UNIVERSITI PUTRA MALAYSIA

PREVALENCE OF RESPIRATORY SYMPTOMS AMONG CEMENT WORKERS AT IPOH, PERAK: A CROSS-SECTIONAL STUDY

NUR KHUSAIRI BIN RAZALI

PREVALENCE OF RESPIRATORY SYMPTOMS AMONG CEMENT WORKERS AT IPOH, PERAK: A CROSS-SECTIONAL STUDY

BY

NUR KHUSAIRI BIN RAZALI

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

Foremost, I would like to express my gratitude to my supervisor, Dr Karmegam Karuppiah for his guidance and expert advice to me throughout this Final Year Project. This project paper would not have been completed without his constructive criticism and support.

I would like to thanks all the lecturers, who have provided me with guidance towards achieving new knowledge.

I am very grateful to all my family members for the continuous encouragement, especially to my parents and my siblings for enduring my long hours spent in my coursework, without their tolerance and support, I would not have been able to complete the project.

Furthermore, I would like to extent my sincere appreciation especially to my project mates, Mr Muhammad Aiman bin Che Zahari and Nur Atikah binti Ahmad Idris for their support and idea during completion of this project. Lastly, thanks to all my friends who have contributed their time, knowledge and resources, during the course of completing this project paper. Thank you for the enjoyable and stressful moment together as well as to all others who have assisted me, one way or another, in completing this project.

ABSTRACT

PREVALENCE OF RESPIRATORY SYMPTOMS AMONG CEMENT WORKERS AT IPOH, PERAK: A CROSS-SECTIONAL STUDY

NUR KHUSAIRI BIN RAZALI

Introduction: Department of Occupational Safety and Health (DOSH) Malaysia reported that the Occupational Health Diseases were increasing from 86 cases in 2015 to 150 cases in 2016. Social Security Organization (SOCSO) reported the number involving respiratory symptoms were 451 cases in 2016. In Malaysia, there were lack of study that comparing on the exposure of dust with the respiratory symptoms and lung function between different work stations in these factories. Therefore, this study aims to determine the prevalence of respiratory symptoms and lung functions among cement workers using lung functions test. **Method:** This study was conducted in a cement factory in Ipoh, Perak. A total of 104 workers involved in this study. This study was set up to measure the particulate matter from different work stations (raw material, kiln and packing), respiratory symptoms data and lung function test. The data were obtained by a set of questionnaire adapted from the European Community Respiratory Health Survey II (EC-RHS II, 2014), spirometer and DustTrak. **Outcome:** Kiln workstation recorded the highest distribution of lung function abnormalities. Meanwhile, the highest reading of dust measurements is in the packing (0.44 mg/m3). This is due to the work process in this work station which generated high volume of dust. The correlation between the dust exposure and lung function, FVC and FEV1 showed significant relationship with the exposure of dust with value of (r = -0.307, p-value = 0.002) and (r = -0.270, p-value = 0.006) respectively. Most significant symptoms reported by the workers was coughing in the morning (p-value = 0.044). The comparison of lung function between all work station, FVC and FEV1 shows statistical differences among work station with the value of (z = 9.568, p-value = 0.008) and (z = 7.769, p-value = 0.021) respectively. **Conclusion:** Majority of the workers had respiratory symptoms of shortness of breath. The highest number of workers that exposed to the dust was workers from the kiln work station. It is also been observed that the workers do not practice of wearing personal protective equipment (PPE) properly in this workstation. Thus, several prevention programs should be conducted for the workers in order to educate them on the importance of wearing PPE. Moreover, this study also can be used as baseline data for the particular cement industry. Also, it is crucial for the management to arrange for a proper medical screening and periodic lung function test by the specialist such as Occupational Health Doctors (OHD).

Keywords: Lung function, spirometry test, cement manufacturing, particulate matter

ABSTRAK

KELAZIMAN SIMPTOM-SIMPTOM RESPIRATORI DALAM KALANGAN PEKERJA KILANG SIMEN DI IPOH, PERAK: SEBUAH KAJIAN KERATAN RENTAS

NUR KHUSAIRI BIN RAZALI

Pengenalan: Jabatan Kesihatan dan Keselamatan Pekerja Malaysia melaporkan Penyakit Kesihatan Pekerjaan semakin meningkat dari 86 kes pada tahun 2015 ke 150 kes pada tahun 2016. Pertubuhan Keselamatan Sosial (PERKESO) telah melaporkan simptom-simptom respiratori dalam kalangan pekerja di Malaysia pada tahun 2016 adalah sebanyak 451 kes. Di Malaysia, tidak banyak kajian yang dijalankan bagi membandingkan pendedahan habuk terhadap simptom-simptom respiratori dan fungsi paru-paru dalam stesen kerja yang berlainan di kilang-kilang. Oleh itu, tujuan utama kajian ini dijalankan adalah untuk mengenalpasti kelaziman simptom-simptom respiratori dan fungsi paru-paru dalam kalangan pekerja kilang simen menggunakan ujian fungsi paru-paru. **Kaedah:** Kajian ini dijalankan di salah sebuah kilang simen di Ipoh, Perak. Seramai 104 pekerja yang telah terlibat dalam kajian ini. Kajian ini dilaksanakan bagi mengukur zarah terampai dari beberapa stesen kerja (bahan mentah, kiln dan pembungkusan), maklumat simptom-simptom respiratori dan ujian fungsi paru-paru. Maklumat untuk kajian ini diperolah dengan menggunakan borang soal selidik yang diadaptasi dari Kaji Selidik Komuniti Kesihatan Respiratori Eropah (EC-RHS II, 2014), spirometer dan DustTrak. **Kesimpulan:** Stesen kerja Kiln merekodkan pengedaran tertinggi bagi fungsi paru-paru yang tidak normal. Sementara itu, catatan pengukuran habuk paling tinggi adalah di stesen kerja Pembungkusan (0.44 mg/m^3). Hal ini disebabkan oleh proses kerja di tempat tersebut menghasilkan habuk yang paling banyak. Kolerasi antara pendedahan habuk dan fungsi paru-paru, FVC dan FEV1 menunjukkan perhubungan yang penting terhadap pendedahan habuk dengan nilai ($r = -0.307$, nlai $p = 0.002$) dan ($r = -0.270$, nilai $p = 0.006$) masing-masing. Simptom-simptom penting yang dilaporkan oleh pekerja-pekerja adalah batuk pada waktu pagi (nilai $p = 0.044$). Pembandingan fungsi paru-paru antara semua stesen kerja, FVC dan FEV1 menunjukkan perbezaan statistik antara stesen kerja dengan nilai ($z = 9.568$, nilai $p = 0.008$) dan ($z = 7.769$, nilai $p = 0.021$) masing-masing. **Kesimpulan:** Kebanyakkan pekerja mengalami simptom sesak nafas. Pekerja yang paling banyak terdedah dengan habuk adalah dari stesen kerja Kiln. Hasil pemerhatian mendapati pekerja-pekerja tidak mengamalkan pemakaian alat pelindung diri yang betul di stesen kerja. Oleh itu, beberapa program pencegahan perlu dijalankan terhadap pekerja-pekerja untuk memupuk mereka terhadap kepentingan pemakaian alat pelindung diri. Tambahan pula, kajian ini juga boleh digunakan sebagai data asas bagi kilang simen tersebut. Juga, hal ini penting bagi pihak pengurusan untuk menyusun jadual untuk pemeriksaan fungsi paru-paru secara berkala oleh pakar seperti Doktor Kesihatan Pekerjaan.

Kata kunci: Fungsi paru-paru, ujian spirometer, kilang simen, zarah terampai

TABLE OF CONTENTS

CHATER 2: LITERATURE REVIEW

CHAPTER 3: METHDOLOGY

CHAPTER 4: RESULTS

CHAPTER 5: DISCUSSION

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVATIONS

WBCSD	World Business Council for Sustainable Development
USGS	United States Geological Survey
HSE	Health, Safety and Environment
FEV1/FVC	Forced Expiratory Volume in One Second per Forced Vital Capacity
FEF	Forced Expiratory Flow
DOSH	Department of Occupational, Safety and Health
KPDNKK	Kementerian Perdangangan Dalam Negeri, Koperasi dan Kepenggunaan
DOSM	Department of Statistics Malaysia
SOCSO	Social Security Organization
OSHA	Occupational Safety and Health Act
COPD	Chronic Obstructive Pulmonary Disorders
VRM	Vertical Raw Mill
LM	Loesche Mill
FVC	Forced Vital Capacity
FEV	Forced Expiratory Volume

PEF	Peak Expiratory Flow
PIF	Peak Inspiratory Flow
EPA	Environmental Protection Agency
PM	Particulate Matter
EC-RHS II	European Community Respiratory Health Survey II
ATS	American Thoracic Society
n	Frequency
%	Percentage
IQR	Interquartile Range
PPE	Personal Protective Equipment
OHD	Occupational Health Doctor

CHAPTER 1

INTRODUCTION

1.1 Background

In this new era, building construction throughout the country is getting an increase. In the making of the building, the most utilized materials in the construction were cement to make up the structure (Zeleke, Moen, & Bråtveit, 2011). As the number of building increase, this would indirectly increase the number of workers in the cement industry due to the high demand of the cement. Cement interest was specifically related to the economic growth and many developing economies were taking a stab for a rapid infrastructure development which underlines the tremendous growth in cement production (WBCSD, 2014). In Asia Pacific, Malaysia was one of the top ten cement producer (USGS, 2012). During the change to in 2017, it was estimated that the production of cement reached approximately 18.8 million metric tons (Statista, 2019). This showed that the production of the cement in Malaysia was quite high as it was listed in the top ten Asia Pacific. The increasing of the production rate showed that the workers in the cement industry were exposed to many kind of occupational hazards especially dust. (Aminian, Aslani, & Haghighi, 2014).

Over the decades, the increase of industrialization causes the demand for cement increased significantly. This lead to a large number of people to work in the cement industry (Aminian et al., 2014). In the cement plant, the production of cement was through three processes which were raw material process, clinker burning process and finish grinding process, (Hse, 1994). This process was done by different steps depend on their suitability which was wet, semi-wet and dry process. In the cement industry, the most common operations can cause the dusty environment which increases the risk of exposure of the workers to the small cement particles (Merenu, Mojiminiyi, Njoku, & Ibrahim, 2007).

Similar to other industries, occupational hazard could occur in the cement industry. Among the hazards that occur in the cement industry were physical hazard, chemical hazard, biological hazard, ergonomics hazard and psychosocial hazard. Most of the workers were exposed to the dust due to some process in the cement industry. Overexposed to the dust could cause many negative impacts on the workers especially to their respiratory system. The occupational and environmental exposure to the cement dust and the effect to human health would lead to the respiratory health problems among the workers (Kim, Kabir, & Kabir, 2015). In this study, the exposure of dust from the cement production was assessed. Due to that, the respiratory symptoms that the workers experienced also assessed to relate with the result of the lung functions.

The exposure of occupational hazards to the workers was not only caused by the type of hazard exposed but it also depends on the concentration of hazard, the duration of the exposure and the route of the exposure. These factors affected the severity of the occupational disease or occupational illness of the workers. The deposition of the dust from the industry may cause adverse health effect to the workers if they were exposed in a longer period. Rafeemanesh et al., (2015) stated that there was an association between the duration of the exposure to the cement dust with the spirometry test which was the indices of Forced expiratory volume in one second per Forced vital capacity (FEV1/FVC) and Forced expiratory flow (FEF).

1.2 Problem Statement

There were many studies shows that industrial dust can cause the increasing of morbidity, mortality or risk of getting respiratory diseases among the exposed population (Sampatakakis et al., 2013) (Bauleo et al., 2018). The number of cases reported at the Department of Occupational, Safety and Health (DOSH) Malaysia regarding to Occupational Lung Diseases was increasing from 86 cases in 2015 to 150 cases in 2016. Thus, occupational exposure to dust was detrimental to the workers. It was important to take account on the workers that were exposed to the dust as this can affect their health. In addition, the number of cement industry in Malaysia also high as it reached 18 plants in Malaysia. One of the cement industry located in Perak was the major cement production in Malaysia (KPDNKK, 2016).

Moreover, the expected number of workers in this sector in 2015 was 0.08 million which one of the top five sectors in Malaysia (DOSM, 2017). Overall, cement manufacturing in this industry can be simplified into several stages which were crusher, grinding, blending, clinkering, milling and packing. All processes will produce a lot of dust but from the HSE-Hazard assessment document US stated that the high exposure of dust was from crusher, clinkering and packing. At the crusher, the raw materials were crushed into small particles which will produce a lot of dust into the air. In the clinkering processes, the materials were heated up at the high temperature to change all the mixed materials into the Portland cement. The heating process will produce varying amount of dust and fume (O'Mara, Flodin, & Plass, 1955). Last, at the packing stage, a lot of dust was produced and released when the cement was filled into their bag. The workers at these station were exposed to a high concentration of dust that can decrease the health level specifically in lung and respiratory function. The exposure of dust into the air can lead to many health problems related to the respiratory function as the workers will breath in the dust along with the air that they breath. The total dust or inhalable dust can be used for the exposure of the assessment in occupational studies (Nordby et al., 2016).

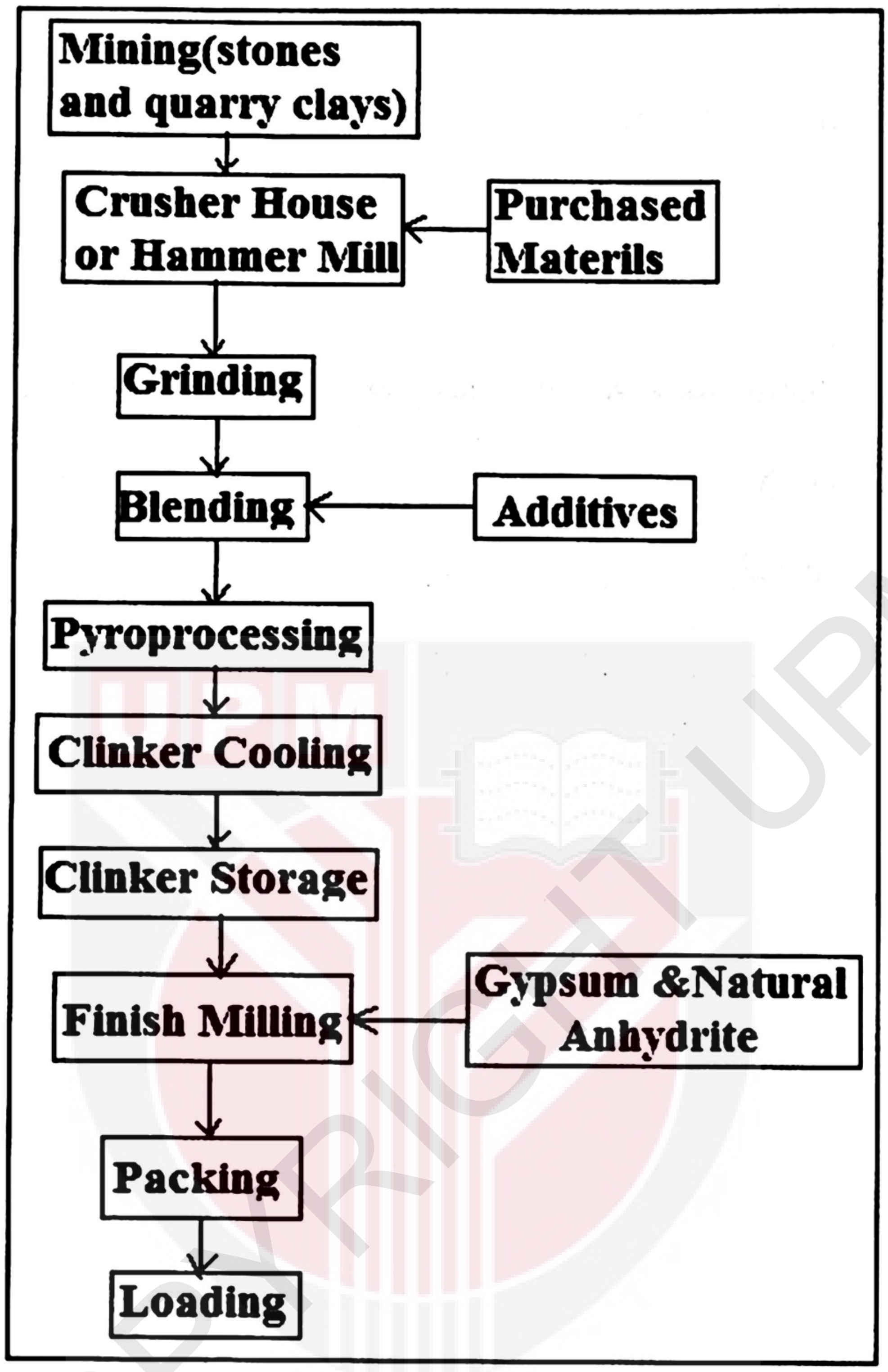

Figure 1.1: Process of Cement Production (Source: International Journal of Information Technology, Control and Automation (IJITCA) Vol.2, No.2, April 2012)

The issues of respiratory problems in industrial workers were overwhelming. This can be seen by the Social Security Organization (SOCSO, 2016) that report a number of cases that involving respiratory symptoms was 451 which consists of 325 cases in male and 126 cases in female. Since the number of cases in respiratory symptoms was increasing across this five years, so it was important to do this study in order to determine the level of lung function and respiratory symptoms on the cement workers as the cement workers also one of the group that highly exposed to the dust.

Pulmonary functions tests were useful in order to diagnose many conditions of the lung and it can help in identifying numerous of nonpulmonary disease processes (Dempsey & Scanlon, 2018). However, there was a limited study done in the lung function test among the workers in the cement industry in Malaysia. Consequently, this study was carried out to measure the status of the lung function of the individual that works in the cement industry. This study can be used as a reference for the chosen industry in overcoming or reducing the pulmonary disease among the workers.

1.3 Research Justification

In Malaysia, limited studies were conducted on occupational exposures and deterioration of lung function and respiratory symptoms among cement industry workers. This study was important as baseline data for the assessment of lung function among the workers in the cement industry besides being a benchmark to the management whether the control measure was adequate. Furthermore, it had been stated by Section 15, Occupational Safety and Health Act (OSHA) 1994 that explained about the duties of the employer to make sure as far as practicable about the safety and welfare of their workers in satisfactory condition.

1.4 Conceptual Framework

This study was done to determine the prevalence of respiratory symptoms and lung function among workers in the cement industry (Figure 1.2). Basically, hazard was anything that had potential to cause damage or harm to people, environment and things whether it can be seen or not, it can be smell or not or even it can be touch or not. There were five types of common hazards in occupational fields that can cause harm to human such as physical hazards, chemical hazards, biological hazards, psychosocial hazards and ergonomics hazards. Nevertheless, the severity of these hazards depends on their condition of workplace or work unit, duration, contact of the hazards and concentration of the hazards.

Each of the hazards had its own consequences to human health. For the cement industry workers, the main hazard exposure was chemical and physical hazard which a lot of research is done about it in the overseas. Most common hazard faced by the cement industry workers was dust. The effect of exposure of dust to human health can be categorized into two consequences which were pulmonary and respiratory health effects. In this study, respiratory health effects were focused. In order to measure the effects, lung functions test was required and abnormality in the lung function was measured using the spirometer. The respiratory symptoms were measured by questionnaire and their relationship with some factors was measured. In this cases, workers that were exposed to the high level of dust in their work unit or workplace, will tend to get respiratory symptoms which can lead to occupationally lung disease such as Chronic Obstructive Pulmonary Disorder (COPD).

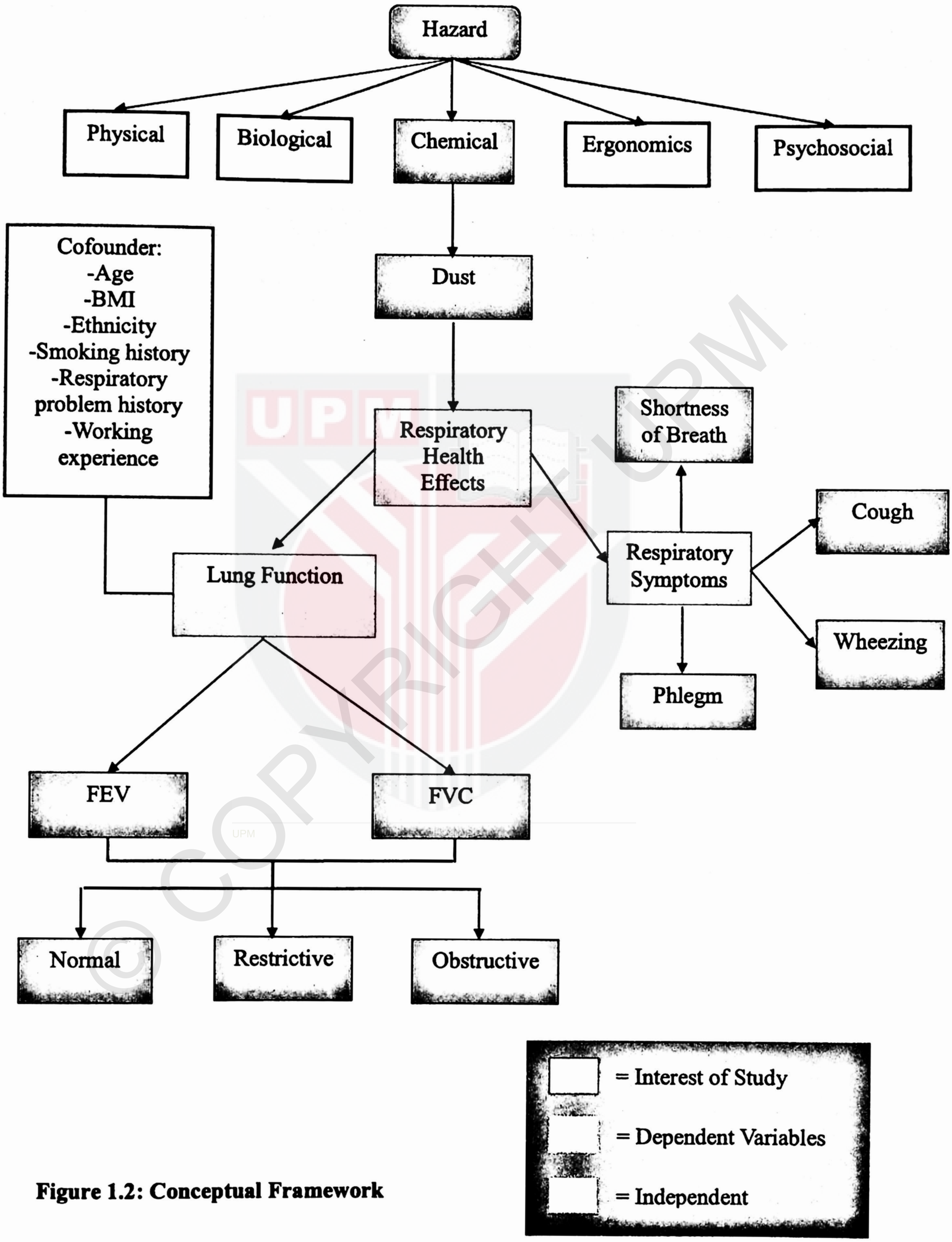

Figure 1.2: Conceptual Framework

1.5 Research Objectives

1.5.1 General Objective

- To determine the prevalence of respiratory symptoms and lung functions among cement workers using lung functions test.

1.5.2 Specific Objectives

- To determine the socio-demographic of the cement workers.
- To determine the distribution of lung function abnormalities, respiratory symptoms and exposure to dust according to the work station.
- To determine the relationship between occupational exposure to dust and lung function.
- To determine the relationship between occupational exposure to dust and respiratory symptoms.
- To determine the differences of lung function and exposure to dust between work station.

1.5.3 Hypothesis

- There is significant relationship between the distribution of lung function abnormalities with the work station.
- There is significant relationship between respiratory symptoms with the work station.
- There is significant relationship between the exposure to dust with the work station.
- There is significant relationship between occupational exposure to dust and lung function.
- There is significant relationship between occupational exposure to dust and the respiratory symptoms.
- There are significant differences between lung function and exposure to dust between the work station.

CHAPTER 2

LITERATURE REVIEW

2.1 Cement

Most common cement produced in Malaysia was Portland Cement. It was widely produced in many cement industries worldwide. Portland Cement was suitable for general concrete construction. It also the most types of cement produced worldwide. Another cement that also produced in the cement industry is Masonry Cement. Masonry Cement usually used in plastering the wall of the construction. Portland cement was made up of unprocessed natural materials which are limestone and clay (Wang & Taylor, 2016). It also generally produced by readily accessible limestone quarry. The components for limestone quarry in the Portland cement was 80% and the other remaining component is clay or shales (W. G. Hime, 2001).

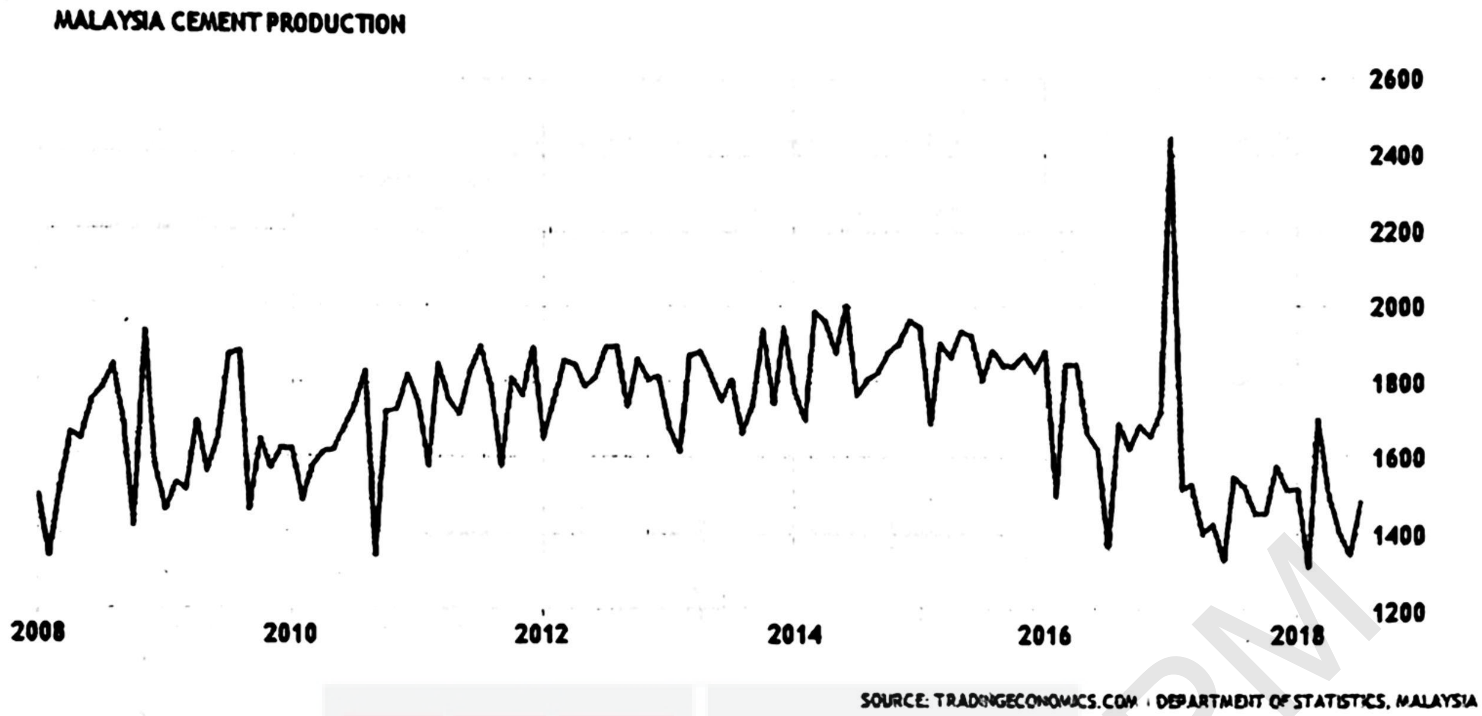

Figure 2.1: Malaysia cement production statistics

The production of cement in Malaysia was 19.18 million MT and the total consumption of cement in Malaysia was 17.97 million MT as of October 2016 (KPDNKK, 2018). The cement was constantly produced in Malaysia for the past five years which in the average of 1600 thousands of tonnes to 2000 thousands of tonnes (Department of Statistics, Malaysia, 2018). This showed that there was no reduction in the number of cement produced in Malaysia. When the production rate of the cement remained in the same values, this can show that the workers were exposed to many kind of hazards especially dust.

2.2 Cement Process

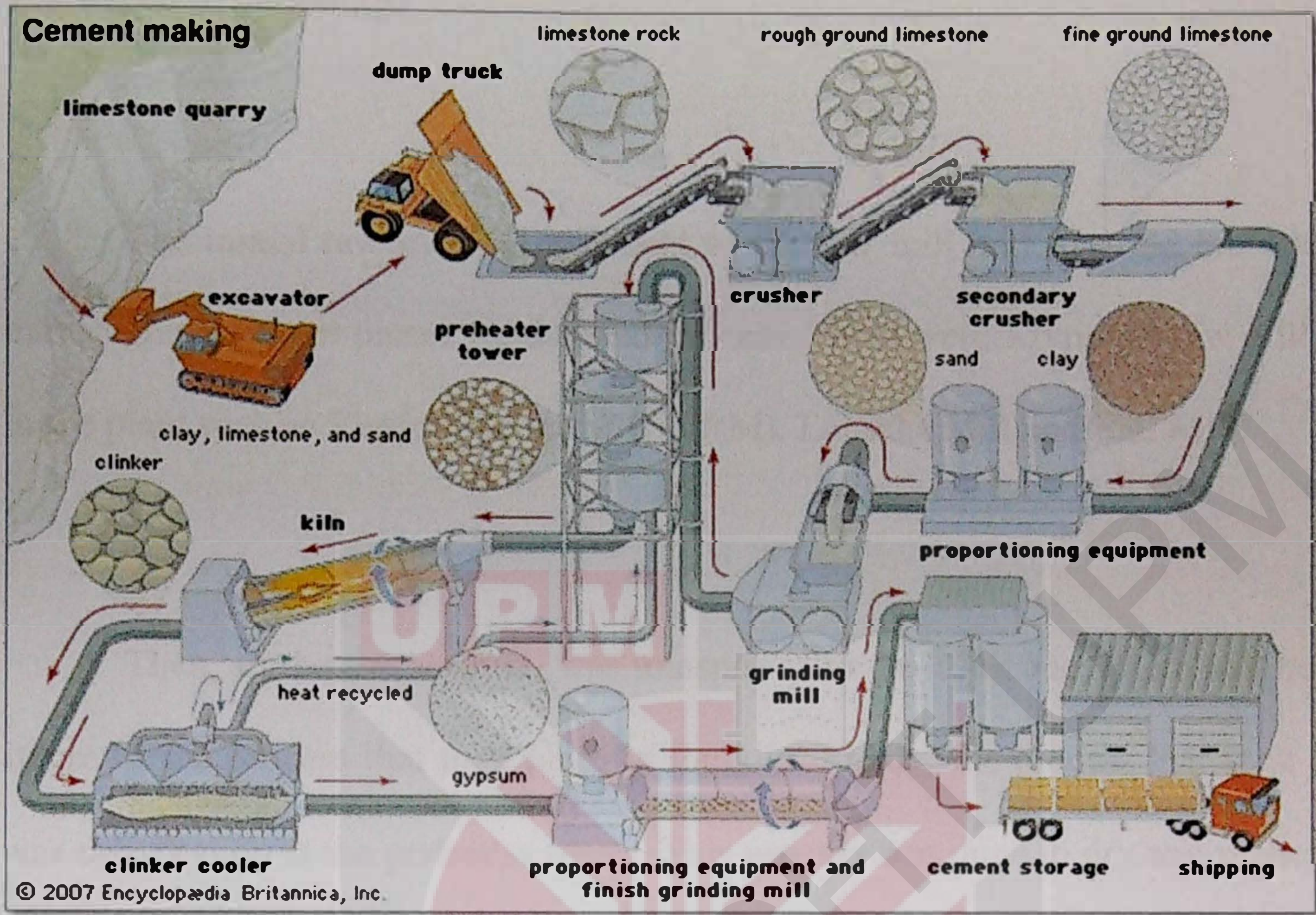

Figure 2.2: Cement Process

All the raw material (limestone, clay, bauxite, iron ore, sand) were mixed together before transferred to the raw mill section. There were three types of raw mill which was Vertical Raw Mill (VRM), Loesche Mill (LM) and Ball Mill. For the raw material that transported to the Loesche mill and Ball mill, the material firstly was dried by the dryer. For the Vertical Roller Mill, the material was entered to the mill although the material was in damped. For the limestone, the material obtained was from the company's quarry area. Then the limestone was transferred to the primary crusher for the early stage of crushing the limestone. After that, the limestone was mixed with other material before entered into the raw mill. Only coal, gypsum, iron ore and bauxite were the material purchased by the company. The purchased material was stored in the storage.

The mixed raw material was sent to the raw mill part to grind the material into small particle or pieces for the next process. There were 3 types of raw mill used in the plant such as Vertical Roller Mill (VRM), Loesche Mill and Ball Mill.

Then, all the raw material was transported to the kiln zone. There will be four stages of the process that took place in the kiln. Firstly, the process that took place was dehydration at the preheater tower. This process was done to dry and preheat the mixture of the materials. Secondly, the process of calcination was taking place in the calciner. In this process, the carbon dioxide, water vapour, petroleum coke and ammonium ions were removed. The third process was the clinkerisation was taken place in the kiln. The last process was the cooling process in the grate cooler. The cooler was carried out the combustion air. The clinker was transported back and forth movement. As a result, the dust was fell onto the hopper and was carried out by the chain drag.

After the mixed materials cooling down, it was transported to the cement mill. The mechanism used in the cement mill was ball mill which was same as raw mill. In the cement mill, the gypsum was added into the clinker and will be mixed together.

The function of the gypsum was to act as a catalyst for the reaction as well as the method to fast hardening the cement.

2.3 Occupational Hazard

There are five types of hazard which was physical hazard, chemical hazard, biological hazard, ergonomics hazard and psychosocial hazard. In cement manufacturing, most of the workers exposed to the dust form from the materials used in making the cement.

Physical hazard was the most common hazard in all workplace. It was including radiation, heat and cold stress, vibration hazards and noise hazards. In cement production lines. The most common physical hazards are particulate matter and noise. The dust formed due to some process in the production line such as grinding and crushing. This hazard can cause harm to the respiratory system. Most of the physical hazard can be reduced by mitigated it from the workers.

Chemical hazard was the hazard that causes by the exposure of chemical in the workplace. This exposure of the chemical can lead to acute and chronic effect on the human. Long exposure to the chemical in the workplace can cause many adverse effects on human. There are many types of hazardous chemical such as neurotoxins, carcinogens and systemic toxins. The usage of chemical such as calcium oxide, silica and aluminium was commonly found in the cement industry. The overexpose of these chemicals can cause harmful effect to the body mostly to the nervous system.

Biological hazard was also known as biohazards were the substances that can cause harm to living organism especially human. This hazard usually comes from virus, microorganisms and toxin. This kind of hazard was not common to the cement industry as this industry does not deal with clinical waste and materials. But, biological hazard can cause by bad sanitation and improper waste management at the industry such as dengue and leptospirosis.

Ergonomic hazard was due to the improper physical factors of the environment that will harm the musculoskeletal system. It was included as uncomfortable workstation, poor body positioning and repetitive movement. The best way to reduce ergonomic hazard was by designing the proper work environment and practicing safe and proper work procedures. There were many ergonomics hazard that can be found in the cement industry such as repetitive movement and carrying a heavy load. These activities can lead to musculoskeletal disorders.

Psychosocial hazard was the hazard that was related to the human mental. It was affected by the psychological well-being of the workers and the ability to participate in a work environment with other people. Most common psychosocial hazard faced by the workers was stress due to either personal or work problems. This hazard can be avoided by providing suitable and proper environment for the workers to do their work.

2.4 Occupational Exposure to Dust

There were many types of occupational health issues reported regarding to the cement manufacturing. This health issue can also cause death if control measure was not taken to the workers in the cement manufacturing. The effect of inhalation dust, fume and gasses form from cement manufacturing can cause occupational health diseases. This was due to inhalation, ingestion, and direct contact with the skin of those agents (Rampuri, 2017). Commonly, the diameter of the particle from cement production leads to the occupational lung diseases (Sana, Bhat, & Balkhi, 2013). The main route for the cement particles to enter to the human body is by respiratory tract and gastrointestinal tract (Green, 1970). Workers that exposed to the small particles in cement manufacturing tend to have restrictive lung disease with a decrease of FVC, FEV and increase FEV/FVC ratio. The group of workers in cement manufacturing commonly had respiratory tract disorders as the result from the inhalation of airborne dust (Manjula et al., 2013).

2.5 Lung Function Test

Most common test used in the industry to diagnose and measure the respiratory disease was spirometry. It was better to use spirometer as it can measure dynamic lung functions than static lung function. There was a study by García-Río et al., (2013) stated that the main pulmonary function test was a spirometer and it was essential in evaluating and monitoring any respirable disease. In addition, the competency of handling and evaluating the spirometry result was essential to avoid human error during the reading were taken.

The spirometry also was used as the screening tool to the workers' exposure to the agents associated with pulmonary diseases. T. Mariammal et al. (2012) stated that the benefits of using the lung function test were it can provide a clearer understanding of pulmonary function in subjects' races, age, sex, occupation and profession.

Normal values were based on age, height, ethnicity and gender. Normal results usually defined in the percentage. A value was considered as abnormal if the results were approximately less than 80% of the predicted value. In order word, the person may have chest and lung disease if they obtain an abnormal result. In some cases, some lung disease such as asthma, chronic bronchitis and even infection can make the lung contain too much air and it will take a longer time to be emptied. It was categorized as obstructive lung disorders. This was reported by Gold WM and Koth LL (2016) and (Dempsey & Scanlon, 2018).

Forced Vital Capacity (FVC) and Forced Expiratory Volume (FEV)

FVC and FEV were the primary variables in spirometry. The FVC represented the maximum volume of air exhaled in a maximal forced expiratory maneuver, initiated after a maximal inspiratory maneuver, that be expressed in liters. While the FEV corresponds to the maximum volume of air exhaled in the first second of the FVC maneuver, also expressed in liters (García-Río et al., 2013).

2.6 Normal Spirometry

A normal Flow-Volume loop begins on the X-axis (Volume axis): at the start of the test both flow and volume were equal to zero. After the starting point, the curve rapidly mounts to a peak: Peak (Expiratory) Flow. After the PEF the curve descends (the flow decreases) as more air was expired. A normal, non-pathological F/V loop was descended in a straight or a convex line from the top (PEF) to bottom (FVC).

The forced inspiration that follows the forced expiration had roughly the same morphology, but the PIF (Peak Inspiratory Flow) is not as distinct as PEF.

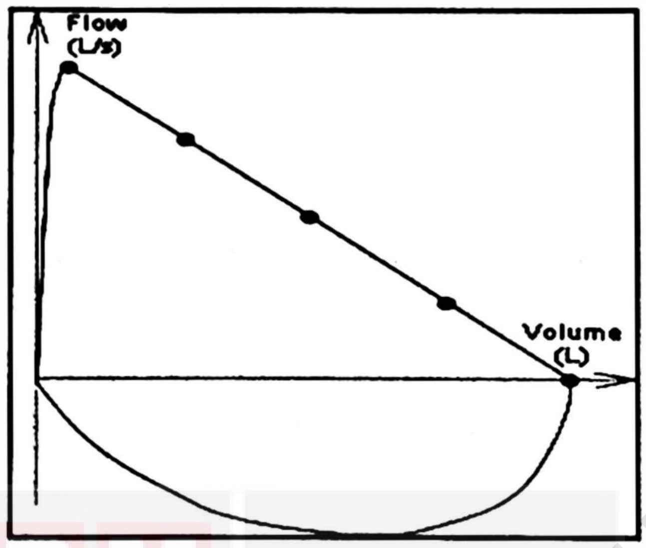

Figure 2.3: Normal spirometry results

2.7 Obstructive Lung Disease

Obstructive lung disease was the shortness of breath due to the difficulty in exhaling all the air from the lung. This disease was occurred due to the damage of the lungs or the airways narrowing inside the lung, hence exhaled air comes out more slowly than normal. After all the air exhaled, and abnormally high amount of air may still stay in the lungs.

The most common cause of obstructive lung disease was chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis, asthma, bronchiectasis and cystic fibrosis.

The person with the obstructive lung disease would face the difficulty to do heavy work activities. As the rate of breathing increase, there was less time to breathe all the air out before the next inhalation (Mason, 2010).

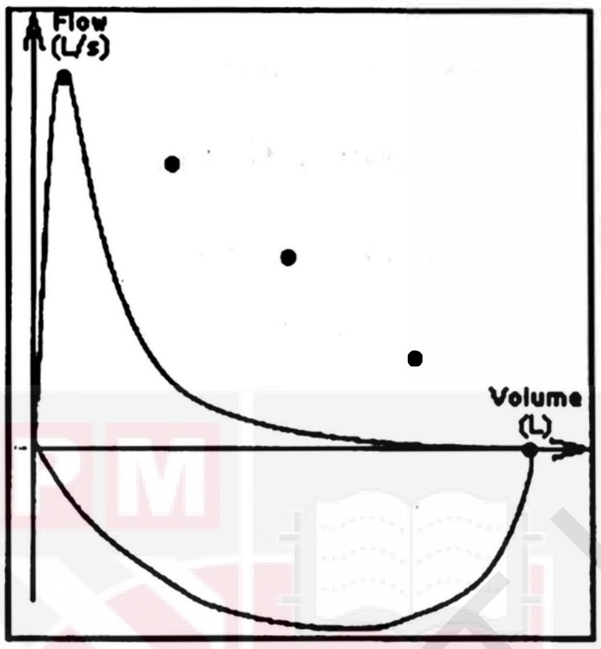

Figure 2.4: Obstructive lung disease results

2.8 Restrictive Lung Disease

Restrictive lung disease was a condition where the patients cannot fully fill their lungs with the air. This was because the lung become restricted from expanding and there was stiffness in the lungs. But, there were some other factors such as stiffness of the wall, weak muscles or damaged nerves in the lung.

Some conditions that cause restrictive lung disease were interstitial lung diseases, such as idiopathic pulmonary fibrosis, sarcoidosis which was an autoimmune disease, obesity, scoliosis and neuromuscular diseases, such as muscular dystrophy or amyotrophic lateral sclerosis (ALS) (Mason, 2010).

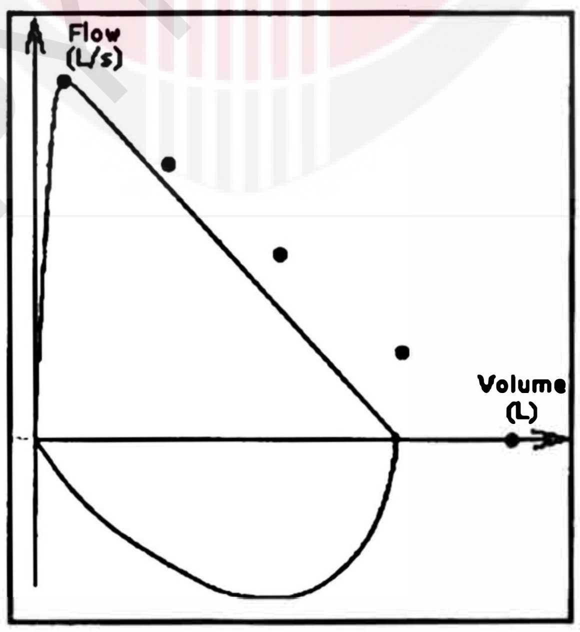

Figure 2.5: Restrictive lung disease results

2.9 Respiratory Symptoms

Singh (2016) reported that the main symptoms of respiratory disorders were breathlessness, chest pain, wheeze, coughing and production of sputum. Lungs also can produce non-respiratory symptoms such as paraneoplastic symptoms of lung malignancy.

There was prevalence of nasal symptoms in bakers had the significant difference in runny nose, as well as high prevalence of respiratory symptoms with significant difference for cough and phlegm compared to the office workers (Mijakoski et al., 2011). There was significant association between these symptoms and the duration of workplace exposure in the bakers. Kayhan et al., (2013) also reported that respiratory irritants represent a major cause of occupational obstructive airways disease related to irritative agents causing occupational asthma.

Moreover, Rovira et al., (2014) found that there were differences in respiratory health effects between the studies that may be related to qualitative and quantitative differences in exposure characteristics of places of studies.

The exposure of the particulate material to the human was affecting their heart and lungs, especially the exposure of the fine particles which contained microscopic solids or liquids droplets that were so small that they could go deep into the lungs and cause other serious health problems (EPA, 2002). EPA was put the concerned on the particles that were 10 micrometers in diameter or smaller (PM10) because those particles can pass through to the human throat and nose. Once the particles passed, it can affect the heart and lungs and can cause serious health effects.

2.10 Occupational Respiratory Disease

Occupational exposure can lead to airways diseases. However, early detection of these work-related diseases was crucial to achieving a successful outcome for the patient. Szram (2012) stated that toxic exposure of the workplace respiratory irritants can also lead to airways disease. Plus, the most common airways disease is asthma. Toxic airways damage and obliterate bronchitis can occur following irritant exposures. COPD had also been associated with the occupation of a person.

Respiratory disease was the common disease related to occupational industries due to the route of entry for the noxious particles and gasses were the lungs. All these agents can be inhaled in the form of fibers and dust. Kayhan et al., (2013) defined work-related or occupational asthma as a chronic inflammatory disorder of the airways with recurrent episodes of respiratory symptoms such as coughing, wheezing, chest tightness, dyspnea, shortness of breath at rest and reversible airflow limitation caused by the particular occupational environment.

CHAPTER 3

METHODOLOGY

3.1 Study Design

This is a cross-sectional study which was designed to determine the prevalence of respiratory symptoms and lung function among workers in cement manufacturing using the lung function test.

3.2 Study Location

This study was conducted in one of the cement manufacturing in Ipoh, Perak which already been permitted by the major director of the industry.

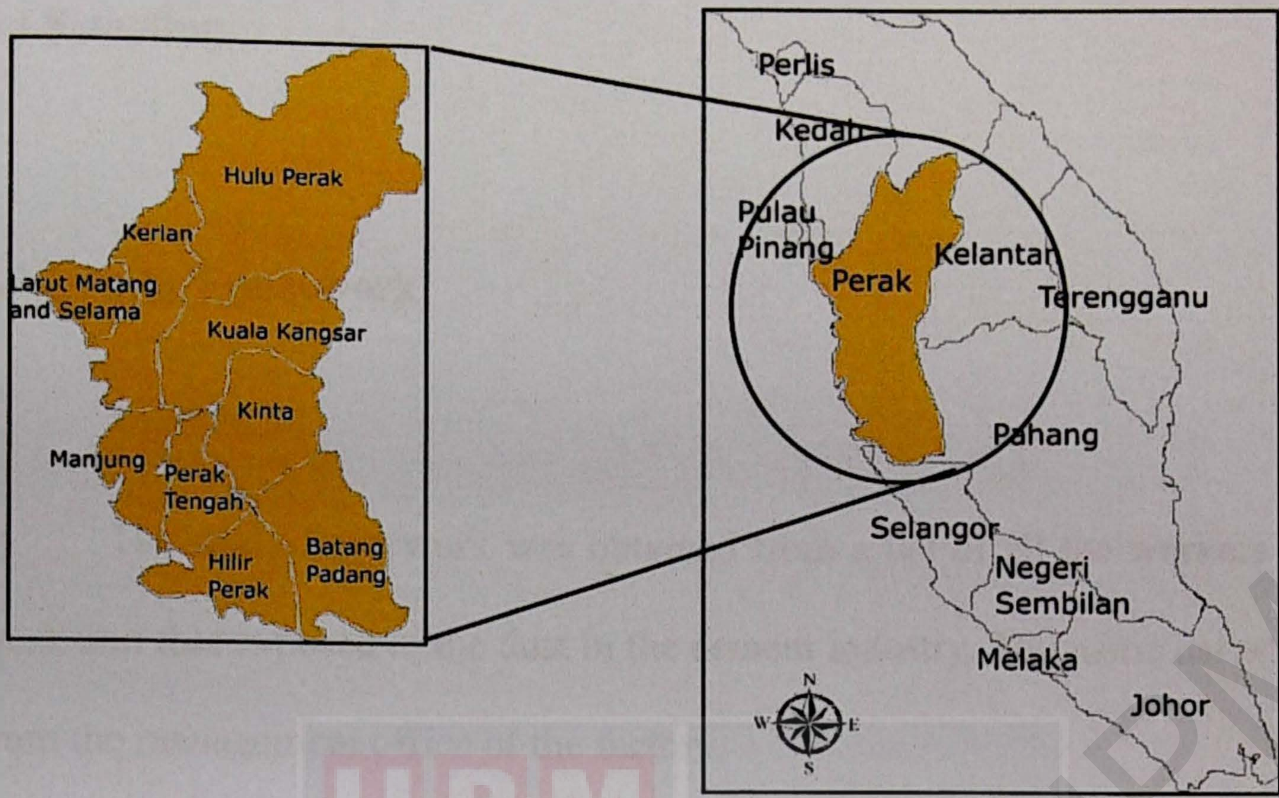

Figure 3.1: Map of Study Location

3.3 Study Population

The study population was the workers in the cement manufacturing in Ipoh, Perak. The workers were chosen from raw material, kiln and packing.

3.4 Sampling

3.4.1 Study Framework

The study framework was obtained from a list of all the workers in specific work unit that exposed to the dust in the cement industry. The name list was obtained from the management office of the factory.

3.4.2 Inclusion Criteria

The sampling unit met the inclusion criteria which were male, aged between 18 to 50 years old with the experience of working in cement manufacturing for at least 3 years and work at raw material, kiln and packing.

3.4.3 Sampling Method

The sampling method used was purposive sampling where the respondents were selected based on the inclusion criteria's. The sample was chosen based on their inclusion criteria which were male, aged between 18 – 50 years old with the experience of working in cement manufacturing for at least 3 years and work at raw material, kiln and packing. Firstly, the male workers aged between 18 – 50 years old with at least 3 years working experience was obtained from the name list of the workers according to their work station. Then, the workers were asked in the questionnaire whether they had any smoking history, asthma (inhaler user), any respiratory tract infection in the last three weeks, had a heart attack in the last three months and any heart disease. The final sample was obtained from these inclusion criteria.

3.4.4 Sample Size

By using the formula from Kirkwood (2009):

$$n = P\ (1 - P)\ /\ e2$$

n = required sample size

P = expected prevalence

e = margin of error at 5%

Based on the formula, the numbers of respondents required by this study were:

$$n = 0.7\ (1 - 0.7)\ /\ 0.52$$

$$n = 0.7\ (0.3)\ /\ 0.025$$

$$n = 84$$

Hence, the sample size that was used in this study was 84. After rounding up (5%) and hence to add 5 more to the sample size, the total sample size was 89. The respondent was chosen according to inclusion and exclusion criteria.

3.4.5 Exclusion Criteria

The exclusion criteria were the workers that had undergone surgery over abdomen area for past 3 months. Current smokers, workers with asthma (inhaler user), any respiratory tract infection in the last three weeks, had a heart attack in the last three months and any heart disease.

3.5 Study Instrumentation and Data Collection

3.5.1 Questionnaires

The questionnaires that were used for the respiratory symptoms was adopted from the European Community Respiratory Health Survey II (EC-RHS II, 2014). Emphasis was laid on inquiry regarding an occurrence of chest tightness, chest compression, wheezing, cough and phlegm appearing in them and the frequency of occurrence, the day of occurrence, duration and relationship work was recorded.

3.5.2 Anthropometry

Age, body weight, and height were recorded in this questionnaires. While the body weight was recorded by standard weighing machine without shoes.

3.5.3 Spirometer

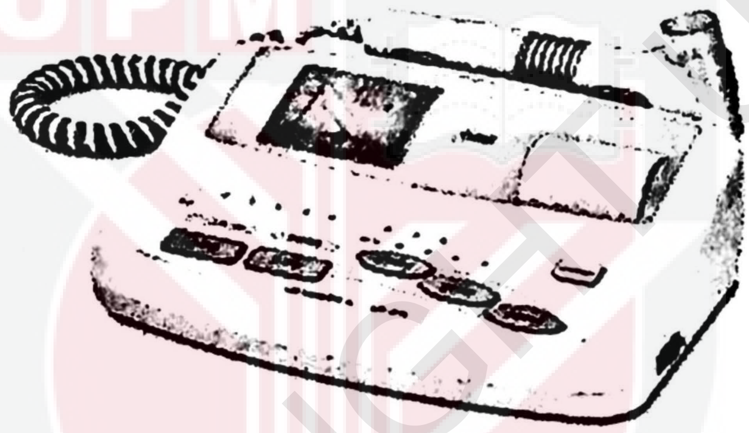

Figure 3.2: Chestgraph H1 – 101 Spirometer

Chestgraph H1 – 101 Spirometer was used to measure the lung function status of the cement industry workers. The procedures as follows:

a) Procedure

After taking a detailed history and anthropometric data, the respondents were informed about the whole manoeuver. The procedure of using this spirometer was adopted from American Thoracic Society (ATS, 2017). The workers were encouraged to practice of using the equipment before the data was taken. The test was performed with the subject was standing position without using the nose clip. The test was repeated three times after adequate rest and the result will be obtained in the spirometer. The measured parameters were:

i) Forced vital capacity (FVC)

The FVC was referring to the maximum volume of air that was exhaled with the maximum forced effort from a maximum expiration, expressed in litres at body temperature and ambient pressure saturated with water vapour (ATS, 2015).

ii) Forced expiratory volume in one second (FEV1)

The FEV1 was the maximum volume that was exhaled in the first second of the forced expiration from the position of full inspiration, expressed in litres of body temperature and ambient pressure saturated with water vapour (ATS, 2015).

iii) Forced expiratory ratio (FEV1/FVC%)

FEV1/FVC% measured how much air of a person could be exhaled during a forced breath. The amount of air exhaled may be measured during the first (FEV1), second (FEV2) and/or third seconds (FEV3) of the forced breath.

The measured results were printed out on a chart called as a spirogram. For the calculation, the FEV1/FVC ratio was calculated. In this study, evaluation of lung function was performed by comparing the obtained value with the normal value which was a standard value.

The evaluation of lung function (normal or abnormal) that had been done based on the American Thoracic Society (1991) classification as shown in Table 1.

Table 3.1: Evaluation of lung function

Obstructive Disease	FEV1%
Normal	≥80
Mild	70 – 79
Severe	60 – 69
Very severe	< 60
Restrictive Disease	FVC%
Normal	≥80
Mild	70 – 79
Severe	60 – 69
Very severe	< 60

Source: American Thoracic Society (1991)

3.5.4 Dust Measurement

Figure 3.3: DustTrak Aerosol Monitor 8534

For dust measurement, a direct reading instrument by using DustTrak DRX Aerosol Monitor 8534 was used. It uses a sheath air system that isolates the aerosols in the optics clean for improved reliability and low maintenance. It is suitable for clean office settings as well as harsh industrial workplace, construction and environmental sites, and other outdoor application (Sources TSI, 2017). This instrument measured aerosol contaminants such as dust, smoke, fumes and mists corresponding to PM1, PM2.5, respirable or PM10 size fraction with a concentration range from 0.001 to 150 mg/m3. The dust level was measured according to each workstation with the instrument will be placed near the breathing zone of the workers.

The sampling interval was set as 30 minutes over 4 times slots for 8 hours. The results were recorded and analyzed.

3.6 Quality Control

Quality control was important for every measurement, especially when using an instrument. These were to ensure the results of the data that obtained throughout the study could be avoided with biases and error. In this study, the quality controls were the questionnaire, spirometer, and anthropometric measurement. Before the study is conducted, a pilot study was carried out. Also, the spirometer was calibrated before use and check for any malfunction.

3.6.1 Questionnaire

An adopted questionnaire from the European Community Health Survey II (EC-RHS II, 2014) was used to know the information background, general health status as well as the prevalence of respiratory symptoms among the respondents. The form used in Bahasa Malaysia so that the respondents can easily to understand the question given. The questionnaire will undergo constructive testing and reliability testing.

For the constructive test, a pre-test was conducted. The function of this test was to know either the subjects understand the questions in the questionnaire or not. Next, the questionnaire was reviewed and edited if there were criticism from the respondents. As for the next day, the same questionnaire was given back to them to ensure the answer was the same.

3.6.2 Anthropometric Measurement

The anthropometric measurements were taken using electronic weight scale and height tape. For each respondent, the measurements were taken three times in order to determine the average.

3.6.3 Spirometer

The maneuvres for this test were used based on US Occupational Safety & Health Administration (OSHA). Apart from that, the spirometer was checked for calibration and accuracy. Based on Miller et al., (2005), the attention to equipment quality control and calibration was an important part of good laboratory practice. At a minimum, the requirements were as follows: 1) a log of calibration results was maintained; 2) the documentation of repairs or other alterations which return the equipment to acceptable operation; 3) the dates of computer software and hardware updates or changes; and 4) if equipment was changed or relocated (e.g. industrial surveys), calibration checks and quality-control procedures must be repeated before further testing begins.

3.6.4 Dust Measurement

The DustTrak that used was calibrated before used and several measurements were taken for the average. Dust that will be measured in this study is $PM_{2.5}$ and PM_{10}. Both particulate matter showed significant to short-term mortality and morbidity effect to the workers (Chatignoux et al., 2014). Dust that emitted from the cement production was in the range of 0.05 to 5 μm (Rachiotis, Kostikas, Pinotsi, Hadjichristodoulou, & Drivas, 2018). It is suitable to take the measurement of $PM_{2.5}$ and PM_{10} emitted from the cement industry.

3.7 Statistical Analysis

The data obtained from this study were analyzed by using the latest version of SPSS. The data was tested depending on the objectives that had been listed as each objective used a different kind of test to analyze the data.

Table 3.2: Statistical Analysis

Objectives	Tests
To study the socio-demographic of the cement workers.	Descriptive analysis
To determine the distribution of lung function abnormalities, respiratory symptoms and exposure to dust according to the work station.	Descriptive analysis
To determine the relationship between occupational exposure to dust and lung function.	Spearman Rho Correlation
To determine the relationship between occupational exposure to dust and respiratory symptoms.	Pearson Chi-Square Test
To determine the differences of lung function and exposure to dust between work station.	Kruskall Wallis

CHAPTER 4

RESULTS

4.1 Respondents Background

Table 4.1 shows some characteristics of the subjects in this study. It shows the socio-demographics of the respondents in the working environment of cement workers. These workers were compromised to work in such situation may be due to poor socioeconomic status and low educational level.

Table 4.1 Socio-demographic on the subject (N=104)

Variables	Frequency (n)	Percent (%)
Race		
Malay	42	40.4
Chinese	6	5.8
Indian	52	50
Others	4	3.8
Educational level		

Variables	Frequency (n)	Percent (%)
None	4	3.8
Primary/UPSR	28	26.9
Secondary/PMR/SPM/STPM	56	53.8
Diploma/Degree Holder	16	15.4
Status		
Single	28	26.9
Married	76	73.1

4.2 The distribution of lung function abnormalities according to work station

Among the various section of the factory, workers in the kiln have the highest number of workers with restrictive patterns of lung function, whereas raw material and packing had the least as shown in Figure 4.1.

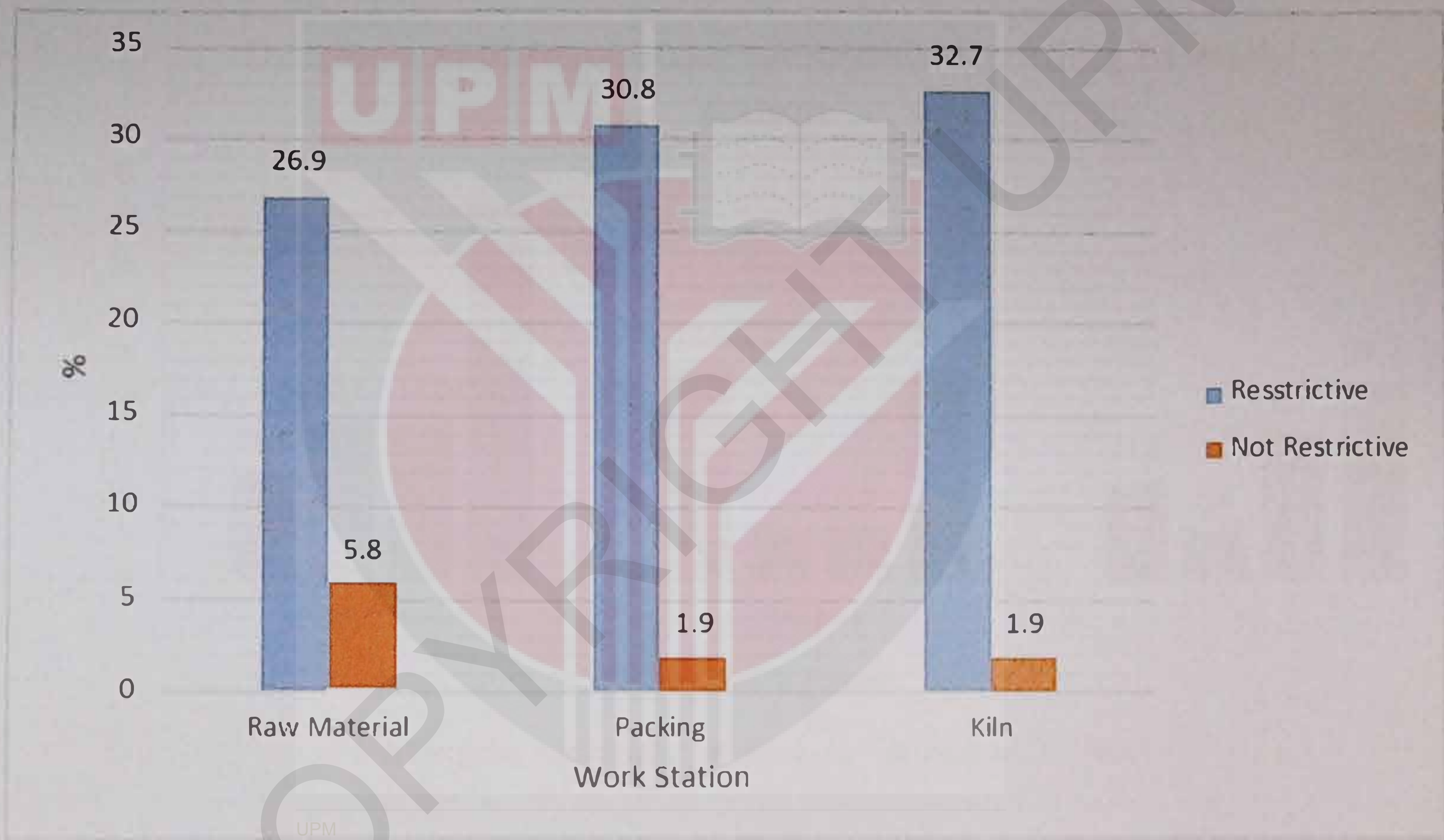

Figure 4.1 Distribution of lung function abnormalities according to work station

4.3 The distribution of respiratory symptoms according to work station

The distribution of workers with respiratory symptoms was as shown in Figure 4.2. Shortness of breath was present highest in raw material workstation compared to packing and kiln section.

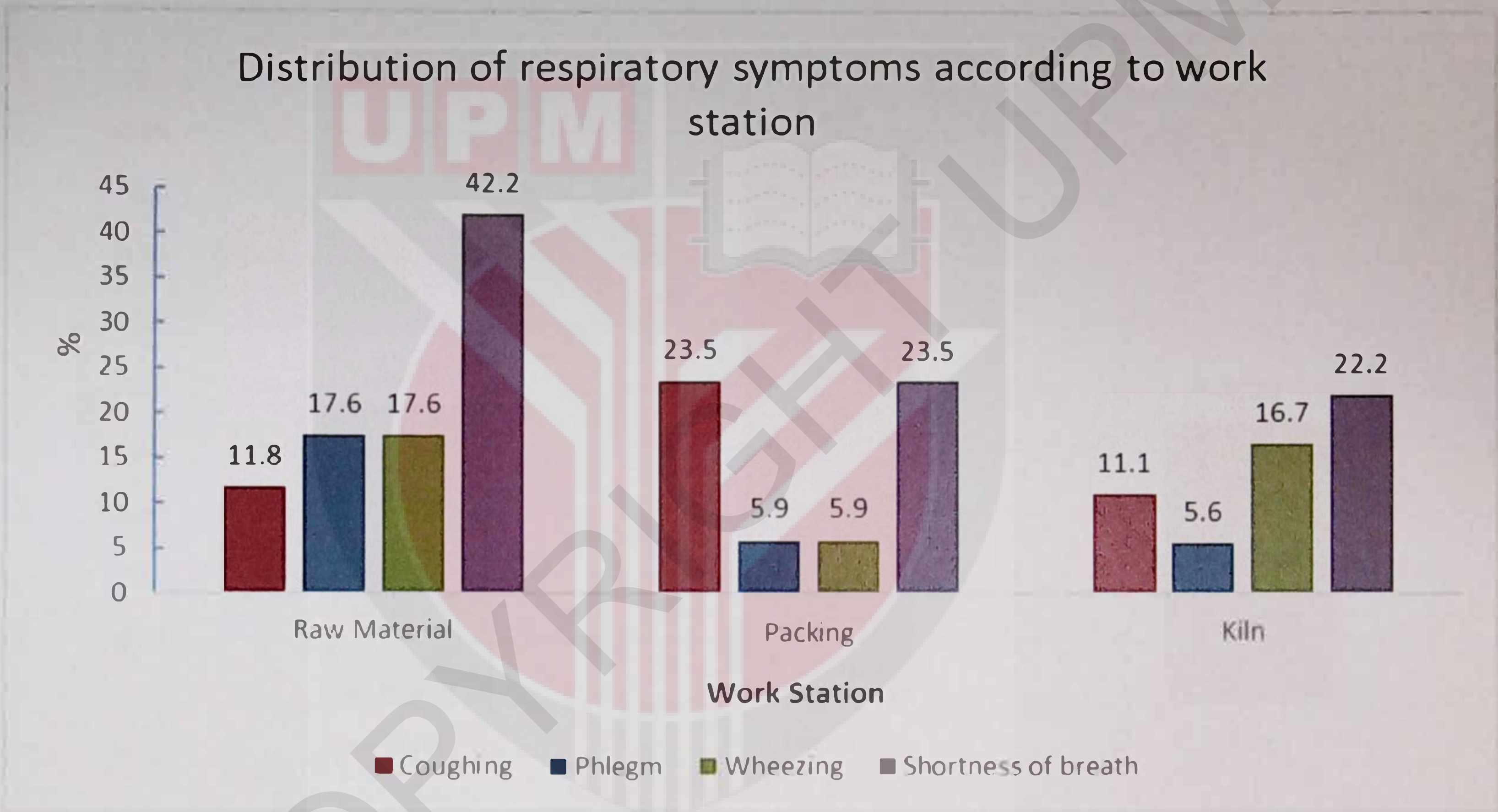

Figure 4.2 Distribution of respiratory symptoms according to work station

4.4 The distribution of exposure to dust according to work station

In Figure 4.3, it shows the distribution of workers with high exposure to dust. From the results, it can be concluded that workers in the packing area were exposed to the highest concentration of dust. Second to packing section is raw material section and followed by kiln section.

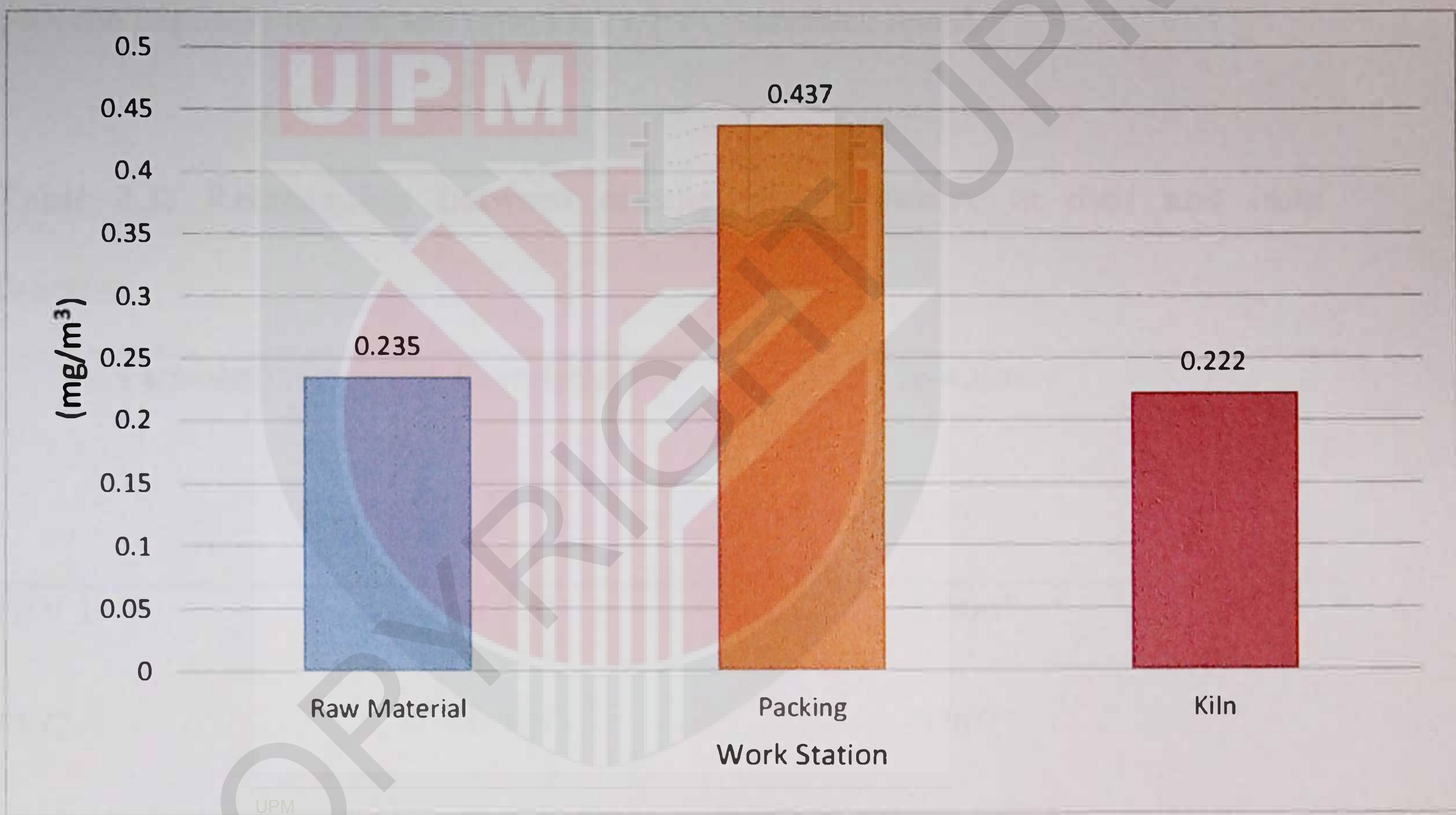

Figure 4.3 Distribution of high exposure to dust (mg/m^3) according to work station

4.5 Occupational exposures to dust and lung function among cement workers

In Table 4.2, it shows the relationship between occupational exposure to dust and lung function. There is significant between exposure to dust and measured FEV1 as well as exposure to dust and measured FVC. However, there is no association between exposure to dust and ratio FEV1/FVC variables found.

Table 4.2: Relationship between occupational exposure to dust and lung function

Variables	Correlation *r* value	p-value
FEV 1	-0.270	0.006*
FVC	-0.307	0.002*
FEV1/FVC	0.039	0.694

*p-value is significant at $p < 0.05$

4.6 Occupational exposures to dust and respiratory symptoms

Table 4.3 shows symptoms experienced by the workers in different exposure to dust which suggest there is a significant different detected (p-value < 0.05) in coughing in the morning. However, there was no significant different between other symptoms such as shortness of breath and cough with phlegm with the exposure of dust.

Table 4.3: Relationship between occupational exposure to dust and respiratory symptoms

Symptoms		Raw Material	Packing	Kiln	X^2 (df)	P
Cough (Frequent)	Yes	4 (11.8)	8 (23.5)	4 (11.1)	2.580 (2)	0.275
	No	30 (88.2)	26 (76.5)	32 (88.9)		
Cough (In the morning)	Yes	6 (17.6)	0 (0.0)	4 (11.1)	6.233 (2)	0.044*
	No	28 (82.4)	34 (100.0)	32 (88.9)		
Cough (All day)	Yes	2 (5.9)	0 (0.0)	0 (0.0)	4.198 (2)	0.123
	No	32 (94.1)	34 (100.0)	36 (100.0)		
Cough (Continuously 3	Yes	0 (0.0)	0 (0.0)	2 (1.9)	3.852 (2)	0.146
	No	34 (100.0)	34 (100.0)	34 (94.4)		

months)						
Phlegm (Frequent)	Yes	6 (17.6)	2 (5.9)	2 (5.6)	3.752 (2)	0.153
	No	28 (82.4)	32 (94.1)	34 (94.4)		
Phlegm (In the morning)	Yes	4 (11.8)	6 (17.6)	4 (11.1)	0.766 (2)	0.682
	No	30 (88.2)	28 (82.4)	32 (88.9)		
Phlegm (All day)	Yes	2 (5.9)	0 (0.0)	0 (0.0)	4.198 (2)	0.123
	No	32 (94.1)	34 (100.0)	36 (100.0)		
Phlegm (Continuously 3 months)	Yes	2 (5.9)	0 (0.0)	2 (5.6)	2.026	0.363
	No	32 (94.1)	34 (100.0)	34 (4.4)		
Cough and phlegm	Yes	2 (5.9)	2 (5.9)	6 (16.7)	3.150 (2)	0.207
	No	32 (94.1)	32 (94.1)	30 (83.3)		
Wheezing	Yes	6 (17.6)	2 (5.9)	6 (16.7)	2.505 (2)	0.286
	No	28 (82.4)	32 (94.1)	30 (83.3)		
Shortness of Breath	Yes	14 (41.2)	8 (23.5)	8 (22.2)	3.756 (2)	0.153
	No	20 (58.8)	26 (76.5)	28 (77.8)		

*p-value is significant at $p < 0.05$

4.7 Differences of lung function and exposures to dust between work station

The results as shown in Table 4.4, it shows that there is a statistical difference in the mean of ratio FVC between the different workstation (z=9.568, p-value=0.008) and mean of ratio FEV between the different workstation (z=7.769, p-value=0.021). hence, there are no statistical differences in the mean of ratio FEV1/FVC between the different workstation (p-value>0.05).

Table 4.4 Comparison of lung function between work station

Variables		N	Median (IQR)	z-value	p-value
FVC	Raw Material	32	3.385 (2.880-3.848)	9.568	0.008*
	Packing	34	3.320 (2.525-3.703)		
	Kiln	36	2.825 (2.450-3.310)		
FEV1	Raw Material	32	3.035 (2.485-3.482)	7.769	0.021*
	Packing	34	2.810 (2.455-3.245)		
	Kiln	36	2.460 (1.990-3.080)		
FEV1/FVC	Raw Material	32	0.900 (0.870-0.940)	1.032	0.597

Packing	34	0.910 (0.870-1.000)
Kiln	36	0.905 (0.870-0.990)

*p-value is significant at $p<0.05$

Post-hoc test (Mann-Whitney U) shows that there is significant different between Raw Material with Kiln for FVC and FEV.

By referring to Table 4.5, the difference between exposure to dust and different groups of workstations is statistically significant (z=103.00, p-value<0.001).

Table 4.5 Comparison of dust exposure between work station

Variables		N	Median(IQR)	z-value	p-value
Dust Exposure	Raw Material	34	0.235 (0.235)	103.00	<0.001*
	Packing	34	0.437 (0.437)		
	Kiln	36	0.222 (0.222)		

*p-value is significant at p<0.05

Post-hoc test (Mann-Whitney U) shows that there is significant different between Raw Material with Packing, Raw Material with Kiln and Packing with Kiln for dust exposure.

CHAPTER 5

DISCUSSION

5.1 Respondents background

In this study, there were 104 male workers involved in the cement manufacturing. The highest respondents were Indian ethnicity, followed by Malay, Chinese and others. Most of the workers involved in this study have a secondary educational level with 56 workers, followed by primary educational level with 28 workers, 16 workers with Diploma or Degree Holder and only four workers did not have any educational level. According to Shaw & Gomes (2015), educational level was related to health because it can affect the income of a person, knowledge of an individual towards their behaviour and lifestyle and also will decrease the level of unemployment.

Furthermore, the marital status of the workers also recorded in the sociodemographic factors. Most of the workers involved in this study were married with 76 respondents and only 28 respondents were single. Thus, marital status and living arrangements had shown a significant effect to the individual's health and mortality (Robards, Evandrou, Falkingham, & Vlachantoni, 2012)

5.2 The distribution of lung function abnormalities according to work station

In order to identify the respiratory disorders among the workers, the respiratory symptoms and pulmonary functions test were used in this study. According to Jha (2009) and American Thoracic Society, (2017), the lung function test that was not normal was mainly observed on the changes of the restrictive and it can be identified through the value of FEV1/FVC that was higher than 0.7. Then, the respiratory symptoms can be identified through the symptoms of coughing, wheezing, phlegm and shortness of breath. The work station that involved were Raw Material, Packing and Kiln. These work stations were chosen because it was the most work station that produced a lot of dust during the operation.

Based on Figure 4.1, the highest distribution of lung function abnormalities was from Kiln and followed by Packing and Raw Material. It showed differences between these work station performing different processes while the manufacturing operated.

In the Kiln work station, the process involved was the reaction process of calcium carbonates with the silica-bearing materials to form a mixture of calcium silicates. This process involved high temperature in order to mix all the matters to form cement. The workers in this work station will be exposed to the dust when there was machine breakdown, spillage or during their inspection of the machine. The workers will go to the work station to make sure the machine operated well. This will cause the workers to be exposed with high level of dust produced from this process.

The workers that had the obstructive pattern of impairment occurs from the result of the damaging on the small airways or bronchioles will led to the decreasing in ability to exhale air. Different from obstructive pattern, restrictive pattern of impairment is due to the condition in which there is a reduction in the volume of air that can be taken in and out of the lungs. It was possible for an individual to has both impairments at the same time unless the exposure was very high and no control measure is taken. These were explained in an article by (Subbarao P., Mandhane P.J., and Sears M.R., 2009).

5.3 The distribution of respiratory symptoms according to work station

In this study, the respiratory symptoms that were assessed were coughing, phlegm, wheezing and shortness of breath. As overall, most of the workers in all of the three work station reported that they experienced shortness of breath. This reported symptom was same as the previous study done by Razlan Musa (2002) Gizaw, Yifred, & Tadesse (2016) and Kebriaei, Hashemi, Sadeghi, & Shahrakipour (2019) where the higher symptom reported also shortness of breath when exposing to the dust that came from the quarry where most of the materials in cement industry came from quarry too.

The second symptoms most reported by the workers was wheezing in Raw Material and Kiln while second symptoms reported in Packing was coughing. This result was comparable with the previous study from (Saji et al., 2018) where most of the workers in the cement industry usually complained to have more than one symptoms especially when they were worked for many years.

5.4 The distribution of exposure to dust according to work station

Different work stations have different exposure of dust. This is due to the different process carried out in each work station. The most higher dust exposure was in Packing work station with the reading at dust of 0.437 mg/m^3 followed by Raw Material with reading of dust at 0.235 mg/m^3 and Kiln with reading of dust at 0.222 mg/m^3.

The exposure of dust was higher at Packing work station because the main purpose of this work area is to fill in the cement into its bag or to fill in the cement in the cement wagon for the transportation of cement in big scale through the railway line. During the cement was filled up into the bag or wagon, the dust from the cement will fly into the air because the dust was very fine and light. So it will easily get out from the bag and wagon. Furthermore, during the reading of dust was taken, the process of cement packing was occurred at that time. This is why the reading of the cement is high in Packing work station compared to Raw Material and Kiln.

Even though the reading of the dust of dust is high at the Packing work station, the exposure of dust in all three work stations were not exceeding the permissible exposure limit as stated in Factories and Machineries Act (Mineral Dust) Regulations 1989 Regulation 6(1) where no workers should be exposed to the mineral dust at more than 5 mg/m^3 of respirable dust over an eight-hour period. In these cases, specific monitoring on crystalline silica should be carried out because it has its own permissible exposure limit for these specific dust. The permissible exposure limit on the crystalline silica is lower than the permissible limit of the respirable dust. Furthermore, one of the raw materials used in cement production was silica and quartz. So it is better to do further monitoring on the exposure of crystalline silica concentration.

5.5 Occupational exposures to dust and lung function among cement workers

This study shows that there is significant relationship between the exposure to dust with the measured FEV1 (r-value = -0.270, p-value = 0.006) and the exposure of dust with the measured FVC (r-value = -0.307, p-value = 0.002). Both associations show negative and fair association which the increasing in dust exposure will decrease the value of FEV1 and FVC from the spirometry test. The exposure of dust with the measured FEV1/FVC does not show the significant relationship as the p-value is more than 0.05. FEV1/FVC is the fraction of air exhaled in the first second relative to the total volume exhaled. Based on the previous study by Kalyoncu et al., (2005), they suggested that both respiratory symptoms and lung function status was associated with dust exposure. There were also significant reduced on the FEV1 with the exposure of dust among the exposed workers in the cement industry (Zeleke et al., 2011). The overexposed to the dust during the working hour among the cement workers may reduce the lung function level of the workers (Kristin, Fell, & Nordby, 2017).

5.6 Occupational exposures to dust and respiratory symptoms

From the data analysis done in Chi-Square Test on exposures of dust with respiratory symptoms, only cough in the morning shows significant different between the other symptoms (X^2 = 6.233, p-value = 0.044). This shows that the workers in the cement manufacturing tend to have cough in the morning due to the exposure of the dust. From the previous study of Pramchoo et al., (2017), the research done previously showed that long-term occupational exposure to air pollutants including dust will associate with the decrease in the lung function or will increase the prevalence of respiratory symptoms. The prevalence of morning cough also increases on the cohort study that was done among cement workers (Kristin et al., 2017). This might due to the accumulation of the dust at their respiratory tract during the working hour.

Moreover, coughing also is one of the natural response of the body towards the dirt or dust that enter into the airways and lung. American Lung Association stated that one of the factors of coughing was due to exposure of the irritants from the workplace. In this case, dust is the main exposure of the workers in the work area. Plus, American Lung Association also had stated that coughing can come along with other symptoms such as shortness of breath and wheezing.

5.7 Differences of lung function and exposures to dust between work station

In the table 4.5, the comparison of lung function between the work station was observed. The result shows that at least one of the work station in this study were significant with FVC (z-value = 9.568, p-value = 0.008) and FEV1 (z-value = 7.769, p-value = 0.021). Post-hoc test was run in order to determine which work station really shows the significant difference with FVC and FEV1. The work station that is showed the significant different is Raw Material and Kiln with the p-value less than 0.05. Taner (2017) stated that dust is one of the main hazard factors in raw material preparation and kiln work station. As the dust is one of the main hazard in this work station, the workers were potentially developed lung function abnormalities which can lead to significant result of the FVC and FEV1 value.

For the comparison of dust exposure between the work stations in Table 4.5, the result shows the significant different between both variables (z=103.00, p-value<0.001). Post-hoc test was run between these variables and it shows that all work stations have significant different with the dust exposure. Ahmad, Nisa & Mohammad (2013) stated that the dust produce in cement manufacturing was high at a certain work station that includes Crusher, Kiln, Cement Mill and Packing work station.

5.8 Conclusion

This study showed that the workers in cement manufacturing were exposed to dust that produced in the production line of the cement industry. Moreover, there was lack of protected equipment used by the respondent in order to reduce the exposure of the dust. The findings of this study were stated below:

a) There were more than 80% of the workers in the cement industry had lung function abnormalities which more than 50% come from Packing and Kiln work station.

b) The most reported respiratory symptoms reported or experienced by the workers in the cement industry were shortness of breath in all work stations.

c) Packing work station showed the highest production of dust compared to the other two work station which was Raw Material and Kiln.

d) There was significant relationship between the exposure of dust with FVC and FEV1 value.

e) There was significant different between the exposure of the workers to dust with the respiratory symptoms of cough in the morning.

f) FVC and FEV1 value showed a statistical difference with the exposure of dust between the different three work stations.

5.9 Limitation

There were some limitations detected in this study which are:

a) Limited access and time to the workstation for the measurement that causes the restriction in proper time management for the dust measurement. Thus, the measurement of the dust should be taken for a longer period of time in each work station in order to get an accurate reading of dust level.

b) This study mainly used questionnaire in order to assess the respiratory symptoms experienced by the workers. This can reduce the validity of the study as some of them might not know the real experienced of having each respiratory symptom.

c) Lack of previous study on comparing the respiratory problems between work station in the cement industry. Most of the study that can be found only comparing between the exposed and unexposed group.

5.10 Recommendation

1) For the socio-demographic data, it is recommended to have a larger number of samples of the workers in the cement industry in order to get better results and to make the samples more representative.
2) From the overall results, it is recommended to do further screening and periodic lung function test towards the exposed workers.
3) Further monitoring on specific dust such as cristobalite and silica can be carried out in order to know this dust was over the limit of exposure or not.
4) The management can consider the hierarchy of control in order to ensure the safety of the workers that start with:

    i. Engineering control – Water spray can be installed in that particular work area in order to reduce the dust from mixing in the air with suitable droplets of water as stated in Factories and Machineries Act (Mineral Dust) Regulations 1989. In the Packing work station, the machine that filled the cement product into its bag should be isolated by installing the barrier in order to reduce the dust from freely exposed into the air.

    ii. Administrative control – The management should introduce the job rotation between the workers in each station by letting the worker to work within the place with concentration of dust in the morning only and change to other that less dust in the evening and vice versa. By practicing this method, the time of the workers exposed to the dust can be limited in only about four hours in a shift.

iii. Personal Protective Equipment (PPE) – The PPE used by the workers was N95 face mask which good in filtering the dust. But, the workers did not frequently change their face mask. Adequate number of face mask should be provided to each worker in order to encourage them to change their mask for at least once a week or whenever needed. Training on using the face mask also should be given to the workers in order to make sure that the mask was used properly so that the dust cannot enter to the respiratory system.

5) Clinical test by Registered Occupational Health Doctor (OHD) or Medical Doctor according to the determination of respiratory symptoms experienced by the workers should be carried out. This is because some workers could define how the feel of each respiratory symptom.

6) Last, a cohort study can be done by using the result from this study as the baseline data in order to get a continuous measurement of the lung function of the workers and to see whether the workers with lung function abnormalities getting higher of lower.

REFERENCES

Ahmad, W., Nisa, S., & Mohammad, N. (2013). ASSESSMENT OF PARTICULATE MATTER (PM 10 & PM 2 . 5) AND ASSOCIATED HEALTH PROBLEMS IN DIFFERENT AREAS OF CEMENT INDUSTRY , HATTAR , (January).

Aminian, O., Aslani, M., & Haghighi, K. S. (2014). Cross-shift study of acute respiratory effects in cement production workers. *Acta Medica Iranica*, *52*(2), 146–152.

Asthma : epidemiology , etiology and risk factors. (2009), *181*(9). https://doi.org/10.1503/cmaj.080612

Bauleo, L., Bucci, S., Antonucci, C., Sozzi, R., Davoli, M., Forastiere, F., & Ancona, C. (2018). Long-term exposure to air pollutants from multiple sources and mortality in an industrial area: A cohort study. *Occupational and Environmental Medicine*, 1–10. https://doi.org/10.1136/oemed-2018-105059

Chatignoux, E., Pascal, M., Corso, M., Blanchard, M., Host, S., Pascal, L., & Larrieu, S. (2014). mortality in nine French cities, *95*. https://doi.org/10.1016/j.atmosenv.2014.06.030

Community, T. H. E. E., Health, R., & Ii, S. (n.d.). THE EUROPEAN COMMUNITY RESPIRATORY HEALTH SURVEY II LUNG FUNCTION PROTOCOL , DATA SHEETS AND.

Culver, B. H., Graham, B. L., Coates, A. L., Wanger, J., Berry, C. E., Clarke, P. K., … Rosenfeld, M. (2017). AMERICAN THORACIC SOCIETY

Recommendations for a Standardized Pulmonary Function Report An Of fi cial American Thoracic Society Technical Statement, *196*, 1463–1472. https://doi.org/10.1164/rccm.201710-1981ST

Dempsey, T. M., & Scanlon, P. D. (2018). Pulmonary Function Tests for the Generalist: A Brief Review. *Mayo Clinic Proceedings*, *93*(6), 763–771. https://doi.org/10.1016/j.mayocp.2018.04.009

García-Río, F., Calle, M., Burgos, F., Casan, P., del Campo, F., Galdiz, J. B., … Puente Maestu, L. (2013). Spirometry. *Archivos de Bronconeumología (English Edition)*, *49*(9), 388–401. https://doi.org/10.1016/j.arbr.2013.07.007

Gizaw, Z., Yifred, B., & Tadesse, T. (2016). Chronic respiratory symptoms and associated factors among cement factory workers in Dejen town , Amhara regional state , Ethiopia , 2015. *Multidisciplinary Respiratory Medicine*, 1–9. https://doi.org/10.1186/s40248-016-0043-6

Hse. (1994). EH75/7 - Portland Cement Dust: Hazard assessment document. https://doi.org/10.1118/1.3458721

Jha, N. (2009). Occupational exposure and pulmonary function of jute mill workers in Sunsari , Nepal, *11*(4), 275–277.

Kalyoncu, A. F., Ug, A., Selc, Z. T., & Enu, T. (2005). Lung health in workers exposed to reed dust, 421–428. https://doi.org/10.1016/j.rmed.2004.08.015

Kayhan, S., Tutar, U., Cinarka, H., Gumus, A., & Koksal, N. (2013). Prevalence of Occupational Asthma and Respiratory Symptoms in Foundry Workers, *2013*, 1–5.

Kebriaei, A., Hashemi, S. R., Sadeghi, M., & Shahrakipour, M. (2019). Iranian

Journal of Environmental Health , Science and Engineering Effects of Exposure to Portland Cement Dust on Lung Function in Portland Cement Factory Workers in Khash , Iran, 10–12.

Kim, K. H., Kabir, E., & Kabir, S. (2015). A review on the human health impact of airborne particulate matter. *Environment International*, *74*, 136–143. https://doi.org/10.1016/j.envint.2014.10.005

Kristin, A., Fell, M., & Nordby, K. C. (2017). Association between exposure in the cement production industry and non-malignant respiratory effects : a systematic review. https://doi.org/10.1136/bmjopen-2016-012381

Manjula R, Praveena R, Clevin RR, Ghattargi CH, Dorle AS, Lalitha DH. Effects of occupational dust exposure on the health status of portland cement factory workers. Int J Med Public Health 2013;3:192-6.

Merenu, I. A., Mojiminiyi, F. B. O., Njoku, C. H., & Ibrahim, M. T. O. (2007). The Effect of Chronic Cement Dust Exposure on Lung Function of Cement Factory Workers in Sokoto , Nigeria, *10*(May), 139–143.

Mijakoski, D., Karadzinska, J., Stoleski, S., Minov, J., Marsenic, M., Atanasovska, A. Respiratory Symptoms, Lung Function Impairement, and Sensitization to Metals in Construction Workers Exposed to Ashes, Cement and Ash-Cement Mixtures. *European Respiratory Journal 2011 (38),* 91058-1056)

Miller, M. R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., … Wanger, J. (2005). Standardisation of spirometry, *26*(2), 319–338. https://doi.org/10.1183/09031936.05.00034805

Nordby, K. C., Notø, H., Eduard, W., Skogstad, M., Fell, A. K., Thomassen, Y., …

Kjuus, H. (2016). Thoracic dust exposure is associated with lung function decline in cement production workers. *European Respiratory Journal*, *48*(2), 331–339. https://doi.org/10.1183/13993003.02061-2015

O'Mara, R., Flodin, C., & Plass, R. (1955). Dust and fume problems in the cement industry. *Air Repair*, *4*(4), 203–209. https://doi.org/10.1080/00966665.1955.10467670

Pramchoo, W., Geater, A. F., Jamulitrat, S., Geater, S. L., & Tangtrakulwanich, B. (2017). Occupational Tasks In fl uencing Lung Function and Respiratory Symptoms Among Charcoal-Production Workers : A Time-Series Study. *Safety and Health at Work*, *8*(3), 250–257. https://doi.org/10.1016/j.shaw.2016.11.006

Rachiotis, G., Kostikas, K., Pinotsi, D., Hadjichristodoulou, C., & Drivas, S. (2018). Prevalence of lung function impairment among Greek, 49–52.

Rafeemanesh, E., Alizadeh, A., Saleh, L. A., & Zakeri, H. (2015). a Study on Respiratory Problems and Pulmonary Function Indexes Among Cement Industry Workers in Mashhad, Iran. *Medycyna Pracy*, *66*(4), 471–477. https://doi.org/10.13075/mp.5893.00115

Rampuri, S. (2017). Study and Analysis of Occupational & Health Diseases in Cement Industries, *2*, 1–7.

Rivas, I., Mazaheri, M., Viana, M., Moreno, T., Clifford, S., He, C., … Querol, X. (2017). Identification of technical problems affecting performance of DustTrak DRX aerosol monitors. *Science of the Total Environment*, *584–585*, 849–855. https://doi.org/10.1016/j.scitotenv.2017.01.129

Robards, J., Evandrou, M., Falkingham, J., & Vlachantoni, A. (2012). Maturitas

Marital status , health and mortality. *Maturitas*, *73*(4), 295–299. https://doi.org/10.1016/j.maturitas.2012.08.007

Rovira, E., Cuadras, A., Aguilar, X., Esteban, L., Borràs-Santos, A., Zock, J. P., & Sunyer, J. (2014). Asthma, respiratory symptoms and lung function in children living near a petrochemical site. *Environmental Research*, *133*, 156–163. https://doi.org/10.1016/j.envres.2014.05.022

Saji, K. G., Zubair, M., Nair, S. B., Varghese, P. R., & College, S. A. (2018). An epidemiological study on effect of occupational exposure of cement, *5*(12), 5105–5109.

Sampatakakis, S., Linos, A., Papadimitriou, E., Petralias, A., Dalma, A., Papasaranti, E. S., … Stoltidis, M. (2013). Respiratory disease related mortality and morbidity on an island of Greece exposed to perlite and bentonite mining dust. *International Journal of Environmental Research and Public Health*, *10*(10), 4982–4995. https://doi.org/10.3390/ijerph10104982

Sana, S., Bhat, G. A., & Balkhi, H. M. (2013). Health Risks Associated With Workers in Cement Factories. *International Journal of Scientific and Research Publications*, *3*(1), 2250–3153. https://doi.org/10.1002/we.1619

Shaw, S. R., & Gomes, P. (2015). The relationship between student health and academic performance : Implications for school psychologists, (February). https://doi.org/10.1177/0143034314565425

Singh, S. (2016). Respiratory symptoms and signs Key points. *Medicine*, *44*(4), 205–212. https://doi.org/10.1016/j.mpmed.2016.02.001

Source: KPDNKK. (n.d.).

symptoms.pdf. (n.d.).

Szram, J. (2012). Occupational airways disease. *Medicine*, *40*(6), 279–282. https://doi.org/10.1016/j.mpmed.2012.03.009

Taner, S. (2017). Occupational health and safety in cement industry, (May 2015).

Wang, X., & Taylor, P. (2016). Mixing , Placing & Curing, (August).

Zeleke, Z. K., Moen, B. E., & Bråtveit, M. (2011). Lung function reduction and chronic respiratory symptoms among workers in the cement industry: A follow up study. *BMC Pulmonary Medicine*, *11*, 1–10. https://doi.org/10.1186/1471-2466-11-50

APPENDIX 1

CONSENT FORM

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

Kelaziman Simtom Pernafasan di kalangan Pekerja Simen di Ipoh, Perak: Kajian secara Keratan Rentas

2. PENGENALAN

Dalam era baru ini, pembinaan bangunan di seluruh negara semakin meningkat. Dalam pembuatan bangunan, bahan yang paling banyak digunakan ialah simen untuk membentuk struktur. Ia adalah bahan binaan yang paling penting di dunia. Peningkatan kadar pengeluaran menunjukkan bahawa pekerja dalam industri simen terdedah kepada banyak bahaya pekerjaan terutamanya habuk. Antara bahaya yang berlaku dalam industri simen ialah bahaya fizikal, bahaya kimia, bahaya biologi, bahaya ergonomi dan bahaya psikososial. Kebanyakan pekerja terdedah kepada habuk akibat beberapa proses dalam industri simen. Berlebihan dengan habuk boleh menyebabkan banyak kesan negatif kepada pekerja terutama kepada sistem pernafasan mereka.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Pertama sekali, anda perlu menandatangani borang persetujuan untuk menunjukkan bahawa anda berminat untuk mengambil bahagian dalam kajian ini. Kemudian, anda perlu membaca semua maklumat yang diberikan dan memahami setiap arahan dan maklumat yang dinyatakan dalam borang persetujuan. Anda juga perlu mengisi borang soal selidik yang mengandungi seksyen A: maklumat demografi, bahagian B: maklumat pekerjaan, bahagian C: status kesihatan, bahagian D: maklumat gaya hidup, bahagian E: gejala akibat pendedahan haba dan seksyen F: maklumat mengenai gejala pernafasan. Akhir sekali, anda perlu membuat ujian fungsi paru-paru menggunakan spirometer. Penyertaan adalah sukarela dan anda boleh menarik diri sekiranya anda tidak berminat untuk meneruskan penglibatan dalam kajian ini.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Peserta yang tidak terlibat dalam kajian ini adalah pekerja wanita dan pekerja yang menjalani pembedahan di kawasan perut selama 3 bulan yang lalu. Pekerja yang mempunyai sejarah merokok, asma (pengguna inhaler), sebarang jangkitan saluran pernafasan dalam tiga minggu yang lalu, mengalami serangan jantung dalam tempoh tiga bulan yang lalu, sebarang penyakit jantung dan pekerja wanita.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Kajian ini akan memberikan subjek status kesihatan mereka kepada masalah-masalah yang timbul. Semua ujian kesihatan yang diberikan kepada rsponden tidak akan dikenakan sebarang kos. Beberapa ujian yang akan diberikan kepada responen ialah indeks jisim badan (BMI) dan ujian fungsi paru-paru.

b) KEPADA PENYELIDIK?

Kajian ini akan membantu penyelidik menilai gejala pernafasan dan ujian fungsi paru-paru. Data ini boleh digunakan sebagai data asas bagi penyelidikan masa depan yang berkaitan dengan fungsi paru-paru dan gejala pernafasan.

6. ADAKAH IA BERISIKO?

Kajian ini tidak akan meberikan sebarang risiko kepada responden.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Semua maklumat yang diperoleh daripada kajian ini akan kekal dirahsiakan dan hanya akan digunakan untuk kajian ini sahaja.

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

Sekiranya anda mempunyai sebarang soalan dan ingin tahu mengenai kajian ini, anda boleh menghubungi penyelia kajian ini, Dr Karmegam Karuppiah di atau megam@upm.edu.my atau penyiasat kajian ini, Nur Khusairi bin Razali di 012-5947407 atau khusairi. razali@gmail.com.

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*)

APPENDIX 2

QUESTIONNAIRE

PROJEK PENYELIDIKAN TAHUN AKHIR
B.S. KESIHATAN PERSEKITARAN DAN PEKERJAAN
FAKULTI PERUBATAN DAN SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA
SERDANG, SELANGOR

"BORANG SOAL SELIDIK BAGI KAJIAN TEKANAN HABA, KELAZIMAN SIMPTOMS RESPIRATORI DAN KESANNYA TERHADAP PEKERJA DI KILANG SIMEN"

ARAHAN SOALAN:

1. Borang soal selidik ini mengandungi empat (5) bahagian iaitu:

   BAHAGIAN A: MAKLUMAT DIRI

   BAHAGIAN B: MAKLUMAT PEKERJAAN

   BAHAGIAN C: MAKLUMAT KESIHATAN

   BAHAGIAN D: MAKLUMAT GAYA HIDUP

   BAHAGIAN E: MAKLUMAT SIMPTOM PENDEDAHAN HABA

   BAHAGIAN F: MAKLUMAT SIMPTOM RESPIRATORI

2. Anda diminta untuk menjawab semua soalan yang ada di dalam buku ini
3. Untuk menjawab, sila tandakan jawapan di bahagian jawapan yang telah disediakan
4. Borang soal selidik hendaklah dikembalikan kepada pengkaji setelah selesai menjawab semua soalan
5. Semua maklumat yang diperoleh di dalam kajian ini adalah rahsia dan hanya digunakan untuk tujuan pembelajaran semata-mata.

Sekian, terima kasih

BAHAGIAN A: MAKLUMAT DIRI

1.1 Tarikh lahir — Tarikh | Bulan | Tahun

1.2 No. Kad Pengenalan/ Pasport

1.3 No. Telefon

1.4 Umur — tahun

1.5 Bangsa — 1. Melayu 2.Cina 3. India 4.Lain-lain

1.6 Warganegara
1. Warganegara
2. Bukan warganegara

1.7 Status
1. Bujang
2. Berkahwin
3. Bercerai

1.8 Pendidikan
1. Tidak Bersekolah
2. Rendah/UPSR
3.Menengah/PMR/SPM/STPM
4. Sijil/Diploma/Ijazah

1.9 Gaji — RM

1.10 Tinggi ☐☐☐ cm

1.11 Berat ☐☐☐ kg

1.12 Isi rumah ☐☐ Orang

BAHAGIAN B: MAKLUMAT PEKERJAAN

2.1 Pernahkah Anda Bekerja Di Tempat Lain Sebelum Ini?

1. ☐ YA 2. ☐ TIDAK

Jika Ya, Nyatakan Jenis Pekerjaan Dan Tempoh Bekerja:

Jenis Pekerjaan	Tempoh Bekerja (Jumlah Tahun)	Tahun Mula Bekerja (Contoh: 2015)

2.2 Apakah Jawatan Anda Sekarang?

____

2.3 Di Bahagian Mana Anda Bekerja Sekarang?

1. ☐ Packing
2. ☐ Cement mill
3. ☐ Raw material
4. ☐ Kiln
5. ☐ Coal mill
6. ☐ Housekeeping
7. ☐ Supervisor
8. Lain-lain: ____________

2.4 Berapa lamakah anda telah bekerja sebagai (pekerjaan di atas)?

______ tahun

2.5 Berapa lamakah anda bekerja di kilang simen ini?

______ tahun

2.6 Shift kerja?

1. ☐ Normal
2. ☐ Shift

2.7 Berapa hari anda bekerja dalam seminggu?

____ hari

2.8 Adakah anda bekerja lebih masa (OT)?

1. ☐ Ya   2. ☐ Tidak

2.9 Jika Ya, secara purata, berapa kerap anda bekerja lebih masa?

1. ☐ Tiada
2. ☐ 1-3 kali sebulan
3. ☐ 3-5 kali sebulan
4. ☐ Lebih dari 5 kali sebulan

2.10 Berapa jamkah anda bekerja dalam sehari?

____ jam

2.11 Adakah anda menggunakan sebarang Peralatan Perlindungan Diri (PPE)?

1. ☐ Ya 2. ☐ Tidak

2.12 Tandakan jenis PPE yang digunakan:

1. ☐ Kasut Keselamatan
2. ☐ Topi Keselamatan
3. ☐ Cermin mata keselamatan
4. ☐ Sarung tangan
5. ☐ Pakaian perlindungan diri
6. ☐ Respirator
7. ☐ Lebih dari 1 PPE
8. Lain-lain: ____________

2.13 Berapa lamakah anda menggunakan PPE dalam sehari?

___ jam

2.14 Adakah latihan penggunaan PPE diberikan?

1. ☐ Ya 2. ☐ Tidak

2.15 Adakah anda terdedah kepada sebarang hazad seperti di bawah:

1. ☐ Bahan Kimia
2. ☐ Panas melampau
3. ☐ Habuk
4. ☐ Bunyi bising
5. ☐ Lebih dari 1 hazad
6. Lain-lain: _______

2.16 Bilangan pekerja yang menjalankan skop kerja yang sama:

____ orang

2.17 Adakah anda membuat kerja sambilan?

1. ☐ Ya 2. ☐ Tidak

Jika Ya, isikan maklumat berkaitan kerja sambilan di bawah.

Jenis Pekerjaan	Jam bekerja sehari	Kekerapan bekerja dalam seminggu (hari)

BAHAGIAN C: MAKLUMAT KESIHATAN

3.1 Adakah anda mengalami sebarang simptom-simptom seperti di bawah? Tandakan

Simptom	1. Ya	2. Tidak
3.1.1 Keletihan		
3.1.2 Pening Kepala		
3.1.3 Pedih Mata		
3.1.4 Sesak Nafas		
3.1.5 Berdebar-debar		
3.1.6 Ruam		
3.1.7 Loya		
3.1.8 Muntah		
3.1.9 Kekejangan Otot		
3.1.10 Strok		
3.1.11 Pitam		
3.1.12 Berdengung		
3.1.13 Sakit Telinga		
3.1.14 Kehilangan Pendengaran Sementara		
3.1.15 Batuk		
3.1.16 Berpeluh		

3.2 **Adakah anda menghidapi penyakit berikut dan telah disahkan oleh doktor?**

Penyakit (a)	1. Ya (b)	2. Tidak (c)	Adakah anda pernah mengambil sebarang ubat-ubatan untuk penyakit tersebut?	
			1. Ya (d)	2. Tidak (e)
3.2.1 Darah Tinggi				
3.2.2 Kencing Manis				
3.2.3 Asma/Lelah				
3.2.4 Jantung				
3.2.5 Schizopernia (mental)				
3.2.6 Insomnia				
3.2.7 Rheumatic Arthritis (Sakit Sendi)				

3.3 **Adakah anda mengalami sebarang kecederaan di mana-mana bahagian anggota badan berikut?**

0. ☐ Tiada Kecederaan
1. ☐ Kepala
2. ☐ Bahu
3. ☐ Tangan
4. ☐ Tulang Belakang
5. ☐ Pinggul
6. ☐ Peha
7. ☐ Lutut
8. ☐ Kaki
9. ☐ Lebih dari 1 bahagian

3.4 **Adakah anda menjalani aktiviti-aktiviti berikut:**

0. ☐ Tidak berkaitan
1. ☐ Pembedahan telinga
2. ☐ Terdedah bunyi bising
3. ☐ Ketenteraan
4. ☐ Senjata api
5. ☐ Lain-lain: ___________
6. ☐ Lebih dari satu aktiviti

3.5 **Adakah anda mengambil sebarang ubat-ubatan selain dari yang dinyatakan dalam soalan 3.2?**

1. ☐ Ya 2. ☐ Tidak

Jika Ya, nyatakan jenis ubat: ___________________________

3.6 **Adakah anda menghidap sebarang penyakit selain dari yang dinyatakan dalam soalan 3.2?**

1. ☐ Ya 2. ☐ Tidak

Jika Ya, nyatakan jenis ubat: ___________________________

3.7 **Adakah penyakit yang dinyatakan di soalan 3.6 (jika ada), menganggu pekerjaan dan menyakitkan otot rangka semasa bekerja?**

1. ☐ Ya 2. ☐ Tidak

BAHAGIAN D: MAKLUMAT GAYA HIDUP (LIFESTYLE)

4.1 Adakah anda mengambil sebarang jenis dadah?

1. ☐ Ya 2. ☐ Tidak

4.2 Adakah anda merokok?

1. ☐ Ya 2. ☐ Tidak

4.3 Adakah anda nelakukan sebarang aktiviti fizikal?

1. ☐ Ya 2. ☐ Tidak

4.4 Adakah anda mengalami kesukaran untuk tidur?

1. ☐ Ya 2. ☐ Tidak

4.5 Adakah anda mengalami gangguan ketika tidur?

1. ☐ Ya 2. ☐ Tidak

4.6 Adakah anda mengambil minuman beralkohol?

1. ☐ Ya 2. ☐ Tidak

4.7 Dalam masa terluang, adakah anda melakukan sebarang aktiviti tersebut?

1. ☐ Berburu
2. ☐ Berkebun
3. ☐ Memasak
4. ☐ Kerja-kerjarumah
5. ☐ Memancing
6. ☐ Olahraga
7. Lain-lain: ___________

BAHAGIAN E: MAKLUMAT SIMPTOM-SIMPTOM PENDEDAHAN HABA

5.1 Adakah anda mengalami sebarang symptom-simptom atau tanda-tanda seperti yang di bawah semasa atau selepas terdedah kepada suhu /haba yang tinggi (panas)? Tandakan.

	Simptom	1. Ya	2. Tidak
E 5.1.1	Keletihan		
E 5.1.2	Pening kepala		
E 5.1.3	Kelihatan pucat		
E 5.1.4	Sesak nafas dan nadi lemah		
E 5.1.5	Berdebar-debar		
E 5.1.6	Ruam dan kulit kemerah-merahan selepas terdedah kepada panas		
E 5.1.7	Loya		
E 5.1.8	Muntah		
E 5.1.9	Kekejangan otot		
E 5.1.10	Terasa lenguh dibahagikan kaki atau tangan		
E 5.1.11	Strok		
E 5.1.12	Pitam		
E 5.1.13	Sawan		
E 5.1.14	Kekeliruan		
E 5.1.15	Pengsan		
E 5.1.16	Dahaga		
E 5.1.17	Kulit kering		
E 5.1.18	Kulit lembap dan terasa sejuk		
E 5.1.19	Peluh berlebihan		
E 5.1.20	Kadar degupan jantung meningkat		
E 5.1.21	Suhu badan yang sangat tinggi		

5.2 Kategori waktu bekerja anda

1. Bekerja berterusan bagi setiap jam
2. 75% bekerja, 25% rehat
3. 50% bekerja, 50% rehat
4. 25% bekerja, 75% rehat

5.3 Berapa lama anda terdedah kepada haba dalam pekerjaan seharian

1. Kurang daripada 2 jam
2. 2-4 jam
3. 4-6 jam
4. 6-8 jam
5. Lebih daripada 8 jam

BAHAGIAN F: MASALAH GEJALA RESPIRATORI

BATUK

6.1 Adakah andas elalu mengalami batuk? (Batuk yang dibuat untuk mengeluarkan kahak tidak dikira)

Ya ☐ Tidak ☐

6.2 Adakah anda batuk sekerap 4 hingga 6 kali sehari, atau lebih dari 4 hari seminggu?

Ya ☐ Tidak ☐

6.3 Adakah anda batuk ketika bangun tidur atau pada pagi hari?

Ya ☐ Tidak ☐

6.4 Selalukah anda batuk sepanjang hari atau pada malam hari

Ya ☐ Tidak ☐

Jika Ya pada mana-mana soalan di atas (6.1-6.4), Sila jawab soalan 6.5 dan 6.6

Jika Tidak pada semua soalan di atas, Sila terus ke soalan 6.7.

6.5 Adakah anda biasanya batuk sedemikian (soalan 3, 4, 5 atau 6) untu kselama 3 bulan berturut-turut sepanjang tahun?

Ya ☐ Tidak ☐

KAHAK (PHELGM)

6.6 Adakah anda selalu berkahak? (termasuk kahak yang ditelan)

Ya ☐ Tidak ☐

6.7 Adakah anda berkahak sekerap 2 kali sehari, 4 hari atau lebih dalams eminggu?

Ya ☐ Tidak ☐

6.8 Adakah anda berkahak ketika bangun tidur atau pada pagi-pagi hari?

Ya ☐ Tidak ☐

6.9 Selalukah anda berkahak sepanjang hari atau pada malam hari?

Ya ☐ Tidak ☐

Jika Ya pada mana-mana soalan di atas (6.6 – 6.9), Sila jawab soalan 6.10

Jika Tidak pada semua soalan di atas, Sila terus ke soalan 6.13.

6.10 **Adakah anda berkahak sedemikian (soalan 6, 7, 8 atau 9) untuk selama 3 bulan berturut-turut sepanjang tahun?**

Ya ☐ **Tidak** ☐

BATUK SERTA BERKAHAK

6.11 **Pernahkah anda mengalami peningkatan batuk-batuk serta berkahak yang berpanjangan lebih dari 3 minggu setiap tahun? (Jika Ya, sila jawab soalan 14)**

Ya ☐ **Tidak** ☐

DADA BERBUNYI (WHEEZING)

6.12 **Adakah anda terasa dada anda berbunyi seperti wisel:**

i.	**Apabila anda mengalami selsema**	**Ya**	☐	**Tidak**	☐
ii.	**kadang-kala di samping selsema**	**Ya**	☐	**Tidak**	☐
iii.	**hampir setiaphari (siang atau malam)**	**Ya**	☐	**Tidak**	☐

SUKAR BERNAFAS (BREATHLESSNESS)

6.13 **Adakah anda mengalami kesukaran bernafas apabila berjalan dengan pantas atau semasa mendaki?**

Ya ☐ **Tidak** ☐

(Jika jawab Ya pada soalan 5.13, sila jawab soalan 5.14 – 5.17. Jika jawab Tidak pada soalan 5.13, sila ke bahagian H)

6.14 **Adakah anda berjalan dengan perlahan kerana sukar bernafas?**

Ya ☐ **Tidak** ☐

6.15 **Adakah anda perlu berhenti seketika untuk bernafas semasa berjalan?**

Ya ☐ **Tidak** ☐

6.16 **Adakah anda perlu berhenti untuk bernafas setelah berjalans ejauh 30 meter (atau selepas beberapa minit)?**

Ya ☐ **Tidak** ☐

6.17 **Adakah anda terasa sukar bernafas semasa meninggalkan rumah atau semasa memakai atau membuka pakaian?**

Ya ☐ **Tidak** ☐

Terima kasih atas kerjasama anda dalam menyiapkan kajian ini.

APPENDIX 3

ETHICAL APPROVAL