UNIVERSITI PUTRA MALAYSIA

EXPOSURE OF $PM_{2.5}$ AND ITS ASSOCIATION WITH RESPIRATORY HEALTH SYMPTOMS AMONG FOOD DELIVERY RIDERS IN KLANG VALLEY

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EXPOSURE OF $PM_{2.5}$ AND ITS ASSOCIATION WITH RESPIRATORY HEALTH SYMPTOMS AMONG FOOD DELIVERY RIDERS IN KLANG VALLEY

BY

SITI KHAIRUNNISA HAFIZAH BINTI BAKRI

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

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ABSTRACT

EXPOSURE TO $PM_{2.5}$ AND ITS ASSOCIATION WITH RESPIRATORY HEALTH SYMPTOMS AMONG FOOD DELIVERY RIDERS IN KLANG VALLEY

SITI KHAIRUNNISA HAFIZAH BINTI BAKRI

Introduction: Food delivery services have grown in the past few years as some people faced difficulty to reach the destination to buy their desired meals due to limited time and the absence of transportation (Nordzi et al., 2018). However, the instant growing rate of food delivery service also impacts the rider's health. The delivery rider spends an enormous portion of their working hours on the road and at the roadsides to deliver food for the customer, which in-creases their exposure to outdoor air pollution, especially $PM_{2.5}$. The level of $PM_{2.5}$ has recently become a great challenge. There is an increasing concern regarding the effects of $PM_{2.5}$ on health due to the increasing number of vehicles on the road that contributes to the significant amount of particulate matter produced (Health Effects Institute, 2010). Therefore, they are immensely exposed to air pollution, especially $PM_{2.5}$, since no mechanical defense can help reduce the exposure. **Objectives:** This study aimed to determine the association between the exposure levels of $PM_{2.5}$ with respiratory health symptoms among food delivery riders. **Methodology:** This study is a cross-sectional study. A self-administered questionnaire was modified from a study by Mohamad Jamil et al. (2019) was given to respondents. Exposure monitoring of $PM_{2.5}$ was conducted by using PurpleAir monitor PA-II. Descriptive statistics were performed to describe the study population in terms of sociodemographic, occupational and health history, also the prevalence of respiratory health symptoms. Chi-square was used to identify the presence of association between the level of $PM_{2.5}$ and respiratory health symptoms. Binary logistic regression was used to determine the level of $PM_{2.5}$ that associated with respiratory health symptoms. **Results and Discussion:** The geometric mean level of $PM_{2.5}$ for food delivery riders was 33.8 µg m–3. It was found that some of them experienced respiratory health symptoms (frequent cough 67.7%, wheezing all day or all night long 86.6%, shortness of breath during walking in fast pace or walking up a slight hill 65.9% and shortness of breath when wears mask 69.8%). The only signifi-cant association established was between the level of $PM_{2.5}$ and shortness of breath ($p < 0.001$). The food delivery riders who exposed to high level of $PM_{2.5}$ were 2 times more likely (95% CI 1.335 – 3.220) to develop shortness of breath**. Conclusion:** Findings from this study, indicated that there was a development of respiratory health symptoms among food delivery rid-ers. Thus, it is important to develop awareness and mitigation plans to minimize exposure to $PM_{2.5}$ during delivering food.

Keywords: $PM_{2.5}$, fine particulate matter, respiratory health symptoms, food delivery riders

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ABSTRAK

PENDEDAHAN KEPADA $PM_{2.5}$ DAN KAITANNYA DENGAN GEJALA RESPIRATORI DI KALANGAN PENGHANTAR MAKANAN DI LEMBAH KLANG

SITI KHAIRUNNISA HAFIZAH BINTI BAKRI

Pengenalan: Perkhidmatan penghantaran makanan telah berkembang sejak beberapa tahun kebelakangan ini kerana sesetengah orang menghadapi kesukaran untuk sampai ke destinasi untuk membeli makanan yang diingini kerana masa yang terhad dan ketiadaan pengangkutan (Nordzi et al., 2018). Walau bagaimanapun, kadar perkhidmatan penghantaran makanan yang meningkat serta-merta turut memberi kesan kepada kesihatan penunggang. Penunggang penghantaran menghabiskan sebahagian besar waktu kerja mereka di jalan raya dan di tepi jalan untuk menghantar makanan kepada pelanggan, yang meningkatkan pendedahan mereka kepada pencemaran udara luar, terutamanya $PM_{2.5}$. Tahap $PM_{2.5}$ baru-baru ini menjadi satu cabaran yang hebat. Terdapat kebimbangan yang semakin meningkat mengenai kesan $PM_{2.5}$ terhadap kesihatan disebabkan peningkatan bilangan kenderaan di jalan raya yang menyumbang kepada jumlah besar zarah yang dihasilkan (Institut Kesan Kesihatan, 2010). Oleh itu, mereka sangat terdedah kepada pencemaran udara, terutamanya $PM_{2.5}$, kerana tiada pertahanan mekanikal boleh membantu mengurangkan pendedahan.**Objektif:** Kajian ini bertujuan untuk mengetahui perkaitan antara tahap pendedahan $PM_{2.5}$ dengan gejala kesihatan pernafasan dalam kalangan penunggang penghantaran makanan. **Metodologi:** Kajian ini merupakan kajian keratan rentas. Soal selidik yang ditadbir sendiri telah diubah suai daripada kajian oleh Mohamad Jamil et al. (2019) telah diberikan kepada responden. Pemantauan pendedahan $PM_{2.5}$ telah dijalankan dengan menggunakan monitor PurpleAir PA-II. Statistik deskriptif dilakukan untuk menggambarkan populasi kajian dari segi sosiodemografi, sejarah pekerjaan dan kesihatan, juga prevalens gejala kesihatan pernafasan. Chi-square digunakan untuk mengenal pasti kehadiran perkaitan antara tahap $PM_{2.5}$ dan simptom kesihatan pernafasan. Regresi logistik binari digunakan untuk menentukan tahap $PM_{2.5}$ yang dikaitkan dengan gejala kesihatan pernafasan. **Keputusan dan Perbincangan:** Tahap purata geometri $PM_{2.5}$ untuk penunggang penghantaran makanan ialah 33.8 µg m–3. Didapati sebilangan daripada mereka mengalami simptom kesihatan pernafasan (kerap batuk 67.7%, berdehit sepanjang hari atau sepanjang malam 86.6%, sesak nafas semasa berjalan dalam kadar pantas atau berjalan mendaki bukit 65.9% dan sesak nafas apabila memakai topeng. 69.8%). Satu-satunya perkaitan penting yang ditubuhkan adalah antara tahap $PM_{2.5}$ dan sesak nafas ($p < 0.001$). Penunggang penghantaran makanan yang terdedah kepada tahap tinggi $PM_{2.5}$ adalah 2 kali lebih berkemungkinan (95% CI 1.335 – 3.220) mengalami sesak nafas. **Kesimpulan: K**ajian ini menunjukkan bahawa terdapat perkembangan gejala kesihatan pernafasan dalam kalangan penunggang penghantaran makanan. Oleh itu, adalah penting untuk membangunkan pelan kesedaran dan mitigasi untuk meminimumkan pendedahan kepada $PM_{2.5}$ semasa penghantaran makanan.

Kata kunci: $PM_{2.5}$, zarah halus, gejala kesihatan pernafasan, penunggang penghantar makanan

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LIST OF ABBREVATIONS

BMI	Body Mass Index
CRSM	Crisis Relief Squad of MCA
EDP	Diesel exhaust particles
PM	Particulate matter
TRPA 1	TRP-class ankyrin 1
TRPV 1	TRP-class vanilloid 1
WHO	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background

Fine particulate matter refers to $PM_{2.5}$. It is a mixture of particles that are emitted directly from the combustion source and produced through photochemical reactions as secondary pollutants that have the size ranges of 0.1 to 2.5 μm (Fan & Lin, 2019; Rappazzo et al., 2021). It has been proven that particulate matter (PM) with a size less than 10 μm has a significant adverse effect on human health. PM with small diameter such as $PM_{2.5}$ have large surface areas that are able to transport a variety of hazardous substances where it can pass through the first line of human defense (nose hair), reach the respiratory tract end and deposit there via diffusion, causing damage to many other regions of the body through lungs air exchange (Xing et al., 2016).

The level of $PM_{2.5}$ has recently become a great challenge. There is an increasing concern regarding the effects of $PM_{2.5}$ on health due to the increasing number of vehicles on the road that contributes to the significant amount of particulate matter produced (Health Effects Institute, 2010). Hence, air quality, economic growth, and human health are being impacted negatively due to exposure to $PM_{2.5}$, leading the air pollution as a major environmental concern (Zhai et al., 2018).

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Food delivery services have grown in the past few years as some people faced difficulty to reach the destination to buy their desired meals due to limited time and the absence of transportation (Nordzi et al., 2018). During this COVID-19 pandemic, the number of food delivery riders is on the rise due to increasing demand for food delivery services, and it acts as a gig economy (Ortiz-Prado et al., 2021; Seghezzi & Mangiaracina, 2020). The gig economy refers to temporary employment paid independently instead of working under an employer (Cambridge University Press, 2022).

Day by day, the demand for food delivery services is increasing greatly. An article from The Malaysian Reserve reported that the representative of Grab Food stated that "over 8,000 merchants signed up" for the food delivery service and "over 10,000 people joining Grab as drivers and delivery-partners". In addition to that, Food Panda also shared that "from March to July, over 20,000 new riders joined us" (Kamel, 2021). Based on the number of members who joined the public group, namely Foodpanda Rider Malaysia and GrabFood Rider Malaysia Official, the estimated number of riders in Malaysia is 118.8 thousand. Besides that, both Grab Food and Food Panda focus not only on food delivery service. They also provided a platform for customers to buy groceries, clothes, electronic appliances, essential things such as personal care products, including gifts and decorations. They partner with various companies with different backgrounds to provide the best service for the customer. The food delivery service keeps growing instantly and providing more job opportunities for those who want to make an income. However, the instant growing rate of food delivery service also impacts the rider's health. The delivery rider spend

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an enormous portion of their working hours on the road and at the roadsides to deliver food for the customer, which increases their exposure to outdoor air pollution, especially $PM_{2.5}$.

The food delivery rider's main transport is motorcycle as it helps the riders increase their mobility and agility significantly amid a high-density city in fulfilling their task. The usage of motorcycles boosts their work productivity and efficiency. However, they are immensely exposed to air pollution, especially $PM_{2.5}$, since no mechanical defense can help reduce the exposure. According to World Health Organization (2013), outdoor air pollution contributes to 3.8 million premature deaths, and about 20% of those deaths are due to respiratory illnesses. In addition, it is expected that the European population's average life expectancy to be reduced to around nine months due to exposure to $PM_{2.5}$.

1.2 Problem Statement

Food delivery riders come with various backgrounds since the requirement applying for the rider only focuses on the applicants' age, type of phone and vehicles, and good work etiquette. Education level does not play an essential role in applying for the job. Hence, the food delivery riders might have minimal awareness and knowledge regarding exposure to $PM_{2.5}$ and the possible effect, including preventive measures.

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Other than that, due to the COVID-19 pandemic, food delivery riders are equipped with minimal protection when performing the work task, which is the surgical face mask. However, the main reason they wear it is to reduce the transmission of COVID-19, not to protect themselves from air pollutants. According to Brosseau and Ann (2009), the surgical face mask only functions as a shield against large respiratory particle droplets, yet they cannot filter out the particulate matter. Therefore, there is no way to ensure that the exposure level of $PM_{2.5}$ towards rider is low and zero risks of development of respiratory symptoms. Referring to an article from The Star, Chin (2020) stated that the Crisis Relief Squad of MCA (CRSM) provided 10,000 face masks to delivery riders in Kuala Lumpur. In addition, on 28th April 2020, Grab also provides over 1 million pieces of face masks to the driver- and delivery partners (Grab Malaysia, 2020). Even though the sole purpose of the face mask is to control the spread of COVID-19, the number of the face masks is not able to continuously accommodate the whole riders. The organizations only focus on the effort to curb the pandemic; however, preventive measure on the exposure of $PM_{2.5}$ is being neglected.

Although there are many studies in Malaysia on exposure of particulate matter during working outside, such as the Malaysian Journal of Medicine and Health Sciences Volume 14, November 2018, which studies traffic policemen, there are no studies on food delivery services. The motorcycle is a common type of transportation used to deliver food in food delivery services. However, motorcycles can be more than just a source of transportation. They can be one of the major sources of particulate matter (PM) resulting from the release of burned and unburned lubrication oils (Chemonics International, Inc., 2000). The prevalence of respiratory symptoms among

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food delivery riders in Malaysia is still unknown as there is no research on respiratory symptoms among food delivery riders. A similar study was conducted in Nigeria and Bangkok, Thailand, which revolved around motorcycle taxi drivers. Both findings are consistent, which showed that motorcycle taxi. In one study, it was found that the prevalence of respiratory symptoms among motorcycle taxi drivers is higher . Approximately 55.5 percent of motorcycle taxi drivers experienced morning cough, phlegm (53.2 %), wheezing (29%) and shortness of breath (47.7%) (Shabani & Mamuya, 2020).

1.3 Study Justification

This study may aid in determining the prevalence of respiratory health symptoms among food delivery riders, particularly in the Klang Valley area. The collected data can serve as a baseline for delivery companies to plan preventive measures to help their workers reduce the risk of developing respiratory health symptoms as a result of their work as delivery riders. Furthermore, the study demonstrates some lessons that have proven that the study of this exposure of particulate matter and respiratory health symptoms problem among riders of food delivery services must be done appropriately.

The findings of this study hope to raise awareness on the importance of preventive measures against exposure to $PM_{2.5}$ and its possible effect among

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Malaysian food delivery riders as well as the Malaysian population that is not involved in delivery services. Also, it can be used as the baseline data for the food delivery company to ensure their riders' safety, health and welfare accordingly. The statistical analysis also reveals the prevalence of respiratory health symptoms among food delivery riders.

Despite the fact that many motorcycles being used as transportation for delivery food in Malaysia, only a little research on exposure to $PM_{2.5}$ and respiratory health symptoms revolved around motorcycle riders. Then, it leads to a lack of research that can be used as guidance and reference. As a result, the findings of this study may aid in future research into respiratory health symptoms related to motorcyclists, particularly those who frequently use motorcycles as part of their daily activities.

1.4 Research Questions

The research question for this study are:

1. What is the average level of particulate matter ($PM_{2.5}$) exosed to food delivery riders on an average working day?
2. What is the prevalence of respiratory health symptoms among food delivery riders?

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3. Is there any association between the levels of $PM_{2.5}$ with respiratory health symptoms?

1.5 Research Objectives

1.5.1 General Objective

To determine the exposure of $PM_{2.5}$ and its associaiton with respiratory health symptoms among food delivery riders in Klang Valley.

1.5.2 Specific Objectives

i. To assess the average level of particulate matter ($PM_{2.5}$) exposed to food delivery riders on an average working day.
ii. To determine the prevalence of respiratory health symptoms among food delivery riders.
iii. To determine the association between the levels of $PM_{2.5}$ with respiratory health symptoms among food delivery riders.

1.6 Research Hypothesis

There is a significant association between the levels of $PM_{2.5}$ with respiratory health symptoms among food delivery riders.

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1.7 Conceptual Definition

1.7.1 $PM_{2.5}$

$PM_{2.5}$ is air pollutants with a diameter less than or equal to 2.5 micrometers, also known as fine particles (He et al., 2020).

1.7.2 Respiratory Health Symptoms

The symptoms of lung disease such as cough, shortness of breath, headaches, sinusitis and nausea are refers as respiratory health symptoms (Tlotleng et al., 2019).

1.7.3 Food Delivery

"Food delivery service is the concept of ordering or calling in food from a restaurant or a fast-food joint, the restaurant would then prepare the food you have ordered, and then send a driver or rider to your sent address to deliver the food to you", (Folo Logistic Enterprise, 2019).

1.7.4 Riders

Those who make deliveries or purchases things for customers are called riders or runners. The purchases things range from groceries, foods, electronic devices, and more depending on the customers' requirements (Nordzi et al., 2018).

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1.8 Operational Definition

1.8.1 $PM_{2.5}$

"PurpleAir monitor, PA-II, is used to measuring the $PM_{2.5}$ number density and mass concentration, including relative humidity, barometric pressure and temperature, which are other environmental parameters. The PurpleAir system provides outdoor data every 2 minutes", (Bi et al., 2021).

1.8.2 Respiratory Health Symptoms

To obtain the major of respiratory health symptoms, we used a questionnaire adopted from the International Union Against Tuberculosis Lung Diseases: Broncial Symptoms Questionnaire (1986) (Mohamad Jamil et al., 2019).

1.8.3 Food Delivery

The registered food delivery rider performed the job task by delivering the food from the registered food premises under the delivery service companies ordered by the customer through the mobile application.

1.8.4 Riders

The individual who registered as food delivery rider under the delivery service companies and execute the job task at the designated place.

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1.9 Conceptual Framework

This study determines the exposure of $PM_{2.5}$ and its association with respiratory health symptoms among food delivery riders. In Figure 1.1, food delivery riders can have a risk of developing respiratory health symptoms. Prolonged exposure to $PM_{2.5}$ is the risk factor for respiratory health symptoms. Age, gender, BMI, working history and lifestyle are all sociodemographic factors that have been studied to determine the sociodemographic characteristics of delivery riders.

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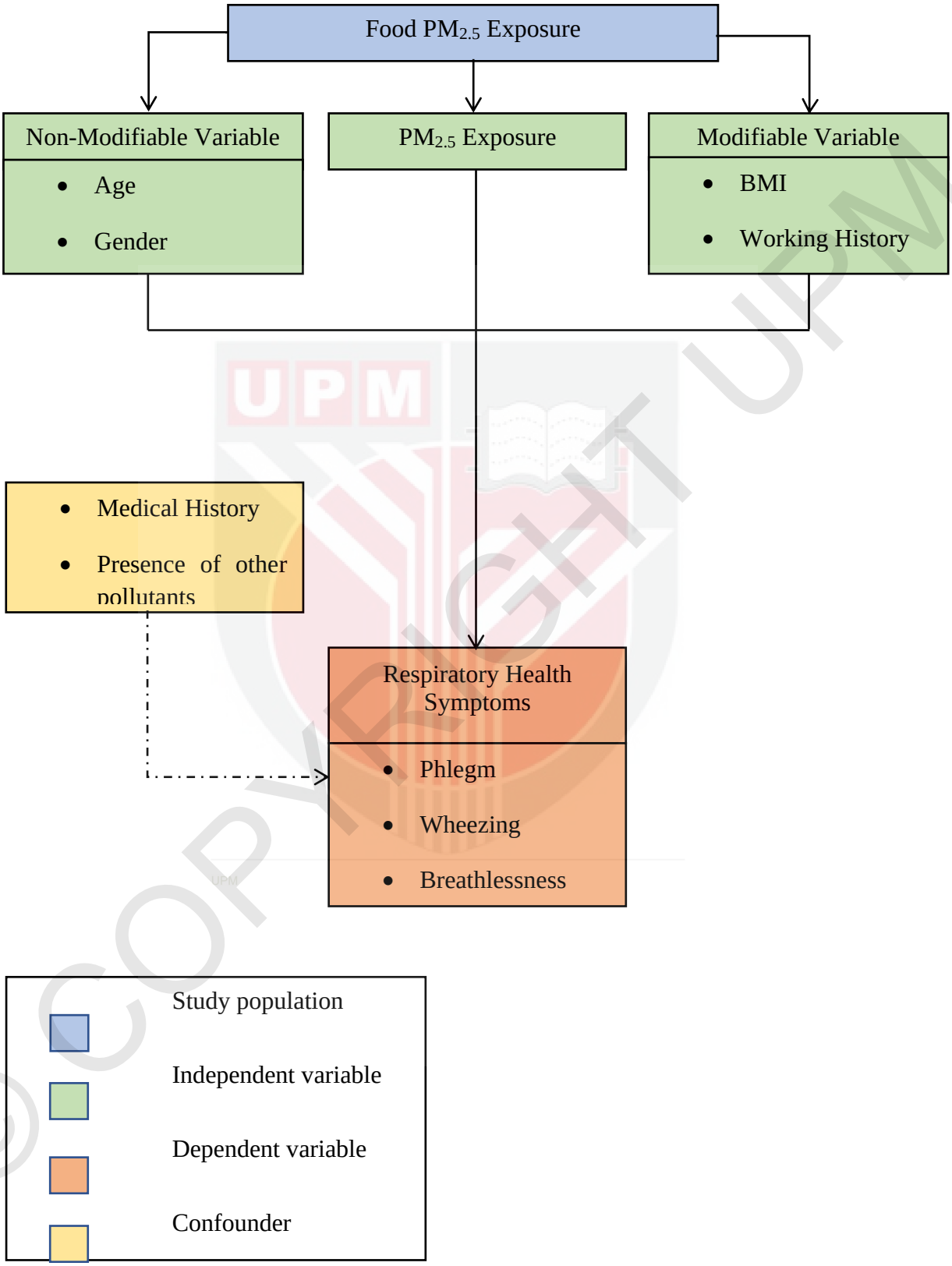

Figure 1.1: Conceptual Framework

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CHAPTER 2

LITERATURE REVIEW

2.1 $PM_{2.5}$

$PM_{2.5}$ define as fine inhalable particles with a diameter less than or equal to 2.5 micrometers (United States Environmental Protection Agency, 2021). Exposure to $PM_{2.5}$ has become a matter of growing public concern compared to the past due to urbanization, industry, and population growth, contributing to the increased $PM_{2.5}$, which lead to the deterioration of ambient air quality despite various mitigation plans being implemented (Lim et al., 2020). In fact, the Road Transport Department Malaysia stated that at the end of 2019, Malaysia had over 31.2 million registered cars, up from 20.1 million in 2010, and the number of cars increased by 11 million (BERNAMA, 2020). Thus, based on the statement, the level of $PM_{2.5}$ might be increased for the upcoming years since the number of vehicles on the road keeps increasing from time to time.

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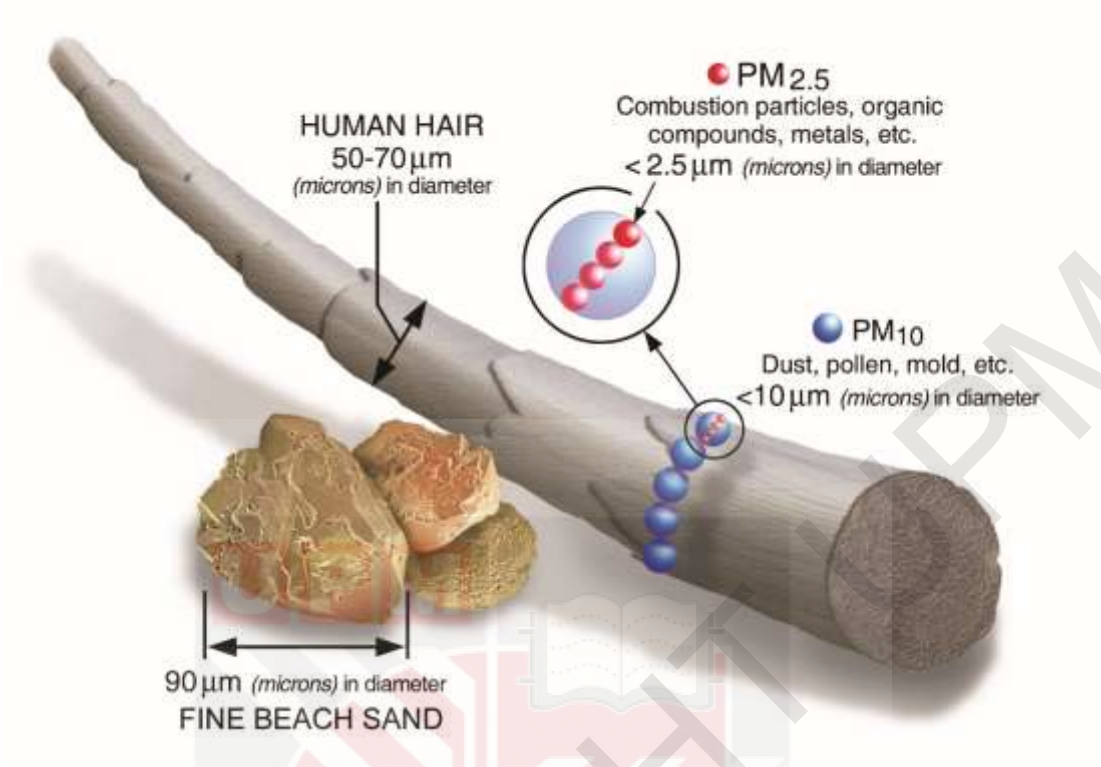

Figure 2.1: Size comparison for PM particles (US EPA, 2021)

$PM_{2.5}$ can remain suspended for a long duration in the atmosphere due to its small diameter, extensive area coverage, strong activity, and bind easily with toxic compounds, posing a major threat to the environment and planetary biological system (He et al., 2020). Exhaust pipes, tyre wear, brake pads and road dust suspended solids contribute to particulate matter emissions, each of the sources produced particulate matter that possessed different physical and molecular properties (Krzyżanowski et al., 2005). Zakaria et al., 2019 discovered that the road dust suspended solids emitted a higher rate of $PM_{2.5}$ compared to the total of exhaust pipes, tyre wear, brake pad emissions on arterials road.

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Besides that, the concentration of secondary $PM_{2.5}$ is said to be at the maximum level during noon due to the availability of sunlight (El Morabet, 2019). For example, the humid and hot conditions will enhance the production of secondary pollution through photochemical reactions since the irradiation intensity increased (Zhai et al., 2018). Recently, it was reported that seven areas in Peninsular Malaysia recorded a yellow-level heat wave (BERNAMA, 2021). In this case, the level of $PM_{2.5}$ might be worse than expected. According to The World Bank (2019), the annual average concentration for $PM_{2.5}$ in 2017 has exceeded the standard value of the World Health Organization's (WHO) Air Quality Guideline, which is 10 μg/m3. Hence, almost 92% of the global population is exposed to pollution that is harmful to health.

2.2 Overview of Respiratory Health Symptoms

The World Health Organization (2013) has acknowledged that the respiratory system's thoracic area can easily enter by $PM_{2.5}$ particles through inhalation due to its small feature. On that account, the morbidity related to the respiratory and cardiovascular systems, like aggravation asthma and respiratory symptoms, occurs due to short-term exposure, which is widely known for the health effects. Therefore, respiratory symptoms are considered an indicator of respiratory illness. Kalhan et al. (2018) found that at aged 30, the development of any respiratory health symptoms was linked with an increased risk of both incident prebronchodilator obstructive and restrictive physiology. They also discovered that obstructive physiology was linked with cough-related symptoms such as cough and phlegm.

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Anyone can be affected by exposure to particulate matter; however, some individuals are much more affected than others. The vulnerable and susceptible groups of respiratory health symptoms are pre-existing lung or heart disease, including older adults and children (World Health Organization, 2013). In addition, respiratory health symptoms might occur due to gastrointestinal or cardiac causes of cough, including shortness of breath caused by anemia and hypothyroidism. These illnesses fall under non-respiratory illness (Singh, 2016).

Many studies have concluded that cough is associated with gastrointestinal in which coughing is present due to acid reflux, generally referred to as heartburn which is a common condition that happens to people upon consuming food that led the digestive juices pouring up the esophagus (Francis, 2016; Madanick, 2013). The digestive juices can create a burning feeling as well as cough (Francis, 2016). However, it is still not clear how cough is caused or aggravated by this condition (Ratini, 2021).

Stec et al. (2007) discovered that the portable multi-channel recorder designated for sleep breathing problems detected an association between premature ventricular complexes (PVCs) and the occurrence of cough. Previously, some studies have recognized that arrhythmias can be induced by coughing (Grabczak et al., 2020). However, it was not widely recognized that rhythm abnormality can trigger a cough.

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2.2.1 Cough

Cough is one of the elements for respiratory symptoms. A spontaneous reflex that is a component of the human immune system that can help the body fight invading contaminants (American Lung Association, 2021). “The cough reflex arc consists of five parts: 1) cough receptors; 2) afferent nerves; 3) brainstem cough generator circuit; 4) efferent nerves; and 5) effector organs (muscles)” (Kardos, 2010).

A wide range of clinical correlations and etiologies is linked to coughing. According to Sharma et al. (2020), the duration of the cough determines the etiology of cough in which a cough is considered acute if it has been present for two to three weeks, while the sub-acute cough is defined as one that lasts three to eight weeks. A chronic cough will be present for more than eight weeks. Deering-Rice et al. (2011) concluded that environmental particulate matter predominantly activates TRP-class ankyrin-1 (TRPA1) and vanilloid-1 (TRPV1) ion channels, which is considered to relate to the cough reflex. In this case, the environmental particulate matter involved is diesel exhaust particles (EDP), a fraction of particulate matter with a diameter less than 2.5 microns, namely $PM_{2.5}$.

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2.2.2 Phlegm

Based on National Cancer Institute, phlegm is described as a surplus of thick mucus produced by the cells lining the upper airways and lungs. Then, it will be produced if there are factors such as smoke or pollutant triggering the irritation of the lungs. Besides, the condition of the respiratory system can be predicted by observing the phlegm's color. For example, normal phlegm is clear, translucent and viscous, whereas yellowish-green phlegm or blood indicates a more severe problem (American Lung Association, 2021).

2.2.3 Shortness of Breath

Shortness of breath also referred as dyspnea, is the unpleasant breathing caused by a variety of symptoms of varied degree. Millions of individuals experience this symptom as it can be the major manifestation of respiratory, cardiac, neuromuscular, or a combination of these illnesses (Hashmi et al., 2018). Lareau et al. (2020) claimed that inhalation of dust, chemicals, or other noxious substances in the environment, whether outdoors or indoors can cause breathlessness. In fact, various studies have associated exposure to particulate matter to a wide range of medical condition, including increased the respiratory symptoms like breathlessness (US EPA, 2021).

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2.2.4 Wheezing

According to Patel et al. (2020), wheezing acts as an indicator for any clinical condition that leads to obstruction in the airway. Usually, it is associated with asthma, although it may occur to those with airway foreign bodies, heart problems, lung cancer, or other condition that affects constriction of the airways.

2.3 Risk Factors for Respiratory Symptoms

The Body Mass Index (BMI) of an individual plays a significant role as a factor that contributes to the occurrence of respiratory symptoms. Even in the absence of significant pulmonary disease, people who are overweight or obese are more likely to experience respiratory symptoms than people who have a normal BMI (Zammit et al., 2010). The adult BMI for healthy weight is in the range of 18.5 – 24.9, while the BMI range for overweight is 25.0 –29.9, and those who have a BMI of 30.0 or higher will be considered obese (Centers for Disease Control and Prevention, 2021).

Occupational history also can affect the respiratory symptoms as every occupation has a certain work environment. The occurrence of the symptoms is caused by particulates in the environment that emitted from a variety of sources such as manufactures, plumes of smoke, exhaust, mining, construction and agriculture (Cedars-Sinai, n.d.). Previous study found that the development workers in a coal mine

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had a significantly higher prevalence of the acute respiratory symptoms (dry cough – 45.7%, breathlessness – 34,8% and blocked nose – 23.9%) (Mamuya et al., 2007).

Unhealthy lifestyle that involves usage of tobacco increases the risk of lung disease. The significant symptoms that occur to smokers are episodes of cough and phlegm, breathlessness and wheezing in which the particles in the tobacco contribute to the inflammation of the airways, affects the alveoli and in a worst-case tumor might presence due to abnormal cells growth (Johns Hopkins Medicine, n.d.; Centers for Disease Control and Prevention, 2017).

2.4 Measurement of $PM_{2.5}$

Mbelambela et al. (2017) measured the $PM_{2.5}$ by using a Digital dust indicator cyclone LD-5 which is portable gas monitor in the unit of microgram per metre cubic. The measurement as conducted at the road intersections. Other than that, a study conducted by Bi et al. (2021) used the PurpleAir system to measure the $PM_{2.5}$. The data included the "PM number densities and mass concentrations, as well as other environmental parameters (relative humidity, barometric pressure, and temperature)".

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2.5 Health Effects of $PM_{2.5}$

Particulate matter ($PM_{2.5}$) is considered as a serious worldwide air problem during the last several decades (Enyoh et al., 2019). Besides that, $PM_{2.5}$ can easily penetrate the respiratory tract and reach the circulatory system. Research studies have found a significant correlation between particle pollution and health concerns, namely premature death. In addition, cardiovascular disorders such as arrhythmias and heart attacks, as well as respiratory symptoms such as asthma episodes and bronchitis, might very well arise (World Health Organization, 2019). Moreover, exposure to $PM_{2.5}$ may cause harmfl health effects on human health, including breast cancer, hematopoietic system disorders, and bladder cancers (Akhbarizadeh et al., 2021). Therefore, exposure to particulate matter can lead to a rise in hospitalizations, emergency room visits, absenteeism from school or work, and limited activity days (US EPA, 2021).

2.6 Association Between $PM_{2.5}$ and Respiratory Health Symptoms

The respiratory health symptoms were mainly reported on occupational exposure for traffic police officers, welder, landfill waste recycler and motorcycle taxi drivers (Fandi et al., 2018; Mohamad Jamil et al., 2018; Shabani, 2020; Tlotleng et al., 2019). According to Shabani (2020), the prevalence of respiratory health symptoms was observed to be greater among motorcycle taxi drivers than among office workers for all symptoms, with a statistically significant difference of p-value < 0.001. In this case, we can assume that the prevalence of respiratory health disease for food delivery

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riders might be higher since there is only a minimal difference between motorcycle taxi drivers and food delivery riders' work tasks.

The scope of respiratory health symptoms covers unspecified, combined, adverse health effects due to exposure to $PM_{2.5}$. Moreover, there is only limited knowledge of $PM_{2.5}$ and its relationship to respiratory health symptoms since cardiovascular illness, gastrointestinal illness, and chronic respiratory illness are the most common. Therefore, the knowledge on the acute health impacts of $PM_{2.5}$ in developing countries is insufficient (Li et al., 2018). It has been suggested that respiratory health symptoms are associated with occupational risk (Dalju et al., 2019). It is very important to pay attention to ambient air quality for health, particularly on the road, as poor ambient air quality can cause respiratory health symptoms and interrupt work productivity (Manisalidis et al., 2020).

2.7 Limitation and Recommendation

Insufficient information became a major problem in the study between exposures to $PM_{2.5}$ and respiratory health symptoms. The study of $PM_{2.5}$ for traffic-related air pollution is not much carried out in Malaysia, especially if the target population is related to motorcycle riders. Most of the study focuses on the exposure of $PM_{2.5}$ to children.

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A study of respiratory symptoms and associated factors among motorcycle taxi drivers was carried out. According to Shabani and Mamuya (2020), the cross-sectional design did not allow for establishing a correlation connecting exposed groups and the prevalence of respiratory effects. However, the non-exposure group enhances the association of the outcome. They further stated that the research was only executed on men since the profession of a motorcycle taxi driver is solely performed by males. Hence, they provided recommendation that to conduct an even more robust research approach, such as a cohort or randomized control trial, should be used in future research.

Mohamad Jamil et al. (2018) highlighted that the limitation of the study on the prevalence of respiratory symptoms among traffic policemen in Malaysia was that it only analyses a subset of Malaysia, not the entire nation. In addition, it is attributed to time and resource restrictions during the study's execution. Therefore, further research should be incorporating a longer timeframe and a larger portion of sample size is suggested for a more accurate evaluation of traffic policemen' exposure to air pollutants and the accompanying health concerns.

Other than that, research under Lim et al. (2020) stated that notwithstanding its diverse implications, their research has intrinsic methodological constraints. For example, they could not analyze non-linear connections, trends, or short intervals since they concentrated on linear trends and connections across the whole research period. Furthermore, because the emphasis was on macroscopic changes and relationships,

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statistically and technically precise analyses were limited. Thus, future research is anticipated to examine a precise correlation in light of comprehensive emission data such as transportation and energy sources and numerous variables such as climatic conditions.

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CHAPTER 3

METHODOLOGY

3.1 Study Design

The type of study design that has been used in this research was cross-sectional study design. This study aimed to assess the exposure of $PM_{2.5}$ and determined the prevalence of respiratory health symptoms among food delivery riders in Klang Valley.

3.2 Study Location

This research was conducted in Klang Valley, which consists of Sabak Bernam, Gombak, Kuala Selangor, Klang, Petaling, Kuala Langat, Sepang, Hulu Langat, Federal Territory of Kuala Lumpur and Federal Territory of Putrajaya. According to Afroz et al. (2003), the total suspended particulate matter concentration in numerous locations of the Klang Valley frequently exceeded the Recommended Malaysian Ambient Air Quality Guidelines. Klang Valley is one of the populated areas with many food premises that offer food delivery services through partnering with GrabFood and FoodPanda.

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Figure 3.1: Study location of this study (Department of Statistics Malaysia, 2021)

3.3 Study Population

The sample population of this study includes male food delivery riders located in Klang Valley.

3.4 Study Duration

The study was conducted from July 2021 to January 2022.

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3.5 Sampling Unit

The sampling unit for this study were food delivery riders in Klang Valley who fulfilled the inclusion and exclusion criteria as follows:

3.5.1 Inclusive Criteria

i. Male

ii. Aged between 18 – 50 years old

iii. Location of work in Klang Valley

iv. More than 6 months of working experience as food delivery rider

3.5.2 Exclusive Criteria

i. Female

ii. Have any chronic respiratory diseases

3.6 Sampling Method

The sampling method used for the recruitment of the respondents was convenience sampling. It was done by distributing self-administrated questionnaires to any food delivery riders eligible based on the inclusion and exclusion criteria using social media platforms (Facebook, Twitter, WhatsApp, Telegram and Instagram).

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3.7 Sample Size

The total sample for the study was as follow using the one propotion:

Formula n = $\frac{Z^2\ 1\frac{\alpha}{2}\ P(1-P)}{d^2}$

n = $\frac{Z^2 P(1-P)}{d^2}$, Shabani and Mamuya, 2020 (Prevalence of shortness of breath)

Where,

n = sample size

$Z^{\alpha}/_{2}$ = standard normal coefficient (For 95% the critical value = 1.96)

p = value of proportion as a decimal percent

d = desired precision level expressed as half of the maximum acceptable confidence interval width (0.05)

n = $\frac{1.96^2\ (0.47)(1-0.47)}{0.05^2}$

n = 383

n = 383 + 20% non-response rate

So, the sample size for this study were 460 respondents.

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3.8 Study Instrument

3.8.1 Self-administered Online Questionnaire

The self-administered questionnaire was modified from Mohamad Jamil et al. (2019). It was prepared in a dual language, English and Malay versions, via Google Form. Respondents were recruited through the distribution of Google Form in the social media platform. The questionnaire contained a brief introduction and the purpose of the study. The questionnaire consisted of five sections as follows:

i) **Section A: Sociodemographic Background**
This section includes sociodemographic data such as age, height, weight, race, marital status and educational level.

ii) **Section B: Occupational Information**
In this section, work-related characteristics such as work experience, name of food delivery company, working day per week, working hours per day, approximation of customers' orders per day and the usage and type of mask while delivering food were also requested.

iii) **Section C: Health Information**
For this section, information regarding medical history and medication consumption was asked.

iv) **Section D: Lifestyle**
This section included questions on smoking behaviour and physical activity.

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v) **Respiratory Health Problem**

The frequency occurrence of cough, wheezing, phlegm and shortness of breath for over the past three months were asked to evaluate the prevalence of respiratory health symptoms.

3.8.2 Exposure Monitoring for $PM_{2.5}$

Exposure monitoring for $PM_{2.5}$ was conducted on 15 respondents that voluntarily agreed to participate in the second part of the study. The sampling areas were in Kajang, Bangi, Serdang and Cyberjaya. The monitoring was conducted for eight hours while riders delivered the customers' orders using a PurpleAir PA-II SD Sensor. The equipment was attached to the motorcycle basket of the riders. The respondents were also equipped with a diary sheet to record the time and environmental status, including their location while delivering the food.

Figure 3.2: Attachment of PurpeAir PA-II SD Sensor to riders' motorcycle basket

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Figure 3.3: Respondent received a set of PurpleAir PA-II SD Sensor and a diary sheet for exposure monitoring

3.8.3 Measurement of $PM_{2.5}$

3.8.3.1 Operation of PurpleAir PA-II SD Sensor

The PurpleAir PA-II SD Sensor was equipped with a micro USB wire, power supply (power bank) and cable ties.

Powering the sensor:

1. The micro USB end of the power supply was plugged into the sensor's base
2. The power supply was switched on.
3. Once the sensor received power, a dim red glow inside the sensor would be seen.
4. Blue light would glow up every minute, indicating that the sensor measured the pollutant.
5. The sensor was installed in a vertical position. Cable ties were used to tie the sensor to the motorcycle basket.

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3.8.3.2 Data Access

SD Card was located at the sensor's base. The reading from the sensor was stored in the SD Card. The data was extracted through Microsoft Excel. Information such as temperature, humidity (%), and concentartion of particulate matter were provided.

3.8.4 IBM Statistical Package for Social Sciences (SPSS) Software Version 26

This software was used to analyse data collected from respondents to perform statistical analysis based on the specific objective of this study.

3.9 Data Collection Procedure

After received the approval and permission from the University Ethics Committee Involving Human Subjects of Universiti Putra Malaysia (JKEUPM) and respondents, the data collection for the first part of this study was conducted via online questionnaire. A brief introduction, objectives of the study, including the declaration of anonymity and confidentiality in a consent form were given to the respondents before filling in the questionnaire. The respondents were required to answer all section in the questionnaire. Figure 3.4 below showed the research flowchart for this study.

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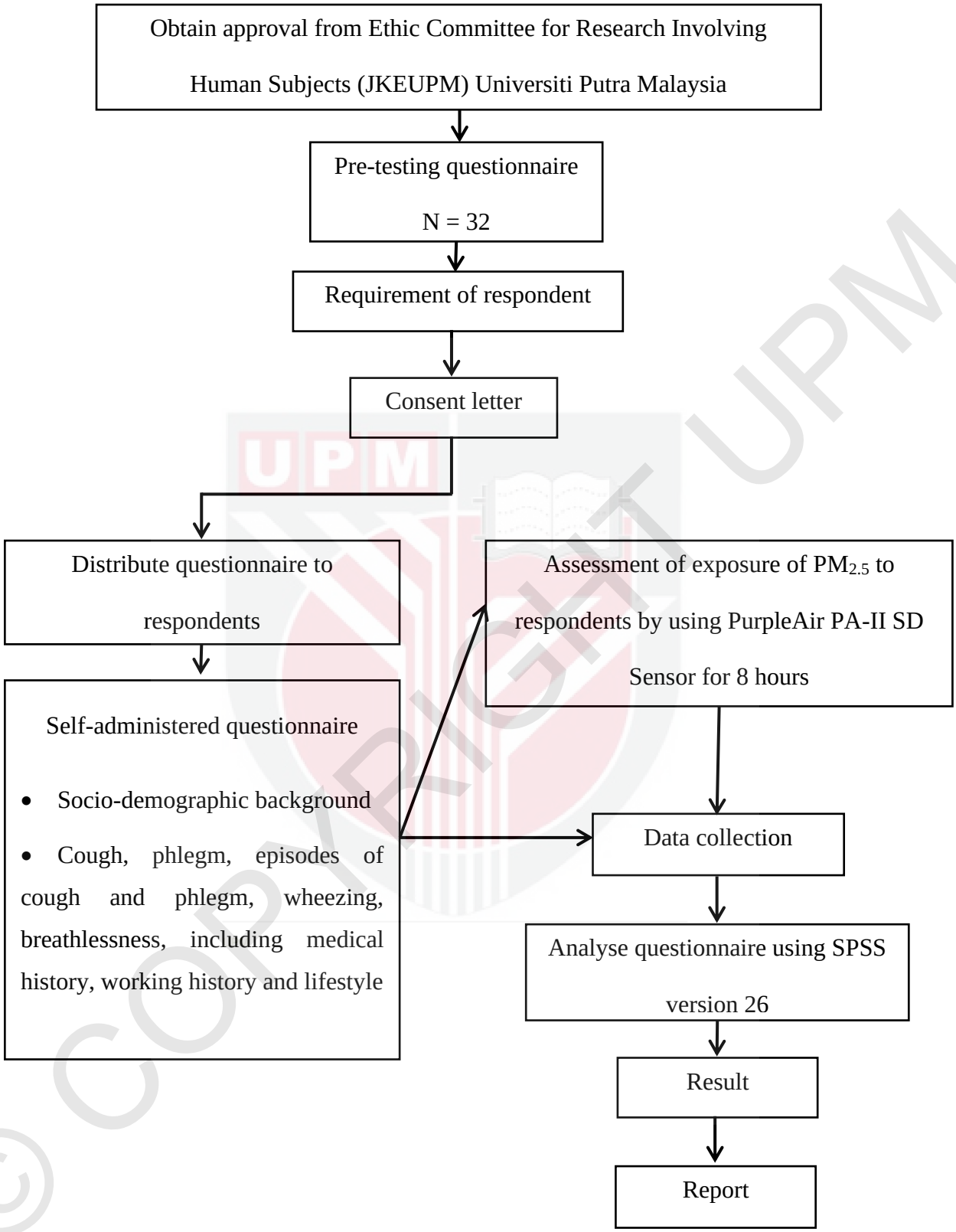

Figure 3.4: Study flowchart

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3.10 Quality Assurance and Quality Control

3.10.1 Content Validity

Before conducting the pre-test, the validity of the self-administered questionnaire was assessed by two experts in the ambient air quality field. It is to ensure that the questionnaire used measures what it is supposed to measure and reflects the objective of the study.

3.10.2 Pre-test

A pre-test was done to test the reliability of the self-administered questionnaire. A total of 32 respondents who have similar characteristics with the target population were involved in the pre-test. After the pre-test was done, the Cronbach alpha value for the pre-test was 0.826. The result is acceptable since the Cronbach alpha value of 0.8 and above is under a good range.

3.11 Data Analysis

IBM SPSS (Statistical Package for Social Science) version 26 was used to compute and evaluate all of the data collected from the questionnaire and extracted from the monitoring sensor. Sociodemographic characteristics, health information, lifestyle, work-related characteristics, distribution of respiratory health symptoms and concentration of $PM_{2.5}$ variables were expressed in frequencies and percentages. Continuous parameters that were normal such as age, BMI, number of cigarettes

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smoked per day, working hours per day and more, were expressed as mean and standard deviation.

Next, a Chi-square test was used to determine the association of concentration of $PM_{2.5}$ and respiratory health symptoms among food delivery riders. The significant level for the Chi-square test was set at 0.05. In addition, binary logistic regression was used to determine the likeliness of riders to develop respiratory health symptoms if exposed to a high level of $PM_{2.5}$.

3.12 Ethical Consideration

As this research involves human subjects as respondents, several documents were filed to the Univesity Ethics Committee Involving Human Subjects of Universiti Putra Malaysia (JKEUPM) to conduct the study (reference number: JKEUPM-2021-368). It can be found in Appendix 1. A brief introduction, objectives of the study, including the declaration of anonymity and confidentiality in a consent form, were given to the respondents before filling in the questionnaire. In addition, a consent form was constructed to receive consent from respondents to use their data for educational reasons. All of the respondents' personal details were treated with confidentiality and were only used for educational reasons. Aside from that, once the study was done and the results were analyzed, the data were not being stored by the researchers. The respondents have the liberty to withdraw from this study at any moment, and they will

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not be penalized for doing so. The consent form's information may be found in Appendix 2.

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CHAPTER 4

RESULTS

4.1 Sociodemographic characteristics of male food delivery riders

A total of 460 respondents were aimed for this study. Throughout this study, 387 respondents were obtained with a response rate of 84%.

The sociodemographic and socioeconomic characteristics of the respondents were shown in Table 4.1. It consists of Malaysian men adults aged between 18 to 49 years old with an average age of 28.02 ± 6.623 years old. Most of the respondents were Malay (91.2%), followed by Chinese (7.2%) and Indian (1.6%). 79.1% of the respondents were single and the other 20.9% were married. For education level of the respondents, most of them attained tertiary education (79.8%).

Table 4.1 also presents data on the lifestyle of the respondents. The percentage of respondents who reported engaging in physical activity was 68.5% (n=265). The respondents who engaged in physical activity have chosen jogging (31.3%), futsal (20.8%), others (20.4%), followed by badminton (18.5%) and cycling (9.1%) as their

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choice of activity during leisure time. Besides, 55% of the respondents were actively smoking and, the mean number of cigarettes per day was 5.86 ± 2.963.

As for the health information of the respondents, all of them were reported in a good health state as the data from this study showed that they do not have high blood pressure (97.4%), diabetes (98.4%), asthma (91.2%), cardiovascular disease (100.0%) and chronic obstructive pulmonary disease (COPD) (100.0%).

Table 4.1: Sociodemographic characteristics of male food delivery riders

Variables		Frequency (N)	%	Mean (SD)
Age (years)				28.02(6.623)
Gender	Male	387	100	
BMI (kg/m^2)				24.36(4.677)
Race	Malay	353	91.2	
	Chinese	28	7.2	
	Indian	6	1.6	
Marital status	Single	306	79.1	
	Married	81	20.9	

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Level of education	Secondary	78	20.2
	Tertiary	309	79.8
Physical activity	No	122	31.5
	Yes	265	68.5
Type of physical activity	Jogging	83	31.3
	Cycling	24	9.1
	Badminton	49	18.5
	Futsal	55	20.8
	Others	54	20.4
High blood pressure	No	377	97.4
	Yes	10	2.6
Diabetes	No	381	98.4
	Yes	6	1.6
Asthma	No	353	91.2
	Yes	34	8.8
Cardiovascular disease	No	387	100
Chronic Obstructive	No	387	100

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Pulmonary Disease (COPD)			
Smoking status	No	174	45.0
	Yes	213	55.0
Number of cigarettes smoked per day			5.86(2.963)

N = 387

4.2 Work-related characteristics of male food delivery riders

According to this study, 69.3% of the food delivery riders registered under GrabFood Malaysia, while 30.7% were from FoodPanda Malaysia. The majority of the respondents worked as food delivery riders for more than 6 months but less than 1 year (85.8%). In terms of the respondents' working hours, the results showed that 43.0% of them worked for 6 to 8 hours per day, with the mean riding hours per day being 7.57 ± 7.91 hours and the mean of the days of work per week was 5.12 ± 1.15 days. Other than that, the mean of the riding distance and orders delivered in a day were 166.26 ± 25.34 km and 16.09 ± 7.93, respectively. During riding hours, the respondents wore cloth masks (30.0%), disposable masks (67.2%) and N95 masks (2.8%).

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Table 4.2: Work-related characteristics of male food delivery riders

Variables		Frequency (N)	%	Mean (SD)
Food delivery company	Grab Food	268	69.3	
	Food Panda	119	30.7	
Work experiences (years)	More than 6 months less than 1	332	85.8	
	1-2	40	10.3	
	2-4	15	3.9	
Working hours (hours)	2-4	18	4.6	
	4-6	112	28.9	
	6-8	167	43.0	
	8 and above	91	23.5	
Riding hours (hour/day)				7.57(1.91)
Days of work (day/week)				5.12(1.15)

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Riding distance (km)			166.26(25.34)
Orders deliver in a day			16.09(7.93)
Usage of face mask during delivery	Yes	387	100
Type of face mask	Cloth mask	116	30.0
	Disposable mask	260	67.2
	N95 mask	11	2.8

N = 387

4.3 The level of $PM_{2.5}$ exposed by the male food delivery riders

Table 4.3 showed the level of $PM_{2.5}$ exposed by 15 food delivery rides for 8 hours of working period in 4 different areas which were located in Bangi, Serdang, Kajang and Cyberjaya. The findings revealed the level of $PM_{2.5}$ ranged between 14.0 and 96. 3 µg m^{-3}. The highest mean of $PM_{2.5}$ level was recorded in Kajang, 42.8 ± 13.1 µg m^{-3} while the lowest value was in Serdang, 26.7 ± 8.7 µg m^{-3}.

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Table 4.3: The level of $PM_{2.5}$ exposed by the male food delivery riders for 8 hours working period in Klang Valley

Respondent's ID	Location	Start	End	No. of records logged (n)	Total minutes of duration	Mean ± SD	Range (Min-Max)
R01	Bangi	1029 16/12/21	1843 16/12/21	134	494	38.7 ± 17.4*	14.0 – 96.1
R02	Serdang	1118 16/12/21	1904 16/12/21	149	466	32.4 ± 11.0	12.6 – 73.3
R03	Serdang	1206 16/12/21	2058 16/12/21	182	532	30.8 ± 11.5	13.5 – 73.8
R04	Kajang	1345 18/12/21	2115 18/12/21	141	450	36.3 ± 10.6*	15.8 – 89.4
R05	Kajang	1017 18/12/21	1839 18/12/21	167	502	38.3 ± 7.2*	25.0 – 63.0
R06	Serdang	1100 18/12/21	1902 18/12/21	156	482	30.0 ± 10.8	12.6 – 71.6
R07	Serdang	0925 19/12/21	1717 19/12/21	152	470	33.5 ± 12.0	14.9 – 81.7

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R08	Bangi	1000 19/12/21	1804 19/12/21	158	484	33.8 ± 8.9	16.3 – 53.2
R09	Bangi	1025 19/12/21	1847 19/12/21	167	502	35.2 ± 10.7*	14.8 – 73.3
R10	Serdang	0857 20/12/21	1707 20/12/21	131	490	32.2 ± 11.8	13.5 – 73.8
R11	Cyberjaya	0902 23/12/21	1712 23/12/21	131	490	33.3 ± 11.6	14.2 – 72.6
R12	Cyberjaya	0930 23/12/21	1746 23/12/21	156	496	28.8 ± 11.0	14.1 – 71.6
R13	Kajang	1002 23/12/21	1856 23/12/21	184	534	42.8 ± 13.1*	20.5 – 96.3
R14	Serdang	0909 24/12/21	1711 24/12/21	157	482	26.7 ± 8.7	14.0 – 52.5
R15	Bangi	0958 24/12/21	1804 24/12/21	161	486	32.5 ± 8.0	14.8 – 53.2

N = 15, *the level of $PM_{2.5}$ exceed the New Malaysia Ambient Air Quality Standards (35 µg m^{-3}).

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4.4 The arthmetric and geometric means of exposure of $PM_{2.5}$ level

Figure 4.1 shows a summary of arithmetic and geometric means of $PM_{2.5}$ exposure towards food delivery riders in Klang Valley. The geometric mean level of $PM_{2.5}$ for food delivery riders was 33.8 µg m^{-3}. The mean difference be-tween the arithmetic and geometric mean was 1.81 ± 0.72 µg m^{-3}.

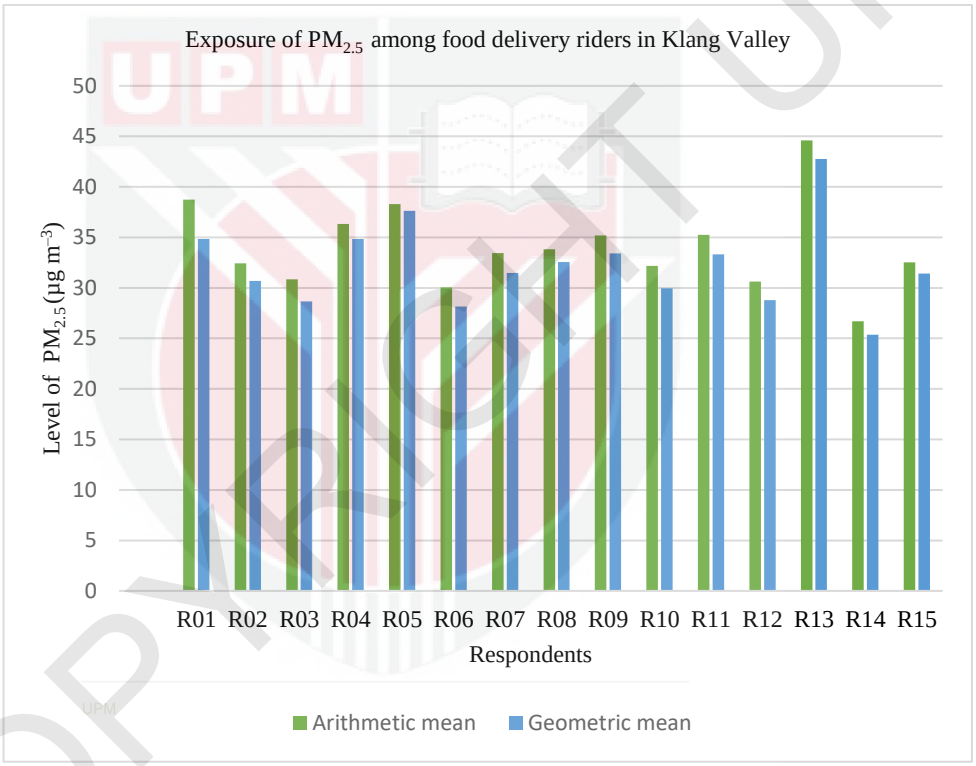

Figure 4.1: The arthmetric and geometric means of exposure of $PM_{2.5}$ level among male food delivery riders in Klang Valley

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4.5 The distribution of respiratory health symptoms

Table 4.4 summarized the distribution of respiratory health symptoms among food delivery riders. It was found that the highest respiratory health symptoms reported by respondents were frequent cough (67.7%), wheezing all day or all night long (86.6%), shortness of breath during walking in fast pace or walking up a slight hill (65.9%) and shortness of breath when wears mask (69.8%).

Variables	Frequency (%) (N=387)
Coughing	
Frequent	
No	125(32.3)
Yes	262(67.7) *
4 to 6 times/ more than 4 days/ week	
No	294(76.0)
Yes	93(24.0)
After waking up or in the morning	
No	294(76.0)
Yes	93(24.0)

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All day long or all night long	
No	254(65.6)
Yes	133(34.4)
Phlegm	
Frequent	
No	283(73.1)
Yes	104(26.9)
4 to 6 times/ more than 4 days/ week	
No	322(83.2)
Yes	65(16.8)
After waking up or in the morning	
No	290(74.9)
Yes	97(25.1)
All day long or all night long	
No	317(81.9)
Yes	70(18.1)
Wheezing	
Frequent	

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No	255(65.9)
Yes	132(34.1)
During fever	
No	226(58.4)
Yes	161(41.6)
All day long or all night long	
No	52(13.4)
Yes	335(86.6) *
Shortness of breath	
During walking in fast pace or walking up a slight hill	
No	130(33.6)
Yes	255(65.9) *
Usually walk in slow pace	
No	250(64.6)
Yes	137(35.4)
Stop for breath when walking at your own pace	
No	338(87.3)

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Yes	49(12.7)
Stop for breath after walking about 30 meters/ a few minutes	
No	307(79.3)
Yes	80(20.7)
Feel breathless when wears mask	
No	117(30.2)
Yes	270(69.8) *

N = 387, *Highest respiratory health symptoms reported by respondents

4.6 The association between level of $PM_{2.5}$ and respiratory health symptoms

The respiratory health symptoms include in this study were cough, phlegm, wheezing and shortness of breath. A significant difference reported in shortness of breath with $p<0.05$ (Table 4.5). The Chi-Square analysis showed the significant association between the level of $PM_{2.5}$ and shortness of breath but not for cough, phlegm and wheezing symptoms.

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Table 4.5: The association between level of $PM_{2.5}$ and respiratory health symptoms among male food delivery riders

Variables	Concentration of $PM_{2.5}$ Frequency (%)		Total Frequency (%) N=387	$\chi 2$	p-value
	Low (<35 $\mu g/m^3$)	High (>35 $\mu g/m^3$)			
Coughing					
No	60(34.7)	65(30.4)	125(32.3)	0.812	0.368
Yes	113(65.3)	149(69.6)	262(67.7)		
Phlegm					
No	135(78.0)	155(72.4)	290(4.9)	1.600	0.206
Yes	38(22.0)	59(27.6)	97(25.1)		
Wheezing					
No	118(68.2)	137(64.0)	255(65.9)	0.747	0.387
Yes	55(31.8)	77(36.0)	132(34.1)		
Shortness of breath					
No	67(38.7)	50(23.4)	117(30.2)	10.706	0.001*

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Yes	106(61.3)	164(76.6)	270(69.8)

N = 387, *Chi square, *Significant at p<0.05

3.7 Binary logistic regression analysis for level of $PM_{2.5}$ that associated with respiratory health symptoms

This study found that the food delivery riders who exposed to high level of PM2.5 were 2 times more likely (95% CI 1.335 – 3.220) to develop shortness of breath. However, the other respiratory health symptoms such as cough, phlegm and wheezing showed no significant association with the level of $PM_{2.5}$. The result of the binary logistic regression was con-cluded as shown in Table 4.6.

Table 4.6: Level of $PM_{2.5}$ that associated with respiratory health symptoms

Variables	B	SE	p-value	OR (95% CI)
Respiratory health symptoms				
Cough	0.197	0.218	0.368	1.217 (0.794-1.867)
Phlegm	0.405	0.235	0.085	1.499 (0.946-2.375)

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Wheezing	0.204	0.303	0.501	1.226 (0.677-2.221)
Shortness of breath	0.729	0.225	0.001*	2.073 (1.335-3.220)

*Significant at $p<0.05$

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CHAPTER 5

DISCUSSION

This research discusses the effect of Particulate matter ($PM_{2.5}$) in air pollutant that causes health problems when its concentration in the air at high percentage. The $PM_{2.5}$ particles in the air reduce visibility and make the air appear hazy when their levels are elevated which is the case in Klang valley. In this study 460 respondents participated where 387 responces were obtained from food delivery riders. In relavance to the social demographic characteristics, the respondents were mainly Malaysian adult men aged between 18 to 49 years old with an average age of 28.02 ± 6.623 years old and good health. Most of the respondents were Malay (91.2%), followed by Chinese (7.2%) and Indian (1.6%). According to this study, 69.3% of the food delivery riders registered under GrabFood Malaysia, while 30.7% were from FoodPanda Malaysia. The majority of the respondents worked as food delivery riders for more than 6 months but less than 1 year (85.8%). In terms of the respondents' working hours, the results showed that 43.0% of them worked for 6 to 8 hours per day, with the mean riding hours per day being 7.57 ± 7.91 hours and the mean of the days of work per week was 5.12 ± 1.15 days. In terms of protection against $PM_{2.5}$ the education level was also monitored where 79.8% respondents were able to finish tertiry education, 68.5% of the grab food and food panda respondents were physically active that promites good health and reduces respiratory diseases. In terms of smokers 55% of the riders were potential smokaers while 45% has never smoked this might also be a contribution factor in the overall respiratory health.

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The present study found that the prevalence of respiratory health symptoms among food delivery riders for cough, wheezing and shortness of breath were approximately higher than 65% of the total food delivery riders who participated in this study. The highest percentage of respondents were reported to experience wheezing all day or all night long (86.6%), followed by shortness of breath when wears mask (69.8%), frequent cough (67.7%), and shortness of breath during walking in fast pace or walking up a slight hill (65.9%). This result was aligned with the prevalence of respiratory health symptoms among motorcycle taxi drivers in Tanzania. In this study, they compared the reported symptoms between motorcycle taxi driver and office attendants. The highest recorded respiratory health symptoms for motorcycle taxi drivers were cough (55.5%), followed by phlegm (53.2%), shortness of breath (47.7%) and wheezing (29%) (Shabani & Mamuya, 2020). The high prevalence of respiratory health symptoms can be explained based on the food delivery riders' nature of job since they were exposed daily to $PM_{2.5}$ for more than 8 hours. Prolonged exposure to $PM_{2.5}$ was linked to a 6-13% significantly increased risk of cardiopulmonary mortality per 10 µg m^{-3} of $PM_{2.5}$ (Krewski et al., 2009).

According to the results, the top three level of $PM_{2.5}$ exposed by the male food delivery riders for 8 hours working period in Klang Valley were experienced at Kajang (R13) with the number of logged records to be 184 and a total exposure duration of 534 minutes highest mean of PM2.5 level recorded to be 42.8 ± 13.1 µg m^{-3}. Similarly, the second and third highest level of $PM_{2.5}$ exposed by the male food delivery riders for 8 hours working period were detected in Bangi (R01) and Kajang (R05) with the number of logged records to be 134 and 167 and a total exposure duration of 494 and

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502 minutes respectively. The highest mean of $PM_{2.5}$ level recorded to be 38.7 ± 17.4 μg m^{-3} in Bangi (R01) and 38.3 ± 7.2 μg m^{-3} in Kajang (R05). These result indicated that the minimum range of exposure in Kajang (R13) can be from 20.5 – 96.3 μg m^{-3}, in Bangi it ranges from 14.0 – 96.1 μg m^{-3} and finally at Kajang which is the third high exposure are will range from 25.0 – 63.0 μg m^{-3}.

In September 2006, EPA revised the PM standards based on thousands of new studies on PM since 1997, by lowering the level of the 24-hour $PM_{2.5}$ standard to 35 μg/m^3 and retaining the level of the annual $PM_{2.5}$ standard at 15 μg/m^3 (EPA, 2019). Similary, the Malaysian Ambient Air Quality Standard (NMAAQS) has set the standard limit of $PM_{2.5}$ to 35 μg/m^3 for a 24-hour average (Abdullah et al., 2020). The current study follows the regulations and standards inposed by EPA where it was found that in all the three main high $PM_{2.5}$ exposure areas the concentraion strandards are higher then the 35 μg/m^3 thus imposing health complications where at a high concetration of >35 μg/m^3 the percentage of riders with coughing problems were reported to be 69.6% which assiociate coughling problems with high risk exposure of $PM_{2.5}$ but the p-value reports to be 0.368 and the Chi-vlaue is reported to be 0.861 that puts coughing with a lower risk in association to $PM_{2.5}$ particle exposure. Similarly, riders with phlegm problems were reported to be 27.6% whereas 72.4% did not associate with phlegm problems this results indicated a p-value of 0.206 and chi-value of 1.600 where it shows that phlegm is not highly associated with $PM_{2.5}$ particle exposure. In addition, wheezing and shortness of breath reported to be 36% and 76.6% by riders exposed to a high concetration of >35 μg/m^3. The resuls shows that the p-value of wheezing is 0.387 and chi-value of 0.747 where the results indicate a lower

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relavence of wheezing to exposure, but on the other hand the p-value and chi-value of shortness of breath were 0.001 and 10.706 that has a high relavance in accordance to exposure association to $PM_{2.5}$ particles. The gruop of riders that were exposed at a high concetration of >35 μg/m^3 were at a high risk to develop health problems assiciated with shortness of breath. This high risk association is further discussed using binary logistic regression where the coefficient of constant (B) value associated with shortness of breath is recirded the highest to be 0.729. Whereas, the standard error around the coefficient for the constant is recorded to be 0.225 with a p-value < 0.005. The results further discuss that the the food delivery riders who exposed to high level of $PM_{2.5}$ were 2 times more likely (95% CI 1.335 – 3.220) to develop shortness of breath.

Based on the New Malaysia Ambient Air Quality, only 5 of the food delivery riders who participated in $PM_{2.5}$ monitoring had mean exposure greater than 35 μg m^{-3}. This result contradicted to a study conducted in Taipei. The motorcyclists who participated in the study were exposed to a continuously significant level of $PM_{2.5}$, which was approximately more than 50 μg m^{-3} (Wang et al., 2021). Besides, by referring to the diary sheets provided to the food delivery riders, it was found that around 8 riders continued delivering orders de-spite unfavorable environmental conditions such as rain. Zalakeviciute et al. (2018) emphasized that if the average relative humidity (RH) of the area were 76% on days with light to moderate rain, the $PM_{2.5}$ level would be around 18.9 μg m^{-3} and with an average RH of 83% on days with heavier rain the $PM_{2.5}$ level decreased to 17.7 μg m^{-3}.

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As indicated by the results the shortness of breath is a significant factor that could be potentially caused by the exposure to $PM_{2.5}$ particles that are > 35 µg m^{-3} in concentration in the air. Asthma, other respiratory conditions, and heart and cardiovascular problems may be made worse by air pollution shortness of breath. Further deterioration of health can be caused by shortness of breath, such as fever, chills, or headaches. A person may also experience muscle pain, or pain in their lungs as a result of deep breathing, especially if they are coughing really hard. There are also individuals who could be overly tired, or very weak and fatigued due to shortness of breath. Long-term breathing of polluted air can lead to even more serious health problems (Manisalidis et al., 2020).

In this present study, the geometric mean level of $PM_{2.5}$ exposure to food delivery riders was 33.8 µg m^{-3}; meanwhile, a study conducted in Oxford found that the geometric mean for personal exposure level for $PM_{2.5}$ was 13.2 µg m^{-3}. The difference in the exposure level might be due to the different target populations as it revolved around random people in the community. The monitoring was explicitly conducted the respondents' house, outside of the house and in the work-place. Therefore, it influenced the level of exposure to $PM_{2.5}$ (Lai et al., 2004).

Next, there was a significant association between the level of $PM_{2.5}$ and the occurrence of shortness of breath among food delivery riders. In contrast with a study conducted among traffic police, they only found significant association between level of $PM_{2.5}$ and cough ($p<0.05$) (Mohamad Jamil et al., 2019). The contradiction of result

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might be due to the usage of mask when delivering food in 2021. The previous study was done before the occurrence of COVID-19.

Moreover, food delivery riders exposed to a high level of $PM_{2.5}$ were more likely to experience shortness of breath than other respiratory health symptoms. It may be due to the declining effectiveness of personal protective equipment such as masks (Brosseau & Ann, 2014). Further investigation should be conducted to derive the primary reason since this study was designed as a cross-sectional study with limited time.

Additionally, in this study, the PurpleAir air quality sensor or particulate sensor was used that consists of a network of elements that connects to the Internet of Things (IOT). Where, PurpleAir uses PMS5003 and PMS1003 laser particle counters to measure particles. Particles are counted in sizes of 0.3, 0.5, 1.0, 2.5, 5.0, and 10um with these sensors. PurpleAir data, which are 75% accurate when uncorrected, accurately report NowCast AQI categories 90% of the time. It is important to note, however, that while PurpleAir sensors are useful for examining spatial patterns of air pollution, their absolute accuracy can be low. Kelly et al. (2017) conducted an analysis of the performance of PurpleAir sensors against research grade instruments and, while they found good correlation, they also discovered that it overestimated particulate matter concentrations during cold air periods. Moreover, PurpleAir sensors also overestimated PM2.5 concentrations in the field, according to Tryner et al. (2020). Therefore, the limitation of this study also accounts for the single PurpleAir Sensor,

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whereas other sensors such as IQAir AirVisual Pro, Atmotube PRO, flow 2, and air beam sensors can be used by future research to improve accuracy and efficiency. In addition, the limitation also imposes on the riders targetted, where this study can be expanded by examining various groups of people that includes, bikers, workers, walkers as well as school students and day-to-day public transport travelling employees.

Finally in this study, we aimed to characterize the impact of $PM_{2.5}$ exposure on food delivery riders on the balance of outdoor $PM_{2.5}$ exposure and the risks they may experience. As a result of the increase in human movement and changed work patterns, pollutants were released into the air at higher concentrations. Food delivery riders may be exposed to health risks from daily median outdoor $PM_{2.5}$ concentrations >35 g/m3, primarily associated with shortness of breath, which may potentially lead to other health problems over time. Thus, it is not advisable for bike food riders in areas such as Kajang and Bangi where the highest risk of exposure > 38 g/m3 exists, to work for long periods of time, and it is more advisable to wear a mask for possible exposure reduction. Therefore, this study holds a strong ground to study the potential risk effects in other groups of people located under the high effect of particulate matter >35 g/m^3 $PM_{2.5}$ concentrations. As this study shows the potetial health effect on food riders, this effct can be not only limited to food riders but should also be considered in other groups of people that are exposed on a daily basis. Therefore, further research is crucial to be done taking in consideration people from various professions that are exposed to the outdoor environment, which might lead to precautionary measure imposed by local government and authorities

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CHAPTER 6

CONCLUSION

6.1 Conclusion

In conclusion, the geometric mean (standard deviation) for $PM_{2.5}$ exposed to the food delivery riders was 33.82 ± 0.72 µg m^{-3}, slightly lower than the New Malaysia Ambient Air Quality, 35 µg m^{-3}. Other than that, this study found the prevalence of respiratory outcomes was relatively high among food delivery riders, and the association between the level of $PM_{2.5}$ and respiratory health symptoms (shortness of breath) was significant.

The results obtained can provide an insight into the prevalence of respiratory health symptoms among food delivery riders in Klang Valley. Moreover, the findings from this study can give an overview of the current situation and recommendations for suitable control measures in this sector.

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6.2 Limitation

A cross sectional study was used in this study. This only involve the male food delivery riders in the locations used in this study. Therefore, accurate measure of association can be deteremined by including all the riders in this study location.

Besides, as the data mostly were self-reported, misreporting, and recall bias are all potential risks. The question for the prevalence of respiratory health symptoms asked if the respondents have experienced respiratory health symptoms in the past three months, which can be considered a long time. The respondents might had difficulty recalling the prevalence of respiratory health symptoms for the past three months. In the future, researchers should try to reduce the duration of the symptoms.

In addition, all the information obtained in this study was mainly based on a self-administered questionnaire, and no observation or medical diagnosis was involved in this study.

Lastly, since this study used a self-administered questionnaire, all the information gathered was depending on the respondent's honesty while answering the questionnaire. However, all the data was considered accurate as it is beyond control to verify the data obtained.

6.3 Recommendation

This study had that the prevalence of respiratory health symptoms is relatively high among the male food delivery riders. For future study, it is suggested to use

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probability sampling such as simple random sampling as the sampling method to recruit respondents so that the results can be generalized for the populations.

In addition, future studies should conduct an exposure monitoring of $PM_{2.5}$ at night since the riders' schedule are still ongoing till midnight and the riders does not have a fixed schedule.

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

Research title	:	**Exposure to Pm2.5 And Its Association with Respiratory Health Symptoms Among Food Delivery Riders in Klang Valley.**
Study Site	:	**Klang Valley**
JKEUPM Ref No.	:	**JKEUPM-2021-368**
Researcher	:	**Siti Khairunnisa Hafizah Binti Bakri**
Supervisor	:	**Assoc. Prof. Dr. Emilia Binti Zainal Abidin**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 14/6/2021
2. Respondent Information Sheet & Consent (English), Version 1 dated 14/6/2021
3. Respondent Information Sheet & Consent (Malay), Version 1 dated 14/6/2021
4. Proposal (English), Version 3 dated 4/9/2021
5. Questionnaire/Interviews (English), Version 1 dated 14/6/2021
6. Questionnaire/Interviews (Malay), Version 1 dated 14/6/2021
7. Curriculum Vitae of:
    a. Assoc. Prof. Dr. Emilia Binti Zainal Abidin

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 30 SEPTEMBER 2022**

Researchers should comply with the following:

I. Complete a Study Final Report upon study completion (Form 3.2).

II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.

III. Applicable for Clinical Trial Studies and Clinical interventional Studies only: Progress Report has to be submitted to JKEUPM at every 6 months from the date of approval (Form 3.1). Report occurrences of all Serious Adverse Events (SAEs), Suspected Unexpected Serious Adverse Reaction (SUSARs) and Protocol Deviation/ Violation at all JKEUPM approved sites to JKEUPM. SAEs are to be reported within 15 calendar days from awareness of event by

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APPENDIX 2

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

RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE:
Exposure to $PM_{2.5}$ and Its Association with Respiratory Health Symptoms among Food Delivery Riders in Klang Valley.

2. INTRODUCTION:
You are invinted to participate in this research because you are at risk in experiencing respiratory health symptoms due to exposure to fine particulate matter which is $PM_{2.5}$ emitted from the motor vehicle exhaust, road dust and tire wear. The respiratory health symptoms are cough, phlegm, wheezing and breathlessness. $PM_{2.5}$ has a diameter less than or equal to 2.5 micrometers. Hence, it can penetrate deeply into the lung and irritation will occur to your respiratory system which leads these respiratory symptoms to occur. The general objective of this research is to associate the exposure of $PM_{2.5}$ and respiratory health symptoms among food delivery riders in Klang Valley.

Your participation in this research is voluntary. You do not have to join this research if you do not want to. You also have the right not to answer any questions you do not want answered. You can also withdraw from this research at any time. If you withdraw, everything information that has been obtained before you withdraw will still be used in this research. If you do not want to participate or withdraw from this research, your actions will not affect all medical rights and privileges the health you deserve.

3. WHAT WILL YOU HAVE TO DO?
You will be given a set of questionnaire form and you will need to complete them in a given period of time which is within 20-30 minutes and give it back to the researcher. From this questionnaire, it contains 5 sections: Section A (Socio-demographic Background), Section B (Occupational Information), Section C (Health Information), Section D (Lifestyle) and Section E (Respiratory Symptom Problems). After you have finished answering the questionnaire, researcher will attach an instrument to your food delivery bag and you will be needed to perform your job task as usual. The presence of the instrument is to assess the levels of $PM_{2.5}$ during your working hour in a day.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?
The inclusion criteria of this study are:

a) Male
b) Aged between 18 – 50 years old
c) Location of work in Klang Valley
d) Have been working for the past 6 months

You should NOT participate in this research if:

a) Female
b) Have any history of respiratory injury for the past 12 months such as accident.

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5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

This research may be beneficial or not at all beneficial to you. All information obtained from this research will help in order to make improvement on the treatment or prevention methods towards the other respondents who might have the same risk exposure, illness or health problem regarding respiratory symptoms that could lead to respiratory illness. The result of the study may help you to prepare the best way to reduce the exposure to $PM_{2.5}$ in order to prevent any development on respiratory symptoms.

(b) TO THE INVESTIGATOR?

This research will be beneficial to the researcher. All the information obtained from this research will be used to evaluate the prevalence of respiratory health symptoms among food delivery riders and its association with exposure to traffic-related air pollutants ($PM_{2.5}$). This information could also be used as a reference towards other future research related to association between exposure of traffic-related air pollutants ($PM_{2.5}$) and respiratory health symptoms in service industry.

6. WHAT ARE THE POSSIBLE RISKS?

Only minimal risk will be impacted from this study because it is not invasive.

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

All your information obtained in this research will be stored and conducted in a confidential manner, in accordance with regulations and/or laws concerned. If the results of this research are published or presented to the public, your identity will not be revealed without your prior permission first. As for the images/photos/video recordings that has been taken, it can only be published according to your permission stated in the consent form. Only research team are allowed to access your information. By signing this consent form, you are agreed to the record review, information storage and data process as per described.

8. WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

If you have any questions about this study or your rights, please contact:

1. Siti Khairunnisa Hafizah Binti Bakri (Researcher)

   H/p: 019-9002455

   Email: nisabakri135@gmail.com

2. Assoc. Prof. Dr. Emilia Zainal Abidin

   H/p: 013-3042644

   Email: za_emilia@upm.edu.my

Please intial here if you have read and understood the contents of this page _____

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RESPONDENT'S INFORMED CONSENT FORM

I ..... Identity Card No. .....
address.....
.....hereby voluntarily agree to take part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature ..... Signature .....
(Respondent) (Witness)

Date :..... Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date ..... Signature .....
(Researcher)

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

PENERANGAN DAN PERSETUJUAN RESPONDEN

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

1.TAJUK KAJIAN
Pendedahan Kepada $PM_{2.5}$ Dan Kaitannya Dengan Gejala Respiratori Di Kalangan Penghantar Makanan Di Lembah Klang.

2. PENGENALAN
Anda dijemput untuk mengambil bahagian dalam penyelidikan ini kerana anda berisiko untuk mengalami masalah gejala respiratori kerana terdedah kepada bahan zarah halus iaitu $PM_{2.5}$ yang dikeluarkan daripada ekzos kenderaan bermotor, debu jalan dan hausan tayar. Antara masalah gejala respiratori adalah batuk, kahak, dada berbunyi dan sukar bernafas. $PM_{2.5}$ mempunyai diameter kurang dari atau sama dengan 2.5 mikrometer. Oleh itu, ia dapat meresap ke dalam paru-paru dan kerengsaan akan berlaku pada sistem pernafasan anda dan menyebabkan masalah gejala respiratori ini berlaku. Objektif am penyelidikan ini adalah untuk mengaitkan pendedahan $PM_{2.5}$ dan gejala kesihatan respiratori di kalangan penghantar makanan di Lembah Klang.

Penyertaan anda dalam penyelidikan ini adalah sukarela. Anda tidak perlu menyertai penyelidikan ini jika anda tidak mahu. Anda juga berhak untuk tidak menjawab soalan yang tidak mahu dijawab. Anda juga boleh menarik diri dari penyelidikan ini pada bila-bila masa. Sekiranya anda menarik diri, semua maklumat yang telah diperoleh sebelum menarik diri masih akan digunakan dalam penyelidikan ini. Sekiranya anda tidak mahu mengambil bahagian atau menarik diri dari penyelidikan ini, tindakan anda tidak mempengaruhi semua hak perubatan dan hak istimewa kesihatan yang anda layak.

3. APAKAH YANG PERLU ANDA LAKUKAN?
Anda akan diberikan satu set borang kaji selidik dan anda perlu melengkapkannya dalam jangka masa tertentu iaitu dalam 20-30 minit dan mengembalikannya kepada penyelidik. Borang soal selidik ini mengandungi 5 bahagian: Bahagian A (Latar Belakang Sosio-demografik), Bahagian B (Maklumat Pekerjaan), Bahagian C (Maklumat Kesihatan), Bahagian D (Gaya Hidup) dan Bahagian E (Masalah Gejala Respiratori). Setelah unda selesai menjawab borang soal selidik ini, penyelidik akan memasangkan instrumen pada bag penghantaran makanan anda dan anda hendaklah melaksanakan kerja anda seperti biasa. Tujuan pemasangan instrumen tersebut adalah untuk menilai tahap $PM_{2.5}$.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?
Kriteria kemasukan kajian ini adalah:

a) Lelaki
b) Berumur antara 18 – 50 tahun
c) Lokasi kerja di Lembah Klang
d) Sudah bekerja selama 6 bulan
e)

Anda TIDAK BOLEH mengambil bahagian dalam penyelidikan ini sekiranya:

a) Perempuan
b) Mempunyai sejarah kecederaan pernafasan selama 12 bulan yang lalu seperti kemalangan.

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5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?
Penyelidikan ini mungkin bermanfaat atau sama sekali tidak bermanfaat bagi anda. Semua maklumat yang diperoleh dari penyelidikan ini akan membantu untuk memperbaiki kaedah rawatan atau pencegahan terhadap responden lain yang mungkin mempunyai risiko pendedahan, penyakit atau masalah kesihatan yang berkaitan dengan gejala pernafasan yang boleh menyebabkan penyakit pernafasan yang lain. Hasil kajian dapat membantu anda mempersiapkan cara terbaik untuk mengurangkan pendedahan kepada $PM_{2.5}$ untuk mencegah pembentukan masalah gejala pernafasan.

b) KEPADA PENYELIDIK?
Penyelidikan ini akan bermanfaat bagi pengkaji. Semua maklumat yang diperoleh dari penyelidikan ini akan digunakan untuk menilai prevalensi gejala respiratori di kalangan penghuntar makanan dan kaitannya dengan pendedahan $PM_{2.5}$. Maklumat ini juga dapat digunakan sebagai rujukan kepada penyelidikan yang akan dilaksanakan pada masa yang akan datang yang berkaitan dengan hubungan antara pendedahan $PM_{2.5}$ dan gejala pernafasan dalam industri perkhidmatan.

6. ADAKAH IA BERISIKO?
Hanya risiko dan kesan sampingan yang minimum yang akan dipengaruhi oleh kajian ini kerana tidak bersifat invasif.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?
Semua maklumat anda yang diperoleh dalam penyelidikan ini akan disimpan dan dilakukan secara rahsia, sesuai dengan peraturan dan / atau undang-undang yang berkaitan. Sekiranya hasil penyelidikan ini diterbitkan atau disampaikan kepada umum, identiti anda tidak akan didedahkan tanpa kebenaran anda terlebih dahulu. Mengenai gambar / rakaman video yang telah diambil, ia hanya dapt diterbitkan mengikut kebenaran anda yang dinyatakan dalam borang persetujuan. Hanya pasukan penyelidik yang dibenarkan mengakses maklumat anda. Dengan menandatangani borang persetujuan ini, anda dipersetujui untuk tinjauan rekod, penyimpanan maklumat dan proses data seperti yang dijelaskan.

8. SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEMASA MENGIKUTI PENYELIDIKAN INI?
Sekiranya anda mempunyai pertanyaan mengenai kajian ini atau hak anda, sila hubungi:

Siti Khairunnisa Hafizah Binti Bakri (Penyelidik)

H/p: 019-9002455

Email: nisabakri135@gmail.com

Assoc. Prof. Dr. Emilia Zainal Abidin

H/p: 013-3042644

Email: za_emilia@upm.edu.my

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

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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 imej/gambar/rakaman video/ rakaman suara digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan ..... Tandatangan .....
(*Responden*) (*Saksi*)

Tarikh :..... Nama :.....

No. K/P: .....

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

Tarikh ..... Tandatangan .....
(*Penyelidik*)

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APPENDIX 3

EXPOSURE TO $PM_{2.5}$ AND ITS ASSOCIATION WITH RESPIRATORY HEALTH SYMPTOMS AMONG FOOD DELIVERY RIDERS IN KLANG VALLEY

PENDEDAHAN KEPADA $PM_{2.5}$ DAN KAITANNYA DENGAN GEJALA PERNAFASAN DALAM KALANGAN PENGHANTAR MAKANAN DI LEMBAH KLANG

ID No. :

Date/ Tarikh : / /

Instructions/ Arahan**:**

This questionnaire contains 5 sections:
Borang kaji selidik ini mengandungi 5 bahagian:

Section A **: Socio-demographic Background**
Bahagian A : Latar Belakang Sosio-demografik
Section B **: Occupational Information**
Bahagian B : Maklumat Pekerjaan
Section C **: Health Information**
Bahagian C : Maklumat Kesihatan
Section D **: Lifestyle**
Bahagian D : Gaya Hidup
Section E **: Respiratory Symptom Problems**
Bahagian E : Masalah Gejala Respiratori

Please answer ALL questions.
Anda diminta untuk menjawab SEMUA soalan.

Please tick your answer and fill in the blanks for the questions.
Untuk menjawab, sila tanda dan isi jawapan anda di bahagian jawapan yang telah disediakan.

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Section A : Socio-demographic Background

Bahagian A : Latar Belakang Sosio-demografik

A1. Age / *Umur*:

A2. Gender / *Jantina*:

1. ☐ Male / *Lelaki*
2. ☐ Female / *Perempuan*

A3. Race / *Bangsa*:

1. ☐ Malay / *Melayu*
2. ☐ Chinese / *Cina*
3. ☐ Indian / *India*
4. ☐ Others / *Lain-lain*

Please specify / *Sila nyatakan*: _____

A4. Nationality / *Warganegara*

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1. ☐ Malaysian / *Warganegara*

2. ☐ Non-Malaysian / *Bukan warganegara*

A5. Marital status / *Status perkahwinan*

1. ☐ Single / *Bujang*

2. ☐ Married / *Berkahwin*

3. ☐ Divorced / *Bercerai*

A6. Educational level / *Tahap pendidikan*

1. ☐ Primary education / *Sekolah rendah*

2. ☐ Secondary education / *Pendidikan menengah*

3. ☐ Tertiary education / *Pengajian tinggi*

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A7. Height / *Tinggi* | | | | cm

A8. Weight / *Berat* | | | | kg

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Section B : Occupational Information

Bahagian B : Maklumat Pekerjaan

B1. What is the name of food delivery company?

Apakah nama syarikat penghantaran makanan?

1. ☐ Grab Food
2. ☐ Food Panda

B2. How long have you worked as food delivery rider?

Berapa lama anda bekerja sebagai rider penghantaran makanan?

_____

B3. How many days do you work in a week?

Berapa harikah anda bekerja dalam seminggu?

_____

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B4. How many hours do you work in a day?

Berapa jamkah anda bekerja dalam sehari?

_____

B5. How many orders you deliver in a day (approximately)?

Berapa banyak pesanan yang dihantar dalam sehari (secara anggaran)?

_____

B6. What is the type of vehicle you use to make food delivery?

Apakah jenis kenderaan yang anda gunakan untuk membuat penghantaran?

1. ☐ Motorcycle / *Motosikal*
2. ☐ Car / *Kereta*

B7. How long have you had the vehicle as stated in B6?

Sudah berapa lama anda memiliki kenderaan seperti yang dinyatakan di B6?

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B8. Do you wear a mask when making food deliveries?

Adakah anda memakai topeng semasa membuat penghantaran makanan?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

If Yes, please answer question B9.

Jika Ya, sila jawab soalan B9.

If No, please proceed to question B10.

Jika Tidak, sila terus ke soalan B10.

B9. What is the type of mask you use when making food deliveries?

Apakah jenis topeng muka yang anda gunakan semasa membuat penghantaran makanan?

1. ☐ Cloth mask / Topeng kain

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2. ☐ Disposable mask / Topeng pakai buang

3. ☐ N95 mask / Topeng N95

4. ☐ Others / *Lain-lain*

Please specify / *Sila nyatakan*: _____

B10. Do you undergo any training for occupational safety and health before start working?

Adakah anda menjalani sebarang latihan untuk keselamatan dan kesihatan pekerjaan sebelum mula bekerja?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

B11. Have you worked at a different workplace before?

Pernahkah anda bekerja di tempat kerja lain?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

B12. What was your previous job?

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Apakah pekerjaan anda sebelum ini?

_____

B13. How long have you worked as (previous position as stated above)?

Berapa lamakah anda bekerja sebagai (pekerjaan dahulu seperti di atas)?

_____ years / *tahun*

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Section C : Health Information

Bahagian C : Maklumat Kesihatan

C1. Do you have the following diseases and have been diagnosed by a doctor?

Adakah anda menghidap penyayakit berikut dan telah disahkan oleh doktor?

	Disease *Penyakit*	**1. Yes** *Ya*	**2. No** *Tidak*	**Have you ever taken any medication for the disease? (a)** *Adakah anda pernah mengambil sebarang ubat-ubatan untuk penyakit tersebut? (a)*	
				1. Yes Ya	**2. No** *Tidak*
C1.1	High Blood Pressure *Darah Tinggi*				
C1.2	Diabetes *Kencing manis*				
C1.3	Asthma *Asma/Lelah*				
C1.4	Cardiovascular disease *Jantung*				
C1.5	Chronic Obstructive Pulmonary Disease (COPD) *Penyakit Kronik Sistem Pernafasan*				

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Section D **: Lifestyle**

Bahagian D *: Gaya Hidup*

D1. Do you smoke?

Adakah anda merokok?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

If Yes, _____ smokes a day

Jika Ya, _____ batang sehari

D2. Do you perform any physical activity?

Adakah anda melakukan sebarang aktiviti fizikal?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

If Yes, please specify: _____

Jika Ya, nyatakan: _____

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Section E **: Respiratory Symptom Problems**

Bahagian E *: Masalah Gejala Respiratori*

Have you experienced any of the following symptoms over the past 3 months:

Pernahkah anda mengalami simptom-simptom berikut sepanjang 3 bulan yang lalu:

Cough (Batuk)

E1. Do you usually have a cough? (Exclude clearing of throat)

Adakah anda selalu mengalami batuk? (Batuk dibuat untuk berkahak tidak dikira)

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E2. Do you usually cough as often as 4 to 6 times a day, or more than 4 days a week?

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

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

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E3. Do you usually cough when you wake up or first thing in the morning?

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

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E4. Do you usually cough during the day or at night?

Selalukah anda batuk sepanjang hari atau pada malam hari?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

If Yes to any of the above questions (E1 – E4) please answer questions E5 and E6.

If No to all of the above questions, please proceed to question E7.

Jika Ya pada mana-mana soalan di atas (E1-E4) sila jawab soalan E5 dan E6.

Jika Tidak pada semua soalan di atas, sila terus ke soalan E7.

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E5. Do you usually cough like this (questions E3, E4, E5 atau E6) on most day for 3 consecutive months or more during the year?

Adakah anda biasanya batuk sedemikian (soalan E3, E4, E5 atau E6) untuk selama 3 bulan atau lebih secara berturut-turut sepanjang tahun?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E6. How long have you had a cough like this?

Berapa lama anda mengalami batuk seperti ini?

_____ years / *tahun*

Phlegm (Kahak)

E7. Do you usually bring up phlegm from your chest? (Including swallowed phelgm)

Adakah anda selalu berkahak? (Termasuk kahak yang ditelan)

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

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E8. Do you usually bring up phlegm like this as much as twice a day, 4 or more days out of the week?

Adakah anda selalu berkahak sekerap 2 kali sehari, 4 hari atau lebih dalam seminggu?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E9. Do you usually bring up phlegm when you wake up or first thing in the morning?

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

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

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E10. Do you usually bring up phlegm during the day or at night?

Adakah anda berkahak sepanjang hari atau pada malam hari?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

If Yes to any of the above questions (E7 – E10) please answer questions E11 and E12.

If No to all of the above questions, please proceed to question E13.

Jika Ya pada mana-mana soalan di atas (E7-E10) sila jawab soalan E11 dan E12.

Jika Tidak pada semua soalan di atas, sila terus ke soalan E13.

E11. Do you usually bring up phlegm like this (questions E8, E9, E10 or E11) on most day for 3 consecutive months or more during the year?

Adakah anda berkahak sedemikian (soalan E8, E9, E10 atau E11) untuk selama 3 bulan berturut-turut sepanjang tahun?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E12. How long have you had trouble with phlegm?

Berapa lama anda mengalami masalah kahak seperti ini?

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years / tahun

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Cough and Phlegm (Batuk Serta Kahak)

E13. Have you had periods or episodes of (increased) cough and phlegm lasting for 3 weeks or more each year? (If Yes, please answer question E14)

Pernahkah anda mengalami peningkatan batuk-batuk serta berkahak yang berpanjangan lebih dari 3 minggu setiap tahun? (Jika Ya, sila jawab soalan E14)

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E14. For how long have you had at least 1 such episode per year?

Berapa lamakah and mengalami sekurang-kurangnya 1 kejadian batuk-batuk berkahak dalam setahun?

_____ years / *tahun*

Wheezing (Dada Berbunyi)

E15. Does your chest ever sound wheezy or whistling?

Adakah anda terasa dada anda berbunyi seperti wisel:

i. When you have a cold / *Apabila anda mengalami selsema* — 1. ☐ Yes / *Ya* 0. ☐ No / *Tidak*

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ii. Occasionally apart from colds — 1. ☐ Yes — 0. ☐ No
Kadang-kala di samping selsema — *Ya* — *Tidak*

iii. Most day or nights — 1. ☐ Yes — 0. ☐ No
Hampir setiap hari (siang atau malam) — *Ya* — *Tidak*

If Yes to any of the above questions E15 i-iii, please answer question E16.
Jika Ya pada mana-mana soalan E15 i-iii, sila jawab soalan E16.

E16. For how long have you had such episode?
Sudah berapa lamakah keadaan ini berlaku?

years / *tahun*

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Breathlessness (Sukar Bernafas)

E17. Are you troubled by shortness of breath when walking in fast pace or walking up a slight hill?

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

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

If Yes to question E17, please answer questions E18 – E21.

Jika Ya pada soalan E17, sila jawab soalan E18 – E21.

E18. Do you walk slowly because you have breathing difficulty?

Adakah anda berjalan dengan perlahan-lahan kerana sukar bernafas?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E19. Do you ever have to stop for breath when walking at your own pace?

Adakah anda perlu berhenti seketika untuk bernafas semasa berjalan?

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1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

E20. Do you ever have to stop for breath after walking about 30 meter (or after a few minutes)?

Adakah anda perlu berhenti untuk bernafas setelah berjalan sejauh 30 meter (atau selepas beberapa minit)?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

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E21. Do you often feel breathless when wears the mask?

Adakah anda sering berasa sesak nafas apabila memakai topeng?

1. ☐ Yes / *Ya*

0. ☐ No / *Tidak*

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APPENDIX 4

Helaian Diari Pengukuran Kualiti Udara

Pendedehan kepadan $PM_{2.5}$ dan Kaitannya dengan Gejala Pernafasan dalam kalangan Penghantar Makanan di Lembah Klang.

Sila isi helaian diari ini sepanjang anda membuat penghantaran makanan atau bergerak ke mana-mana destinasi iaitu selama 8 jam anda bersama alat PurpleAir. Ini akan membantu pihak kami untuk menyuaipadankan dengan data kualiti udara disekeliling anda berdasarkan alat PurpleAir. Seterusnya, membolehkan pihak kami menyampaikan info dan hasil kajian yang tepat kepada pihak anda.

Jika ada soalan berkenaan dengan helaian diari ini, sila hubungi;

Siti Khairunnisa Hafizah Bakri
Penyelidik
Jabatan Kesihatan Persekitaran dan Pekerjaan
Fakulti Perubatan dan Sains Persekitaran
Universiti Putra Malaysia
nisabakri135@gmail.com
019-9002455

Contoh helaian diari yang telah diisi adalah seperti berikut;

Contoh:

No.	Destinasi Awal	Destinasi Akhir	Masa Bergerak (am/pm)	Masa Tiba (am/pm)	Nota
1	Kolej Tujuh Belas, UPM	KFC Taman Sri Serdang	9:30 am	9:41 am	
2	KFC Taman Sri Serdang	Taman Serdang Jaya	10:00 am	10:04 am	Merokok/Vape *salah satu

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					yang berkenaan
3	Taman Serdang Jaya	Petronas Sri Serdang	10:06 am	10:11 am	
…					
25	The Mines	Zeta Residence	3:30 pm	3:45 pm	Hujan renyai
26	Zeta Residence	IOI City Mall	4:00 pm	4:19 pm	Hujan lebat

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Nama : -

_____

Nombor Telefon :

_____

Tarikh :

_____

No.	Destinasi Awal	Destinasi Akhir	Masa Bergerak (am/pm)	Masa Tiba (am/pm)	Nota
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

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