ENERGY INTAKE AND ENERGY REQUIREMENT OF OVERWEIGHT NON-SMOKING MEN DURING THE COVID-19 PANDEMIC LOCKDOWN 2.0

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ENERGY INTAKE AND ENERGY REQUIREMENT OF OVERWEIGHT NON-SMOKING MEN DURING THE COVID-19 PANDEMIC LOCKDOWN 2.0

by

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CERTIFICATE

This is certify that the dissertation entitled ENERGY INTAKE AND ENERGY REQUIREMENT OF OVERWEIGHT NON-SMOKING MEN DURING THE COVID-19 PANDEMIC LOCKDOWN 2.0 is the bona fide record of research work done by Ms NURSHARLINA BINTI SHARAN during the period from March 2020 to June 2021 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfilment for the degree of Bachelor of Health Science (Honours) (Exercise and Sports Science).

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

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Nursharlina Binti Sharan

Date: ……23/6/2021……………...

ACKNOWLEDGEMENT

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PENGAMBILAN TENAGA DAN KEPERLUAN TENAGA BAGI LELAKI YANG TIDAK MEROKOK DENGAN BERAT BADAN BERLEBIHAN SEMASA PERINTAH BERKURUNG COVID-19 2.0

ABSTRAK

Objektif: Penyelidikan ini dilakukan untuk mengenalpasti faktor terbaik yang menyumbang kepada penggunaan tenaga dan keperluan tenaga serta kaitannya dengan pengambilan makanan, komposisi badan dan ketersediaan tenaga di kalangan lelaki yang tidak merokok dengan berat badan berlebihan semasa perintah berkurung COVID-19 2.0. Kaedah: Tiga puluh enam orang lelaki tidak aktif dan tidak merokok dengan berat badan berlebihan berumur 25 ± 7 tahun, berat badan 82 ± 15 kg dan indeks jisim badan 29 ± 5 kg/m^2 direkrut dalam kajian keratan rentas ini. Soal Selidik Aktiviti Fizikal (PAR-Q), pengambilan makanan 24 jam dan komposisi badan dicatatkan. Peratusan lemak badan diukur dengan menggunakan persamaan dari Van Itallie et al.(1990). Di samping itu, penggunaan tenaga dikira dengan menggunakan formula persamaan Harris Benedict (Roza & Shizgal, 1984: Ismail et al., 1998). Faktor terbaik yang menyumbang kepada sindrom metabolik adalah sama ada pengambilan pemakanan 24 jam, komposisi badan (berat, ketinggian, peratusan lemak badan dan jisim bebas lemak) atau penggunaan tenaga di kalangan lelaki yang tidak merokok berat badan berlebihan ditentukan dengan menggunakan Regresi Stepwise Linear. Hasil: Hasil kajian menunjukkan bahawa berat badan lelaki tidak merokok dan peratusan lemak badan adalah 82 ± 15 kg dan 27 ± 7 %, dan semuanya dikategorikan sebagai berat badan berlebihan. Purata penggunaan tenaga mereka ialah 2181 ± 587 kkal/hari yang dianggap normal dan penggunaan tenaga mereka (373 ± 41 kkal/hari) yang menghasilkan baki tenaga positif. Tahap ambang ketersediaan tenaga adalah 30 ± 10 kkal/kg FFM/hari yang lebih rendah daripada nilai normal. Berat badan (r= 0.977, p= 0.000), tinggi (r= 0.553, p= 0.000), BMI (r= 0.863, p= 0.000), peratusan lemak badan (r=

0.835, p= 0.000) dan jisim bebas lemak (r= 0.958, p= 0.000) dikaitkan secara positif dengan penggunaan tenaga. Tambahan pula, tidak ada hubungan yang signifikan antara tahap aktivit fizikal, pengambilan tenaga dan ketersediaan tenaga dengan penggunaan tenaga. Walau bagaimanapun, berat badan didapati sebagai pengaruh yang paling tepat untuk mempengaruhi penggunaan tenaga. Dalam kajian ini, tidak ada hubungan antara ketersediaan tenaga dengan tahap aktiviti fizikal kerana para peserta adalah tidak aktif secara fizikal.

ENERGY INTAKE AND ENERGY REQUIREMENT OF OVERWEIGHT NON-SMOKING MEN DURING COVID-19 PANDEMIC LOCKDOWN 2.0

ABSTRACT

Objective: This research was conducted to predict the best factors contributed to energy intake and energy requirement and association with dietary intake, body composition and energy availability among overweight non-smoking men during COVID-19 pandemic lockdown 2.0. Method: Thirty-six overweight sedentary non-smoking men aged 25 ± 7 years old, body weight 82 ± 15 kg and body mass index 29 ± 5 kg/m^2 were recruited in this cross-sectional study. Physical Activity Readiness Questionnaire (PAR-Q), 24-hours dietary intake, and body composition were recorded. Body fat percentage was measured by using the equation by Gomez-Ambrosi et al.(2012), while fat free mass was measured by using equation from Van Itallie et al.(1990). In addition, energy expenditure was calculated by using revised-Harris Benedict equation formula (Roza & Shizgal, 1984: Ismail *et al.*, 1998). The prediction of the best factor contributes to metabolic syndrome either 24-hour dietary intake, body composition (weight, height, body fat percentage and fat free mass) or energy expenditure among overweight non-smoking men is determined by using the Stepwise Linear Regression. Results: The findings show that, non-smoking men body weight and body fat percentage were 82 ± 15 kg and 27 ± 7 %, respectively and they were all categorised as overweight. Their mean energy intake was 2181 ± 587 kcal/day which considered as normal, and their energy expenditure was 373 ± 41 kcal/day which resulted in positive energy balance. The threshold level of energy availability was 30 ± 10 kcal/kg FFM/day which was lower than normal value. Body weight (r= 0.977, p= 0.000), height (r= 0.553, p= 0.000), BMI (r= 0.863, p= 0.000), body fat percentage (r= 0.835, p= 0.000) and fat free mass (r= 0.958, p= 0.000) were positively associated with energy expenditure. Furthermore, there were no significance association

between physical activity level, energy intakes and energy availability with energy expenditure. However, body weight was found to be the best predictor to influence energy expenditure. In this study, there was also no association between the energy availability with physical activity level since the participants are physically inactive.

CHAPTER 1

INTRODUCTION

1.1   Background of Study

Overweight and obesity are the major problem in Asia country, especially in Malaysia. The national prevalence of overweight and obesity in Malaysia were 33.4% (95% CI: 32.5, 34.4) and 30.6% (95% CI: 29.5, 31.6) based on the Malaysian Clinical Practice Guidelines of Obesity (2004) classifications. Thus, it shows that the highest prevalence of overweight was among male adults aged 50-54 years and highest prevalence of obesity were among females. There are many causes that contributing to overweight and obesity prevalence, and one of the causes was the availability of easy access food. Malaysia is known as a development country, so by development of modernization and technology, people tend to buy things online. For example, there are several applications which provides food delivery such as GrabFood, Food Panda, McD Delivery and others. Most of the services related to delivery fast food and online groceries shopping. The modernization and development of technology has facilitated the continuous decline in energy expenditure required for daily living which leads to increase in sedentariness (WHO, 2017: Wiklund, 2016).

Overweight and obesity is a causative factor in the development several non-communicable chronic diseases (NCD) such as cardiovascular disease, diabetes mellitus, cancer and musculoskeletal disorder (Afshin *et al.*, 2017). The examples of metabolic syndromes are high blood sugar, high blood pressure, hypertension and it also linked to a condition called insulin resistance. Metabolic syndromes are characterized by the emergence of three of the following conditions, increase in blood pressure, LDL cholesterol levels, triglyceride levels and a fasting blood glucose levels and waist circumference ratio above normal values (Arum *et al.*, 2018). However, there also another factor that develop the metabolic syndrome which is smoking. Smoking

increases the risk of cancer, respiratory and cardiovascular diseases and is the leading preventable cause of death in developed countries (Doll *et al.*, 2014).

Over 80% of smokers wish to quit smoking but only 33% attempt to do so (Hughes, 2003; Rigotti, 2002). Mortality rate of the non-smokers usually lower than smoker as it is considered as healthy lifestyle by not being addicted in taking tobacco in daily life. Besides, the life expectancy of obese smokers is around 13 years shorter than non-obese, never smokers (Peeter *et al.*, 2003). However, non-smokers are more likely to be obese than current smokers. Previous study showed that current smokers are less likely to be obese than never smokers and former smokers are more likely to be obese (Dare *et al.*, 2015). Some studies shown, there is no significant association between smoking status and body mass index (BMI) (Zbikowski *et al.*, 2011) others have suggested that smoking may be associated with lower BMI (Klesges *et al.*, 1989) and smoking cessation with increased BMI (Munafo *et al.*, 2009).

In addition, the macronutrient intake among overweight and obese should be higher than normal people. However, from the study conducted by Kim & Song (2019), males with metabolically abnormal but normal weight (MANW), obtained a higher proportion of energy from carbohydrate and lower proportions from fat and protein than did the other groups (MHNW, metabolically healthy and normal weight; MHO, metabolically healthy but obese; MAO, metabolically abnormal and obese). Thus, macronutrient intake proportions did not differ significantly and exhibited no trend by the obesity or metabolic risk phenotypes, in either males or females. Both high and low macronutrient intakes are associated with body fat levels and obesity in previous studies (Park *et al.,* 2018; Mansoor *et al.,* 2016; Hall *et al.,* 2015), suggesting that variations in the levels of carbohydrate, protein and fat consumed may affect obesity and may increase the risk of cardiovascular disease (CVD) and mortality. Furthermore, the median energy intake of Malaysians recorded in NHMS (2014) was 1466 kcal/day with

significantly higher values among men. Recommendation of the macronutrient intake for total energy contribution is 55% for carbohydrates, 16% for protein and 29% for fat.

Moreover, overweight and obesity also occur as they have low energy expenditure but have high energy intake and high energy availability. When the energy availability is low it will lead to a negative energy balance and thereby weight loss because the body's energy reserves substantially contribute to fuel needs (Loucks, 2004). For high energy availability, the results will be vice versa which it will leads to a positive energy balance and weight gain. Therefore, the high prevalence of overweight and obesity are because of they do not considered eating according to their daily energy expenditure and leads to non-communicable chronic diseases (NCD).

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body fat percentage (BFP) generally increases with age in the range 20 to 79. The cut off points for body fat percentage (BFP) is 24.0% in men and 31.4% in women (Hung *et al.,* 2017). If the individuals exceeding the body fat percentage (BFP) cut off points more likely the individuals to be overweight or obese. When the individuals have high percentage of body fat, it will be more risk for them to get non-communicable diseases such cardiovascular disease (CVD), hypertension and diabetes. When too much fat in the blood or arteries, this will lead to high blood pressure as the circulation of the blood in the body become narrow and can cause hypertension chronically. Normal blood pressure is 120/80 mmHg while for high blood pressure, the reading is 130/80 mmHg (AHA, 2017).

Furthermore, there also involving an environment factor where the world is now facing the COVID-19 pandemic lockdown. Due to this condition, many people have change their eating and lifestyles as they had very different routine before the lockdown. The worst scenario is where they try to adapt working from home but their boredom or stress level increasing and affects their mental psychologically and body physiologically. Psychological and emotional responses to the COVID-19 outbreak may increase the risk

of developing dysfunctional eating behaviours (Wang *et al.,* 2020; Montemurro, 2020). A study show considering the smoking, there are significant association exists between SARS-CoV-2 infection and air pollution and in this context in smokers, more severe COVID-19 symptoms occur (Engin *et al.,* 2020). Modifications for smoking might happen as they cannot buy the cigarettes during lockdown as they have to stay at homes and have to wear a face mask whenever they go outside the house. Thus, the air pollution occur by the releasing of carbon monoxide from the transportations and smoking might be decrease.

Therefore, the purpose of this study was predicting the best factor contribute to energy intake and energy requirement and association with dietary intake, body composition or energy availability among overweight non-smoking men during the COVID-19 pandemic lockdown 2.0.

1.2   Problem Statements

Increases of overweight, obesity and non-communicable diseases are result of the latest pattern of transition in physical activity, diet and nutritional status in human history (Popkin, 2006). However, the risk factor can be modified for cardiovascular disease and other non-communicable diseases (NCD) by doing physical activity. Scientific evidence has accumulated over last decades to show the wide array of health benefits of physical activity (Vuori, 2001). Declination in daily physical activity levels and insufficient energy expenditure due to sedentary lifestyle is one of the causes of energy imbalance leading to increasing trends of obesity levels (Saris *et al.*, 2003).

Furthermore, most of the overweight and obese people found that doing exercises or physical activity is not enjoyable and wasting time. They are rather live-in sedentary life instead of being physically active (Ruby *et al.,* 2011). Physical inactivity is one of the modifiable risks for cardiovascular disease and variety of other chronic disease including diabetes mellitus, colon and breast cancer, obesity, hypertension, bone and joint diseases as well as depression (WHO, 2003). Therefore, society should be aware the importance in maintaining healthy lifestyle in their life.

Also, overweight and obesity factors influenced by the unhealthy nutrition intake which people are likely to eat what they want without caring the calories intake. The energy intake by an individual has been exceeding the energy expenditure that cause them to be overweight and obese. According to Recommended Nutrient Intakes (NCCFN, 2017), energy requirement must be estimated based on energy expenditure and not energy intake. Energy expenditure components are physical activity, basal metabolic rate (BMR) metabolic cost of food and metabolic cost of growth. The excessive energy intake causes positive energy availability which it may lead to increase body weight.

1.3   Objectives of the Study

1.3.1 General objective: Identifying the energy intake and energy requirement of overweight non-smokers men during the COVID-19 pandemic lockdown 2.0.

1.3.2 Specific objectives:

1. Assessing 24 hours dietary intake, body composition and energy availability among overweight non-smoking men during the COVID-19 pandemic lockdown 2.0.

2. Predicts the best factor contribute to energy expenditure either 24-hour dietary intake, body composition or energy availability among overweight non-smoking men during the COVID-19 pandemic lockdown 2.0.

1.4   Hypotheses of the Study

H_O: There is no significance relationships between the 24-hours dietary intake, body composition and energy availability among non-smoking men during the COVID-19 pandemic lockdown 2.0.

H_A: There are significance relationships between the 24-hours dietary intake, body composition and energy availability among non-smoking men during the COVID-19 pandemic lockdown 2.0.

1.5   Significance of the Study

From the findings, it gives great contributions to the society especially among the overweight and obesity categories as it increases the people awareness in health status. The non-communicable chronic diseases such as cardiovascular disease, high blood pressure, diabetes mellitus and others can be decreases or can be treated by having a healthy lifestyle, and proper dietary intake. Proper dietary intake means the contributions of macronutrients towards total daily energy intake (TEI) of the Malaysian adult population should be within these ranges: carbohydrates 50-60% TEI, fat 25-30% TEI and protein 10-20% TEI (NCCFN, 2017). The most common accepted definition of metabolic syndrome risk factors includes abdominal obesity, high blood pressure, triglycerides and glucose and reduction in high-density lipoprotein (HDL) (Grundy, 2016).

The knowledge of the society in the benefits of doing physical activity or exercise are important as they help improving health status. For example, doing jogging or aerobic dances which are types of aerobic exercises and going to gym for muscle strength can promote better health. Numerous studies have revealed aerobic and strength exercises substantially promote overall health, weight loss as well as improve metabolic syndrome risk factors (Lira *et al.,* 2010; Nybo *et al.,* 2010; Pollock *et al.,* 2000; Strasser *et al.,* 2010). Moreover, adequate intake of food is essential for a good health. For examples, the intake of fruits and/or vegetables which has various component of nutrients such as antioxidant and plant bioactive compound have shown to lower the incidence of cardiovascular diseases, diabetes mellitus and obesity (NHMS, 2015).

CHAPTER 2

LITERATURE REVIEW

Obesity and overweight have been major health issues among adults. Both have been described as anomalous accumulation of excessive body fat which may be harmful to health (WHO,2009). Excessive body fat will surround the important organs such as the heart, liver, kidney and others that may cause the organs malfunctioning. Body Mass Index (BMI) and body fat cut-off points are the main indicator of overweight and obesity which generally taken from WHO as it related to energy intake and energy requirement of an individual. Besides, the disruption of the normal satiety feedback mechanism, hyperinsulinism, insulin resistance and genetics are some of the biophysiological causes of overweight and obesity (Codogno & Meijer, 2010). The percentage of overweight and obesity population can be reduced by changing to healthy lifestyles and maintaining the healthy lifestyles for a better quality of life.

2.1   Energy Intake and Energy Requirement of Adult Men

Sufficient of nutrients and energy require have to meet metabolic needs for optimal functioning of the body constitutes what one refers to as a 'nutritionally-adequate' diet. Malaysia Adults Nutrition Survey (MANS) data suggested low and decreasing energy intake among adults. MANS in 2003 compared with 2014, the median energy intake is decreased approximately by 771 kcal (Wan *et al.*, 2015). The intake among males decreased from 1722 kcal to 1464 kcal, while for females increased from 1400 kcal to 1437 kcal. Low caloric intake is beneficial for long-term health. According to Teng *et al.* (2011), among aging Malaysian men, caloric restriction for three months results in body weight and fat loss, alleviated depression and improved quality of life. However, MANS results showed that reduced energy intake do not support the increasing trend of overweight and obesity in Malaysia. The prevalence of overweight among men increased

from 28.6% to 33.3% while obesity increased from 9.7% to 14.5% (Baharudin, 2015). This is because of the low energy expenditure of an individual when they consumed the energy intake. Most studies implicate imbalance in the amounts of calories consumed and those expended are the reasons of overweight and obesity (WHO, 2009).

Energy needs are determined by energy expenditure while estimation of energy requirement should be based on measurements of energy expenditure. The large component in energy expenditure is basal metabolic rate (BMR) as the basis for calculating all components of total energy expenditure. The energy requirements recommended for adults and elderly are based on moderate active lifestyles (Physical Activity Level (PAL) is 1.75 for adults and 1.60 for elderly) and the average body weight of Malaysians as reported by Lim *et al.* (2000). Energy requirements for adults and elderly men are 19 to 29 years require 2440 kcal/day or 10.21 MJ/day, for 30 to 59 years require 2460 kcal/day or 10.29 MJ/day and more than 60 years require 2010 kcal/day or 8.41 MJ/day.

2.1.1 Energy Availability of Adult Men

Energy availability is calculated as energy intake minus energy expended during exercise relative to fat free mass (FFM). Low energy availability defined as low caloric intake relative to exercise energy expenditure and the threshold of energy availability is 30 kcal/kg FFM/day. From the finding, the low energy availability (15 kcal/kg FFM/day) in exercising men was associated with reduction in leptin, insulin and fasting glucose while increased in glycerol and free fatty acid (FFA) concentrations (Karsten *et al.,* 2016). Changes in leptin, insulin, glucose and FFA did not differ when low energy availability was attained through caloric restriction alone or through a combination of caloric restriction and exercise. For energy availability in men, reproductive disorder such as reduced sperm motility and quality have also been reported in men participating in energetically expensive sports (De Souza *et al.,* 1994; Lucia *et al.,* 1996) but it remains

questionable as the prevalence of reproductive disorders in deficient men is as high as in energy deficient women.

Moreover, the energy availability in adult men does not have many studies as in women. However, the effect on low energy availability in men will risk more on the hormone while women will give effect to the bone mineral density (BMD). Also, the energy availability in the individuals depends on the energy intake related to fat free mass and the energy expenditure during exercise. If the individuals have low energy expenditure but high in energy intake, the amount of energy availability in the body will be more than the threshold which is 30 kcal/kg FFM/day. Thus, the individuals tend to have high risk of being overweight and obesity.

2.1.2   Body Composition in Overweight and Obesity

Body composition in overweight and obesity can be measured by using body mass index (BMI) and body fat percentages. The term overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health (WHO, 1995). Body mass index (BMI) for overweight is range from 25.0 kg/m^2 to 29.9 kg/m^2 while for obesity (class I) is 30.0 kg/m^2 to 34.9 kg/m^2 and obesity (class II) is 35.0 kg/m^2 to 39.9 kg/m^2 (WHO, 1997). Also, obese individuals defined by body fat percentage (BFP) which related to higher cardiometabolic risk, prediabetes and type 2 diabetes mellitus development, even having normal BMI (Gomez *et al.*, 2012; Chuang *et al.,* 2012; Romero *et al.,* 2010). The common cut-off points used for BFP are 25 % in men and 30 % in women (Kim *et al.,* 2013).

However, BMI measurements cannot be used solely to categorise the individual either overweight or obesity. It is because the measurements only refer to the height and weight of the individual. The individual may have more weight due to their sport speciality such as body builder, weightlifter and martial arts which the weight comes from the muscle mass and not from the fat mass in the body. Thus, BMI measurements does not

give the actual body fat and any indication as to the distribution of fat in the body and in adults, central adiposity is more closely associated with health risk than general adiposity (Coutinho *et al.*, 2013; Wang *et al.*, 2005). Moreover, it is more accurate to used BFP as indicator to categorise the overweight and obesity.

2.2　Unhealthy Lifestyle Habits

Unhealthy lifestyle habits can be categorized in various aspects of life. For examples, lack of physical activity, unhealthy eating behaviours, not enough sleep and high amounts of stress. Physical inactivity is a modifiable risk factor for cardiovascular disease and a variety of other chronic diseases, including diabetes mellitus, colon and breast cancer, obesity, hypertension, bone and joint diseases, as well as depression (WHO, 2003).

Lack of physical activity are the common or major reason among the overweight and obesity due to more time on screening glass such as computer, smartphone and television. A decline in daily physical activity levels and insufficient energy expenditure due to a sedentary lifestyle is one of the causes of energy imbalance leading to increasing trends of obesity levels (Saris *et al,* 2003). Therefore, numerous studies have revealed aerobic and strength exercise substantially promote overall health, weight loss as well as improve metabolic syndrome risk factors (Lira *et al.,* 2010; Nybo *et al.,* 2010; Pollock *et al.,* 2000; Strasser *et al.,* 2010). The physical activity level by the individuals can be measured by using International Physical Activity Questionnaire (IPAQ). However, from the surveys, it lacks reporting the pattern of physical activity and the energy expenditure of the individuals.

Decline in physical activity will be the risk factors of being overweight and obesity. Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Casperson et al., 1985). Regular and

adequate levels of physical activity in adults are key contributors to energy expenditure and are essential for energy balance and weight control (WHO, 2016). Previous studies showed that physical activity can reduce the risk of cardiovascular disease and other chronic diseases, including diabetes mellitus, hypertension, obesity, cancer (colon and breast) and osteoporosis (Warburton et al., 2006). So, it is important for the individual to maintain a healthy lifestyle by doing physical activity in daily life.

Another study conducted by Sugathan & Bagh (2014), showed that among the medical student, none of them were meeting the current physical activity recommendations which is 150 minutes per week or more of moderate or vigorous physical activity. The highest duration of physical activity done by medical students who have very limited time to do long duration of physical activity was only 100 minutes per week due to their hectic schedule, especially those in clinical years. One of the previous study showed that 30.1% of medical students in a private medical school in Malaysia were overweight or obese where Malays and Indians were more obese than the Chinese. Thus, a significantly high proportion of the male students were found to be overweight (Boo *et al.,* 2010).

According to WHO guidelines (2010), an adult aged 18 to 64 years old should perform at least 150 minutes per week of moderate-intensity aerobic physical activity, or 75 minutes per week of vigorous-intensity aerobic physical activity which is equivalent to a total physical activity level of at least 600 metabolic equivalent-minutes per week (MET-minutes/week) or 10 MET-hours/week. There are various types, amounts and intensities of physical activity are required for different health outcomes based on the appropriate calorie's intake. For example, if an individual is physically active man, they require more calories intake as it is equal to energy expenditure. If the calories intake higher than energy expenditure, it will lead to accumulation of fats around the abdominal part, thus increase the waist circumference.

Furthermore, other risk factors of overweight and obesity is unhealthy eating behaviours such as improper calories intake, oversized portions, eating too much saturated and trans fats also eating food high in added sugars. When the calories intake is more than energy expenditure, it will increase weight gain of the individual. Low fibre intake and excessive fat intake are reported as distal risk factors for overweight and obesity. An individual should eat the right number of calories for the body, which will depend on gender, age and physical activity level. The unhealthy eating habits are divided into two categories (Conceição *et al.,* 2015) which are related to eating disorder and maladaptive eating habits (emotional eating, snacking between meals and food cravings) (Wnuk & Du, 2017). For instance, university student populations are widely reported to engage in unhealthy lifestyle behaviours including unhealthy eating behaviours such as high consumption of snack foods, consumption of convenience foods, high consumption of fast foods and insufficient consumption of fruit and vegetables. This probably will be at risk of weight gain and future development of non-communicable diseases (NCDs). Research has reported that students living outside of the family home consume fewer fruit and vegetables (Ansari *et al.,* 2012; Papadaki *et al.,* 2007).

Sleep also plays an important role in physical health. Continuous sleep deficiency is linked to an increased risk of heart disease, kidney disease, high blood pressure, diabetes and stroke. Several studies in the scientific literature, suggest that sleep deprivation has metabolic effects that predispose to weight gain. In USA, the prevalence of obesity is increased from 22.9% in 1988 until 1994 to 37.7% in 2013 until 2014 (Flegal *et al.,* 2016). The rate of obesity had reached 35.0% among adult men and 40.4% among adult women in 2014 which indicate that the adult population in USA is getting less sleep (Liu *et al.,* 2016) and a significant proportion receives less than the recommended 7 hours of sleep per night (Watson & Badr, 2015).

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Therefore, findings by Cooper *et al.,* (2018) is sleep deprivation may mediate increases in body mass index through elevated ghrelin (a hormone that expresses hunger), suppressed leptin (a hormone that expresses fullness) and augmented hedonic signalling during food intake. Lack of sleep will make level of ghrelin goes up and level of leptin goes down, thus, this will make individuals feel hungrier than when they are well-rested. Next, decreased sleep results in increased of fatigue, which may lower capability for exercise and obesity increases the risk for sleep disorders which may compromise sleep quality. In addition, getting enough quality sleep at the right times helps to function well throughout the day.

Moreover, high amounts of stress can be the risk factors of overweight and obesity as stress can disturb the dynamic balance of all organisms. The association between obesity and chronic stress in adolescence is related to biological and behavioural pathways. Also, stress leads to secretion of catecholamine and increased concentration of insulin. Acute and chronic stress may affect the brain and trigger the production of hormones such as cortisol, that control our energy balances and hunger urges. Hence, it may affect eating behaviour especially in adolescence because of response to stressors (Wardle & Gibson, 2002; Takeda *et al.*, 2004).

Besides, stress can affect health and eating through mechanisms such as reducing food intake in the short term but increasing sweet and high fat food intake, slow gastric emptying, increasing blood pressure and activation of adrenal in the long term effect (Oliver *et al.,* 2000). Hormones such as corticotropin-releasing hormone (CRH) and noradrenaline can suppress appetite while some can induce appetite such as cortisol during stress. Increasing of cortisol level in the body or cortisol injection can improve appetite, especially for high sugar and fat foods (Epel *et al.,* 2001).

In contrast, to depression which leads to less food consumption and body weight reduction among adolescents, stress causes high food intake and excess body weight gain (Dallman *et al.,* 2003). Thus, stress induces eating tendency, particularly a desire

for high-calorie foods (foods with high sugar and fat) (Torres & Nowson, 2007). According to Vriendt *et al.* (2009), stress can affect obesity through three mechanisms among adolescents which are 1) by increasing energy intake and appetite, 2) decreasing energy expenditure and physical activity and 3) by accumulation of visceral fat and abdominal obesity.

2.3   Unhealthy Environment

Overweight and obesity represents a population that lack the willingness to change their poor lifestyle habits. Overweight and obesity is a multifactorial disease (Allison *et al.*, 2008) that is caused by a combination of biological, genetic, social, environmental and behavioural determinants. Many environmental factors can increase the risk for overweight and obesity. For examples, social factors, built environment factors and exposure to chemicals.

For social factors such as having a low socioeconomic status or an unhealthy social or unsafe environment in the neighbourhood can be the risk factors of overweight and obesity. When having low-income families, it is more vulnerable for them to become overweight and obese because of low access of high quality, nutritious food in their neighbourhoods. The contribution of fast foods intake is the marketing techniques implemented by food industries across multiple mediums as the common misconception by the consumers about healthy foods are more expensive. However, research suggests this perception is based on misleading price metrics as well as changes in fruit and vegetables convenience and level of preparedness (Carlson & Frazão, 2014). Furthermore, neighbourhoods that lack access to nutritious foods are food deserts (Lopez, 2007). Designation of food desert has been positively linked to obesity in the United States and simply switching from a non-food desert census tract to a food desert census tract can increase the odds of obesity by 30% (Chen *et al.,* 2016). In addition,

due to financial constraint, socioeconomically disadvantaged groups maximize energy value for money resulting in energy-dense, nutrient poor diets that contribute to obesity (Lee *et al.,* 2012).

Next, built environment factors such as easy access to unhealthy fast foods, limited access to recreational facilities or parks and few safe or easy ways to walk in the neighbourhood. Therefore, a study showed that in a high-income neighbourhood and a low income neighbourhood, the number of recreational facilities was equitable in the neighbourhoods, the residents of the low income neighbourhood perceived that they had less access to recreational facilities (Giles-Corti & Donovan, 2002). In low-income neighbourhoods, they are burdened with an abundance of fast food outlets. Fast food restaurants offer inexpensive, calorie-dense food but that same food also nutrient-poor and unhealthy with high levels of sugar, fat and sodium. From United States Department of Agriculture (USDA), the recommendation for daily calorie intake by McDonald's meal has more than half a day's worth of calories. Also, the risk of being overweight and obesity in the society is because of the changes in occupation related physical activity due to improvements in labour-saving technology. Hence, the advancement of technology is associated between decreases in work-related energy expenditure and weight gain over the same period (Church *et al.,* 2011).

Besides, the exposure to chemicals known as obesogens which can change hormones and increase fatty tissue in our bodies. The term obesogens was coined around 2006, based on research that showed exposures to specific chemicals during early development disrupted normal metabolic processes and increased susceptibility to weight gain across the life span (Grun & Blumberg, 2006). Unhealthy diets and lack of exercise are the main factors that can contribute to overweight and obesity but obesogens may also be playing a role and known as endocrine disruptors. These chemicals had been shown to induce weight loss at high concentrations but at lower concentrations, it might contribute to weight gain (Baillie-Hamilton, 2002). The chemicals

can be found in the diet, cigarette, pharmaceutical products, industrial chemicals and environmental pollution (Holtcamp, 2012). It comes in many forms such as pesticides, dyes, pigments, medicine, food flavouring and colouring and perfumes. Hence, obesogens may lead to increased lipogenesis, reduced lipolysis, enlargement of adipocytes and its accumulation, also the abnormality in appetite and satiety control that consequently leads to obesity.

Furthermore, changes in food system continuously promote obesity such as ultra-processed foods known for the availability of ready-to-eat or-heat foods. Ultra-processed foods are manufactured with substances extracted from foods or synthesized in laboratories (dyes, flavouring and other additives) (Monteiro *et al.,* 2016). Thus, ultra-processed food consumption may increase the risk of overweight and obesity by increasing the total intakes of calories, added and free sugar and fats and providing an inadequate relation of nutrients potentially involved in the genesis of the accumulation of body fat (WHO, 2014; Moubarac *et al.,* 2013; Monteiro *et al.,* 2011). Hence, the easier preparation of the food, the higher the intake of calories and the higher the risk of overweight and obesity.

2.4   Overweight and Obesity in Non-Smokers Men

Smoking and obesity have been a major public challenge and the prevalence of both is increasing globally. Compared to normal-weight never smokers, individuals who were normal-weight, obese or underweight and smoked heavily at the same time had a poorer general lifestyle. From Framingham Heart Study, it showed that, life expectancy of obese smokers is around 13 years shorter than non-obese, non-smokers (Peeter *et al.,* 2003). Besides, the general perception that smoking may protect against obesity is the common reason for starting smoking among adolescents (Potter *et al.,* 2004). Both smokers and non-smokers believe that smoking is an effective way of reducing body weight. This

usually occur when the overweight and obesity individuals want to lose weight in a fastest and easiest way. However, there also have possible causal mechanisms explored by previous study which is a peripheral metabolic effect. Since nicotine is a cholinergic agonist and readily crosses the blood brain barrier, a central effect on eating is hypothetically plausible yet to be established (Chiolero *et al.,* 2008; Zhang *et al.,* 2001).

Overall, current smokers were likely to be obese than never smokers, but this was not true among younger participants and those living in the most affluent areas of residences (Dare *et al.,* 2015). The findings of the study are the obesity increased among the former smokers and it has similar results from the study conducted by Reas *et al.* (2009) who reported increased BMI following smoking cessation and Basterra-Gortari *et al.* (2010) who reported higher BMI in former than never smokers. People who smoked more than 20 cigarettes per day were more likely to be overweight than those who had smoked less but were still less likely to be overweight than never smokers (Mackay *et al.,* 2013). However, the prevalence of overweight and obesity mostly from former smoker, as they have to find replacement to reduce smoking addiction compared to current smoker and non-smoker.

2.5   COVID-19 Pandemic Lockdown

In 2019, Coronavirus diseases or COVID-19 has been spread to the world which cause pandemic where it is a severe acute respiratory syndrome caused by SARS coronavirus 2 (SARS-CoV-2). The virus apparently comes from the transferring from the animals to humans at the Huanan seafood market and rapidly spread from Wuhan City of Hubei, China to the rest of the world (Wang *et al.,* 2020). Due to this condition government had decided to take strict preventive measures from spreading the viruses which is stay at home, social distancing, banning on mass gathering and events and prohibition for inter-state travel. A drastic change has been impacted people strongly.

Especially lifestyles changes where people being unaware of their eating habits and behavioural changes. For working people, when they work at home, it could result in boredom, which in turn is associated with a greater energy intake (Moynihan *et al*., 2015). They did not aware of their physical changes Furthermore, hearing or reading continuously about COVID-19 from media can be stressful and it leads to desire of eating 'comfort foods' that rich in sugar, defined as "food craving" (Yilmaz & Gökmen, 2020: Rodriguez-Martin & Meule, 2015). According to Ma, Ratnasabapathy & Gardiner (2017), foods that mainly rich in simple carbohydrates, can reduce stress as they encourage serotonin production with a positive effect on mood. Their energy intakes or the calorie intakes tend to exceed the energy requirement which cause the increasing in weight and lead to overweight and obesity.

The pandemic lockdown has led people to compromise in maintaining a healthy lifestyle, such as regular physical activity. For example, people that involved in contact sports cannot play as usual, gym has been stopped operating and postponing competition or sport events. Due to this standard operating procedure, people are limited in being physically active. However, they still can take initiative to do physical activity at home where they can watch Youtube exercise channel or any exercise program online. For example, Fit Malaysia X online class session which operated by National Sport Institute of Malaysia (ISN) where they were conducting different type of exercise classes. Such as yoga, upper and lower body strength and cardio-training.

CHAPTER 3

METHODOLOGY

3.1   Study Design

A cross-sectional study has been conducted to identify energy intake and energy requirement of overweight non-smoking men. Participants that involved in this study were non-smokers men from the Health Campus Universiti Sains Malaysia students and staffs.

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│                         Non-smoking men                            │
│                      Age: 18 – 40 years old                        │
│       Body Mass Index (BMI): 25.0 kg/m² to 34.9 kg/m²              │
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Non-smoking men

Age: 18 – 40 years old

Body Mass Index (BMI): 25.0 kg/m^2 to 34.9 kg/m^2

Physical Activity Readiness Questionnaire (PAR-Q)	**24-Hours Diet Recall**	**Anthropometry and Body Composition**	**Energy Expenditure and Energy Availability**
	Breakfast, lunch, afternoon tea, dinner and supper	Weight	Total Daily Energy Expenditure (TDEE)
	Portion	Height	- Revised Harris Benedict Equation (Roza & Shizgal, 1984)
	Amount of calories	Body Mass Index (BMI)	
	Energy intake	Body Fat Percentage	Energy Availability (Reed *et al.*, 2014)
		Fat Free Mass	

Statistical Analysis

3.2   Participants Recruitment and Location of Data Collection

Men with Body Mass Index (BMI) 25.0 kg/m^2 to 34.9kg/m^2 are the reference population. The students and staffs come from Health Campus Universiti Sains Malaysia. The location of data collection for the participants are varied since the questionnaires can be answer from the link given through WhatsApp. The participants were selected based on inclusion and exclusion criteria will be given the link to fill the questionnaires.

Inclusion Criteria	Exclusion Criteria
Participants with Body Mass Index (BMI) is 25.0 kg/m^2 to 34.9 kg/m^2	Participants who are active (do exercise more than 3 times per week) or involved in any competition or training
Non-smoker's men	Having uncontrollable disease
Healthy individual	Having habits of consuming any nutritional supplements on regular basic
Participants age between 18 and 40 years old	Had history of upper and lower limb injuries for the past 6 months.

3.3   Sample Size Calculation

Sample size was calculated by using the single proportion formula. The number of samples from previous study are used as input in the formula. Based on the previous study, the participants involved were 13172 people and there has 73.69 % of participants were overweight and obesity people (Sulliga *et al.*, 2015). The sample size of the previous study was *n*=193, where the participants have a history of cardiovascular system disease, strokes, diabetes or cancer were excluded from the analysis. However, in this study, the excluded results from the analysis were used as the objective of this study was to identify the energy intake and energy requirement of overweight non-smokers men during the COVID-19 pandemic lockdown. The precision of 0.05 at 95 % confidence interval, the sample size needed for this study was 30 participants. However, 36 participants were recruited after considering 20 % drop out rate.

Using single proportion formula:

$$N = \left[\left(\frac{Z}{\Delta}\right)^2 (p\,(1-p))\right]$$

N = minimum required sample size

Z = value of standard normal distribution = 1.96 for 95%

Δ = precision

p = true proportion

3.4 Diet Assessment and Questionnaire

3.4.1 24-hours diet recall

Participants were required to fill in 24-hours dietary recall form from google link given through WhatsApp. The dietary recall method was carried out online since the COVID-19 pandemic started to break the chain of COVID-19 infection. The form consists of a few sections such as the questions regarding food intakes for each mealtime (breakfast, lunch, afternoon tea, dinner and supper), portion of the foods and drinks intakes and calories intakes. Measurements household tools were used such as teaspoons, tablespoons, cups, bowls and glass also, mealtime, type of meal, quantity taken, methods of cooking and recipes of some of the dishes were also recorded. The calories intake from overweight participants were calculated by using MyNutriDiari 2 application launched by Ministry of Health Malaysia (MOHE).

Figure 3.1: MyNutriDiari 2 application launched by MOHE

3.4.2   Physical Activity Readiness Questionnaire (PAR-Q)

The questionnaire has been recommended for low-to-moderate exercise involvement. The PAR-Q was developed in the 1970s as a method of identifying persons for who increased physical activity may be contraindicated (Chisholm *et al.,* 1975). The questionnaire determines the individual readiness for physical activity also as first step in the fitness assessment and exercise prescription process. Furthermore, the questionnaire composed of seven general health questions and approximately 80% specific questions (Shephard, 1994).

3.5   Data Collection

3.5.1   Body Composition

The participants were required to measure the body composition consists of weight, height, Body Mass Index (BMI), body fat percentage, and fat free mass. Participants that have BMI 25.0 kg/m^2 to 34.9 kg/m^2, fat percentage more than 25% were selected. The weight and height of participants' information were filled in the form given on their own (self-measured). Thus, Body Mass Index (BMI), body fat percentage and fat free mass of the participants were calculated manually by using formula.