim
    b. Assoc Prof. Dr. Shamsul Bahari bin Shamsuddin

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance to the ICH-GCP Guidelines.

Decision by JKEUPM:

[X] Approved

[X] **Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research**

[ ] Disapproved

Please note that the approval is **VALID UNTIL 27 DECEMBER 2019**

Appendix II

Approval Letter (Ministry of Education and Sabah State Education Office)

KEMENTERIAN PENDIDIKAN MALAYSIA
BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN
ARAS 1-4, BLOK E8
KOMPLEKS KERAJAAN PARCEL E
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62604 PUTRAJAYA

TEL 0388846591
FAKS 0388846579

Ruj. Kami : KPM.600-3/2/3-eras(2496)
Tarikh : 2 Disember 2018

SITI RAIHAN BINTI MOHD FUAD
NO. KP : 960809017404

JB 2158, JALAN ANGGERIK, TAMAN CEMPAKA,
77400 SUNGAI RAMBAI
MELAKA

Tuan,

KELULUSAN BERSYARAT UNTUK MENJALANKAN KAJIAN :
PENILAIAN TERHADAP ALAHAN DAN SIMPTOM-SIMPTOM PERNAFASAN DALAM KALANGAN PELAJAR SEKOLAH MENENGAH DI KOTA KINABALU : PENGARUH MIKROORGANISMA DI PERSEKITARAN SEKOLAH

Perkara di atas adalah dirujuk.

Sukacita dimaklumkan bahawa permohonan tuan untuk menjalankan kajian seperti di bawah telah diluluskan dengan syarat :

" PERLU MENDAPAT KEBENARAN IBU BAPA/ PENJAGA MURID "

Kelulusan adalah berdasarkan kepada kertas cadangan penyelidikan dan instrumen kajian yang dikemukakan oleh tuan kepada bahagian ini. Walau bagaimanapun kelulusan ini bergantung kepada kebenaran Jabatan Pendidikan Negeri dan Pengetua / Guru Besar yang berkenaan.

4. Surat kelulusan ini sah digunakan bermula dari **10 Januari 2019** hingga **13 Februari 2019**

Tuan dikehendaki menyerahkan senaskhah laporan akhir kajian dalam bentuk *hardcopy* bersama salinan *softcopy* berformat pdf dalam CD kepada Bahagian ini.Tuan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak diterbitkan di mana-mana forum, seminar atau diumumkan kepada media massa.

Sekian untuk makluman dan tindakan tuan selanjutnya. Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Ketua Sektor
Sektor Penyelidikan dan Penilaian
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan
Kementerian Pendidikan Malaysia

salinan kepada:-

JABATAN PENDIDIKAN SABAH

* SURAT INI DIJANA OLEH KOMPUTER DAN TIADA TANDATANGAN DIPERLUKAN *

Appendix III

Subject Information Sheet

(Malay version)

JAWATANKUASA ETIKA UNIVERSITI UNTUK PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

BORANG 2.4: PENERANGAN DAN PERSETUJUAN RESPONDEN

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1.TAJUK KAJIAN

Faktor kualiti udara serta kesan alahan dan asma dalam kalangan pelajar sekolah di Malaysia.

2. PENGENALAN

Penyelidikan ini akan dijalankan untuk mengkaji hubungan di antara pendedahan terhadap pencemaran udara dengan asma, alahan dan simptom-simptom pernafasan dikalangan kanak-kanak sekolah menengah.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Penyertaan dalam kajian ini adalah secara sukarela dan tidak akan ada sebarang pembayaran dikenakan. Persetujuan dari ibu bapa atau penjaga diperlukan bagi setiap peserta sebelum menyertai kajian ini. Semua peserta akan menerima satu cenderamata sebagai tanda penghargaan menyertai sesi penyelidikan ini. Tiada pampasan tambahan akan diberikan.

Peserta yang memenuhi kriteria inklusi akan menjalani beberapa prosedur penyelidikan termasuk:

1. Isikan soal selidik yang dibantu oleh penyelidik.
2. Ujian penilaian nitrogen oksida dalam hembusan nafas (FeNO), pelajar akan diminta untuk menarik nafas sedalam-dalam dan menghembus nafas dengan aliran berterusan ke dalam alat penganalisa. Pelajar akan mengulangi proses ini selama tiga kali untuk mendapatkan hasil purata. Prosedur ini hanya mengambil masa 5 minit.
3. Ujian untuk mengukur kadar masa bagi selaput mata untuk pulih, satu alat khas akan didekatkan kepada mata dan pelajar akan diminta untuk melihat ke dalam alat tersebut. Penilaian akan dibuat oleh penyelidik. Prosedur ini tidak menyakitkan dan hanya mengambil masa dalam 5 minit.
4. Ujian fungsi paru-paru, pelajar akan bernafas melalui mulut yang dipasang pada alat rakaman (spirometer). Pelajar akan melakukan ujian selama 3 kali untuk hasil purata.
5. Ujian alahan (hama rumah, debunga yang berkaitan, kucing dan lipas) hanya akan dilakukan pada kulit tangan peserta. Jumlah kecil alergen (hama rumah, debunga yang berkaitan, kucing, dan lipas) dalam bentuk cecair akan dimasukkan ke dalam lapisan atas kulit dengan membuat tusukan kecil. Pelajar akan dipantau dengan teliti untuk melihat bagaimana reaksi kulit terhadap alergen selama 20 minit. Prosedur ini akan dijalankan oleh pegawai perubatan yang pengalaman.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Subjek yang mempunyai fizikal yang normal dan sihat boleh menyertai kajian ini secara sukarela selepas mendapat keizinan daripada ibu/bapa atau penjaga. Subjek mestilah pelajar Tingkatan 2 yang telah bersekolah di sekolah yang sama sejak Tingkatan 1. Selain itu, individu yang mempunyai penyakit kronik seperti penyakit jantung, hipertensi dan kelainan dada fizikal kongenital tidak akan dimasukkan dalam kajian ini.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Hasil kajian yang bakal diperolehi daripada ujian kesihatan percuma yang akan dijalankan boleh membantu pelajar dan ibu bapa untuk mengetahui status keadaan kesihatan pelajar tanpa sebarang kos. Pihak pengurusan sekolah juga akan mendapat manfaat maklumat kadar pencemaran udara di sekolah dan tahap kesihatan pelajar tanpa perlu mengeluarkan sebarang kos. Di samping itu, kami berharap hasil kami akan menambah pengetahuan mengenai hubungkait persekitaran sekolah terhadap alergi dan asma.

b) KEPADA PENYELIDIK?

Hasil dari kajian ini akan memberikan maklumat penting dalam usaha untuk membina pangkalan data komprehensif untuk memantau kualiti udara dalaman di kalangan kanak-kanak. Selain itu,melalui kajian ini juga akan memberikan pemahaman yang lebih baik dan keupayaan yang lebih baik untuk mengenal pasti pencemar toksik semasa dan mengesyorkan strategi yang berkesan untuk mengurangkan pencemaran udara dalaman.

6. ADAKAH IA BERISIKO?

Peserta tidak akan mengalami apa-apa risiko dalam menghadiri set soal selidik yang hanya memerlukan anda menyatakan butiran peribadi, sejarah perubatan, pendedahan kepada alergen dan gejala yang berpengalaman berkaitan dengan pencemaran udara dalaman.

Begitu juga dengan ujian kadar nitrogen oksida dalam hembusan nafas (FeNO), ujian fungsi paru-paru dan ujian kadar masa bagi selaput mata untuk pulih, tidak ada sebarang risiko yang akan berlaku sepanjang prosedur-prosedur ini dijalankan. Semua prosedur yang bakal dijalankan adalah seragam dan selamat.

Prosedur ini akan dilakukan oleh ahli perubatan dan teknologi yang telah terlatih dan mempunyai pengalaman yang mencukupi dalam prosedur. Pegawai perubatan akan berada di tempat proses mengaruhkan kahak setiap masa semasa prosedur dijalankan.

Manakala untuk prosedur ujian alahan, terdapat risiko anafilaksi (reaksi di dalam salur darah) yang sangat rendah. Prosedur ini akan dijalankan oleh pegawai perubatan yang terlatih dan sebagai langkah keselamatan ubat alahan akan disediakan jika berlaku anafilaksi. Disamping itu pemantauan akan dibuat terhadap semua peserta untuk tempoh 40 minit selepas prosedur dijalankan.

Secara keseluruhannya, pihak penyelidik akan menggunakan pegawai perubatan dan ahli teknologi perubatan yang terlatih dan berpengalaman untuk menjalankan semua prosedur klinikal terhadap peserta. Pihak penyelidik juga akan menyediakan ambulance sebagai langkah berjaga-jaga jika berlaku sebarang risiko yang tidak diingini.

Pihak penyelidik juga akan menyediakan Insuran Liabiliti Awam untuk setiap peserta jika berlaku sebarang kecelakaan sepanjang tempoh prosedur klinikal ini dijalankan. Sebarang tuntutan boleh dibuat

berdasarkan terma dan syarat yang telah ditetapkan oleh pihak pembekan Insuran Liabiliti Awam tersebut.

Diakhir proses penyelidikan, semua peserta akan diberi cenderamata sebagai tanda penghargaan daripada pihak penyelidik di atas kesudian menjadi peserta secara sukarela.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Semua maklumat peserta adalah rahsia. Hanya penyelidik yang terlibat dalam kajian ini dan mereka yang bertanggungjawab untuk penyelidikan akan mempunyai akses kepada maklumat yang anda berikan. Keputusan umumnya akan diterbitkan sebagai ringkasan perbincangan, bukan transkrip / balasan individu. Bahan penerbitan tidak akan dikenal pasti nama atau dengan apa cara lain yang mana peserta dapat dikenal pasti oleh pembaca laporan tersebut.

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

Jika anda mempunyai pertanyaan, sila hubungi:

No	Nama	Alamat	No Tel.Bimbit/ No Tel. Pejabat	E-mail
1	Prof. Dr. Zailina Hashim	Jabatan Kesihatan Persekitaran & Pekerjaan Faculti Perubatan & Sains Kesihatan, UPM Serdang	017- 6361367/ 03-947240	zailina@upm.edu.my
2	Nur Haslyna binti Mohd Hamizul	Jabatan Kesihatan Persekitaran & Pekerjaan Faculti Perubatan & Sains Kesihatan, UPM Serdang	018-2182320	nurhaslynamh@gmail.com
3	Nur Shahira binti Mohamad Fadzil	Jabatan Kesihatan Persekitaran & Pekerjaan Fakulti Perubatan & Sains Kesihatan, UPM Serdang	011-40685226	nurshahirafadzil@gmail.com
4	Siti Raihan binti Mohd Fuad	Jabatan Kesihatan Persekitaran & Pekerjaan Fakulti Perubatan & Sains Kesihatan, UPM Serdang	017-7527076	sitiraihanmohdfuad@gmail.com
5	Anis Zahira binti Zainudin	Jabatan Kesihatan Persekitaran & Pekerjaan Fakulti Perubatan & Sains Kesihatan, UPM Serdang	013-2803841	anisiera95@gmail.com

Nota: Borang penerangan dan persetujuan ibu bapa ini adalah gabungan daripada empat (4) kajian pelajar.

Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini _____

9. PERSETUJUAN

Saya…… No Kad Pengenalan. ……
beralamat……
……dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam penyelidikan yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi, risiko dan komplikasi (seperti tertulis pada Helaian Penerangan 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 yang berkaitan identiti saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang melibatkan saya.

I setuju/tidak bersetuju untuk imei/gambar/rakaman video/ rakaman suara digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan ……
(*Responden*)

Tarikh :……

Tandatangan ……
(*Saksi*)

Nama :……

No. K/P: ……

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

Tarikh ……

Tandatangan ……
(*Penyelidik*)

MAKLUMAT TAMBAHAN

Berikut adalah maklumat tambahan mengenai prosedur-prosedur terlibat. Peserta akan menjalani penilaian klinikal yang mudah pada nitrogen oksida (NO) dalam hembusan nafas (FeNO) dengan menggunakan alat penganalisa seperti dicadangkan American Thoracic Society (ATS). Peserta akan diminta untuk menarik nafas sedalam-dalam dan menghembus nafas dengan aliran berterusan ke dalam corong mulut khas alat penganalisa. Peserta perlu mengulangi proses ini selama tiga kali untuk mendapatkan hasil purata. Prosedur ini hanya mengambil masa 5 minit.

Ujian Spirometry (ujian fungsi paru-paru) dilakukan selepas seperti yang dicadangkan oleh American Thoracic Society, 1987. Spirometer telah dikalibrasi terlebih dahulu dengan menyuntikkan 3 liter udara ke dalam spirometer menggunakan jarum 3L. Untuk ujian, pelajar akan bernafas melalui mulut yang dipasang pada alat rakaman (spirometer). Untuk mendapatkan hasil yang terbaik, semua responden melakukan ujian selama 3 kali. Maklumat yang dikumpul oleh spirometer dicetak pada carta yang disebut spirogram.

Peserta akan menjalani satu ujian klinikal yang mudah dan selamat menggunakan alatan khas, Tearscope Plus untuk mengukur kadar masa bagi selaput mata untuk pulih (Tear Film Break Up Time). Peserta akan diberi penerangan dan alatan khas ini akan didekatkan kepada mata dan peserta akan diminta untuk melihat kedalam alat tersebut. Penilaian akan dibuat oleh penyelidik. Prosedur ini tidak menyakitkan dan hanya mengambil masa dalam 5 minit.

Penilaian klinikal ujian alergi hanya akan dilakukan pada kulit peserta. Jumlah kecil alergen (hama rumah, debunga yang berkaitan, kucing dan lipas) dalam bentuk cecair akan dimasukkan ke dalam lapisan atas kulit dengan membuat tusukan kecil. Peserta akan dipantau dengan teliti untuk melihat bagaimana reaksi kulit terhadap alergen. Selepas 20 minit, diameter wheal akan diukur. Prosedur ini akan dijalankan oleh pegawai perubatan yang pengalaman.

Selain langkah keselamatan yang dijelaskan seperti di atas, pihak penyelidik akan menyediakan pegawai perubatan, penolong pegawai perubatan/ jururawat yang terlatih dan bertauliah untuk membantu dan memantau semua prosedur klinikal yang dinyatakan di atas. Pihak penyelidik juga akan menyediakan insuran liabiliti untuk setiap peserta jika berlaku sebarang perkara yang tidak diingini. Sebagai langkah keselamatan yang terakahir, sebuah ambulance akan ditempatkan di lokasi persempalan setiap masa.

Appendix IV

Consent Letter (Malay version)

JAWATANKUASA ETIKA UNIVERSITI UNTUK PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

BORANG 2.5: PENERANGAN DAN PERSETUJUAN IBUBAPA/PENJAGA

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1.TAJUK KAJIAN

Faktor kualiti udara serta kesan alahan dan asma dalam kalangan pelajar sekolah di Malaysia.

2. PENGENALAN

Penyelidikan ini akan dijalankan untuk mengkaji hubungan di antara pendedahan terhadap pencemaran udara dengan asma, alahan dan simptom-simptom pernafasan dikalangan kanak-kanak sekolah menengah.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Penyertaan dalam kajian ini adalah secara sukarela dan tidak akan ada sebarang pembayaran dikenakan. Persetujuan dari ibu bapa atau penjaga diperlukan bagi setiap peserta sebelum menyertai kajian ini. Semua peserta akan menerima satu cenderamata sebagai tanda penghargaan menyertai sesi penyelidikan ini. Tiada pampasan tambahan akan diberikan.

Peserta yang memenuhi kriteria inklusi akan menjalani beberapa prosedur penyelidikan termasuk:

1. Isikan soal selidik yang dibantu oleh penyelidik.
2. Ujian penilaian nitrogen oksida dalam hembusan nafas (FeNO), pelajar akan diminta untuk menarik nafas sedalam-dalam dan menghembus nafas dengan aliran berterusan ke dalam alat penganalisa. Pelajar akan mengulangi proses ini selama tiga kali untuk mendapatkan hasil purata. Prosedur ini hanya mengambil masa 5 minit.
3. Ujian untuk mengukur kadar masa bagi selaput mata untuk pulih, satu alat khas akan didekatkan kepada mata dan pelajar akan diminta untuk melihat ke dalam alat tersebut. Penilaian akan dibuat oleh penyelidik. Prosedur ini tidak menyakitkan dan hanya mengambil masa dalam 5 minit.
4. Ujian fungsi paru-paru, pelajar akan bernafas melalui mulut yang dipasang pada alat rakaman (spirometer). Pelajar akan melakukan ujian selama 3 kali untuk hasil purata.
5. Ujian alahan (hama rumah, debunga yang berkaitan, kucing dan lipas) hanya akan dilakukan pada kulit tangan peserta. Jumlah kecil alergen (hama rumah, debunga yang berkaitan, kucing, dan lipas) dalam bentuk cecair akan dimasukkan ke dalam lapisan atas kulit dengan membuat tusukan kecil. Pelajar akan dipantau dengan teliti untuk melihat bagaimana reaksi kulit terhadap alergen selama 20 minit. Prosedur ini akan dijalankan oleh pegawai perubatan yang pengalaman.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Subjek yang mempunyai fizikal yang normal dan sihat boleh menyertai kajian ini secara sukarela selepas mendapat keizinan daripada ibu/bapa atau penjaga. Subjek mestilah pelajar Tingkatan 2 yang telah bersekolah di sekolah yang sama sejak Tingkatan 1. Selain itu, individu yang mempunyai penyakit kronik seperti penyakit jantung, hipertensi dan kelainan dada fizikal kongenital tidak akan dimasukkan dalam kajian ini.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANAK/JAGAAN SAYA SEBAGAI PESERTA?

Hasil kajian yang bakal diperolehi daripada ujian kesihatan percuma yang akan dijalankan boleh membantu pelajar dan ibu bapa untuk mengetahui status keadaan kesihatan pelajar tanpa sebarang kos. Pihak pengurusan sekolah juga akan mendapat manfaat maklumat kadar pencemaran udara di sekolah dan tahap kesihatan pelajar tanpa perlu mengeluarkan sebarang kos. Di samping itu, kami berharap hasil kami akan menambah pengetahuan mengenai hubungkait persekitaran sekolah terhadap alergi dan asma.

b) KEPADA PENYELIDIK?

Hasil dari kajian ini akan memberikan maklumat penting dalam usaha untuk membina pangkalan data komprehensif untuk memantau kualiti udara dalaman di kalangan kanak-kanak. Selain itu,melalui kajian ini juga akan memberikan pemahaman yang lebih baik dan keupayaan yang lebih baik untuk mengenal pasti pencemar toksik semasa dan mengesyorkan strategi yang berkesan untuk mengurangkan pencemaran udara dalaman.

6. ADAKAH IA BERISIKO?

Peserta tidak akan mengalami apa-apa risiko dalam menghadiri set soal selidik yang hanya memerlukan anda menyatakan butiran peribadi, sejarah perubatan, pendedahan kepada alergen dan gejala yang berpengalaman berkaitan dengan pencemaran udara dalaman.

Begitu juga dengan ujian kadar nitrogen oksida dalam hembusan nafas (FeNO), ujian fungsi paru-paru dan ujian kadar masa bagi selaput mata untuk pulih, tidak ada sebarang risiko yang akan berlaku sepanjang prosedur-prosedur ini dijalankan. Semua prosedur yang bakal dijalankan adalah seragam dan selamat.

Prosedur ini akan dilakukan oleh ahli perubatan dan teknologi yang telah terlatih dan mempunyai pengalaman yang mencukupi dalam prosedur. Pegawai perubatan akan berada di tempat proses mengaruhkan kahak setiap masa semasa prosedur dijalankan.

Manakala untuk prosedur ujian alahan, terdapat risiko anafilaksi (reaksi di dalam salur darah) yang sangat rendah. Prosedur ini akan dijalankan oleh pegawai perubatan yang terlatih dan sebagai langkah keselamatan ubat alahan akan disediakan jika berlaku anafilaksi. Disamping itu pemantauan akan dibuat terhadap semua peserta untuk tempoh 40 minit selepas prosedur dijalankan.

Secara keseluruhannya, pihak penyelidik akan menggunakan pegawai perubatan dan ahli teknologi perubatan yang terlatih dan berpengalaman untuk menjalankan semua prosedur klinikal terhadap peserta. Pihak penyelidik juga akan menyediakan ambulance sebagai langkah berjaga-jaga jika berlaku sebarang risiko yang tidak diingini.

Pihak penyelidik juga akan menyediakan Insuran Liabiliti Awam untuk setiap peserta jika berlaku sebarang kecelakaan sepanjang tempoh prosedur klinikal ini dijalankan. Sebarang tuntutan boleh dibuat berdasarkan terma dan syarat yang telah ditetapkan oleh pihak pembekan Insuran Liabiliti Awam tersebut.

Diakhir proses penyelidikan, semua peserta akan diberi cenderamata sebagai tanda penghargaan daripada pihak penyelidik di atas kesudian menjadi peserta secara sukarela.

7. ADAKAH MAKLUMAT DAN IDENTITI ANAK/JAGAAN SAYA KEKAL RAHSIA?

Semua maklumat peserta adalah rahsia. Hanya penyelidik yang terlibat dalam kajian ini dan mereka yang bertanggungjawab untuk penyelidikan akan mempunyai akses kepada maklumat yang anda berikan. Keputusan umumnya akan diterbitkan sebagai ringkasan perbincangan, bukan transkrip / balasan individu. Bahan penerbitan tidak akan dikenal pasti nama atau dengan apa cara lain yang mana peserta dapat dikenal pasti oleh pembaca laporan tersebut.

8. SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEPANJANG PENYELIDIKAN INI?

Jika anda mempunyai pertanyaan, sila hubungi:

No	Nama	Alamat	No Tel.Bimbit/ No Tel. Pejabat	E-mail
1	Prof. Dr. Zailina Hashim	Jabatan Kesihatan Persekitaran & Pekerjaan Faculti Perubatan & Sains Kesihatan, UPM Serdang	017- 6361367/ 03-947240	zailina@upm.edu.my
2	Nur Haslyna binti Mohd Hamizul	Jabatan Kesihatan Persekitaran & Pekerjaan Faculti Perubatan & Sains Kesihatan, UPM Serdang	018-2182320	nurhaslynamh@gmail.com
3	Nur Shahira binti Mohamad Fadzil	Jabatan Kesihatan Persekitaran & Pekerjaan Fakulti Perubatan & Sains Kesihatan, UPM Serdang	011-40685226	nurshahirafadzil@gmail.com
4	Siti Raihan binti Mohd Fuad	Jabatan Kesihatan Persekitaran & Pekerjaan Fakulti Perubatan & Sains Kesihatan, UPM Serdang	017-7527076	sitiraihanmohdfuad@gmail.com
5	Anis Zahira binti Zainudin	Jabatan Kesihatan Persekitaran & Pekerjaan Fakulti Perubatan & Sains Kesihatan, UPM Serdang	013-2803841	anisiera95@gmail.com

Nota: Borang penerangan dan persetujuan ibu bapa ini adalah gabungan daripada empat (4) kajian pelajar.

Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini.....

9. PERSETUJUAN

Saya..... No Kad Pengenalan. .....
beralamat.....
.....dengan ini secara sukarela bersetuju membenarkan *anak / jagaan saya ..... menyertai **penyelidikan tersebut di atas *(klinikal/percubaan ubat-ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).**

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi, risiko dan komplikasi (seperti yang tercatat dalam Helaian Penerangan). Saya memahami bahawa *anak / jagaan saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti *anak / jagaan saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang **melibatkan** *anak / jagaan saya.

I setuju/tidak bersetuju untuk imej/gambar/rakaman video/ rakaman suara berkaitan dengan anak/ jagaan saya digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan .....
(*Ibubapa/ Penjaga*)

Tandatangan .....
(*Saksi*)

Tarikh :.....

Nama :.....

No. K/P: .....

Saya mengesahkan bahawa saya telah menerangkan kepada ibubapa/penjaga responden mengenai sifat dan tujuan penyelidikan tersebut di atas.

Tarikh .....

Tandatangan .....
(*Penyelidik*)

MAKLUMAT TAMBAHAN

Berikut adalah maklumat tambahan mengenai prosedur-prosedur terlibat. Peserta akan menjalani penilaian klinikal yang mudah pada nitrogen oksida (NO) dalam hembusan nafas (FeNO) dengan menggunakan alat penganalisa seperti dicadangkan American Thoracic Society (ATS). Peserta akan diminta untuk menarik nafas sedalam-dalam dan menghembus nafas dengan aliran berterusan ke dalam corong mulut khas alat penganalisa. Peserta perlu mengulangi proses ini selama tiga kali untuk mendapatkan hasil purata. Prosedur ini hanya mengambil masa 5 minit.

Ujian Spirometry (ujian fungsi paru-paru) dilakukan selepas seperti yang dicadangkan oleh American Thoracic Society, 1987. Spirometer telah dikalibrasi terlebih dahulu dengan menyuntikkan 3 liter udara ke dalam spirometer menggunakan jarum 3L. Untuk ujian, pelajar akan bernafas melalui mulut yang dipasang pada alat rakaman (spirometer). Untuk mendapatkan hasil yang terbaik, semua responden melakukan ujian selama 3 kali. Maklumat yang dikumpul oleh spirometer dicetak pada carta yang disebut spirogram.

Peserta akan menjalani satu ujian klinikal yang mudah dan selamat menggunakan alatan khas, Tearscope Plus untuk mengukur kadar masa bagi selaput mata untuk pulih (Tear Film Break Up Time). Peserta akan diberi penerangan dan alatan khas ini akan didekatkan kepada mata dan peserta akan diminta untuk melihat kedalam alat tersebut. Penilaian akan dibuat oleh penyelidik. Prosedur ini tidak menyakitkan dan hanya mengambil masa dalam 5 minit.

Penilaian klinikal ujian alergi hanya akan dilakukan pada kulit peserta. Jumlah kecil alergen (hama rumah, debunga yang berkaitan, kucing dan lipas) dalam bentuk cecair akan dimasukkan ke dalam lapisan atas kulit dengan membuat tusukan kecil. Peserta akan dipantau dengan teliti untuk melihat bagaimana reaksi kulit terhadap alergen. Selepas 20 minit, diameter wheal akan diukur. Prosedur ini akan dijalankan oleh pegawai perubatan yang pengalaman.

Selain langkah keselamatan yang dijelaskan seperti di atas, pihak penyelidik akan menyediakan pegawai perubatan, penolong pegawai perubatan/ jururawat yang terlatih dan bertauliah untuk membantu dan memantau semua prosedur klinikal yang dinyatakan di atas. Pihak penyelidik juga akan menyediakan insuran liabiliti untuk setiap peserta jika berlaku sebarang perkara yang tidak diingini. Sebagai langkah keselamatan yang terakahir, sebuah ambulance akan ditempatkan di lokasi persempalan setiap masa.

Appendix V

Questionnaire (Malay version)

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

NO	
NAME	
CLASS	

BORANG SOAL SELIDIK KAJIAN

TAJUK: PENILAIAN ALAHAN DAN SIMPTOM PERNAFASAN DALAM KALANGAN PELAJAR SEKOLAH DI KOTA KINABALU: PENGARUH MIKROORGANISMA DALAM PERSEKITARAN SEKOLAH

ADALAH DIMAKLUMKAN BAHAWA ANDA TELAH TERPILIH UNTUK MENYERTAI KAJIAN INI SILA JAWAB SEMUA SOALAN DENGAN TEPAT DAN LENGKAP

TERIMA KASIH DI ATAS KERJASAMA ANDA

MAKLUMAT KEPADA PESERTA KAJIAN

Pengenalan

Penyelidikan ini akan dijalankan untuk mengkaji hubungan di antara pendedahan terhadap pencemaran udara dengan asma, alahan dan simptom-simptom pernafasan dikalangan kanak-kanak sekolah menengah. Persekitaran sekolah adalah persekitaran yang penting untuk kanak-kanak, dan terdapat keperluan untuk mengetahui bagaimana persekitaran tersebut dapat memberi kesan kesihatan terhadap kanak-kanak sekolah di Malaysia. Dengan mengaplikasikan kombinasi soal selidik yang telah dipiawaikan, penyiasatan kesihatan, dan pengukuran persekitaran udara dalaman di bilik darjah, pengetahuan baru mengenai hubungan di antara persekitaran sekolah dengan simptom-simptom asma, alahan dan simptom-simptom yang lain dapat diperolehi.

Hak Responden

Penyertaan dalam kajian ini adalah secara sukarela dan tidak akan ada sebarang pembayaran dikenakan. Persetujuan dari ibu bapa atau penjaga amatlah diperlukan bagi setiap peserta sebelum menyertai kajian ini. Peserta bebas untuk tidak mengambil bahagian, untuk menamatkan penyertaan pada bila-bila masa atas sebarang sebab atau enggan menjawab sebarang pertanyaan tanpa penalti atau kehilangan cenderamata.

Semua peserta akan menerima satu cenderamata sebagai tanda penghargaan menyertai sesi penyelidikan ini. Tiada pampasan tambahan akan diberikan.

Maklumat Rahsia

Semua jawapan peserta adalah rahsia. Hanya penyelidik yang terlibat dalam kajian ini dan mereka yang bertanggungjawab untuk penyelidikan akan mempunyai akses kepada maklumat yang anda berikan. Keputusan umumnya akan diterbitkan sebagai ringkasan perbincangan.

Jika terdapat sebarang kemusykilan atau soalan mengenai kajian atau soal selidik ini, sila bertanya kepada para penyelidik yang mengendalikan kajian ini di sekolah anda.
Sekian, terima kasih.

Ketua Penyelidik
Prof. Dr. Zailina Hashim
Jabatan Kesihatan Persekitaran & Pekerjaan, Fakulti Perubatan & Sains Kesihatan, UPM
+6017-6361367/03-947240

BAHAGIAN A : MAKLUMAT LATAR BELAKANG

Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan yang berkenaan.

	MAKLUMAT LATAR BELAKANG RESPONDEN
1	Nama Penuh:
2	Jantina: ☐ Lelaki ☐ Perempuan
3	Bangsa: ☐ Kadazan-Dusun ☐ Bajau ☐ Murut ☐ Lain-lain, nyatakan: _____
4	Tarikh Lahir:
5	Alamat Rumah: _____ _____ _____
6	No. Telefon: Diri Sendiri _____ Ibu/Bapa _____
7	Nama Sekolah: _____ Nama Kelas: _____
	MAKLUMAT LATAR BELAKANG IBUBAPA/PENJAGA
8	Tahap pendidikan tertinggi **bapa/penjaga** anda: ☐ Tiada pendidikan formal ☐ Sijil/A Level/Diploma ☐ Sekolah Rendah ☐ Universiti (Sarjana Muda/Master/PhD) ☐ Sekolah Menengah
9	Status pekerjaan **bapa/penjaga** anda sekarang: ☐ Tidak bekerja ☐ Bekerja separuh masa ☐ Bekerja sepenuh masa Jika **bekerja**, sila nyatakan maklumat dibawah: a) Nama pekerjaan: _____ b) Tempat kerja: _____
10	Pendapatan semasa **bapa/penjaga** anda dalam sebulan: **RM**_____
11	Tahap pendidikan tertinggi **ibu** anda: ☐ Tiada pendidikan formal ☐ Sijil/A Level/Diploma ☐ Sekolah Rendah ☐ Universiti (Sarjana Muda/Master/PhD) ☐ Sekolah Menengah

12	Status pekerjaan **ibu/penjaga** anda sekarang: ☐ Tidak bekerja ☐ Bekerja separuh masa ☐ Bekerja sepenuh masa Jika **bekerja**, sila nyatakan maklumat dibawah: a) Nama pekerjaan: _____ b) Tempat kerja: _____
13	Pendapatan **isirumah** anda dalam sebulan (jumlah pendapatan ibu dan bapa sebulan):_____

BAHAGIAN B : ASMA DAN ALAHAN (ALERGI)

Dada Berbunyi & Bersiul Arahan: Sila tanda (✓) untuk setiap jawapan		Ya	Tidak
14	Pernahkah anda mengalami dada berbunyi dan bersiul dalam tempoh **tahun 2018**? **Jika "TIDAK", teruskan ke SOALAN 18, jika "YA" jawab soalan di bawah (SOALAN 15-17):**		
15	Pernahkah anda mengalami sesak nafas apabila dada anda berbunyi?		
16	Pernahkah anda mengalami dada berbunyi tanpa menghidap selsema?		

Kesukaran bernafas Arahan: Sila tanda (✓) untuk setiap jawapan		Ya	Tidak
18	Pernahkah anda mengalami sesak nafas di siang hari ketika anda berehat pada bila-bila masa pada **tahun 2018**?		
19	Pernahkah anda mengalami sesak nafas setelah anda melakukan aktiviti lasak pada bila-bila masa pada **tahun 2018**?		
20	Pernahkah anda terjaga dari tidur akibat sesak nafas **tahun 2018**?		

Dada Berbunyi & Bersiul Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan yang berkenaan.		Ya	Tidak
21	Pernahkah anda menghidapi asma? **Jika "Tidak", teruskan ke SOALAN 28, jika "Ya" jawab soalan di bawah (22-27):**		
22	Jika **YA**, adakah penyakit asma itu telah didiagnosis oleh doktor?		
23	Jika **YA**, berapakah umur anda apabila anda didiagnosis oleh doktor?	_____tahun	
24	Jika **YA**, berapakah umur anda pada kali **pertama** anda diserang asma?	_____tahun	
25	Jika **YA**, pada umur berapakah anda diserang asma yang terkini?	_____tahun	

26	Pernahkah anda mengalami serangan asma pada **tahun 2018**?		
27	Adakah anda kini mengambil ubatan asma? (semburan, ubat pil, serbuk sedutan) Jika **YA**, sila nyatakan nama ubat :_____		

Alahan (Alergi) Hidung Arahan: Sila tanda (✓) untuk setiap jawapan yang berkenaan.		**Ya**	**Tidak**
28	Pernahkah anda mengalami masalah bersin, hidung berair atau hidung tersumbat dalam keadaan anda tidak selsema pada **tahun 2018**? **Jika "Tidak", teruskan ke SOALAN 30, jika "Ya" jawab soalan di bawah (29):**		
29	Jika **YA**, adakah masalah ini berlaku disertai dengan mata berair atau gatal?		

Ekzema atau Alahan (Alergi) Kulit Arahan: Sila tanda (✓) untuk setiap jawapan yang berkenaan.		**Ya**	**Tidak**
30	Pernahkah anda mengalami ruam-ruam gatal yang wujud dan sembuh dalam tempoh masa **sekurang-kurangnya 6 bulan mulai Jun 2018 – Januari 2019**? **Jika "Tidak", teruskan ke SOALAN 33, jika "Ya" jawab soalan di bawah (31-32):**		
31	Jika **YA**, pernahkah anda mengalami ruam gatal ini **sepanjang tahun 2018**?		
32	Jika **YA**, pernahkah ruam gatal ini berlaku **pada bila-bila masa** di kawasan seperti di lipatan siku, lipatan lutut, di buku lali, di bawah punggung atau di sekitar leher, telinga dan mata?		

BAHAGIAN C : KESIHATAN DAN ALAHAN (ALERGI) YANG DIALAMI SEKARANG

Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan yang berkenaan.

33	Berapa kalikah anda mengalami jangkitan saluran pernafasan dalam tempoh **3 bulan yang lepas mulai September – Disember 2018**?		_____kali	
34	Pernahkah anda menghidapi penyakit yang memerlukan anda berjumpa dengan doktor pada **tahun 2018**? Jika **YA**, apakah penyakit tersebut? Sila nyatakan: _____	Ya, lebih dari sekali	Ya, sekali	Tidak pernah
35	Pernahkah anda mengambil antibiotik (contoh penicillin) untuk masalah jangkitan saluran pernafasan pada **tahun 2018**?	Ya, lebih dari sekali	Ya, sekali	Tidak pernah
36	Adakah anda seorang perokok?		Ya	Tidak

Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan	Ya	Tidak	Tidak

yang berkenaan.			pasti	
37	Adakah anda hipersensitif/alahan terhadap **kucing**?			
38	Adakah anda hipersensitif/alahan terhadap **anjing**?			
39	Adakah anda hipersensitif/alahan terhadap **barangan berkulat**?			
40	Adakah anda hipersensitif/alahan terhadap **debunga**?			
41	Adakah anda hipersensitif/alahan terhadap **makanan**? Jika **YA**, sila nyatakan jenis makanan tersebut: _____			

BAHAGIAN D : MASALAH ALAHAN (ALERGI) DI KALANGAN AHLI KELUARGA LAIN

Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan yang berkenaan.

42	Bilangan adik beradik yang lebih tua daripada anda	_____ orang
43	Bilangan adik beradik yang lebih tua yang menetap di rumah bersama anda sekarang	_____ orang
44	Bilangan adik beradik yang lebih muda daripada anda	_____orang
45	Bilangan adik beradik yang lebih muda yang menetap di rumah bersama anda sekarang	_____ orang

46 Adakah di antara ahli keluarga anda yang mengalami masalah alahan?
Tandakan (√)pada ruangan yang berkenaan, sama ada mereka pernah atau tidak mengalami masalah alahan.

Alahan	Bapa		Ibu		Adik beradik	
	Ya	Tidak	Ya	Tidak	Ya	Tidak
Asma						
Simptom alahan hidung						
Ekzema						

BAHAGIAN E : ZAMAN KANAK-KANAK

Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan yang berkenaan.

47 Adakah anda disusui ibu semasa zaman kanak-kanak?

☐ Ya ☐ Tidak ☐ Tidak Pasti

Jika **YA**, sehingga anda berusia_____bulan

48	Adakah ahli keluarga anda yang merokok sejak anda dilahirkan sehingga anda berusia satu tahun? **Tandakan (V)** pada ruangan yang berkenaan, sama ada mereka pernah atau tidak merokok ketika itu.

Keluarga	Ya	Tidak
Ayah merokok		
Emak merokok		
Ahli keluarga lain merokok		

49	Pernahkah anda ditempatkan di rumah asuhan kanak-kanak? ☐ Tidak pernah ☐ Ya, 1-3 tahun ☐ Ya, kurang dari 1 tahun ☐ Ya, lebih dari 3 tahun Jika **YA**, pada umur berapakah anda mula ditempatkan di rumah asuhan tersebut? ☐ Kurang dari 1 tahun ☐ 1-2 tahun ☐ Lebih dari 2 tahun

BAHAGIAN F : KEADAAN SEMASA PERSEKITARAN RUMAH

Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan yang berkenaan.

50	Apakah jenis bangunan kediaman anda sekarang? ☐ Rumah Teres/ Berkembar ☐ Rumah Sebuah ☐ Rumah Bertingkat (Apartment/Flat/Condo) ☐ Lain-Lain, sila nyatakan: _____
51	Adakah anda tinggal di kediaman yang sama sejak lahir? ☐ Ya ☐ Tidak Jika **TIDAK**, pada tahun berapakah anda berpindah ke kediaman sekarang? _____(tahun)
52	Pada tahun berapakah (anggaran) kediaman anda sekarang dibina? _____(tahun)
53	Berapa meter persegikah keluasan kediaman anda sekarang? _____(m^2)
54	Bahan apakah yang digunakan untuk membina bangunan kediaman anda sekarang? (Tandakan satu atau lebih jawapan yang sesuai). ☐ Bata ☐ Konkrit/Simen ☐ Kayu ☐ Bahan lain,sila nyatakan: _____
55	Adakah bahagian dalaman rumah anda yang telah dicat pada **tahun 2018**? ☐ Ya ☐ Tidak Jika **YA**, bilakah ia dicat? _____(bulan)_____(tahun)

56	Adakah lantai di dalam rumah anda telah ditukar pada **tahun 2018?** ☐ Ya ☐ Tidak
57	Adakah terdapat haiwan peliharaan di kediaman anda ? ☐ Ya ☐ Tidak Jika **YA**, sila nyatakan jenis haiwan peliharaan anda: _____
58	Adakah anda/ahli keluarga merokok di dalam kediaman anda sekarang? ☐ Tidak Pernah ☐ Ya, Selalu (1-4 kali/minggu) ☐ Ya, Kadang-kala (1-3kali/bulan) ☐ Ya, Setiap hari
59	Pernahkah terdapat masalah kelembapan atau kerosakan air berlaku di kediaman anda dalam tempoh **5 tahun yang lepas mulai 2014-2018?** ☐ Ya ☐ Tidak Jika **YA**, sila nyatakan sebab masalah kelembapan atau kerosakan air. ☐ Kebocoran paip ☐ Masalah struktur binaan ☐ Bencana alam
60	Pernahkah salah satu daripada perkara di bawah berlaku di kediaman anda pada **tahun 2018?**

Perkara	Ya	Tidak
Kebocoran air atau kerosakan air pada dinding, lantai atau siling dalam rumah		
Buih atau warna kekuningan pada lantai plastik atau kehitaman pada lantai parket		
Kulat yang tumbuh pada dinding, lantai atau siling rumah		
Bau kulat dalam satu atau dua bilik		
Bau lain yang terdapat di rumah, sila nyatakan: _____		

BAHAGIAN G : SIMPTOM SEMASA

Arahan: Sila tanda (✓) untuk setiap jawapan yang berkenaan.

61 Adakah anda mengalami simptom-simptom berikut dalam tempoh **tiga (3) bulan** yang lepas **mulai Oktober –Disember 2018?**

	Simptom	Ya, setiap hari	Ya, selalu (1-4 kali/minggu)	Ya, Selalu (1-3 kali/bulan)	Tidak Pernah
A	Ruam pada tangan atau lengan				
B	Ruam pada muka atau leher				
C	Kemerahan kulit, Jika **YA**, dimana? Sila nyatakan:_____				
D	Gatal pada muka atau leher				
E	Gatal pada tangan atau lengan				
F	Iritasi mata (kemerahan, kering, gatal)				
G	Kelopak mata bengkak				
H	Pening kepala				
I	Rasa loya/mual				
J	Hidung berair/hidung berhingus				
K	Hidung tersumbat				
L	Tekak kering				
M	Terasa akan menghidapi selsema				
N	Sakit tekak				
O	Batuk yang beriritasi				
P	Susah bernafas				
Q	Berasa letih dan tidak bermaya				

Arahan: Sila isi maklumat dan tandakan (✓) untuk setiap jawapan yang berkenaan.

62 Adakah simptom-simptom di atas (Soalan 61) terdapat peningkatan?

Apabila anda **berada di sekolah**

- ☐ Ya
- ☐ Tidak
- ☐ Tidak Pasti

Jika **YA**, simptom yang mana satu?
(tuliskan huruf bagi simptom berkenaan,
Sila rujuk **SOALAN 61**:

_____

Apabila anda **berada di rumah**

- ☐ Ya
- ☐ Tidak
- ☐ Tidak Pasti

Jika **YA**, simptom yang mana satu?
(tuliskan huruf bagi simptom berkenaan,
Sila rujuk **SOALAN 61**:

_____

Appendix VI

Calibration Certificate

Appendix VII

Picture of Study

During data collection