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KNOWLEDGE, PERCEPTION AND PRACTICES IN RELATION TO THE IMPACT OF HEAT ON THE HEALTH AND PRODUCTIVITY OF PINEAPPLE FARMERS IN JOHOR

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BY

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ABSTRACT

Knowledge, Perception and Practices in relation to the Impact of Heat on the Health and Productivity of Pineapple Farmers in Johor

Nuzul Fadhilah Binti Mohd Nawi

Objective: To study the knowledge, perception and practices in relation to the impact of heat on the health and productivity of pineapple farmers in Johor. **Method**: This study involved 82 male farmers, selected based on the inclusion and exclusion criteria. Background and working information was obtained using questionnaire. Wet Bulb Globe Temperature (WBGT) was used to measure 24 hours heat index for 18 days. While physiological measurements (blood pressure, heart rate and body temperature) were measured during and after the work period and the productivity was observed in the morning and evening according to the work tasks. **Result:** Farmers at the farm were at high risk to heat stress as most of days recorded exceeded the standards of TLV. Majority of the farmers have moderate scores on knowledge and perception but poor practices on the impact on health and productivity with the majority of the farmers consumed 3 litres/day of water at the frequency of 5-10 times/day of water intake. There was a significant correlation (p=0.031) between WBGT and body core temperature during work. All the physiological parameters (blood pressure, body core temperature and heart rate) were significantly different during and after work period. While the productivity of planters and harvesters were significantly correlated with the WBGT heat index in term of humidity both in the morning (p=<0.001, p=<0.001) and in the evening (p=0.026, p=0.018) respectively. Productivity of suckers and harvesting were significantly different in the morning and evening where the output was decreased in the evening. Knowledge scores were significantly associated with fainting as of health symptoms. Perception scores were significantly associated with vomit as of health symptoms. Work task had a significant relationship with fatigue symptom, metabolic rate with headache symptom, age with severe thirst symptoms, BMI with the muscle cramps symptom and WBGT had a significant relationship with dizziness symptom. For the productivity of the farmers for each work task, humidity had significant relationship with the planting and harvesting task, heart rate with sucker task and diastolic blood pressure had a significant relationship with manual weeding task of the farmers. **Conclusion**: The farmers had fair score on knowledge and perception on heat and poor score on practices of heat protection. The farmers were exposed to high risk of heat stress for most of the days recorded exceeded the standards of TLV. The most common symptoms experienced by the farmers were heavy sweating and fatigue. Heat index in term of humidity had a significant correlation with body core temperature of the farmers and also the productivity of planters and harvesters.

Keywords: Heat, health, productivity, knowledge, perception and practices, pineapple farmers

ABSTRAK

Pengetahuan, Persepsi dan Sikap Berhubungkait Terhadap Impak Haba Kepada Kesihatan dan Produktiviti Petani Nanas di Johor

Nuzul Fadhilah Binti Mohd Nawi

Objektif: Untuk mengkaji pengetahuan, persepsi dan sikap berhubungkait terhadap impak haba kepada kesihatan dan produktiviti petani nanas di Johor. **Metodologi:**Kajian ini melibatkan 82 orang petani lelaki yang dipilih mengikut kriteria kemasukan dan kecualian. Maklumat latar belakang dan pekerjaan mereka diperolehi menggunakan borang soal selidik. 'Wet Bulb Globe Temperature' (WBGT) diukur selama 18 hari untuk sepanjang hari pekerja bekerja di ladang. Pengukuran fisiologi (tekanan darah, kadar degupan jantung dan suhu badan) diukur semasa dan selepas kerja, manakala pemerhatian produktiviti petani adalah pada waktu pagi dan petang mengikut bahagian kerja masing-masing. **Keputusan:** Petani di ladang berisiko tingi terhadap stres haba di mana kebanyakan hari yang dicatatkan melebihi had nilai yang ditetapkan mengikut piawaian (TLV). Kebanyakan petani mempunyai skor pengetahuan dan persepsi yang sederhana tetapi sangat rendah bagi sikap yang diamalkan dalam perlindungan daripada haba semasa bekerja. Walau bagaimanapun, majoriti petani mengambil 3 liter air sehari pada kekerapan 5-10 kali sehari. Terdapat perhubungan yang signifikan (p=0.031) antara WBGT dan suhu badan semasa bekerja. Semua parameter fisiologi (tekanan darah, suhu badan dan kadar degupan jantung) mempunyai hubungan yang signifikan pada perbezaan semasa dan selepas bekerja. Manakala untuk produktiviti penanam dan penuai buah, mempunyai hubungan yang signifikan dengan nilai WBGT (kelembapan) pada waktu pagi (p=<0.001, p=<0.001) dan petang (p=0.026, p=0.018). Produktiviti petani bahagian benih dan penuai buah mempunyai hubungan yang siginifikan pada perbezaan antara waktu pagi dan petang dimana pengeluaran kerja berkurangan pada waktu petang. Skor pengetahuan petani mempunyai hubungan yang signifikan dengan tanda-tanda keletihan, kadar metabolisma dengan tanda-tanda sakit kepala, umur dengan tanda-tanda dahaga, BMI dengan tanda-tanda kejang otot dan WBGT mempunyai hubungan yang signifikan dengan tanda-tanda pening. Manakala untuk produktiviti petani mengikut bahagian kerja, kelembapan mempunyai hubungan yang signifikan terhadap aktiviti tanam dan tuai buah, kadar degupan jantung terhadap aktiviti membenih dan tekanan darah diastolik mempunyai hubungan yang signifikan terhadap aktiviti merumput. **Kesimpulan:** Petani mempunyai skor sederhana pada pengetahuan dan persepsi terhadap haba manakala skor yang rendah pada sikap yang diamalkan untuk berlindung dari haba. Petani terdedah kepada risiko tinggi untuk kebanyakan hari yang dicatatkan melebihi had nilai yang ditetapkan (TLV). Antara tanda-tanda kesihatan yang biasa dialami oleh petani adalah berpeluh dengan banyak dan letih. Indeks haba (kelembapan) mempunyai hubungan yang signifikan dengan suhu badan petani dan juga produktiviti penanam dan penuai buah.

Kata kunci: Haba, kesihatan, produktiviti, pengetahuan, persepsi dan sikap, petani nanas

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LIST OF ABBREVIATIONS

<	Less than
>	More than
≤	Equal and less than
%	Percentage
N	Sample size
R	Correlation
P	Significant value
SD	Standard Deviation
IQR	Interquartile Range
CI	Confidence Interval
WBGT	Wet Bulb Globe Temperature
TLV	Threshold Limit Value
BMI	Body Mass Index
BCT	Body core temperature
BP	Blood pressure
HR	Heart rate
L	Litre
bpm	beats per minute
et al.	and others

CHAPTER 1

INTRODUCTION

1.1 Introduction

The earth's climate has changed throughout history with the abrupt end of the ice age 7,000 years ago which marking the beginning of the modern climate era and human civilization. Since the Mid-20th century, human activity is extremely likely (greater than 95 percent probability) to be the result for the current warming trend and proceeding at a rate that is unprecedented over decades to millennia. In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) concluded that there's a better than 95 percent probability that human-produced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused the increase in Earth's temperature over the past 50 years. Since the late 19th century, global temperature has risen about 2.0 degrees Fahrenheit (1.1 °C) and 2016 became the warmest year on record with the average temperature were 1.78 degrees Fahrenheit (0.99 °C) in which eight of the 12 months that make up the year from January to September, with the exception of June according to National Aeronautics and Space Administration (NASA, 2017).

According to Kjellstrom et al. (2013), people working in heavy physical activity are particularly affected as the activity produces additional intra-body heat that must be dissipated. Most workers die because of heat stroke as they work beyond safe heat exposure limits such as agricultural workers that work outdoor in the sun and their pay based on their product output, as happened in USA. The increasing temperature of ocean surface water also will create more evaporation of water and higher humidity of the atmosphere causing outdoor workers to be exposed to excessive heat exposure from these trends.

Climate change will affect, in profoundly adverse ways, some of the most fundamental pillars of health: food, air and water. Extreme weather events, such as intense storms, heat waves, drought, flood could be abrupt and the consequences can be dramatically felt as the warming of the planet will be gradual. In 2000, 154,000 deaths occurring globally from the climate change and about 77,000 occurred in countries of the South-East Asia (SEA) Region. From the climate change, adaption is needed and failure to respond will be costly in term of disease, health care expenditure and loss productivity based on Twenty-Sixth Meeting of Ministers of Health (World Health Organization, 2008).

Heat stress, communicable disease, air pollution, lack of food and water security, extreme weather events, malnutrition, stress, mental health issues, vulnerable shelter and population migration among others are among negative health effects from climate change. The most vulnerable and the main sectors that are directly affected by climate change are outdoor workers include agriculture, industry, fisheries, forestry, small and medium sized enterprises, indoor workplaces (without air conditioning), semi-outdoor workshops and construction work. Social impact on enterprises and workers, on employment and income, on working conditions and other social dimensions is less understood besides the economic impact (Lundgren et al., 2013).

According to International Labour Organization (ILO) in Code of Practice on Safety and Health in Agriculture (2011), agriculture is one of the most hazardous of all sectors and many agricultural workers suffer occupational accidents and ill-health each year including when exposed to noise, vibration, dust, chemicals and also extreme temperature. Tawatsupa et al. (2013), stated that workers with physical jobs had much more heat stress at work than office workers.

As the extreme temperature can cause heat stress among workers, it has a direct impact on production by causing poor task performance and increase the possibility of work-related morbidity and injuries (Cortez, 2009). Department of Occupational Safety and Health (DOSH) Malaysia has stated in the Guidelines on Heat Stress Management at Workplace 2016 that heat stress is the overall heat load to which an employee may be exposed from the combined contributions of metabolic heat, environmental factors (i.e. air temperature, humidity, air movement, and radiant heat), and clothing requirement. When the body's means of controlling its internal temperature starts to fail, caused the heat stress to occur. Heat strain and other physiological reactions such as increased sweat production, higher body core temperature and increased heart rate in body can be caused by the heat stress that imposed on human body. Heat strain also may cause health problems, such as heat cramps, heat exhaustion, heat syncope, heat rashes and heat stroke (Bahri et.al, 2015).

1.2 Problem Statement

Outdoor workers include any workers who spend a substantial portion of the shift outdoors such as construction workers, agricultural workers, baggage handlers, electrical power transmission and control workers, and landscaping and yard maintenance workers. These workers are exposed to hot and humid conditions are at risk of heat-related illness as the weather gets hotter and more humid (Occupational Safety and Health Administration (OSHA) (n.d). Based on the investigation by OSHA (n.d), 25 incidents of heat-related illness in 2005 where almost half of the cases involved the worker on their first day of work as they did not build up the tolerance for hot conditions (acclimatized).

According to U.S National Oceanographic and Atmospheric Administration (NOAA) (n.d.), the body's ability to cool itself during extreme hot and humid weather is challenged. Heat-related illness may be experienced when too much fluid or salt is lost too much through dehydration or sweating, caused rising in body temperature. United States Department of Labour stated in the Occupational Heat Exposure that when a person works in a hot environment, the body must get rid of excess heat through circulating blood to the skin and through sweating to maintain a stable internal temperature. If the body cannot get rid of excess heat, it will store it and cause the body's core temperature to rise and heart rate increases. The person also begins to lose concentration, may become sick and loses desire to drink.

Risk of heat stroke or collapse could occur if the blood temperature rises above 39 °C and at above 41 °C, delirium and confusion could occur and even fatal at this level. Dehydration and heat stress has the possibility to occur when working in hot weather which can lead to fatigue, muscle cramps, rashes, fainting and loss of consciousness. Therefore, for outside workers, the workers should be issued with sunscreen and hat, ensure light and suitable clothing, regular breaks and access to fresh water as a protection for the workers. (Trades Union Congress, 2017).

Agriculture in Malaysia remain as important sector of Malaysia's economy with the contribution on 12 percent to national GDP and providing employment for 16 percent of the population (Nations Encyclopedia, 2017). Agriculture is among the major employer in the developing world, where farmers normally at high risk of heat stress as they work under high pressure, perform extended hours of work in high heat and humidity, suffer dehydration and the knowledge on the prevention of heat is not sufficient enough (Lukman, 2016).

For the past three decades, world pineapple trade had shown increasing trend with Malaysia was listed number 15 of the world fresh pineapple exporter and number 9 for canned pineapple (Economic and Technology Management Review, 2012). In Malaysia, pineapple is one of the most popular tropical fruits which is categorized in a group of major fruit that has potential to generate incomes for farmers and the countries as well. Mostly planted pineapples are in the states of Johor, Sarawak, Sabah, Kedah, Selangor, Penang and Kelantan (Noorlidawati, 2016). According to Department of Agriculture (2016), pineapples are grown in area of around 10,847 hectares with an estimated production of 272,570 metric tons in 2015. In addition, Malaysian Pineapple Industry Board (MPIB, 2016) reported that Malaysia exports about 20, 178.9 tons of fresh pineapple to several countries followed by processes products such as canned pineapples, pineapple slips and pineapple juice that shows a potential to enter new markets such as China and Europe. The exportation of fresh pineapple also showed a constant trend with a higher demand from local consumption (Noorlidawati, 2016).

1.3 Study Justification

This research study on the knowledge, perception and practices in relation to the impact of heat on the health and productivity of pineapple farmers in Johor. According to Climate-Data (n.d.), Pontian's climate is classified as tropical with a significant rainfall. According to World Weather Online (2018), as of February 2018, Pontian has recorded the average temperature of 28 °C with the maximum temperature of 31 °C. While in Johor Bahru, the average temperature is 29 °C with the maximum and minimum temperature of 31 °C and 24 °C respectively as of February 2018. Maximum temperature recorded in Pontian and Johor Bahru for last year, 2017 around April to June, were 35 °C and 36 °C respectively.

Furthermore, agriculture in Malaysia have become an important sector of Malaysia's economy. Pineapple is one of the most popular tropical fruits in Malaysia that its popularity is due to its multi-forms in consumption which are can be eaten fresh, cooked or processed into juice or jams. The most planted area for pineapple in

Malaysia are in the states of Johor, Sarawak, Sabah, Kedah, Selangor, Penang and Kelantan (Noorlidawati, 2016). According to Department of Agriculture (2016), Johor is the largest hectares or planted area among other states which is 8,934.5 Ha with the harvested area of 6,700.9 Ha. Pontian and Johor Bahru are among the district that has planted area for pineapples where Pontian has a big planted area of 1,558.2 Ha among other districts.

The purpose of this study is also to create awareness or educate the farmers worked in a hot environment on the heat exposure, symptoms related to heat exposure and also how to cope with the heat. These kind of education or exposure to the farmers could be used in the identification of risk of hazard as well as the prevention of heat stress such as regular breaks, frequent intake of water, light clothing and shading and cooling system. Besides, knowledge, perception and practices of the farmers toward heat exposure can be assessed and from this research, can change or improve their knowledge, perception and practices along with how they can control or prevent heat stress.

In this research, as physiological changes and productivity also are being studied in term of production output and the body core temperature, blood pressure and heart rate, the farmers will be able to know how that part of study could affect the outcome and working condition when exposed to high temperature. Moreover, the research also can be served as the reference for other researchers in studying this field from the data obtained for the future studies.

1.4 Objectives

1.4.1 General objective

i. To study the knowledge, perception and practices in relation to the impact of heat on the health and productivity of pineapple farmers in Johor.

1.4.2 Specific objectives

i. To determine the background data (age, sex, height, weight, BMI etc.) and working characteristics (work tasks, rest time, type of clothing etc.) of the farmers.

ii. To determine the farmer's knowledge, perception and practices on heat.

iii. To determine heat index and metabolic rate.

iv. To determine the correlation between heat index (WBGT) with the prevalence of self-reported heat-related symptoms, physiological parameters and the productivity of the farmers.

v. To compare the physiological changes during work and after work period.

vi. To compare productivity of the farmers in the morning and evening.

vii. To determine the association between knowledge, perception and practices with health symptoms, physiological changes and productivity.

viii. To determine the risk factors that have significant relationship with the health symptoms and productivity of the farmers.

1.5 Research Hypothesis

i. Heat index (WBGT) is significantly correlated with the prevalence of heat-related symptoms, physiological parameters and the productivity of the farmers.

ii. Physiological changes of the farmers are significantly higher after work.

iii. Productivity of the farmers are significantly different in the morning and evening.

iv. Knowledge, perception and practices are significantly associated with health symptoms, physiological changes and productivity.

v. Heat index have a significant relationship with the health symptoms and productivity of the farmers.

1.6 Conceptual Framework

This conceptual framework as in Figure 1.1, consists on how heat exposure impact from the climate change occurred around the world could affect the farmers especially outdoor workers such as in agriculture to their health and productivity of the farmers along with the confounding factors. Among the negative health effects from the climate change are heat stress, communicable disease, air pollution, water security, extreme weather events, malnutrition, stress, mental health issues, vulnerable shelter and population migration among others (Lundgren et al., 2013).

Farmers exposed to intense heat unable to activate mechanisms, putting their health at risk besides it also has a direct impact on production output cause for a poor performance as well as increase work-related morbidity and injuries (Cortez, 2009). Prevalence of heat-related symptoms and physiological changes experienced by the farmers during work period also could put a risk to their health.

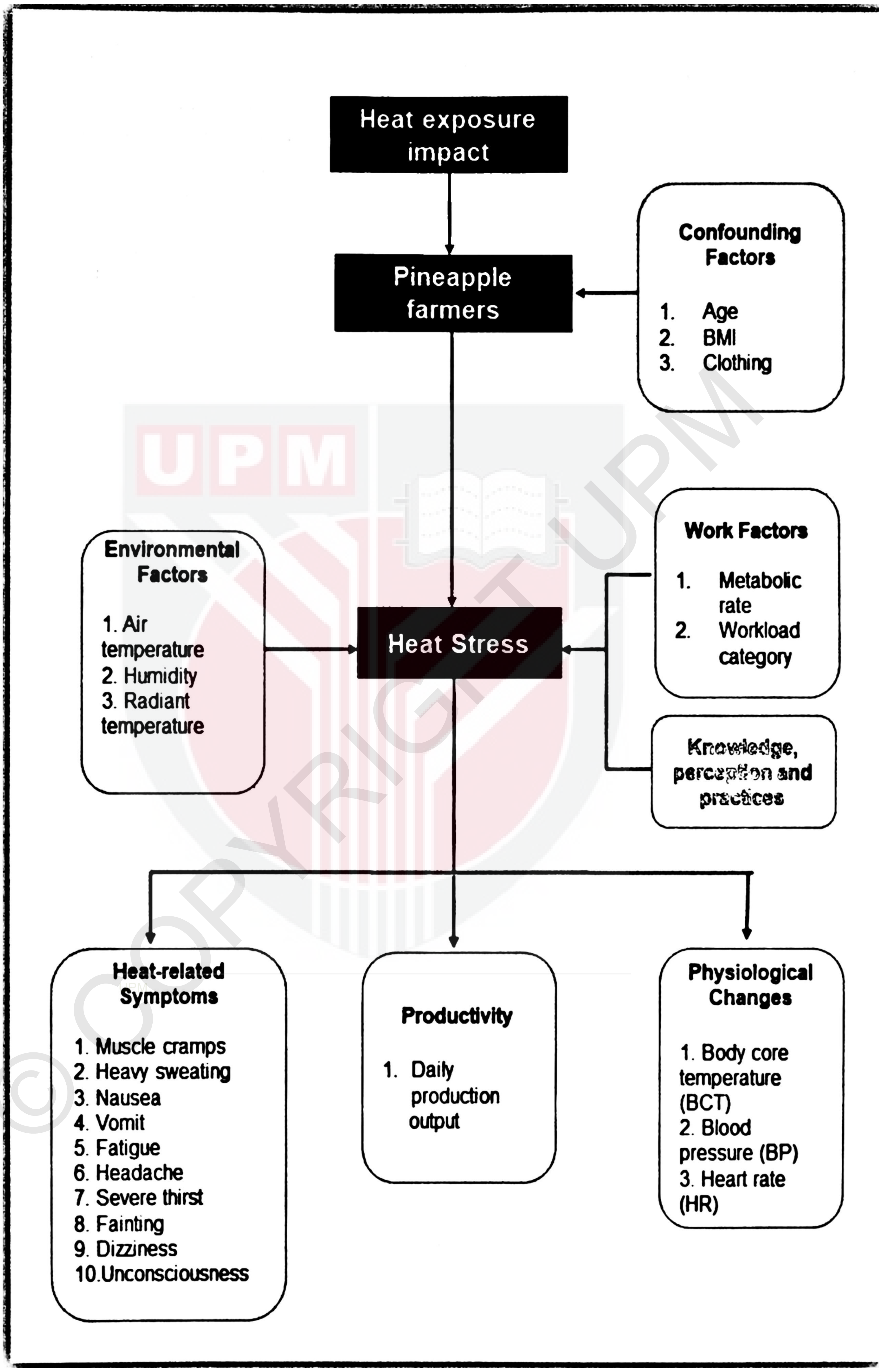

Figure 1.1: Conceptual framework

1.7 Term of Definitions

1.7.1 Conceptual definition

1.7.1.1 Heat Stress

Heat stress is the overall heat load to which an employee may be exposed from the combined contributions of metabolic heat, environmental factors such as air temperature, humidity, air movement and radiant heat and also from the clothing requirements based on the Guidelines of Heat Stress Management at Workplace 2016 (Department of Occupational Safety and Health, 2016). Heat stress also may be defined as aggregate of environmental and physical factors causing the total heat load on human body which can cause heat strain and other physiological changes such as increased in sweating, high body core temperature and increased heart rate in body (Bahri et.al, 2015).

1.7.1.2 Knowledge, Perception and Practices

Knowledge is facts, information and skills acquired through experience or education; the theoretical or practical understanding of a subject besides an awareness or familiarity that gained by experience of a situation. While perception is the way in which something is regarded, understood and interpreted and the practices is defined as actual application or use of an idea, belief, or method as opposed to theories related to it according to Oxford Dictionary (2017).

1.7.1.3 Health

According to World Health Organization (WHO), (2017), health is a state of complete physical, mental and social well-being and not mere the absence of disease or infirmity.

1.7.1.4 Heat-related Symptoms

According to the type of heat-related illness, the symptoms can vary such as nausea, fatigue, dizziness, fainting, excessive sweating, muscle cramp, headache and vomiting (Better Health Channel, 2017). Heat stroke, exhaustion, heat cramps, heat rash and heat syncope are the illness that related to heat (Department of Occupational Safety and Health (DOSH), 2016).

1.7.1.5 Productivity

Productivity is a measure of output per unit of input where it may be examined collectively or viewed by industry to examine the trend in labor growth, wage levels and technological improvement. Taking regular breaks of five-minute break every 90 minutes can improve the individual productivity

(Investopedia, 2017). In addition, productivity is strongly dependent on thermal conditions, during physically demanding work that many studies indicate that changes in temperature of a few degrees can significantly influence performance in several tasks. After one hour of moderate physical work in temperature above 32 °C is estimated to affect the productivity as well (Lundgren et al., 2013).

1.7.1.6 Physiological Changes

Physiological changes or response is an automatic reaction that triggers a physical response to a stimulus such as when placed in a stressful situation, it may cause sweating and increase heart rate. The physiological response may be mild or severe but not generally dangerous as consult with the physician (Verywellmind, 2017).

1.7.1.7 Body Core Temperature

Core body temperature is the physical state at which the internal organs and bodily function at an optimal level. It is the body's ability to control its operating temperature within a constant range, where the ideal body core temperature is 37.7 °C (Encyclopedia, 2017). According to Lundgren et al. (2013), body core temperature beyond 38-39 °C, there is increased risk of heat exhaustion and can cause heat stroke with the failure of central nervous thermoregulatory system.

1.7.1.8 Blood Pressure

Blood pressure is the pressure of blood in the arteries that changes as the heart beats. The measurement is recorded into two which are systolic, the maximum pressure when the heart contracts and diastolic, the minimum pressure when the heart is at rest (British Heart Foundation, n.d.). Normal blood pressure for adults is defined as systolic pressure below 120 mmHg and a diastolic pressure below 80 mmHg while abnormal increase in blood pressure is having the blood pressure higher than 120/80 mmHg (National Heart, Lung and Blood Institute, 2015).

1.7.1.9 Heart Rate

Heart rate is the number of heart beats per minute which is based on the contraction of ventricles. It can be too fast or too slow (MedicineNet, 2017). Normal heart rate varies from person to person. Heart rate is normally between 60 and 100 beats per minute if in sitting or lying position or calm condition (American Heart Association, 2015)

1.7.2 Operational Definitions

1.7.2.1. Heat Stress

Heat stress can be measured using wet bulb globe temperature (WBGT) for every working days. The parameters are Dry Bulb Temperature (T_{db}) that is measured by thermal sensor, Natural Wet Bulb Temperature (T_{nwb}), measured by exposing a wet sensor and Globe Temperature (T_g) which the temperature measured inside a blackened, hollow, thin copper globe (Department of Occupational Safety and Health (DOSH), 2016). WBGT can be calculated using the formula for outdoor with a solar load:

$$WBGT_{out} = 0.7\ T_{nwb} + 0.2\ T_g + 0.1$$

Where:

WBGT = Wet bulb globe temperature index

T_{db} = Dry bulb temperature

T_{nwb} = Natural wet bulb temperature

T_g = Globe temperature

1.7.2.2. Knowledge, Perception and Practices

Knowledge, perception and practices was assessed by researcher-administered questionnaire on Section C. The questions cover on the respondent's response on the heat exposure which is mostly based on yes/no answers.

1.7.2.3. Health

Health status of the farmers are determined by the heat-related symptoms that experienced by the farmers during work period and also the physiological changes which are blood pressure, heart rate and body core temperature. These physiological changes were measured using an instant ear digital thermometer and digital blood pressure monitor during work and after work, while the heat-related symptoms were identified using the questionnaire based on the frequency of the farmers experienced the symptoms.

1.7.2.4 Heat-related Symptoms

Heat-related symptoms will be identified by researcher-administered questionnaire on Section D which is the impact of heat on health, for the symptoms experienced by the farmers and the frequency of experiencing the symptoms. The symptoms asked were based on the Likert Scale from never, rarely, sometimes, often and always in experiencing the symptoms.

1.7.2.5 Productivity

Productivity of the farmers were assessed using a productivity data sheet form that will be observed on the daily production output of the farmers for each day according to the group of work task during the working hours of the farmers. There are four work tasks involved in this research which are planting, suckers, manual weeding and harvesting. Planting and suckers group will be assessed by the number of tree planted and cutting off the suckers, while the weeding group will be observed based on the number of ridges done by the farmers per day. For the harvesting group, the productivity will be observed on the number of pineapples harvested per day. These productivity are observed in the morning and evening.

1.7.2.6. Body Core Temperature

An instrument for measuring body core temperature of the farmers was used, known as instant ear digital thermometer which measured for two times, during and after work period.

1.7.2.7 Blood Pressure

Blood pressure was measured using a blood pressure monitor during and after work period.

1.7.2.8 Heart Rate

Heart rate also was measured using the blood pressure during and after work period.

CHAPTER 2

LITERATURE REVIEW

2.1 Climate Change and Heat Stress

According to NASA (2017), climate change is a change in the typical or average weather of a region or city, also a change in Earth's overall climate which could be a change in Earth's overall climate or Earth's typical precipitation patterns. Average temperature has risen a little more than one-degree Fahrenheit during the past 100 years or so based on the observations that showed Earth's climate has been warming and can lead to big impacts although it is small changes in the Earth's average temperature. The warming climate likely will cause more flood, drought and heat waves with the rising of sea levels and melting of snow or ice. Intergovernmental Panel on Climate Change (IPCC) also stated in the Fifth Assessment Report, that a group of 1,300 independent scientific experts from countries all over the world under the auspices of United Nations, concluded there's a more than 95 percent probability that human activities over the past 50 years have warmed our planet and also forecasts a temperature rise of 2.5 to 1.0 degrees Fahrenheit over the next century. By 2100, the average global temperature is increasing and it will go up further 1.8 – 4.0 °C (estimated average 3.0 °C) depending on the actions to limit the greenhouse gas emissions (Kjellstorm et al., 2009).

Increasing ambient temperature means higher human exposure to heat can create unhealthy environment for people who are not able to protect themselves with air conditioning or other cooling methods in which during hot seasons in hot parts of the world (Kjellstorm et al., 2009). Jackson and Rosenberg (2010) stated in their research that heat exposure was indicated as the cause of death for about two thirds of the cases and as a contributing factor to the balance of the deaths. Heat stress, communicable disease, air pollution, lack of food and water security, extreme weather events, malnutrition, stress, mental health issues, vulnerable shelter and population migration among others are among the negative health effects from climate change. Heat stress is defined as the net heat load which a farmer is exposed according to Occupational Safety and Health Administration (OSHA). Heat stress occurs when the body fails to regulate internal temperature and the temperature may not return to normal by itself. For farmers that work in hot environments especially those exposed to high humidity condition simultaneously, can cause a serious health problem (Department of Occupational Safety and Health (DOSH), 2016).

2.2 Agriculture and Heat

According to International Labor Organization (ILO) in Code of Practice on Safety and Health in Agriculture (2011), agriculture is one of the most hazardous of all sectors and many agricultural workers suffer occupational accidents and ill-health each year including when exposed to noise, vibration, dust, chemicals and also extreme temperature. It is emphasized again by Lundgren et al. (2013) that they stated outdoor workers include agriculture, industry, fisheries, forestry, small and medium sized enterprises, indoor workplaces (for example without air conditioning), semi-outdoor workshops and construction work are the most vulnerable and the main sectors than are directly affected by climate change.

Agriculture is among the major employer in the developing world, where farmers normally at high risk of heat stress as they work under high pressure, perform extended hours of work in high heat and humidity, suffer dehydration and the knowledge on the prevention of heat is not sufficient enough (Lukman, 2016). 423 heat-related deaths among agricultural workers in the USA, 1992 – 2006 showed that the problem is still occurring based on the impact of heat exposure from a recent study (Kjellstorm et al., 2009). In addition, due to physically demanding labor and dangerous machinery, heat and sun exposure make agricultural work more dangerous, that they work all day without taking water or shade breaks, causing heat-related illness among them. They also face economic pressure to skip shade or water breaks in orde for them to earn more money as they usually get paid by (National Farm Workers Ministry, n.d.).

2.3 Heat Stress Affecting Physiological Changes

Heat stress can cause heat strain and other physiological reactions such as increased sweat production, higher body core temperature (BCT) and increased heart rate (HR) in body (Bahri et al., 2015). As mentioned by Lukman (2016) in his research study, a healthy human body is expected to maintain a core body temperature of 37 °C, temperature higher than that can result to body system malfunctioning. Therefore, according to Global Health Action (2009), if core body temperature (BCT) exceed 38 °C for over several hours, heat exhaustion and reduced psychometric motor capacity will occur and above 39 °C, more serious heat stroke and unconscious may occur. While according to Jackson and Rosenberg (2010), in their research on preventing heat-related illness among agricultural workers, emphasized that if body core temperature reaches 104° F, organ failure and death are likely to occur if cooling of the individual and medical care are not immediately obtained as such situation happened to any worker.

While for heart rate, ACGIH (1992) stated that individual heat stress exposure should be stopped when heart rate is in the excess 180 bpm sustained over several minutes for recovery heart rate at 1 minute exceed 110 bpm (Lukman, 2016). A normal resting heart rate for adults ranges from 60 to 100 beats a minute (Mayo Clinic, 2015).

High temperature can cause blood temperature to plummet as it can rise the blood pressure and the water loss through sweating decreased the blood volume, lowered the blood pressure and rapid heart rate and falls. In cold temperature, the diameter of blood vessels constricts causing the heart to work harder to push blood through the veins and arteries (Livestrong, 2017). Normal blood pressure ranges less than 120/80 mmHg in which the upper number indicate systolic blood pressure while the lower number indicate the diastolic blood pressure (American Heart Association, 2017). In addition, Blood Pressure Association (2008), discussed on the high blood pressure where the readings of blood pressure are consistently 140 over 90 or higher over a number of weeks, the probability of hypertension to occur and increase the risk of heart attack and stroke.

However, the impacts of extreme heat are not restricted to physiological changes only as heat is oppressive that could result in cognitive impairment and behavioral effects. Mental health concerns and increased suicide rates also has been linked to climate change (Hanna et al., 2011). Besides, comfort, strength, endurance, vision, coordination, concentration and judgement such as unsafe acts, injuries and illnesses are more likely to be influenced by the heat-induced physiological changes and dehydration as exposed to heat (Jackson and Rosenberg, 2010).

2.4 Heat-related Symptoms and Illness

Exposure to prolonged amounts of heat and humidity without relief or adequate fluid intake can cause various types of heat illness such as heat rash, heat cramps, heat exhaustion, heat syncope and heat stroke (Department of Occupational Safety and Health, 2016). According to Occupational Safety and Health Administration (OSHA)

(2006), heat cramps, heat exhaustion and heat stroke are the three kinds of major heat-related disorders. The risk of heat exhaustion starts when the body core temperature between 38 – 39 °C and can be progressed to heat stroke if not treated. The symptoms range from headache, fainting, seizures, confusion, vertigo, hallucination, delirium, and possibly coma as characterized by the rise of temperature, hot dry flushed skin and central nervous system dysfunction of a life-threatening condition (Lukman, 2016). While Luber and McGeehin (2008) in their study, said that the signs and symptoms include intense thirst, heavy sweating, weakness, paleness, discomfort, anxiety, dizziness, fatigue, fainting, nausea or vomiting and headache. Global Health Action (2009) in its publication, even emphasized that serious heat stroke and even death could occur after a short time if body core temperature (BCT) above 42 °C.

In order to prevent heat-related illness, Jackson and Rosenberg (2010) have mentioned some recommendations to maintain a healthy balance of heat gain and loss, such as avoid sun exposure, reduce exertion level while increasing rest breaks in hot weather, drinking early and often to maintain the hydration of workers and not only drinking in response to thirsty, regular rest breaks and education. For the hydration, general occupational guidance stated that the workers should drink about 1 cup of water per 20 minutes as the fluid loss primarily from sweating and urination. Workers must be ensured to stay hydrated and not lose more than 1.5 % body weight during shift (Dowell & Tapp, 2007). In addition, clothing also plays a crucial role during working as light colored, single layer clothing help reduce heat stress which also provide UV protection as well as providing a shade at the work area (Jackson and Rosenberg, 2010).

2.5 Heat Stress and Productivity

Agriculture workers, soldiers and labourers are often exposed to severe environmental heat stress which may decrease the work efficiency and productivity and may even threaten health (Epstein et.al, 2006). According to Kjellstorm et al. (2009), a few researches have been carried out aiming at quantifying the relationship between occupational heat exposure and productivity in work situations where the workers are 'self-paced'. However, although a method in reducing impacts of heat stress on health and work capacity such as 'siesta' are generally effective in avoiding serious health impacts however, it undoubtedly reduces the hourly productivity of the exposed workers. In addition, approximately 5 % of work productivity reduced from an increase of heat exposure (WBGT) of 1 °C (Sahu et al., 2013).

2.6 Metabolic Rate

According to DOSH (2016) in the Guidelines of Heat stress management at workplace, the metabolic rate influenced by the workers job scope and duration of heat exposure at work. Table 2.1 below showed the metabolic rate of farmers by work category;

Table 2.1: Work load category and metabolic rate according to DOSH.

Work Category	Metabolic Rate	Description
Rest	115 W	Sitting
Light	180 W	Sitting with manual work with hands and arms and driving. Standing with some light arm work and occasional working.
Moderate	300 W	Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling. Normal working. Moderate lifting
Heavy	415 W	Intense arm and trunk work, carrying, shoveling, manual sawing, pushing and pulling heavy loads, and walking at a fast pace. Heavy materials handling
Very heavy	520 W	Very intense activity at fast to maximum pace.

Source: TLVs and BEIs by ACGIH 2015 (DOSH, 2016)

2.7 Acclimatization

Department of Occupational Safety and Health (DOSH) stated in the guidelines on heat stress management at workplace 2016 that acclimatization is the process in which an individual adjusts to a gradual change in its environment such as change in temperature or humidity, that allowing it to maintain performance across a range of environmental conditions and the complete heat acclimatization itself need seven to fourteen days generally. As according to Dowell and Tapp (2007), body's acclimatization will continue to improve each day in the environment up to 3 weeks. The acclimatization begins with the consecutive exposure to working conditions for 2 hours at a time with a rise in metabolic rate that cause the body to reach 33% of optimum acclimatization by the fourth day of exposure. When the activity under heat stress condition is discontinued and a noticeable loss occurs after 4 days, the loss of acclimatization begins at that situation.

Lack of acclimatization, poor physical fitness and being overweight become the risk factors for exertional heat-related illness. Moreover, agricultural workers benefited from the acclimatization as it increased tolerance to heat stress although the seasonality of farm and inherent variability in maintaining work may play a role in the worker's ability to acclimate to hot conditions (Stoecklin-Marois et al., 2013).

CHAPTER 3

METHODOLOGY

3.1 Study Population

Pineapple farmers who were exposed to heat or high level outdoor temperature during work period at the farmland in Pontian and Ulu Tiram, Johor.

3.2 Study Area

Figure 3.1 showed the map location of study area which is Pontian, Johor. Pontian is a district in southwest Johor in which the name of Pontian was transformed form a Malay word "Perhentian" which means a stop. The name of Pontian is also used in the names of two towns in the district which are Pontian Besar and Pontian Kechil, in which the latter serves as the district capital (Tourism Johor, 2015). As of February 2018, Pontian has recorded the average temperature of 28 °C with the maximum temperature of 31 °C while Johor Bahru, the average temperature is 29 °C with the maximum and minimum temperature of 31 °C and 24 °C respectively (World Weather Online, 2018.). Maximum temperature recorded in Pontian and Johor Bahru for last year, 2017 around April to June, are 35 °C and 36 °C respectively. Besides, Johor is the largest hectarage of 8,934.5 hectares in Malaysia among other states with

Pontian as among the biggest hectarage for planted area of pineapple with 1,558.2 Ha (Department of Agriculture (DoA), 2016).

Figure 3.1: Study locations in Pontian and Ulu Tiram, Johor Bahru.

3.3 Study Design

This research was a cross sectional study on the knowledge, perception and practices in relation to the impact of heat on the health and productivity of pineapple farmers in Johor which is in Pontian and Ulu Tiram, Johor. It is a research tool used to collect data for a specific point of time in a defined population. For this research, pineapple farmers were the target population from the agricultural sector.

3.4 Sampling

3.4.1 Sample Unit

Sample unit for this study was the pineapple farmers that fulfilled the inclusion and exclusion criteria.

3.4.2. Sample Frame

List of farmers were obtained from the human resource management sections of both companies.

3.4.3 Sample Size

For this study, the sample size was calculated using for comparing two means (www.openepi.com - Sullivan et al., (2009)) as in Figure 3.2. The data used in calculating the sample size was based on previous study on Assessment on Physiological Effects on Heat Stress among Palm Oil Mill in Tropical Climate Condition (Dayana Hazwani, et al. 2014). The data used was as below;

Table 3.1: Data on previous study for sample size calculation

Variables	Mean ± SD
Body core temperature (before shift)	35.60 ± 0.48 ℃
Body core temperature (after 8 hours)	36.16 ± 0.60 ℃
Systolic BP (before shift)	105.17 ± 6.62 mm Hg
Systolic BP (after 8 hours)	113.13 ± 7.25 mm Hg
Diastolic BP (before shift)	82.93 ± 8.29 mm Hg
Diastolic BP (after 8 hours)	91.17 ± 6.78 mm Hg
Heart rate (before shift)	92.87 ± 5.89 bpm
Heart rate (after 8 hours)	99.50 ± 6.12 bpm

(Source: Dayana Hazwani, et al., 2014)

From the above data, sample size was calculated using the formula;

$$n = \frac{(\sigma_1^2 + \sigma_2^2/K)(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

$$n = \frac{(\sigma_1^2 + \sigma_2^2 * K)(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

Where;

n = Sample size

$Z_{1-\alpha/2}$ = standard error associated with confidence interval (95%) = 1.96

$Z_{1-\beta}$ = power

σ_1 = standard deviation of Group 1

σ_2 = standard deviation of Group 2

K = ratio = n_2/n_1

μ_1 = mean (larger)

μ_2 = mean (smaller)

Sample Size For Comparing Two Means

Input Data

Confidence Interval (2-sided)	95%		
Power	80%		
Ratio of sample size (Group 2/Group 1)	1		

	Group 1	Group 2	Difference*
Mean	35.6	36.16	-0.56
Standard deviation	0.48	0.6	
Variance	0.2304	0.36	

Sample size of Group 1	15
Sample size of Group 2	15
Total sample size	30

*Difference between the means

Results from OpenEpi, Version 3, open source calculator--SSMean
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

Figure 3.2: Sample size calculator on mean difference (Source:www.openepi.com)

The summary of the calculation was as below using the formula given;

Table 3.2: Results on sample size calculation for each variable

Variables	Sample size
Body core temperature (before shift vs after 8 hours)	30
Systolic BP (before shift vs after 8 hours)	24
Diastolic BP (before shift vs after 8 hours)	28
Heart rate (before shift vs after 8 hours)	26

From the above calculation and summary, the highest number of sample size was 30 from the variable of body core temperature. After consideration of 20% non-response rate, the sample size was 36 respondents.

3.4.4 Sampling Method

3.4.4.1 Location

Purposive sampling method was used for the selection of Pontian and Ulu Tiram as Johor is the largest hectarage of 8,934.5 hectares in Malaysia among other states. Besides, Pontian is among the areas with the biggest hectarage in Johor with 1,558.2 Ha (DoA, 2016).

3.4.4.2 Subject

As for sampling for study subjects, universal sampling method was used where the subjects were pineapple farmers. All farmers were taken as the subjects, however, only farmers that fulfilled the inclusion and exclusion criteria were selected for the study sample.

3.4.5 Inclusion Criteria

The inclusion criteria for the study were:

i. Full time farmers
ii. Age between 18 – 60 years
iii. Had been working for at least three months to be acclimatized to the working environment

3.4.6 Exclusion Criteria

i. Had been diagnosed to have chronic disease such as diabetes, hypertension, asthma and heart disease.
ii. Women
iii. Work task involving chemicals such as pesticide and fertilizers.

3.5 Material and Instruments

3.5.1 Questionnaire and Productivity Data Sheet

Questionnaire is a set of questions to obtain information from individual for the purpose of a survey or statistical study. In this study, the questionnaire consisted of 5 sections which were background information, working information, knowledge, perception and practices on heat exposure, impact of heat to health and impact of heat to the productivity (Appendix C). Researcher-administered questionnaire was involved in this study. This questionnaire was in bilingual language questionnaire where English and Malays version were used for the respondents to answer the questions according to language preference.

While the productivity data sheet was constructed to be able to measure the production output of the farmers daily during work period. Observation to the farmers during working was done by the researcher herself in order to fill in the data sheet form. The observation was based on four groups of work task which were planting, suckers, manual weeding and harvesting in the morning and evening. Planting and suckers group were assessed by the number of tree planted and number of suckers cut off, while the weeding group was observed based on the number of ridges done by the farmers per day. For the harvesting group, the productivity was observed on the number of pineapples harvested per day.

3.5.2 Wet Bulb Globe Temperature (WBGT)

Based on Figure 3.3, 3M QuesTemp WBGT was used for this study as it is the most accurate tool for adjusting the temperature for heat stress factors including the humidity, air temperature, radiant heat and temperature. It measured the heat index to which an individual was exposed to heat or high temperature. WBGT consisted of three sensors that input data into calculation which are dry-bulb thermometer, natural wet-bulb thermometer and globe thermometer. The meter automatically calculated the adjusted temperature using the sensor data inputs and programmed equations which for outdoor environments;

$$WBGT_{out} = 0.7\ T_{nwb} + 0.2\ T_g + 0.1$$

Where:

WBGT = Wet bulb globe temperature index

T_{db} = Dry bulb temperature, which indicates the ambient air temperature

T_{nwb} = Natural wet bulb temperature, which indicates humidity

T_g = Globe temperature, which indicates radiant heat

The measurement and placement of the instrument was as close as possible to the work area or around the working environment and measured for every working day as of work period. It was set up using a tripod stand and let the sensors to stabilize or achieve equilibrium for at least 25 minutes. For natural wet bulb thermometer, it consisted of wick that kept wet with distilled water and placed over a thermometer bulb which indicated the lowest temperature reached by the evaporation of water only, represented latent heat. The data of the sensors recorded were downloaded to a computer in an electronic form for analysis.

Figure 3.3: 3M QuesTemp WBGT

3.5.3 Instant Ear Digital Thermometer

Omron MC-510 Instant Ear Digital Thermometer as in Figure 3.4 was used to measure body core temperature of the farmers. The measurement was taken during and after work period. The reading of the thermometer was within 60 seconds and measured in the ears of the farmers.

Figure 3.4: Omron MC-510 Instant Ear Digital Thermometer

3.5.4 Digital Blood Pressure Monitor

For the measurement of blood pressure and heart rate of the farmers when exposed to heat, an Omron HEM-7120 Automatic Blood Pressure Monitor in Figure 3.5 was used which recorded both systolic and diastolic reading for blood pressure and heart rate as well. These measurements also was taken for two times as well, in which during and after work period in order to compare the physiological changes between different periods.

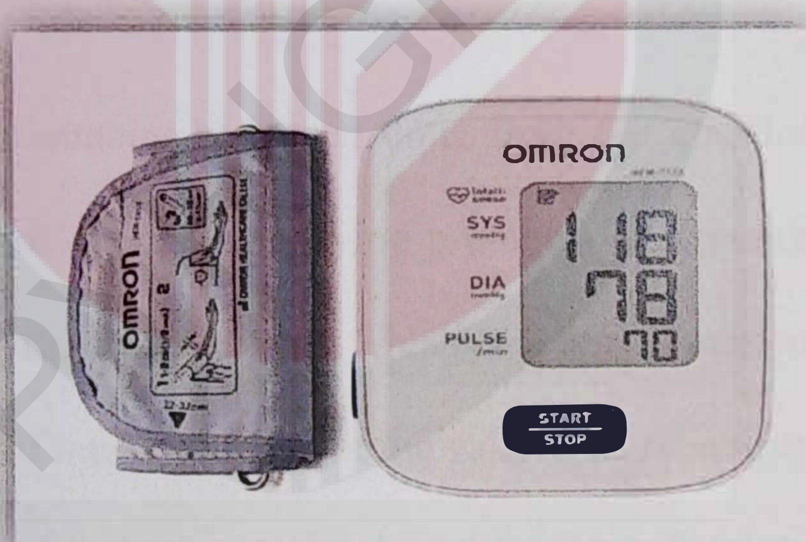

Figure 3.5: Omron HEM-7120 Automatic Blood Pressure Monitor

3.6 Data Quality Control

3.6.1 Calibration

All the instruments were calibrated before used in the actual data collection. Calibration was carried out to eliminate any measurement error and for the accuracy of the data collected. Each calibration was carried out according to the Standard Operating Procedure (SOP)

3.6.2 Pre-Test Questionnaire

Pre-test questionnaire had been done from the questionnaire constructed to improve the quality of data in identifying problems encountered from the questions being asked and solving the problems. This pre-test was carried out in a small target group or population of interest to test for the validity or reliability of the questionnaire. It was an opportunity for the researcher to get feedback from the pre-testing group to ensure the data collected was of quality.

Therefore, the pre-test questionnaire was carried out to 10 % of the sample size calculated and the respondents involved were from agricultural sectors to ensure similar background. Based on the pre-test questionnaire, the reliability of Cronbach's Alpha was 0.8 which was above 0.7, the acceptable reliability coefficient.

3. 7 Data Analysis

All the data were analyzed using IBM Statistical Package for Social Sciences (SPSS) Statistic Version 22.

Table 3.3: Research statistical analysis

No.	Specific Objectives	Statistical Analysis	
1.	To determine the background data (age, sex, race, height, weight, etc.) and working characteristics (duration of employment, work hours, break time etc.)	Descriptive analysis	
2.	To determine the farmer's knowledge, perception and practices on heat exposure with the heat index and workload category.		
3.	To determine heat index and metabolic rate.		
		Parametric	**Non-Parametric**
4.	To determine the correlation between heat index (WBGT) with the prevalence of heat-related symptoms, psychological parameters and productivity of the farmers.	Pearson correlation	Spearman Rank Correlation
5.	To compare the physiological changes during work and after work period and productivity in the morning and evening.	Paired T-test	Wilcoxon Signed Rank Test
6.	To compare productivity of the farmers in the morning and evening.		
7.	To determine the association between knowledge, perception and practices with health symptoms, physiological changes and productivity.	Chi-square	
8.	To determine the risk factors that have significant relationship with the health symptoms and productivity among farmers.	Multiple linear regression	

3.8 Ethical Consideration

Ethical issue of this study was obtained from Research Ethic Committee, Jawatankuasa Etika Penyelidikan Melibatkan Manusia (JKEUPM), Universiti Putra Malaysia and approved by the committee. The respondents were given the consent form and some descriptions informing them regarding this research study with the purpose of this study, procedure taken and activities to be done before participating in this study.

CHAPTER 4

RESULTS

4.1 Response rate

Eighty-two farmers participated in this study after considering inclusion and exclusion criteria. All participants were willingly participate for blood pressure, heart rate and body temperature measurement along with observation of their productivity based on the consent forms given to the farmers.

4.2 Background information

Background data were obtained from the questionnaire which include the information on age, height, weight, body mass index, nationality and medical status. From Table 4.1, this study involved 82 male farmers (100%) which made up of 80 (97.6%) Indonesian farmers. The farmer's age were ranged from 18 years old to 60 years old.

Majority of the farmers (74.4 %) have a normal body mass index while only one farmer (1.2 %) is in obese state. For their medical status, no farmer has any medical problem when participating in this research since farmers with medical problem were excluded from this study.

Table 4.1: Background information of the farmers

Variables	N	%
Age		
- ≤20	7	8.5
- 21-30	38	46.3
- 31-40	21	25.6
- 41-50	13	15.9
- 51-60	3	3.7
Nationality		
- Malaysian	2	2.4
- Indonesian	80	97.6
BMI		
- Underweight	6	7.3
- Normal	61	74.4
- Overweight	14	17.1
- Obese	1	1.2

N = 82

4.3 Working information

Based on Table 4.2 below, majority of the farmers were at harvesting work station, (32.9 %). Most of the farmers (35.4 %) employed around the range of one to five years of employment. About 73.2 % of the farmers took 15-30 minutes/once with 66 farmers (80.5%) took rest only once during working, All of the farmers wore a light work clothing during working and 62 of them claimed that no shady area was available at their workplace.

Table 4.2: Working information

Variables	N	%
Work task		
- Planting	11	13.4
- Suckers	25	30.5
- Manual Weeding	19	23.2
- Harvesting	27	32.9
Years of employment		
- <1 year	32	39.0
- 1 – 5 years	29	35.4
- 6 – 10 years	19	23.2
- > 10 years	2	2.4
Resting time		
- 10-15 minute/once	13	15.9
- 15-30 minute/once	60	73.2
- More than an hour/once	9	11.0
Frequency of resting		
- 1 times	66	80.5
- 2 times	15	18.3
- 3 times	1	1.2
Type of Clothing		
- Light work clothing (cotton t–shirt)	82	100.0
Availability of shady place at the place of work		
- Yes	20	24.4
- No	62	75.6

N = 82

4.4 Water intake

Water intake of the farmers per day was vary on each individual where from Table 4.3 below, 32 farmers (39.0 %) drank 3.0 litre a day with 41 farmers (50.0 %) drank water at the frequency of 5-10 times per day. Maximum water intake by the farmers were 7.5 - 8 litre per day which was only one farmer each.

Table 4.3: Water intake of the farmers.

Variables	n	%
Water intake per day		
- 1.0 litre	1	1.2
- 1.5 litre	22	26.8
- 2.0 litre	4	4.9
- 3.0 litre	32	39.0
- 4.0 litre	2	2.4
- 4.5 litre	13	15.9
- 5.0 litre	2	2.4
- 6.0 litre	4	4.9
- 7.5 litre	1	1.2
- 8.0 litre	1	1.2
Frequency of water intake per day		
- <5 times	17	20.7
- 5-10 times	41	50.0
- >10 times	24	29.3

N = 82

4.5 Knowledge on heat

Based on the findings on the farmer's knowledge as in Table 4.4 and Table 4.5, majority of the farmers (74.4 %) have a fair knowledge on heat, that they knew direct sunlight exposure, heavy clothing, lack of airflow, heavy workload and dehydration could contribute to heat stress. However, 100 % of the farmers stated that having diseases could not contribute to heat stress. This scoring method was adopted from the study on knowledge, attitude and practice (KAP) by Nahida (2007), where 80-100 % was classified as good, 50-79 % was fair or adequate and less than 50 % was considered as low (Enquselassie & Ayele, 2015).

Table 4.4: Knowledge on heat

Variables	N (Yes)	%
Increase in temperature contribute to heat stress	45	54.9
Direct sunlight exposure contribute to heat stress	54	65.9
High level of humidity in the environment contribute to heat stress	21	25.6
Wearing heavy clothing contribute to heat stress	52	63.4
Lack of air flow in the environment contribute to heat stress	73	89.0
Heavy workload or high demanding task contribute to heat stress	68	82.9
Body dehydration contribute to heat stress	78	95.1
Existing illnesses (hypertension, cardiovascular disease & etc) contribute to heat stress	0	0

N = 82

Table 4.5: Score on knowledge

Variables	n	%
Good	10	12.2
Fair	61	74.4
Poor	11	13.4

N = 82

4.6 Perception on heat

From Table 4.6 and Table 4.7, about 49 farmers (59.8 %) have a fair perception on heat, in which most of them have perception that personal protective equipment such as hats was necessary during working in the field (91.5 %) and this heat protection practices could prevent them from heat stress (85.4 %).

Table 4.6: Perception on heat

Variables	N (Yes)	%
Do you think that you have a risk of heat stress	33	40.2
Feeling tired when working in the field is a serious problem to me	39	47.6
It is necessary to use personal protective equipment when working in the field	75	91.5
Physiological changes are related to heat stress	59	72.0
Heat protection practices prevent from heat stress	70	85.4
Heat stress influences my health	32	39.0
Heat stress influences my productivity	31	37.8
I am healthy and do not need to protect myself from the sun exposure	14	17.1

N = 82

Table 4.7: Score of perception on heat

Variables	n	%
Good	7	8.5
Fair	49	59.8
Poor	26	31.7

N = 82

4.7 Practices on heat protection

Based on Table 4.9, showed the evaluation of farmer's practices on heat exposure, 73 farmers (89 %) have a poor practices or attitude when exposed to high temperature of outdoor working. As in Table 4.8, the most common practices by the farmers were to stay hydrated with enough fluid (n=82) and to use personal protective equipment such as hats (n=61). In addition, only 19 of the farmers planned heavy activities during early morning or late evening of the day.

Table 4.8: Farmers' practices when exposed to heat

Variables	N (Yes)	%
Stay hydrated with enough fluids	82	100.0
Move to cooler environment/shady area	17	20.7
Cool bath/Shower	17	20.7
Wear light-coloured, loose-fitting, breathable clothing (cotton)	52	63.4
Use any personal protective equipment's (sun glasses, hat and mask)	63	76.8
Plan heavy activities during the early morning or evening of the day	19	23.2
Wet the clothing or sprinkle water on body when working under direct sunlight	0	0

N = 82

Table 4.9: Score of practices on heat protection

Variables	n	%
Good	0	0
Fair	29	35.4
Poor	53	64.6

N = 82

4.8 Impact of heat on health

Prevalence of self-reported heat-related symptoms were obtained from the questionnaire where the symptoms are heavy sweating, nausea, vomit, headache, dizziness, fainting, fatigue, severe thirst, muscle cramps and unconsciousness. The symptoms were ranked into five scales which were never, rarely, sometimes, often and always as shown in Table 4.10. Heavy sweating, severe thirst and fatigue were highest reported symptoms, with 100%, 79.3 % and 95.1 % respectively. While for unconsciousness, 100% of the farmers never experienced the symptoms during their working period.

Table 4.10: Heat-related symptoms reported by the farmers

Variables	n	%
Nausea		
- always	1	1.2
- often	1	1.2
- sometimes	4	4.9
- rarely	16	19.5
- never	60	73.2
Vomit		
- sometimes	2	2.4
- rarely	10	12.2
- never	70	85.4
Headache		
- always	2	2.4
- often	5	6.1
- sometimes	20	24.4
- rarely	15	18.3
- never	40	48.8
Dizziness		
- always	2	2.4
- often	5	6.1
- sometimes	22	26.8
- rarely	15	18.3
- never	38	46.3
Fainting		
- rarely	1	1.2
- never	81	98.8
Fatigue		
- always	78	95.1
- often	4	4.9
Severe thirst		
- always	65	79.3
- often	17	20.7
Muscle cramps		
- always	1	1.2
- often	3	3.7
- sometimes	9	11
- rarely	14	17.1

N = 82

4.9 Productivity

Based on Table 4.11, for the productivity of the farmers when exposed to high temperature, 97.6 % of them did have a production target for their work task each day and 69.5 % achieved the target. However, 30.5 % of the pineapple farmers did not achieve the production target and 22.0 % of them stated that heat stress became a reason for them to not be able to complete the target. Among the 18 farmers (22.0 %), 9 farmers (50.0 %) were not able to complete the production target during working.

Table 4.11: Farmer's productivity

Variables	n	%
Any production target for each day		
- yes	80	97.6
- no	2	2.4
Achieve the production target		
- yes	57	69.5
- no	25	30.5
If NO, did heat stress becomes a reason for you to not be able to achieve the target		
- yes	18	22.0
Exposure to heat affect your working productivity by		
- absenting from work	3	16.7
- requiring additional time to complete the target than usual	6	33.3
- not being able to complete the production target during working	9	50.0

N = 82

4.10 Heat index and metabolic rate

Heat monitoring was conducted for 18 days where heat index was range from 27.2 °C (lowest) to 31.6 °C (highest) with the mean value for WBGT of 18 days was 29.5 °C. While mean value for humidity was 60.2 % with the range from 48.3 % (lowest) to 72.8 % (highest) on the recorded days.

From Table 4.13, the metabolic rate varied for each work task in which Threshold Limit Value (TLV) for heavy workload is 27.5 °C while 29.0 °C for moderate work according to 75% work and 25% rest regimes (ACGIH, 2015).

Based on Table 4.12, most of the day recorded on Wet Bulb Globe Temperature (WBGT), it showed that 17 days over 18 days were exceeded TLV for heavy work (planting and harvesting) which is 27.5 °C. While 12 days over 18 days showed an exceed limit of WBGT from TLV of moderate work which is 29.0 °C. In addition, the highest humidex recorded was during the first day which was 40.7 °C, indicated that great discomfort and uncomfortable with the condition.

Table 4.12: Heat index and humidity by day

Day	WBGT value (°C)	Humidity (%)	Humidex (°C)
1	29.6	65.8	40.7
2	28.6	66.0	38.2
3	29.0	59.4	37.6
4	29.0	62.9	37.5
5	29.8	54.5	38.3
6	29.2	56.3	37.4
7	30.8	58.3	40.1
8	30.0	63.2	40.3
9	27.9	72.8	36.3
10	28.0	60.9	36.5
11	27.2	54.2	34.8
12	28.2	70.2	34.6
13	28.9	57.4	34.8
14	30.2	63.9	39.6
15	30.9	62.1	39.1
16	31.2	54.3	39.3
17	31.6	48.3	39.2
18	30.3	52.2	38.9

Table 4.13: Workload category for each work task

Work Task	Workload Category	TLV for heat (°C)
Planting	Heavy	27.5
Suckers	Moderate	29.0
Manual weeding	Moderate	29.0
Harvesting	Heavy	27.5

4.11 Correlation between WBGT with heat-related symptoms, physiological parameters and productivity

Self-reported heat-related symptoms of respondents was obtained from research-administered questionnaire in which consist of 10 symptoms that related to heat exposure as the respondents have experienced during outdoor working. From the correlation analysis in Table 4.14, there was no significant correlation between the prevalence of heat-related symptoms and WBGT recorded with only symptoms of headache, dizziness and fainting have a positive correlation while others were otherwise.

Table 4.14: Correlation between WBGT and heat-related symptoms

Symptoms	WBGT	
	Coefficient (r)[a]	P
Nausea	- 0.058	0.602
Vomit	- 0.030	0.792
Headache	0.105	0.346
Dizziness	0.197	0.076
Fainting	0.071	0.523
Fatigue	-0.146	0.192
Severe thirst	-0.197	0.076
Muscle cramps	-0.099	0.374

[a] Spearman rank correlation Coefficient
N = 82

Table 4.15 above showed the correlation between WBGT and physiological parameters (blood pressure, body temperature and heart rate). All of the physiological parameters which were systolic blood pressure, diastolic blood pressure, body temperature and heart rate showed a positive correlation with WBGT, in which indicated that increased in WBGT, cause increased core body temperature, blood pressure and heart rate. However, only body temperature has significant correlation between WBGT and physiological parameters during work (p=0.031).

While for the after work, statistical analysis showed there was no significant correlation between WBGT and physiological parameters. However, systolic blood pressure and body core temperature showed a positive correlation with more strong positive correlation on body core temperature than systolic blood pressure.

Table 4.15: Correlation between WBGT and physiological parameters during work and after work

Physiological Parameters	WBGT			
	During Work		After Work	
	Coefficient (r)[a]	p	Coefficient (r)[a]	p
Systolic Blood Pressure	0.384	0.273	0.058	0.873
Diastolic Blood Pressure	0.278	0.436	-0.306	0.390
Body Core Temperature	0.680	0.031*	0.536	0.110
Heart Rate	0.284	0.427	-0.125	0.731

[a] Pearson Correlation Coefficient
***significant at $p<0.05$**
n = 77

As for the productivity of the farmers, there were four work tasks that were observed in the morning and evening, which were planting, suckers, weeding and harvesting. Only few representatives of each work task were observed for their productivity, in which six planters, five from suckers, four from manual weeding and eleven harvesters.

According to Table 4.16, there were a significant correlation between WBGT and productivity of planting and harvesting with a negative correlation both in the morning and evening. In the morning, planting and harvesting were significant at ($p=<0.001$, $p=<0.001$), while in the evening, the significance was at ($p=0.026$, $p=0.018$) respectively. While the other two work tasks (suckers and manual weeding) showed no significant correlation between WBGT and the productivity in the morning and evening. However, each work task showed negative correlative between WBGT and the productivity of two different periods in which indicated that productivity decreased as WBGT increased.

Table 4.16: Correlation between WBGT and productivity in the morning and in the evening

Productivity	WBGT			
	Morning		Evening	
	Coefficient (r)[a]	p	Coefficient (r)[a]	P
Planting [b]	-0.945	<0.001***	-0.693	0.026*
Suckers [c]	-0.296	0.629	-0.364	0.547
Manual weeding [d]	-0.092	0.908	-0.547	0.453
Harvesting [e]	-0.937	<0.001***	-0.693	0.018*

[a] **Pearson Coefficient Correlation**
***significant at p<0.05**
*****significant at p<0.001**
$n^b = 6$, $n^c = 5$, $n^d = 4$, $n^e = 11$

4.12 Comparison of physiological changes of the farmers during work and after work and productivity in the morning and evening

From the result shown in Table 4.17, there were significant differences of body temperature (p=<0.001), systolic blood pressure (p=0.001) and diastolic blood pressure (p=<0.001) and also heart rate (p= <0.001) during and after work. The mean value of body temperature, blood pressure and heart rate were higher during work that could be due to temperature changes as of working time and physical activities performed by the farmers.

Table 4.17: Comparison of physiological changes of the farmers during and after work

Physiological Changes	Mean (SD)		t-statistics	P
	During Work	After Work		
Body Core Temperature	36.18 (0.16)	35.89 (0.19)	6.47	<0.001***
Systolic Blood Pressure	133.60 (4.47)	125.60 (5.72)	5.08	0.001**
Diastolic Blood Pressure	80.58 (4.28)	73.35 (5.26)	9.62	<0.001***
Heart Rate	82.14 (6.88)	76.19 (5.12)	6.55	<0.001***

[a] **Paired T-Test**
****significant at p<0.01**
*****significant at p<0.001**
n = 77

For the productivity of the farmers, there was a decrease in their productivity in the morning and evening for each work task according to mean value in Table 4.18. However, only suckers and harvesting have a significant difference between morning and evening (p=0.013, p=<0.001) respectively.

Table 4.18: Comparison of productivity of the farmers in the morning and evening

Productivity	Mean (SD)		t-statistics	p
	Morning	Evening	(df)	
Planting [b]	926.90 (332.286)	686.50 (819.802)	0.971 (9)	0.357
Suckers [c]	1170.20 (189.670)	613.00 (177.641)	4.277 (4)	0.013*
Manual Weeding [d]	55.50 (44.170)	51.50 (80.401)	0.211 (3)	0.847
Harvesting [e]	726.82 (445.452)	264.27 (156.549)	4.688 (10)	<0.001***

[a] Paired T-test
***significant at p<0.05**
*****significant at p<0.001**
$n^b = 6$, $n^c = 5$, $n^d = 4$, $n^e = 11$

4.13 Association between knowledge, perception and practices with health symptoms, physiological changes and productivity

Based on the Table 4.19, there were only two significant association found, in which perception was significantly associated with the vomit symptom (p=0.030), while knowledge was significantly associated with fainting symptom (p=0.038). For physiological changes and productivity in Table 4.20 and Table 4.21 respectively, no significant association with knowledge, perception and practices was found from the analysis.

Table 4.19: Association between knowledge, perception and practices with health symptoms

	Nausea			Vomit			Headache			Dizziness			Fainting			Muscle cramps		
	N (%)	X^2	p	N (%)	X^2	p	N (%)	X^2	p	N (%)	X^2	p	N (%)	X^2	P	N (%)	X^2	p
Knowledge																		
- Good	10 (12.2)			10 (12.2)			10 (12.2)			10 (12.2)			10 (12.2)			10 (12.2)		
- Fair	61 (74.4)	0.272	0.873	61 (74.4)	0.502	0.778	61 (74.4)	1.180	0.554	61 (74.4)	0.062	0.969	61 (74.4)	6.534	0.038*	61 (74.4)	1.394	0.498
- Poor	11 (13.4)			11 (13.4)			11 (13.4)			11 (13.4)			11 (13.4)			11 (13.4)		
Perception																		
- Good	7 (8.5)			7 (8.5)			7 (8.5)			7 (8.5)			7 (8.5)			7 (8.5)		
- Fair	49 (59.8)	4.511	0.105	49 (59.8)	6.998	0.030*	49 (59.8)	1.258	0.533	49 (59.8)	0.042	0.979	49 (59.8)	2.180	0.336	49 (59.8)	1.094	0.579
- Poor	26 (31.7)			26 (31.7)			26 (31.7)			26 (31.7)			26 (31.7)			26 (31.7)		
Practices																		
- Fair	29 (35.4)	0.862	0.353	29 (35.4)	0.661	0.416	29 (35.4)	0.005	0.946	29 (35.4)	0.068	0.795	29 (35.4)	0.554	0.457	29 (35.4)	1.451	0.228
- Poor	53 (64.6)			53 (64.6)			53 (64.6)			53 (64.6)			53 (64.6)			53 (64.6)		

Chi square analysis
***significant at p<0.05**

Table 4.20: Association between knowledge, perception and practices with physiological changes

	Body core temperature			Systolic blood pressure			Diastolic blood pressure			Heart rate		
	N (%)	X^2	p	N (%)	X^2	p	N (%)	X^2	p	N (%)	X^2	p
Knowledge												
- Good	4 (20.0)			4 (20.0)			4 (20.0)			4 (20.0)		
- Fair	13 (65.0)	1.410	0.494	13 (65.0)	2.764	0.698	13 (65.0)	4.615	0.329	13 (65.0)	0.567	0.753
- Poor	3 (15.0)			3 (15.0)			3 (15.0)			3 (15.0)		
Perception												
- Good	2 (10.0)			2 (10.0)			2 (10.0)			2 (10.0)		
- Fair	18 (90.0)	0.000	1.000	18 (90.0)	4.568	0.102	18 (90.0)	0.794	0.672	18 (90.0)	0.117	0.732
- Poor	-			-			-			-		
Practices												
- Fair	15 (75.0)	0.267	0.606	15 (75.0)	0.741	0.690	15 (75.0)	4.457	0.108	15 (75.0)	0.351	0.554
- Poor	5 (25.0)			5 (25.0)			5 (25.0)			5 (25.0)		

Chi square analysis

Table 4.21: Association between knowledge, perception and practices with productivity (work task)

	Planting			Suckers			Manual weeding			Harvesting		
	N (%)	X^2	p	N (%)	X^2	p	N (%)	X^2	p	N (%)	X^2	p
Knowledge												
- Good	4 (20.0)			3 (30.0)			2 (25.0)			4 (18.2)		
- Fair	13 (65.0)	0.834	0.659	6 (60.0)	2.000	0.368	5 (62.5)	1.600	0.449	15 (68.2)	2.025	0.363
- Poor	3 (15.0)			1 (10.0)			1 (12.5)			3 (13.6)		
Perception												
- Good	2 (10.0)			2 (20.0)			2 (25.0)			3 (14.3)		
- Fair	18 (90.0)	0.022	0.881	8 (80.0)	2.500	0.114	6 (75.0)	0.889	0.346	18 (85.7)	0.489	0.783
- Poor	-			-			-			-		
Practices												
- Fair	15 (75.0)	0.067	0.795	7 (70.0)	0.476	0.490	5 (62.5)	1.600	0.206	15 (68.2)	0.050	0.823
- Poor	5 (25.0)			3 (30.0)			3 (37.5)			7 (31.8)		

Chi square analysis

4.14 Selected factor related to the self-reported health symptoms and productivity

From Table 4.22 and Table 4.23, showed the selected factors that contributed to health symptoms and productivity. Among the variables selected, work task, age, body mass index (BMI), metabolic rate and WBGT value were the risk factors that have significant relationship with the health symptoms. The health symptoms were fatigue, headache, dizziness, severe thirst and muscle cramps.

Productivity was analysed by work tasks which consisted of planting, suckers, manual weeding and harvesting. In Table 4.23, humidity has a significant relationship with the planting and harvesting work task respectively. Heart rate and diastolic blood pressure were significantly related to suckers and manual weeding respectively.

Table 4.22: Selected factor related to self-reported health symptoms

Variables	B (95% CI)	t-statistics	P
Fatigue [a]			
- **Work task**	-0.059 (-0.103, -0.015)	-0.2660	0.009**
Headache [b]			
- **Metabolic rate**	0.520 (0.040, 0.999)	2.157	0.034*
Dizziness [c]			
- **WBGT**	70.690 (1.168, 140.212)	2.023	0.046*
Severe thirst [d]			
- **Age**	0.012 (0.002, 0.021)	2.454	0.016*
Muscle Cramps [e]			
- **BMI**	0.076 (0.012, 0.141)	2.356	0.021*

Multiple Linear Regression (Stepwise)
***significant at $p<0.05$**
****significant at $p<0.01$**
$R^{2\,a} = 0.081$, $R^{2\,b} = 0.055$, $R^{2\,c} = 0.049$, $R^{2\,d} = 0.070$, $R^{2\,e} = 0.065$

Table 4.23: Selected factor related to productivity (work task)

Variables	B (95% CI)	t-statistics	p
Planting [a]			
- **Humidity**	-20.133 (-30.609, -9.657)	-6.116	0.009**
Suckers [b]			
- **Heart rate**	254.000 (95.586, 412.14)	5.103	0.015*
Manual Weeding [c]			
- **Diastolic blood pressure**	17.378 (7.838, 28.918)	5.797	0.010**
Harvesting [d]			
- **Humidity**	17.586 (7.547, 27.626)	5.575	0.011*

Multiple Linear Regression
***significant at $p<0.05$**
****significant at $p<0.01$**
$R^{2\,a} = 0.926$, $R^{2\,b} = 0.897$, $R^{2\,c} = 0.918$, $R^{2\,d} = 0.912$

CHAPTER 5

DISCUSSION

5.1 Background information

This study involved all male farmers consisted of Indonesian farmers (97.6%) and Malaysian farmers (2.4%), in which from two different locations where there was no significant difference between these two locations on the temperature, humidity and pressure, in which it was assumed as equal between these two locations. The difference in gender was supported and explained by Lundgren et al. (2013) in the study, as for extremely hot and dry environments, males have higher maximal sweat rates that enhance their tolerance to that environments. In addition, the effect of heat stress on performance seem to be more adverse for males than females (Witterseh et al., 2004). Besides, since the workers varied with age from young age to elderly, elderly can be seen more on the adverse health effects (Heidari et al., 2015).

There were 74.4% of the farmers with normal body mass index while 7.3 % with an underweight and 17.1 % and 1.2 % of the farmers were overweight and obese. This was supported by a study by Lundgren et al. (2013), whom with small body size, overweight, elderly and people with medical conditions such as cardiovascular diseases, diabetes, skin, liver, kidney and lung problems and pregnancy were the people with the highest risk when working in heat. According to Dowell and Tapp (2007), age, weight, physical fitness, acclimatization, metabolism, alcohol or drugs, medications and medical conditions such as diabetes and hypertension affect a person's sensitivity to heat. Those who were taking medications could impair the body's cooling mechanism and alter normal distribution of blood flow in response to heat exposure.

5.2 Working information

Sixty farmers rested (73.2 %) for 15-30 minutes/once and 66 of them (80.5 %) only rested once during work period. It was different from a study by Dowell and Tapp (2007) on frequency of resting in which there times, where NIOSH REL and ACGIH TLV assume that normal work/rest regimen of 5-day workweek and an 8-hour workday with two 15-minutes break (short morning and afternoon breaks) and a 30 minutes lunch break. Resting reduces direct heat gain from solar radiation and improves the thermal gradient between the body and environment. Frequent alternating between work-rest cycles can significantly reduce heat stress while maintaining the production flow, besides extend the time for physiological recovery.

In addition, all the workers wore light work clothing which can reduce heat stress and the clothing choices itself could impact the heat stress at some degree (Jackson & Rosenberg, 2010).

5.3 Water intake

About 32 (39.0 %) farmers drank 3.0 litre a day with 41 farmers (50.0 %) drank water at the frequency of 5-10 times per day. While the maximum of water intake was 7.5 - 8 litre per day which was only one farmer each. According to Lundgren et al. (2013), fluid requirements generally depend on work rate, the ambient climatic conditions and on individual physiological and biochemical characteristics. Normal human body contain approximately 60% of water, about 34-40 L in an adult person. People that highly motivated to perform hard work may incur losses of 3-4 L before serious thirst forces them to stop and drink and mostly they are being aware of thirst once they have lost 1-2 L of body water (Cortez, 2009). Therefore, proper hydration with enough fluid is important as the workers sweat about 1 litre per hour (Sahu et al., 2013).

This was supported by Stoecklin-marois et al., (2013), that employer must encourage workers to drink an 8 ounces cup of water every 15 minutes to maintain hydration in order to counter body fluid loss when working in extreme heat. In addition, employers required to provide farmers with clean and cool drinking water.

5.4 Knowledge on heat exposure

From Table 4.5, 12.2 % of the farmers had a good knowledge on heat, while 74.4 % has a fair knowledge according to the scoring method for 82 farmers. It was similar to a study by Heidari et al. (2015), where people employed on the farm often do not pay much attention to hazards when working and take preventive measures due to low level of awareness and also lack of knowledge on heat exposure. This can be implied in this study that majority of the farmers had a fair knowledge on heat as Table 4.5. While in another study supported by Lundgren et al. (2013), stated that it is common as for farm workers that work in heat and high humidity often do not have sufficient knowledge on the prevention from heat exposure.

However, it was different by a study by Stoecklin-marois et al. (2013).which discussed on the level of heat knowledge between women and men, in which the results stated the level of knowledge was moderate 70 % of both men and women that they were not at all concerned on the risk of heat illness at workplace, however men is significantly higher percentage than women with correct response.

5.5 Perception on heat exposure

The farmers were majority on fair perception. This perception of them could be as they have adapted or acclimatized to the working environment as the minimum duration of employment of the farmers in this study was three months as they said that feeling tired was not a serious problem to them during working. Dowell and Tapp (2007) supported this study, as body's acclimatization will continue to improve each day in the environment up to 3 weeks. They also stated having heat stress did not the impact their health and productivity according to 61 % and 62.2 % of the farmers that were saying no on that.

5.6 Practices on heat protection

Based on the scoring method, 53 farmers (64.6 %) had a poor practices on heat exposure although most of them kept themselves hydrated, and used hats to protect from heat exposure. Based on the researcher's observation, this is because usually their work activities depend on the working schedule, conditions as well as the production target that must be completed for the day.

Dehydration, sodium loss and elevated body core temperature are due to inadequate water and electrolyte intake as they perform heavy work in a hot conditions. Ideally, fluid should be ingested every 15-20 minutes (5-7 ounces) at temperature 50 - 70 °F (Dowell & Tapp, 2007). While in another study supported by Golbabaei et al. (2016), short break in shaded areas, drinking water frequently, using personal protective equipment like sunglasses, hats and mask are the most common method that outdoor workers used while working in hot weather. The study also found that almost all the respondents have poor level of workers behavior to avoid heat.

5.7 Impact of heat on health

Heavy sweating, thirst and fatigue had the highest 'always' recorded symptoms, in which 100%, 79.3 % and 95.1 % respectively. While no farmer had experienced for unconsciousness during their outdoor work period. From a similar previous study supported by Bahari and Dubashini (2015), also recorded acute health complaints due to thermal stress with the highest percentage of farmers experienced fatigue (65%), headache (45%) as the second highest and fainting (3.3%) as the lowest percentage of health complaints by 60 farmers.

While in a study on the study on physiological effects on palm oil mill workers exposed to extreme heat condition by Bahri et al. (2015), there were five symptoms that were complaint by the workers, in which fatigue, headache, nausea, uncoordinated muscle and also dizziness. However, from the results shown in that study, the most complaint symptoms by the workers were fatigue and headache, 100 % and 79.7 % complaint respectively.

5.8 Heat index and metabolic rate

Heat index was range from 26.2 °C (lowest) to 31.6 °C (highest) with the mean value for WBGT of 18 days was 29.5 °C. While mean value for humidity was 60.15 % with the range from 48.3 % (lowest) to 72.8 % (highest) from the recorded days. The combination of hot weather and high humidity with worker's physical exertion and dehydration can cause heat-related illness among workers as well as reduce work performance and productivity (Tawatsupa et al., 2012).

Threshold Limit Value (TLV) for heavy workload is 27.5 °C while 29.0 °C for moderate work according to 75% work and 25% rest regimes (ACGIH, 2015). This was supported from a study by Kjellstrom et al. (2009), where they discussed on the recommended maximum WBGT exposure levels at different work intensities and rest/work ratios for an acclimatized worker wearing light clothing. For 75% work capacity and 25% rest time, the maximum WBGT exposure for moderate and heavy work are 29 °C and 27.5 °C respectively. Both planting and harvesting were categorised into heavy work load as their works required them to push and pull a heavy loads with intense arm and trunk work, while suckers and manual weeding were moderate work with moderate hand, arm and leg work.

Most of the day recorded on Wet Bulb Globe Temperature (WBGT) showed WBGT value exceeded TLV for both moderate work which is at 29.0 °C and heavy work at 27.5 °C. According to Department Of Occupational Safety And Health (2016) on the Guidelines on Heat Stress Management at Workplace, WBGT value that exceeded TLV is concluded as high risk for heat stress in which further analysis may be required. It was supported by Srivastavaf et al., (2000), on a note to TLV for heat stress, higher heat exposure than stated in the TLV are permissible if the workers are under medical surveillance and they are more tolerant to work in heat than the average worker. However, no worker should continue their work when their body temperature exceeds 38 °C.

Besides, from the data on humidex recorded for 18 days, the highest humidex number was 40.7 °C which indicated the great discomfort and uncomfortable condition to the farmers. According to Infrastructure Health and Safety Association, (n.d.), most people are comfortable at humidex level less than 29 °C, some discomfort at the range from 30 °C to 39 °C, uncomfortable at the range from 40 °C to 45 °C and for the humidex levels over 45 °C, the labour must be restricted.

5.9 Correlation between WBGT and heat-related symptoms

There was no significant correlation between the prevalence of heat-related symptoms and WBGT recorded however positive correlation for the symptoms nausea, vomit and muscle cramps. However, based on the descriptive analysis, all 82 farmers reported as experienced the symptom of sweating as always and unconsciousness as never.

Jackson and Rosenberg (2010) supported this study, mentioned that sets of these symptoms reported by the workers caused by excess heat and the body's autonomic dissipation mechanisms commonly categorized as one of the five illnesses, which are heat rash, heat syncope, heat cramps, heat exhaustion and heat stroke. The level of severity of the heat-related illnesses started from low severity, heat rash to high severity, heat stroke. Heat stroke can cause fatal due to breakdown of body's thermoregulation ability and as of that, it should be prompt immediately to medical attention

5.10 Correlation between WBGT and physiological parameters during work and after work

Systolic blood pressure, diastolic blood pressure, body temperature and heart rate showed a positive correlation with WBGT, in which indicated that increased in WBGT, cause increased core body temperature, blood pressure and heart rate. However, only body temperature has significant correlation between WBGT and physiological parameters during work at the significant value p=0.031.

This study was supported by a study by Kjellstrom et al., (2009), where the worker were at risk of increased core body temperature at above 38 °C when the physical activity is high in a hot working environment. Besides, heat stroke may occur if the temperature exceed 39 °C and cause life-threatening to the worker above 40.6 °C. In addition, increased heart rate indicates cardiac stress both from the physical work and heat exposure (Sahu et al., 2013).

5.11 Correlation between WBGT and productivity in the morning and evening

WBGT and productivity for planting and harvesting were significantly correlated in the morning (p=<0.001, p=<0.001) and in the evening (p=0.026 and p=0.018) respectively with negative correlation. This could be due difference in the metabolic rate and also the physical activities performed by the farmers as planting and harvesting were in heavy work category and use more energy than suckers and manual weeding which were in moderate category. The negative correlation indicated that higher WBGT values, decreased the work output or productivity of the farmers.

According to Parsons (2006), thermal conditions can affect output, accident rates, behavioral and cognitive performance. The productivity is affected after about one hour of moderate physical work in temperature above 32 °C (Lundgren et al., 2013). This implied to negative correlation on suckers and manual weeding of moderate works that indicated high heat index cause the decrease in productivity of the farmers although no significant correlation is recorded from the analysis of the result.

This study was supported by Sahu et al. (2013), which emphasized that increase in heat exposure as well as the order of working hour gradually decreases the work productivity per hour as the workers produce less as their working time progresses. Work productivity may reduce approximately 5% with the increase of WBGT of 1 °C. It is also supported by Kjellstorm et al. (2009) in their research that tolerance time in heavy work could reduce by 4-5 minutes per 1 °C increases of WBGT.

On the other hand, increase of individual metabolic rate make the human body more heat from the heavy workload of heavy activities at the farm. Dehydration, heat-related illness and rise of body core temperature above 38 °C were the results from losing too much sweat through heavy activities under hot temperature that the body cannot have enough water loss to cool itself (Heidari et al., 2015).

5.12 Comparison of physiological changes of the farmers during work and after work

The results showed that there were significant differences of body temperature (p=<0.001), systolic blood pressure (p=0.001) and diastolic blood pressure (p=<0.001) and also heart rate (p=<0.001) during and after work. The mean value of body temperature, blood pressure and heart rate were higher during work that could be due to difference due to temperature changes as of working time and also the physical activities performed by the farmers.

This was supported by Bahri et al. (2015), as when a person performs a heavy physical labor, metabolic rate increases along with the internal heat. Besides, increased blood flow in skin at expense of blood flow in other tissues causing an increase in systolic and diastolic blood pressure was due to acute heat exposure. Heart rate also increases in order to quickly deliver oxygen when needed while performing physical activity. In addition, increased in body's core temperature will increase the volume of oxygen causes the heart to pump harder and pulse will be increased (Bahari and Dubashini, 2015).

5.13 Comparison of productivity of the farmers in the morning and evening

Based on Table 4.18, only suckers and harvesting had a significant difference between morning and evening, although the mean values of productivity of each work task showed a decline in the output in the morning and evening. Suckers was categorized as moderate while harvesting was heavy after considering their work characteristics.

In a study by Sahu et al. (2013), the study was different on the measurement period, where they measured the productivity based on hourly work output for 28 group between morning and noon. However, the results shown was supported as there were close correlation between WBGT level and work productivity for the 1st hour of work and 5th hour of work. It indicated that the workers were more tired after four hours of work with a higher heat levels in the 5th hour, in which concluded that as WBGT increased, the work output decreased.

Therefore, there was no different between this study that showed a decreased in output in the morning and evening as compared to the study by Sahu et al. (2013), as workers produce less as the working time progresses with the increase in heat exposure.

5.14 Association between knowledge, perception and practices with health symptoms, physiological changes and productivity

Based on the result in Table 4.19, only health symptoms (fainting and vomit) did showed a significant relationship (p=0.038, p=0.030) respectively with knowledge and perception of the farmers on heat. This explained that fair knowledge and perception of heat did affect how the impact of heat to their health which could also cause heat-related illness. While for the association with physiological changes and productivity, showed no significant association found from the analysis.

In a similar study by Stoecklin-marois et al. (2013), it was found that the level of heat knowledge was moderate with correct answer 4-5 questions for both men and women which different from this study that the comparison was made between different gender while this study only involved male farmers. For the factors that were associated with a high level of knowledge on heat illness, women had twice the odds of reporting a high level of concern about heat-illness and were significantly less likely to have a high knowledge score which supported this study as well.

5.15 Selected factors related to the self-reported health symptoms and productivity

Based on Table 4.22, fatigue symptom with the risk factor of work task showed a significant relationship at p=0.009. There were four work tasks involved in this study which were planting, suckers, weeding and harvesting. Each work task varied on their workload category. Planting and harvesting categorized into heavy work based on the metabolic rate while suckers and weeding were both moderate work.

Heavy activities cause loss of too much sweat and the body cannot have enough water loss to cool itself which results in the dehydration and rise the body temperature above 38 °C, create potential for heat-related illnesses such as heat exhaustion from excessive fatigue (Heidari et al., 2015). Besides, Stoecklin-marois et al. (2013) supported this study, by mentioning that lack of acclimatization, poor physical fitness, and overweight were the risk factors for exertional heat-related illness as well as the weather conditions (air temperature, radiant heat, and humidity). Most respondents in their study, also correctly stated that wearing dark colored clothing, age and overweight were the risk factors for heat stress.

Humidity, heart rate and diastolic blood pressure were the risk factors that had significant relationship with the productivity based on the Table 4.23. High amount of humidity rise the natural wet bulb temperature cause WBGT to reach above Threshold Limit Value (TLV) even though air and globe temperature had been not very high. Relative humidity has become the most important parameters that can change WBGT index values. In Japan, death from heat stroke occurred at 34 °C and more at dry bulb temperature when the relative humidity was less than 40% while at more than 60% of humidity, it occurred at around 28-30 °C at dry bulb temperature (Heidari et al., 2015).

Heat-related illness or heat exhaustion could be potentially occurred with the combination of hot temperature and high humidity with the worker's physical exertion and dehydration, in which could increase occupational injury and reduce work performance and productivity (Tawatsupa et al., 2013).

When working in hot conditions, body responds to heat by increasing the blood stream dermis, increasing sweat rate, heart rate and body temperature. Therefore, due to increase in heat exposure, the work productivity gradually decrease as well that increase of 1 °C of WBGT, reduce 5% of work productivity (Sahu et al., 2013).

CHAPTER 6

CONCLUSION, RECOMMENDATION AND LIMITATION

6.1 Conclusion

In conclusion, the farmers at pineapple farms were at high risk to heat stress as most of the days recorded for heat index (WBGT) exceeded the Threshold Limit Value (TLV). Their knowledge and perception scores were on moderate while poor scores on practices on heat protection. However, majority of the farmers managed to drink 3 litres of water per day at the frequency of 5-10 times per day. The most common symptoms experienced by the farmers were heavy sweating and fatigue.

For the physiological parameters (blood pressure, heart rate and body core temperature) measured, heat index also influenced the farmer's health and productivity as the increased in heat index, lead to an increased in blood pressure, heart rate and body temperature while on the other hand, also reduced the productivity. Moreover, work task, WBGT, age, BMI and metabolic rate were the factors that have significant relationship with health symptoms. While humidity, diastolic blood pressure and heart rate were the factors that had significant relationship with the productivity, These factors indicated that they could affect the symptoms and productivity of the farmers as they were working under hot environment.

6.2 Recommendations

Based on the findings from this study, there are some recommendations for the farmers that exposed to high heat index;

i. **Wear proper clothing**

- Light-coloured clothing reflect heat and sunlight and help to maintain normal body temperature. Besides, regularly wear hats when working, specifically hat with a brim, which can protect face and head of the farmers and helps them to maintain cooler temperature.

ii. **Provide portable water and shades at the workplace**

- Instead of the farmers bring their own water to the workplace, the employer should provide a portable water to ensure the farmers work with enough fluids and remain hydrated to prevent themselves from heat stress. The shades can be established or set up near the farmlands or attached to the machinery for the farmers to rest and avoid heat stress.

iii. **Provide safety talk and awareness or training on heat exposure**

- The employee should be given training or talks on the safety and awareness on heat exposure by the employer such as talk on heat-related illnesses, heat protection and first aid training as they are working in the hot environment for the whole day in order for them to be aware on the conditions of the environments that they were exposed to during work. The first aid training is also essential for emergency purpose.

iv. **Supervision of farmers**

- The farmers should not work alone where heat stress is possible that they should be closely supervised and work in pairs or groups to ensure any heat disorder or illness can be identified and treated immediately

6.3 Study Limitations

There were some limitations found during conducting this study. First, this study was conducted at two different locations in order to get enough sample size.

However, statistics showed that there was no significant difference in the temperature, humidity and pressure between the two locations

There was also limitation on the physiological and productivity measurements individually since the farms were not easily accessible by car for the researcher to individually monitor them.

In addition, this study only measured environmental heat stress and not individual measurement due to limited number of equipment can be provided by the department in measuring heat index.

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APPENDICES:

APPENDIX A

RESEARCH PHOTOS

Photo 1: WBGT measurement

Photo 2: Work task on cutting off the suckers.

APPENDIX B

CONSENT FORM (MALAY VERSION)

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

BORANG 2.4: PENERANGAN DAN PERSETUJUAN RESPONDEN

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

1.TAJUK KAJIAN

Impak Haba terhadap Kesihatan dan Produktiviti serta Hubungkait dengan Pengetahuan, Kesedaran dan Persepsi dikalangan Petani Nanas di Johor.

2. PENGENALAN

Stres haba adalah satu satu daripada kesan negatif daripada perubahan iklim yang berlaku dimana pekerja yang bekerja pada persekitaran luar industri pertanian, pembinaan, industri, perikanan dan lain-lain, merupakan golongan yang mudah terdedah kepada risiko stres haba sebagaimana kerja mereka memerlukan pendedahan kepada haba pada persekitaran yang panas terutamanya pada musim panas. Pendedahan kepada haba yang terlalu ekstrim mendatangkan kepada hazad kesihatan kepada semua yang aktif secara fizikal, terutamanya pekerja luaran dan dalaman dengan minimum akses kepada sistem penyejukan apabila bekerja dalam keadaan yang panas. Sepertimana pemanasan global yang berterusan menghasilkan haba and hari-hari yang panas, risiko kesihatan di masa hadapan akan tinggi sepertimana impak stres haba tidak terhad kepada perubahan fisiologi sahaja malah turut memberi kesan kepada kapasiti dan produktiviti kerja seseorang pekerja. Justeru, tujuan kajian ini adalah untuk mengkaji impak haba terhadap kesihatan dan produktiviti serta hubungkait dengan pengetahuan, kesedaran dan persepsi dikalangan petani nanas di

Johor, di mana skop kajian ini melibatkan hanya petani lelaki sebagai peserta kajian ini.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Untuk kajian ini, keizinan anda diperlukan bagi pengkaji mendapatkan maklumat mengenai pendedahan haba diri, tekanan darah, kadar degupan jantung dan suhu badan responden. Selain itu, kami memerlukan anda untuk menjawab soalan-soalan di dalam kaji selidik yang diberikan yang merupakan sebahagian daipada kajian kami. Anda berhak untuk menarik diri daripada terlibat dalam penyelidikan ini pada bila-bila masa.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Anda tidak boleh menyertai kajian ini sekiranya :

i. Anda telah didiagnosis penyakit-penyakit kronik seperti kecing manis, darah tinggi, asma dan penyakit jantung
ii. Anda adalah seorang perempuan
iii. Kerja anda melibatkan bahan kimia seperti meracun dan membaja.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Andan dapat mengetahui dan menerima data yang diukur pada suhu badan, tekanan darah dan kadar degupan jantung sebagaimana kajian ini dijalankan selain berpeluang meningkatkan dan mengamalkan pengetahuan terhadap pendedahan kepada haba terutamanya semasa bekerja di bawah persekitaran yang panas semasa musim panas.

b) KEPADA PENYELIDIK?

Daripada data tersebut, kami dapat menentukan bagaimana pendedahan kepada haba memberi kesan kepada kesihatan dan produktiviti berdasarkan pemerhatian, pengukuran dan analisa yang dijalankan untuk kajian ini. Kami juga dapat mengakses pengetahuan, kesedaran dan persepsi daripada responden itu sendiri terhadap haba yang ditafsir mengikut tahap kesihatan dan produktiviti mereka. Tambahan, **kami dapat** membantu pengkaji yang lain dalam bidang pengajian inin menggunakan data yang diperolehi sebagai rujukan dan maklumat asas mengenai pendedahan haba.

6. ADAKAH IA BERISIKO?

Tiada risiko kepada responden dalam kajian ini.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Ya, setiap maklumat adalah sulit dan hanya untuk tujuan kajian penyelididkan sahaja. Data anda tidak akan didedahkan kepada mana-mana badan atau pihak lain.

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

Sekiranya anda mempunyai sebarang soalan, anda boleh hubungi:

Nuzul Fadhilah Binti Mohd Nawi
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Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini ________

9. PERSETUJUAN

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

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

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

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

*potong yang tidak berkenaan

Tandatangan ……..……………………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)

APPENDIX C

QUESTIONNAIRE (MALAY VERSION)

UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

TAJUK PENYELIDIKAN

PENGETAHUAN, PERSEPSI DAN SIKAP BERHUBUNGKAIT TERHADAP IMPAK HABA KEPADA KESIHATAN DAN PRODUKTIVITI PETANI NANAS DI JOHOR.

Kajian ini bertujuan untuk menilai kesan tekanan haba kepada kesihatan dan produktiviti petani nanas. Soal selidik ini terdiri daripada 5 bahagian iaitu sosio-demografi, maklumat pekerjaan, pengetahuan, kesedaran dan persepsi tentang pendedahan haba, kesan haba kepada kesihatan dan produktiviti. Semua data yang diperolehi akan dirahsiakan dan hanya digunakan bagi tujuan penyelidikan. Terima kasih atas kerjasama dan masa yang diberikan dalam menyertai penyelidikan ini.

Nama :

Tempat :

Tarikh & Masa :

BAHAGIAN A: MAKLUMAT LATAR BELAKANG

Bahagian ini bertujuan menentukan maklumat latar belakang responden untuk penyelidikan ini.

1. Jantina:

a) Lelaki ☐

b)Perempuan ☐

2. Umur: ________ years old

3. Bangsa:

Warganegara Malaysia ☐

b) Bukan Warganegara ☐

4. Tinggi: ________________ cm

5. Berat: ________________ kg

6. BMI: ________________

7. Adakah anda mempunyai masalah kesihatan?

Ya ☐ Tidak ☐

8. Sekiranya Ya, nyatakan: ________________________

BAHAGIAN B: MAKLUMAT PEKERJAAN

Bahagian ini adalah untuk mengenalpasti dan menentukan maklumat pekerjaan pekerja

1. Jenis pekerjaan:

a) Penanaman ☐ b) Penuaian ☐

2. Tempoh bekerja: ________ bulan/tahun

3. Waktu bekerja setiap hari tidak termasuk waktu rehat: ________ jam

4. Tempoh berehat:

a) 10-15 minit/sekali ☐

b) 15-30 minit/sekali ☐

c) 30-60 minit/sekali ☐

d) Lebih daripada 1 jam/sekali ☐

5. Kekerapan berehat setiap hari: ____________________ kali

6. Jenis pakaian yang dipakai semasa bekerja:

a) Seluar Pendek/T-shirt/ Tidak memakai sebarang pakaian perlindungan ☐

b) Pakaian kerja yang ringan ☐

c) Coverall/Jaket Kapas ☐

d) Dua lapis coverall/Apron/Baju Hujan/Pakaian kalis air ☐

e) Suit pelindung yang ringan ☐

f) Pakaian pelindung penuh termasuk sarung tangan dan kepala ☐

7. Berapakah jumlah pengambilan air semasa bekerja dalam keadaan panas ?

__________ liter/cawan/botol

8. Berapa kerap anda minum dalam sehari ?

a) < 5 kali ☐

b) 5-10 kali ☐

c) > 10 kali ☐

9. Adakah kawasan perlindungan di sediakan di tempat kerja anda ?

Ya ☐ Tidak ☐

BAHAGIAN C: PENGETAHUAN, PERSEPSI DAN SIKAP TERHADAP HABA

Bahagian C adalah bertujuan menentukan pengetahuan, persepsi dan sikap pekerja terhadap haba berhubungkait kait dengan kesan kepada kesihatan dan produktiviti pekerja.

1. Adakan anda selesa dengan suhu di tempat kerja anda ?

Ya ☐ Tidak ☐

2. Pernahkah anda mendengar tentang tekanan haba ?

Ya ☐ Tidak ☐

3. Pernahkah anda mengalami tekanan haba semasa bekerja ?

Ya ☐ Tidak ☐

4. Pendedahan kepada haba/ tekanan haba memberi kesan kepada kerja anda ?

Ya ☐ Tidak ☐

5. Adakah anda sedar dengan perubahan suhu sepanjang tempoh bekerja?

Ya ☐ Tidak ☐

6. Jika YA, adakah suhu tersebut.........................?

a) Meningkat secara harian, mingguan, bulanan ☐

b) Menurun secara harian, mingguan, bulanan ☐

c) Tidak menentu secara harian, mingguan, bulanan ☐

7. Penyataan berikut menguji pengetahuan anda tentang tekanan haba dan beberapa faktor yang menyumbang kepada tekanan haba.

No.	Perkara	Ya	Tidak
a)	Peningkatan suhu merupakan faktor tekanan haba		
b)	Pendedahan cahaya matahari secara terus menyumbang kepada tekanan haba		
c)	Tahap kelembapan yang tinggi menyumbang kepada tekanan		
d)	Memakai pakaian yang tebal menyumbang kepada tekanan haba		
e)	Kekurangan kadar aliran udara menyumbang kepada tekanan		
f)	Beban kerja yang berat menyumbang kepada tekanan haba		
g)	Dehidrasi menyumbang kepada tekanan haba		
h)	Penyakit sedia ada (tekanan darah tinggi, penyakit kardiovaskular & sebagainya menjadi faktor kepada tekanan		

8. Penyataan berikut bertujuan untuk mengetahui persepsi anda terhadap tekanan haba

No.	Perkara	Ya	Tidak
a)	Adakah anda rasa anda mempunyai risiko tekanan haba?		
b)	Rasa letih semasa bekerja masalah serius bagi saya		
c)	Adakah anda perlu memakai alat perlindungan diri semasa		
d)	Perubahan fisiologi berkaitan dengan tekanan haba?		
e)	Adakah pengamalan langkah perlindungan boleh melindungi anda daripada tekanan haba?		
f)	Adakah tekanan haba mempengaruhi kesihatan anda?		
g)	Adakah tekanan haba mempengaruhi produktivti anda?		
h)	Adakah anda berasa sihat dan tidak perlu melindungi diri daripada pendedahan cahaya matahari ?		

8. Penyataan berikut bertujuan untuk mengetahui sikap/amalan anda dalam melindungi diri anda dari tekanan haba.

No.	Perkara	Ya	Tidak
a)	Kekal hidrasi dengan pengambilan air secukupnya		
b)	Pindah ke kawasan kerja yang lebih sejuk/kawasan terlindung		
c)	Mandi		
d)	Pakai pakaian berwarna cerah, longgar dan serap peluh(fabrik kap		
e)	Memakai alat perlindungan peribadi (cermin mata, topi, topeng muka)		
f)	Merancang pelaksanaan kerja berat pada waktu pagi atau petang		
g)	Membasahkan pakaian atau menyebur air ke badan semasa bekerja di bawah cahaya matahari		

BAHAGIAN D: KESAN TEKANAN HABA KEPADA KESIHATAN

Objektif bahagian ini adalah untuk menetukan kesan kepada kesihatan pekerja dari segi tanda-tanda yang dialami dan kekerapannya apabila terdedah kepada haba.

1. Pernahkah anda mengalami simptom berikut ketika bekerja pada suhu yang tinggi ?

Gejala / Skala	(1) Tidak Pernah	(2) Jarang (1-2 kali sebulan)	(3) Kadang-Kadang (3-4 kali sebulan)	(4) Sering (2-3 kali seminggu)	(5) Sentiasa (hampir setiap hari)
a) Berpeluh dengan banyak					
b) Loya/Mual					
c) Muntah					
d) Sakit Kepala					
e) Pening					
f) Pengsan/Pitam					
g) Keletihan					
h) Kehausan					
i) Kejang otot					
j) Tidak sedarkan diri					

BAHAGIAN E: KESAN TEKANAN HABA KEPADA PRODUKTIVITI

Bahagian E adalah untuk mengenalpasti dan menentukan kesan haba kepada produktiviti pekerja apabila terdedah kepada suhu yang tinggi pada persekiran luar dan cahaya matahari.

1. Adakah anda mempunyai sasaran pengeluaran setiap hari ?

Ya ☐ Tidak ☐

2. Adakan anda mencapai target tersebut ?

Ya ☐ Tidak ☐

3. Jika TIDAK, adakah tekanan haba menjadi punca tersebut ?

Ya ☐ Tidak ☐

4. Pendedahan kepada suhu yang tinggi menyebabkan anda :

a) Tidak hadir bekerja ☐

b) Perlu masa tambahan untuk mencapai target pengeluaran ☐

c) Tidak mencapai target pengeluaran yang ditetapkan ☐

APPENDIX D

APPROVAL LETTER OF

RESEARCH ETHIC COMMITTEE (JKEUPM)

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

Research title	:	**The Impact of Heat on Health and Productivity in Relation with the Knowledge, Awareness and Perception Among Pineapple Farmers in Johor**
Study Site	:	**Johor**
JKEUPM Ref No.	:	**JKEUPM-2018-016**
Researcher	:	**Nuzul Fadhilah bt Mohd Nawi**
Supervisor	:	**Prof. Dr. Zailina bt Hashim**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 12/1/2018
2. Respondent Information Sheet & Consent (English), Version 2 dated 28/2/2018
3. Respondent Information Sheet & Consent (Malay), Version 2 dated 28/2/2018
4. Proposal (English), Version 2 dated 20/2/2018
5. Questionnaire (English), Version 2 dated 20/2/2018
6. Questionnaire (Malay), Version 2 dated 20/2/2018
7. Curriculum Vitae of:
    a. Prof. Dr. Zailina bt Hashim

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 6 MARCH 2019**

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.