



UNIVERSITI PUTRA MALAYSIA

***FACTORS ASSOCIATED WITH BODY MASS INDEX AMONG
ENGINEERING MAJOR STUDENTS OF A PUBLIC UNIVERSITY IN
SELANGOR***

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ENGINEERING MAJOR STUDENTS OF A PUBLIC UNIVERSITY IN
SELANGOR**

By

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Project Submitted as fulfillment of the requirements for the Degree of Bachelor
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APPROVAL

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DECLARATION

I declare that the thesis is my original work, with the exception of appropriately acknowledged quotations and citations.

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ABSTRACT

FACTORS ASSOCIATED WITH BODY MASS INDEX AMONG ENGINEERING MAJOR STUDENTS OF A PUBLIC UNIVERSITY IN SELANGOR

Nur Azznizza binti Mohd Abd Razak

Prevalence of overweight and obesity has always become a concern in the world due to its association with various illnesses and recent data shows that the prevalence has increased among young adults. However, studies among young adults, especially among university students, are still limited. Therefore, this study was carried out to assess the factors associated with body mass index (BMI) among university students. A total of 285 participants aged 18 to 29 years from the Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia participated in this cross-sectional study but only completed data from 274 participants were analysed. Data collected including participants' height and weight, participants' socio-demographic (age, gender, date of birth, ethnicity, year and course of study, family income and household number), psychological (stress, depression and anxiety) and lifestyle (sedentary behaviour, physical activity, smoking status and sleep quality) were collected based on self-reported technique. In this study, results showed that most of the participants, 63.9% (n = 175) were Malay, 32.1% (n = 88) first year students and 55.5% (n = 152) of participants were from the M40 group of family income. Results also showed 17.9% (n = 49) and 8.4% (n = 23) of the participants were overweight and obese respectively. There were significant correlations between family income and physical activity with BMI ($r = -0.227$; $r = -0.273$; $p < 0.001$). There was also a significant mean difference between course of study with BMI ($F = 3.426$; $p = 0.009$) which showed that mean $\pm$ SD of BMI was highest among Mechanical Engineering students ($25.59 \pm 5.32 \text{ kg/m}^2$). The mean of BMI was higher ($23.58 \pm 3.99 \text{ kg/m}^2$) among non-smoker group compared to current smoker ($22.10 \pm 3.73 \text{ kg/m}^2$) ($t = -1.978$, $p = 0.049$). Sleep quality also showed a significant association with BMI classification ($\chi^2 = 19.485$; $p < 0.001$) which indicated that the percentage of good sleepers were higher among overweight (81.6%) and obese (65.2%) participants. No significant association was observed between age, gender, ethnicity, depression, anxiety, stress and sedentary behaviour with BMI and BMI classification. This prevalence of overweight and obese was quite high among participants of this study. Health awareness and intervention programs should be done to prevent overweight and obesity among this group population, particularly during this current pandemic situation.

ABSTRAK

FAKTOR-FAKTOR YANG DAPAT MEMPENGARUHI INDEKS JISIM BADAN PELAJAR BIDANG KEJURUTERAAN DALAM UNIVERSITI UMUM SELANGOR

Nur Azznizza binti Mohd Abd Razak

Berat badan berlebihan dan kegemukan sering kali menjadi perhatian besar dunia dari masa ke semasa kerana berkait dengan pelbagai penyakit dan data terkini menunjukkan peningkatan indeks jisim badan di kalangan belia. Walau bagaimanapun, kajian dalam kalangan belia terutamanya di kalangan pelajar universiti masih terhad. Oleh itu, kajian ini dilakukan dalam kalangan pelajar universiti untuk menilai faktor-faktor yang berkaitan dengan indeks jisim badan. Seramai 285 peserta berumur 18 hingga 29 tahun dari Fakulti Kejuruteraan dan Alam Binaan Universiti Kebangsaan Malaysia telah mengikuti kajian ini tetapi hanya data dari 274 peserta yang telah dianalisis. Data yang dikumpulkan termasuk tinggi dan berat peserta, sosio-demografi peserta (umur, jantina, tarikh lahir, etnik, tahun dan kursus pengajian, pendapatan keluarga dan bilangan isi rumah), psikologi (tekanan, kemurungan dan kegelisahan) dan gaya hidup (tingkah laku tidak aktif, aktiviti fizikal, status merokok dan kualiti tidur) diambil berdasarkan laporan sendiri. Dalam kajian ini menunjukkan bahawa sebahagian besar peserta, 63.9% ($n = 175$) adalah berbangsa Melayu, 32.1% ($n = 88$) pelajar tahun satu dan 55.5% ($n = 152$) peserta berasal dari kumpulan keluarga M40. Hasil kajian juga menunjukkan 17.9% ($n = 49$) dan 8.4% ($n = 23$) peserta masing-masing berlebihan berat badan dan mengalami masalah kegemukan. Terdapat hubungan yang signifikan antara pendapatan keluarga dan aktiviti fizikal dengan BMI ($r = -0.227$; $r = -0.273$; $p < 0.001$). Terdapat juga perbezaan purata yang signifikan antara kursus pengajian dengan BMI ($F = 3.426$; $p = 0.009$) yang menunjukkan bahawa $\text{min} \pm \text{SD}$ BMI adalah tertinggi di kalangan pelajar Kejuruteraan Mekanikal ($25.59 \pm 5.32 \text{ kg/m}^2$). Purata BMI lebih tinggi ($23.58 \pm 3.99 \text{ kg/m}^2$) di antara kumpulan tidak pernah merokok berbanding perokok semasa ($22.10 \pm 3.73 \text{ kg/m}^2$) ($t = -1.978$, $p = 0.049$). Kualiti tidur juga menunjukkan hubungan yang signifikan dengan klasifikasi BMI ($\chi^2 = 19.485$; $p < 0.001$) yang mana peratusan berlebihan berat badan yang tinggi (81.6%) dan kegemukan (65.2%) di kalangan mereka yang mendapat tidur yang baik. Tidak ada hubungan yang signifikan antara umur, jantina, etnik, kemurungan, kegelisahan, tekanan dan tingkah laku tidak aktif dengan BMI dan klasifikasi BMI. Kelaziman berat berlebihan dan masalah kegemukan ini agak tinggi dalam kalangan peserta kajian ini. Program kesedaran dan intervensi kesihatan harus dilakukan untuk mencegah berat badan berlebihan di kalangan kumpulan populasi kajian ini terutamanya semasa keadaan pandemik ini.

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CHAPTER 1

INTRODUCTION

1.1 Background

Overweight and obesity has always become a big concern in the world from year to year. According to the World Health Organization (2020), obesity and overweight is characterised as abnormal or excessive fat deposition that poses a risk to human health. Meanwhile, the body mass index (BMI) is a metric that was currently used which derived from the equation of weight of a person (in kilograms) divided by the square of the person's height (in meters) and individual anthropometric characteristics would be classified based on the result (WHO, 2020). Generally, there are four categories in classification of BMI that are underweight ($<18 \text{ kg/m}^2$), normal ($18.5 - 24.9 \text{ kg/m}^2$), overweight ($25.0 - 29.9 \text{ kg/m}^2$) and obese ($\geq 30.0 \text{ kg/m}^2$). The emergence of significant health threats such as high blood pressure, type 2 diabetes, coronary heart disease, dyslipidemia and stroke associated with being overweight and obese, has become a serious issue currently (Centers for Disease Control and Prevention (CDC), 2020).

According to the data obtained from WHO 2020, statistics of obesity across the world had been increasing almost tripled since 1975. In 2016, there were more than 1.9 billion of adults who were overweight that age 18 years and older and among them 650 million were obese. It also had been stated that there were high cases of mortality in the countries where the population had a high number of obesity and overweight

(WHO, 2020). In Malaysia, there was also shown a significant increase in the statistics of overweight and obesity for every year. Based on the data from the National Health and Morbidity Survey (NHMS), the prevalence of overweight had increase from 16.6% in 1996 (NIH, 1996) to 30.0% in 2015 (NIH, 2015) while obesity prevalence was increasing from 4.5% in 1996 (NIH, 1996) to 17.7% in 2015 (NIH, 2015). According to the latest data, the prevalence of overweight is 30.4% and obesity is 19.7% in 2019 (IPH, 2019). This had shown significant increases of 0.4% and 2% for the prevalence of overweight and obesity respectively compared to the last five years. Based on latest data from NHMS, the percentage of overweight among young adults age 18-19, 20-24 and 25-29 was 15.3%, 19.7% and 24.7% respectively while percentage of obesity was 16.2%, 11.5% and 20.3% respectively (IPH, 2019). Furthermore, the percentage of obesity among adults in United State age 20 – 39 in the year 2015 – 2016 was 35.7% that shows quite high in numbers (Hales et al., 2017).

Transition phase from adolescence or puberty to adulthood is the definition for young adults that aged between 18-25 years old (Poobalan & Aucott, 2016). According to recent data, middle-aged adults between 45-49 and 35-39 years old had the highest prevalence of overweight and obesity respectively (NIH, 2019). Similar findings also stated that compared to other age groups, middle-aged adults aged 40-59 years old had highest prevalence of severe obesity (Hales et al., 2020). However, several studies also found that there were increasing trend in overweight and obesity among young adults in several countries especially among university and college students (Huang et al., 2009; Kabir et al., 2014; Pell et al., 2016; Peltzer et al., 2014; Poobalan & Aucott, 2016). In Malaysia, based on a study that had been conduct among post graduate students in public university showed that the prevalence of overweight and obese

among participants was 23.1% and 8.9% respectively (Kabir et al., 2014). Based on the result from the study showed that male (29.4%) had higher prevalence of overweight than female (19.7%) while the prevalence of obese also was higher among male (9.0%) than female (8.8) (Kabir et al., 2014). Next, a systematic review had been done among young adults age range of 16 – 30 years in a developing country (Poobalan & Aucott, 2016). Based on the research showed that the prevalence of overweight as high as 28.8% while obesity was in the range of 2.3% to 12.0% among young adults in developing countries (Poobalan & Aucott, 2016). Furthermore, according to a cross-sectional study across 22 countries among 15746 undergraduate from different universities had concluded that overall prevalence of overweight or obesity was 22% with prevalence among men (24.7%) higher than women (19.3%) (Peltzer et al., 2014).

In this critical period of time, many young women and men having to undergo some changes from school to tertiary education or careers, peer pressures, newly found autonomy and exposure to new foods, activities and environment that eventually create a dynamic ecological process that navigates youth and influences subsequent behaviours (Pell et al., 2016). These critical moments in the period of development make young adults susceptible to energy imbalance, frequently contributing to weight gain, which may not be alarming at the moment, but accumulates later (Khan et al., 2018; Neuhauser, 2005; Poobalan & Aucott, 2016). A study also stated that the accumulated results of years of dietary habits and insufficient physical activity developed at a younger age also often result in obesity (Pell et al., 2016).

Besides age, there are also many other variables that likely influence body mass index. Socio-demographic background factors such as gender, ethnicity and family income may also influence body mass index of young adults (Kabir et al., 2014;

Malaysian Medical Association (MMA), 2008; Peltzer et al., 2014; Radzi et al., 2019; Ren et al., 2015; Tapera et al., 2017). There also studies that shown lifestyle factors such as smoking, sedentary behavior, physical activity level (Alexopoulos et al., 2010; Biddle et al., 2017; Ginawi et al., 2016; Micklesfield et al., 2017; Mokhtari et al., 2015; Surbakti et al., 2018) and sleep quality (Beccuti & Pannain, 2011; Rahe et al., 2015; Rathod et al., 2017; Sa et al., 2020) affect the body mass index of young adults. Another significant factor found to be strongly associated with higher BMI of university students is stress (Fahad et al., 2018; Gupta et al., 2009; Radzi et al., 2019), depression (Odlaug et al., 2015) and anxiety (Abdel Wahed & Hassan, 2017; Boyce & Kuijer, 2015; Haidar et al., 2018; Mokhtari et al., 2015; Rivenes et al., 2009). Due to COVID-19 pandemic, there might be differences in recent data compared to previous study. Therefore, through this study, researchers will be able to classify the variables correlated with body mass index by observing the body mass index of university students especially during this COVID-19 pandemic.

1.2 Problem Statement

According to National Institutes of Health, National Heart, Lung, and Blood Institute (2013), obesity can be known to be metabolically unhealthy, contributing to chronic conditions such as coronary disease, type 2 diabetes, asthma, stroke, gallbladder disease, infertility, sleep apnea, hormonal cancers, and osteoarthritis. Various cancers, miscarriage, slow wound healing and poor hepatitis B vaccine antibody response are the risk factors of obesity (CDC, 2020). Recently, obesity also had been known as a chronic and systemic inflammatory condition, though excess adipose reserves were once thought to be inactive (Bueno et al, 2014; Grimble, 2010;

Rocha & Folco, 2011). The secretion of a wide variety of active substances involves adipose tissue, but not all of those are engaged in inflammatory acts (Bueno et al, 2014; Grimbale, 2010; Rocha & Folco, 2011). The consequences result in fundamental development of hyperlipidemia, metabolic syndrome, diabetes mellitus, muscle protein loss, CVD, stroke, and some cancers (Bueno et al, 2014; Grimbale, 2010; Rocha & Folco, 2011). Overweight and obesity are also linked with non-alcoholic fatty liver disease (NAFLD) and could contribute to end-stage liver disease (Chalasani, 2016). Hence, realistic steps need to be taken in order to address the increasing prevalence by defining the variables associated with overweight and obesity.

A new form of coronavirus, SARS-CoV, was been identified in early 2020 by the World Health Organization (WHO) after the outbreak in China around December 2019. The epidemic spread across the world rapidly (Pathak, 2020; WHO, 2020). CDC (2020) stated that adults with excess weight are at much higher risk of severe illness from COVID-19 and the risk of hospitalization might be tripled because of an infection with COVID-19. Obesity can also reduce the capacity and reserve of the lungs and can make breathing harder (Simonnet et al., 2020). Based on a study among patients that been admitted in intensive care for SARS-CoV-2, those who had obesity (BMI>30) and severe obesity (BMI >35) were present among 47.6% and 28.2% of cases respectively and the total of patients that required invasive mechanical ventilation (IMV) was 68.6% (Simonnet et al., 2020). The proportion of patients needing IMV increases with classification of BMI (Simonnet et al., 2020). In addition, obesity specifically in male patients and younger groups, plays a major role in the risk of death from COVID-19 (Tartof et al., 2020). Besides that, according to a study among 244 young and middle-aged in Saudi Arabia had showed that there was significant decrease

in duration of doing physical activity during and before COVID-19 lockdown (57.1%) (Barwais, 2020). On the other hand, as reported through a survey among Malaysian during COVID-19 pandemic, 40% of respondents stated they did exercise during Movement Control Order (MCO) while 38% playing video or online games (Hirschmann, 2020). The least activity respondents did during MCO is playing board games or offline games (19.0%) (Hirschmann, 2020). It is therefore very vital to identify the incidence of overweight and obesity during this COVID-19 and its related causes that may increase incidence.

A limited study was conducted on body weight status variables among young adults, especially university students in Malaysia. Cross-sectional research and only a limited number of intervention studies, observational studies and systematic analysis have been reported in the majority of obesity studies involving adults aged 18 and over in Malaysia (Safiza et al., 2018). Based on analysis of obesity that had been done among Malaysian university students indicate that the prevalence of overweight and obese was 21.2% and 16.3% respectively of the total in the study population, with a particular prevalence of 23% and 17.6% respectively among Bachelor, 21.9% and 14.3% respectively among Master and 17.8% and 18.4% respectively among Doctoral students (Radzi et al., 2019). However, the research concerned mostly about the risk factor of obesity among university students at various educational levels, but the study did not establish the correlation of race, gender, depression and anxiety with overweight and obesity in university students. The study also was a combination of five universities and did not show the results based on each university. Reported on the research of low middle class and developing countries among university students from 22 universities, it was found that 22% were overweight and obese overall (Peltzer

et al., 2014) but there were no data in associate between educational level, stress, anxiety, sedentary behavior and sleep quality with overweight and obesity among university students.

Besides that, based on a study that had been done among undergraduate students in Universiti Kebangsaan Malaysia (UKM), 17.0% were overweight and 9.5% were obese (Yeng & Sedek, 2012). However, the study was in the year 2012 and there was no recent study of the prevalence of overweight and obesity among students in UKM. In addition, the study only focused on the body weight perception and weight control behaviors of the students but other factors that were associated with overweight and obesity was not assessed nor identified (Yeng & Sedek, 2012). The goal of this study is therefore to determine the relationship between socio-demographic background factors, psychological factors and lifestyle factors with body mass index among university students, especially during this COVID-19 pandemic.

1.3 Research Questions

The present research was carried out to address the following questions:

- 1) What is the prevalence of body weight status among university students?
- 2) What are the association between socio-demographic background factors, psychological factors and lifestyle factors with body mass index of university students?

1.4 Significance of the Study

There was no update study in determining the factors that are associated with body mass index specifically being done among university students in UKM. Previous study had been done about 9 years ago and that only focused on the body weight perception

and weight control behaviors of the students. Although previous data did not show any high prevalence of overweight and obesity among the students but a new study needs to be conducted in order to determine the prevalence especially during this COVID-19.

The present research would help by incorporating new awareness of the related variables with body mass index of university students. In addition, this study will serve as baseline data for future studies particularly on the body mass index among university students in Malaysia during this COVID-19 pandemic. Having this study also could help the health practitioners to carry out adequate and successful intervention measures to attain healthier body weight among young adults, especially university students, during this pandemic, which may lead most students to reduce physical activity due to online classes and stay-at-home policies. In managing and sustaining balanced body weight of university students, the research findings would be helpful for future prevention initiatives.

1.5 Research Objectives

1.5.1 General Objective

To determine the factors associated with body mass index among students in Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).

1.5.2 Specific Objectives

- i. To identify the socio-demographic background factors (gender, age, ethnicity, family income, education level) among students in Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).

- ii. To identify the psychological factors (depression, stress, anxiety) among students in Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).
- iii. To identify the lifestyle factors (sedentary behavior, physical activity, smoking, sleep quality) among students in Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).
- iv. To determine the body weight status of students in Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).
- v. To determine the association between socio-demographic background, psychological and lifestyles factors with body mass index among students in Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).

1.6 Research Hypothesis

- Null Hypothesis:

There was no significant association between socio-demographic background factors, psychological factors and lifestyle factors with body mass index among students in Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).

- Alternative Hypothesis:

There was a significant association between socio-demographic background factors, psychological factors and lifestyle factors with body mass index among students in

Faculty of Engineering and Built Environment of Universiti Kebangsaan Malaysia (UKM).

1.7 Research Framework

This research framework consists of independent variables which include socio-demographic background factors, psychological factors and lifestyle factors and the dependent variable was body mass index.

Socio-demographics background factors such as gender, age, ethnicity, family income and education level were found to be associated with body mass index of university students (Peltzer et al., 2014; Radzi et al., 2019). It had been found that BMI was significantly associated with gender among adults (Mokhtari et al., 2015). Based on the data from NHMS, it shows that there was a high prevalence of overweight among male (30.8%) while obesity among females (24.7%) in the year 2019 (IPH, 2019). Other studies also found that more males (33.7%) were overweight than females (Kuan et al., 2011). In addition, age and ethnicity are both statistically important predictors of BMI (Pell et al., 2016). Based on the data it shows that obesity and overweight much higher among those who aged 31-35 years old than ages 16-20 years old and the prevalence of obesity was highest among Orang Asli meanwhile across the age groups, there was high obesity rates among Indian population (Pell et al., 2016). Another study found that the prevalence of 11 overweight within ethnicity was higher among Indians (38.3%) while obesity was higher among other ethnicities (23.8%) (Kabir et al., 2014).

Based on a study that had been made across 22 developing countries among university students, it had been found that there was association between higher BMI

with poor mental health (Peltzer et al., 2014). The data showed that about 25.8% of both men and women had severe depression (Peltzer et al., 2014). Besides that, there was a research that suggested that low levels of anxiety participants had higher BMI scores (Mokhtari et al., 2015). However, there was also a study that found report histories of major depressive significantly associate with obese male students compared to overweight and normal weight male students and major depressive and panic disorder had been found among obese female students (Odlaug et al., 2015).

Next, there was an association between physical activity with BMI due to most of the students tend to have lack of exercises and busy study schedule (Surbakti et al., 2018). On the contrary, a research found that spending time watching television was significantly related to the likelihood of obesity which watching television categorized as sedentary behavior (Hu et al., 2003). Besides that, prevalence of obesity had been found significantly higher among ex-smokers than those who never smokes and current smokers ($p < 0.05$) (Ginawi et al., 2016). Nevertheless, other study found that more obese participants choose to smoke compared to non-obese participants (Chen et al., 2019) and this similar to one study that determine the association between smoking with physical inactivity leading gradually to an increase in the distribution of abdominal fat (Kim et al., 2016). As stated in one study, there was positive association between higher BMI with participants who had sleep problems. In particular, compared to their normal weight peers, college students with obesity were even more prone to have insufficient sleep time and low sleep efficiency (Sa et al., 2020)

All of the socio-demographic background factors, psychological factors, lifestyle factors and body mass index were identified through a self-administered questionnaire. The socio-demographic factors of gender, age, ethnicity, family income and education level were included. Other than that, psychological factors such as depression, stress and anxiety were assessed through DASS-21 questionnaire. Then, lifestyle factors such as sedentary behavior was assessed through PAST Questionnaire while physical activity was assessed through GPAQ. Other lifestyle factors such as sleep quality was assessed through PSQI Questionnaire while smoking status was assessed through GATS. Body weight status was assessed through Body Mass Index (BMI) which height and weight were self-reported and BMI was calculated. The body weight status was determined based on Clinical Practice Guideline (CPG) on Management of Obesity (2004) classification of underweight ($<18.5 \text{ kg/m}^2$), normal ($18.5\text{-}24.9 \text{ kg/m}^2$), overweight ($25.0\text{-}29.9 \text{ kg/m}^2$) and obese ($\geq 30.0 \text{ kg/m}^2$).

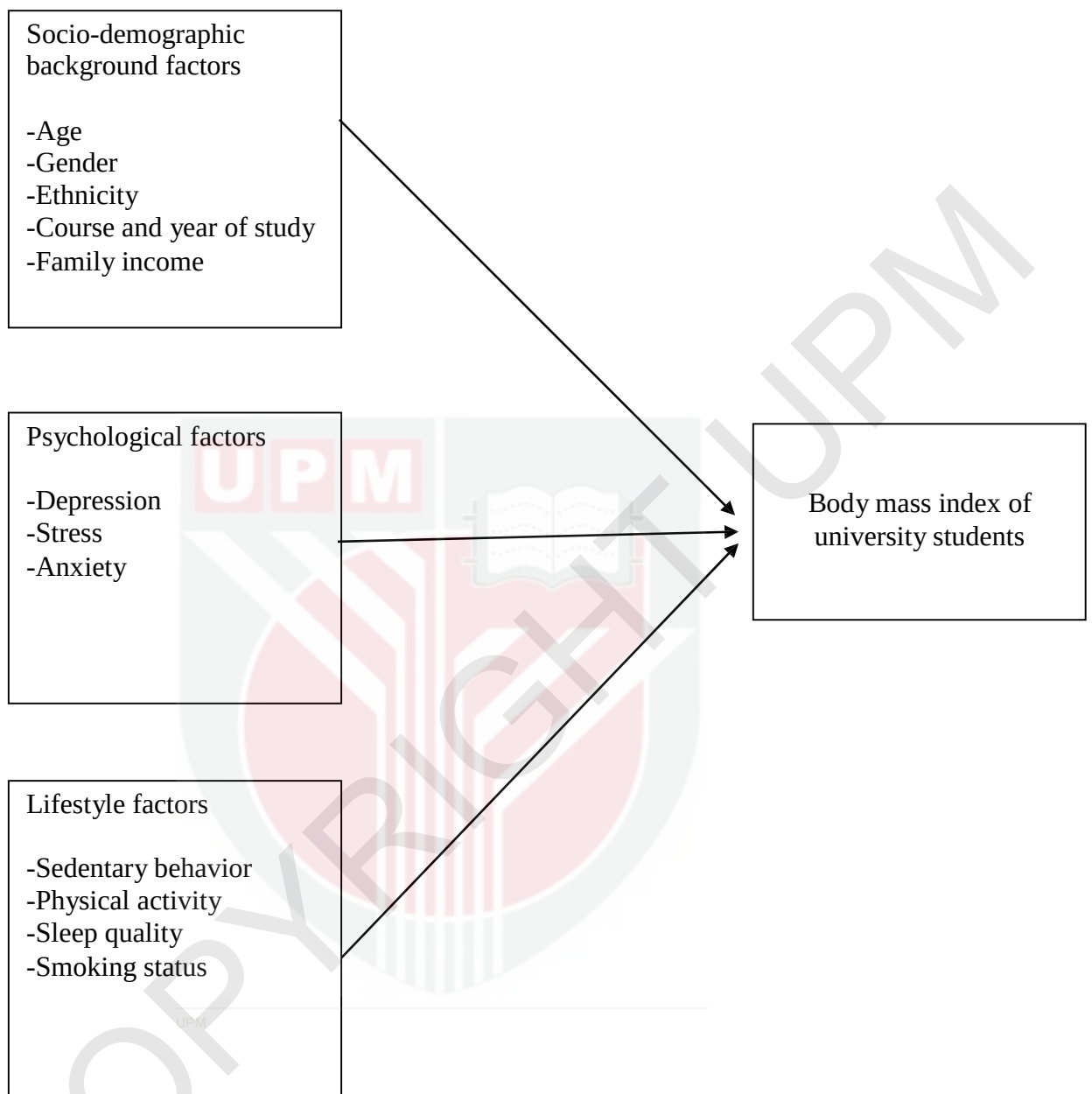


Figure 1.1: Research Framework

CHAPTER 2

LITERATURE REVIEW

2.1 Overweight and Obesity

According to World Health Organization (2020), Overweight and obesity is characterised as abnormal or excessive fat deposition that poses a risk to human health. According to the data obtained from WHO 2020, statistics of obesity across the world had been increasing almost tripled since 1975. In the year 2016, the prevalence of overweight was 39% while obesity was 13% among adults aged 18 years and above (WHO, 2020) and result in 8% of the global death in the year 2017 (Ritchie, 2017). Two over third adults were overweight or obese in most high-income countries while about 1 in 5 adults in low-income countries such as South Asia and Sub-Saharan Africa were overweight or obese (Ritchie, 2017). On the other hand, the percentage of deaths that were attributed to obesity in middle-income countries were more than 15% while in high-income countries is in the range of 8% - 10% and less than 5% of deaths of obesity in most low-income countries especially Sub-Saharan Africa (Ritchie, 2017).

Meanwhile in Malaysia, data obtain based on NHMS shows that the prevalence of overweight had increase from 16.6% in 1996 (IPH, 1996) to 30.4% in 2019 (IPH, 2019) while prevalence of obesity had increase from 4.5% in 1996 (IPH, 1996) to 19.7% in 2019 (IPH, 2019). This had shown significant increases of 13.8% and 15.2% for the prevalence of overweight and obesity respectively compared to the last 24 years. Although according to recent data, the highest prevalence of overweight and

obesity were mostly among middle-aged adults between age 45-49 (39.6%) and age 35-39 (25.3%) years old respectively (IPH, 2019), the prevalence of overweight and obesity among young adults also quite high (IPH, 2019). The percentage of overweight among young adults age 18-19, 20-24 and 25-29 was 15.3%, 19.7% and 24.7% respectively while percentage of obesity was 16.2%, 11.5% and 20.3% respectively (IPH, 2019). Besides that, the percentage of obesity among adults in United State age 20 – 39 in the year 2015 – 2016 was 35.7% that shows quite high in numbers (Hales et al., 2017).

Next, there was also study among university students from 22 countries and based on the study it shows that the total prevalence of overweight and obesity was 22% (Peltzer et al., 2014). Based on the study, in Asia, Bangladesh had showed highest percentage of obesity among male (16.2%) while India showed highest percentage of obesity among female (7.7%) (Peltzer et al., 2014). On the other hand, in Africa, the highest percentage of obesity was among male in Egypt (12.5%) while among female in South Africa (15.6%). In Caribbean and Latin America, the highest prevalence of obesity was among male and female university students in Barbados that result in 13.0% and 18.7% respectively (Peltzer et al., 2014). Meanwhile in Malaysia, based on a study that had been conduct among 945 post graduate students in public university showed that the prevalence of overweight and obese among participants was 23.1% and 8.9% respectively (Kabir et al., 2014). Result from the study showed that the prevalence of overweight was higher among male (29.4%) than female (19.7%) while the prevalence of obese also was higher among male (9.0%) than female (8.8) (Kabir et al., 2014).

Also a study by Kabir et al (2014) result in the prevalence of overweight based on ethnicity was highest among Indians (38.3%; 95% CI: 24.4%, 52.2%), followed by others ethnicities (33.3%; 95% CI: 13.1%, 53.4%), and Malays (22.5%; 95% CI: 19.5%, 25.5%) meanwhile for the prevalence of obesity was highest among other ethnicities (23.8%; 95% CI: 5.6%, 42.0%), and followed by Malays (9.8%; 95% CI: 7.7%, 11.9%). However, the prevalence of overweight (19.0%; 95% CI: 12.2%, 25.8%) and obesity (2.4%) based on ethnicities was the lowest among Chinese (Kabir et al., 2014). On the other hand, official data from NHMS stated that in Malaysia, the highest prevalence of overweight was among Bumiputera Sabah (35.3%) while the highest prevalence of obesity was among Indian (29.3%). Based on data from CDC (2020), in United States, the highest prevalence of obesity was among non-Hispanic blacks (49.6%) followed by Hispanic (44.8%) and non-Hispanic whites (42.2%).

Then, for educational level, based on a data by NHMS, adults with primary education level (39.6%) had the highest prevalence of overweight while adults with secondary education level (21.2%) had the highest prevalence of obesity in Malaysia (IPH, 2019). Furthermore, based on data by NHMS also stated that there was high prevalence of overweight among adults in T20 income group (32.0%) while the prevalence of obesity was high among adults in M40 income group (21.5%) (IPH, 2019). Income range for T20 income group is more than RM 10960 while M40 is more than RM 4850.

2.2 Association of Socio-Demographic Factors with Body Mass Index

2.2.1 Age

Based on data from NHMS, the percentage of overweight among young adults age 18-19, 20-24 and 25-29 was 15.3%, 19.7% and 24.7% respectively while percentage of obesity was 16.2%, 11.5% and 20.3% respectively (IPH, 2019). Besides that, obesity among adults in United State age 20 – 39 in the year 2015 – 2016 was also showed quite high percentage that was 35.7% (Hales et al., 2017). Based on a study among university students from 22 countries showed that the highest prevalence of obesity or overweight was among participants age 22 and above (25.6%) followed by participants age 16 – 19 (21.8%) and the least among participants age 20 – 21 (19.7%) and had showed significant correlation with overweight and obesity among the university students ($p = 0.004$) (Peltzer et al., 2014). On the other hand, based on study in Malaysia, the percentage of overweight and obesity among participants age 20 – 24 was 25.9% while participants age 25 – 29 was 29.5% and showed significant association with overweight and obesity ($p < 0.001$) (Kabir et al., 2014). Furthermore, another study in Malaysia among young adults result in higher prevalence of obesity (20.9%) and overweight (28.4%) between aged 31 – 35 years old compared to prevalence of obesity (8.4%) and overweight (12.8%) between aged 16 – 20 years old. Therefore, the prevalence of underweight (4.6%) and normal BMI (46.1%) among aged 31 – 35 years old was lower than the prevalence of underweight (21.7%) and normal BMI (56.7%) among aged 16 – 20 years old (Pell et al., 2016). This suggested that one unit rise in age corresponds to an enhanced risk of being overweight of 1.05 ($p < 0.001$) and an increase in obesity of 1.06 ($p < 0.001$) (Pell et al., 2016).

However, there was a study by Baalwa et al (2010) among young adults in Uganda found that no significant association between age with BMI ($p > 0.05$) and these findings also similar with study by Jiang et al (2018). Both studies were participated among students age 18 years and above.

2.2.2 Gender

Based on a study among post graduate students in public university, the results showed that the prevalence of overweight was higher among male (29.4%; 95% CI: 24.4%, 34.5%) than female (19.7%; 95% CI: 16.6%, 22.8%) while for obese the prevalence was also higher among male (9.0%; 95% CI: 5.9%, 12.1%) than female (8.8%; 95% CI: 6.6%, 11.0%) and had showed significant association with overweight and obesity ($p = 0.002$) (Kabir et al., 2014). Next, there is also study among undergraduates in Sarawak showed that significant association between gender and BMI ($\chi^2 = 18.697$, $p < 0.001$) where the percentage of overweight was more among male (34.0%) than female (22.0%) (Kuan et al., 2011). Based on other study in Malaysia also stated that the prevalence of overweight was higher among male (21.0%) than in female (18.7%) but the prevalence of obesity was higher among female (15.4%) than in male (11.1%) and showed significant association with BMI ($p < 0.001$) (Pell et al., 2016). Besides that, in a study among 50 Chinese universities state that the male students have high prevalence of overweight and obesity (13.9%; 95% CI: 11.5%, 16.7%) than in female (6.1%; 95% CI: 4.1%, 8.1%) (Jiang et al., 2018).

Despite that, there was also studies that showed no significant association between gender with BMI (Araújo et al., 2007; Genena & Salama, 2017). A study by Araújo et al (2007) among 684 adults in Brazil result in no significant association between

gender with BMI ($p > 0.05$). Similar findings by Genena and Salama (2017) among students in Egypt result in no significant mean difference between male ($25.22 \pm 4.60 \text{ kg/m}^2$) and female ($24.63 \pm 4.20 \text{ kg/m}^2$) with BMI ($p = 0.232$).

2.2.3 Ethnicity

Based on latest data from NHMS, it showed that the highest prevalence of overweight was among Bumiputera Sabah (35.3%), followed by Indian (34.6%), Bumiputera Sarawak (34.4%) and Malay (30.9%) while for obesity was highest among Indian (29.3%), followed by Malay (22.7%), Bumiputera Sarawak (20.8%) and Bumiputera Sabah (19.5%) (IPH, 2019). According to a study among young adults in Malaysia, it showed that the Orang Asli had the highest prevalence of obesity (22.8%) while Chinese had the lowest prevalence of obesity (7.6%) (Pell et al., 2016). As the base result, the relative risk ratios (RRRs) compare Indian, Chinese, and Orang Asli to normal BMI among Malay and result in doubled relative risk of being overweight among Orang Asli young adult ($p = 0.002$) while the risk of obesity (factor 0.74, $p < 0.05$) and overweight (factor 0.46, $p < 0.001$) reduced among Chinese young adult (Pell et al., 2016). This result in ethnicity was statistically significant predictors of BMI (Pell et al., 2016). There was also other study been conducted among post graduates in a public university in Malaysia and the outcome of the study was significant association between ethnicity with overweight and obese ($p < 0.001$) (Kabir et al., 2014). According to the study, the highest prevalence of overweight was among Indians (38.3%; 95% CI: 24.4%, 52.2%), followed by others ethnicities (33.3%; 95% CI: 13.1%, 53.4%), and Malays (22.5%; 95% CI: 19.5%, 25.5%) meanwhile the highest prevalence of obesity was among other ethnicities (23.8%; 95% CI: 5.6%,

42.0%), and followed by Malays (9.8%; 95% CI: 7.7%, 11.9%) (Kabir et al., 2014). However, the lowest prevalence of both overweight (19.0%; 95% CI: 12.2%, 25.8%) and obesity (2.4%) was among Chinese (Kabir et al., 2014).

On the other hand, a study among 240 medical students of the International Medical University in Malaysia result in no significant association between Chinese and other ethnicities with BMI ($p > 0.05$) but showed significant association between Malay and Indian with BMI ($p < 0.04$; $p < 0.002$). A study by Odlaug et al (2015) among university students in Midwestern United States University also found no significant association between ethnicities with BMI ($p > 0.05$).

2.2.4 Course and year of study

Based on a study by Beaudry et al (2019) among freshman students aged 17 to 20 years attended Brock University found that there was significant associated between year of study with BMI (< 0.001). The findings result in males (1.2 kg/m^2) gains higher BMI than female (0.7 kg/m^2) (Beaudry et al., 2019). A study by Smith-Jackson & Reel (2012) among 235 freshmen college women also stated that there was significant association with BMI and showed significant increase of BMI ($p < 0.05$) that result in high number of overweight and obesity among the students. Despite that, a study by Khalil et al (2020) that had been done among students in Medina result in no significant association between year of study with BMI ($p > 0.05$). No significant association between junior (semester 6 and 7) and senior (semester 8 and 9) with BMI in a study by Boo et al (2010) among 240 students in Malaysia.

Then for the course of study, there was not much study had been done specifically among engineering students. Despite that, a study by Selvakumar (2015) among

engineering students in Chennai result in significant association between the course with BMI ($p < 0.05$) which higher number of students were found to be overweight and obese. Other study on medical course by Gudegowda et al (2018) among 424 medical students also result in significant association between the course with BMI ($p < 0.05$) and result in higher number of overweight, 62 students and obese, 48 students. Another study by Hameed et al (2019) among 320 students of medical course in Kathua result in significant association between medical courses with BMI. Neverthelss, studies by Abdalla et al (2020) and Aslani et al (2021) showed no significant between courses of study with BMI among the university students ($p > 0.05$).

2.2.5 Family income

According to the latest data from NHMS showed that there was high prevalence of overweight among adults in T20 income group (32.0%) while the prevalence of obesity was high among adults in M40 income group (21.5%). A study among university students in Malaysia showed that there was significant association between income with BMI ($r = 0.22$, $p = 0.001$) that result in adults with higher income levels had more BMI scores (Mokhtari et al., 2015). Besides that, based on a study among 50 Chinese universities also stated that the higher family income associated higher overweight and obesity among males but not female students (Jiang et al., 2018).

However, a study among university students in Iraq did not showed any association between BMI with family income (Kumah et al., 2015). In addition, a study by Hsieh et al (2020) among adults in Taipei also suggested no significant association between income with BMI ($p > 0.05$).

2.3 Association of Psychological Factors with Body Weight Status

2.3.1 Depression

Many studies had proved that there were significant association between obesity with depression. Major depressive disorder or depression is a serious and extreme psychiatric disease that affected feeling, thinking and responding towards negativity (Torres, 2020). Depression could also trigger feelings of disappointment and lack of confidence (Torres, 2020). It can contribute to a number of physical and mental difficulties and can reduce your potential to interact at work and at home (Torres, 2020). Symptoms of depression differ from mild to severe but fortunately, depression is treatable (Torres, 2020). First, based on a study among 9125 adults in United State (US) indicated that obesity was significant associated with major depression (OR = 1.21; 95% CI: 1.09-1.35) (Simon et al., 2006). Next, there was also study among 65648 adults aged 20 – 89 years old and had showed significant association between depression and obesity among female (OR = 1.24; 95% CI: 1.12 – 1.38) and male (OR = 1.17; 95% CI: 1.04 – 1.32) (Rivenes et al., 2009). However, there was no significant association between adults who underweight and depression (Rivenes et al., 2009). After that, there was also a study conducted among 6000 students from large Mid-Western United States University and when compared to overweight (9.5%) and normal weight (10.6%) male students, obese male students were much more likely to have records of major depressive disorder. (28.6%; $\chi^2 = 16.91$; $p < 0.001$) (Odlaug et al., 2015).

However, there was also study that stated no significant associate between depression with higher BMI. A cross-sectional study among medical students of Fayoum University that had been participated by 442 students result in no association

between depression with obesity ($p > 0.05$) (Abdel Wahed & Hassan, 2017). Similar to cross-sectional study that had been conducted among 311 university students in Malaysia, the study also showed that there was no association between depression and BMI ($r = -0.084$; $p > 0.05$) (Mokhtari et al., 2015).

2.3.2 Stress

Stress is the body's response to a transition that requires adaptation or reaction (National Institute of Mental Health (NIMH), 2020). The body reacts to these changes with physiological, behavioural and emotional reactions (NIMH, 2020). Stress can be positive and also negative. A negative stress reaction is when stress that goes on without relief results to a state called distress (NIHM, 2020). Distress can disrupt the inner equilibrium or balance of the body, resulting in physical symptoms such as headaches, an upset stomach, high blood pressure, chest pain, sexual dysfunction, and sleeping issues (NIHM, 2020). Continued pressure from stress on your body can lead to serious health problems (NIHM, 2020). According to some studies, stress could be a factor that associate with body weight status. A cross-sectional study among medical students of Fayoum University that had been participated by 442 students result in significant association of stress with obesity and overweight ($p = 0.002$, $p = 0.04$) (Abdel Wahed & Hassan, 2017). In addition, students with abdominal obese also showed high stress score than normal weight student (Abdel Wahed & Hassan, 2017). Other cross-sectional study among 200 undergraduates in India also showed significant but weak association between stress with BMI ($r = -0.152$, $p = 0.03$) (Sheen, 2013).

However, there was also cross-sectional study that been conducted among 441 college students in US that result in higher stress associated with overweight or obesity (crude prevalence ratio (PR): 1.05; 95% CI: 1.01 – 1.09) but after controlled for the health risk behavior, the significant association was not found (PR: 1.04; 95% CI: 1.00 – 1.08) (Pelletier et al., 2015). Other study among 122 undergraduates also showed that there was no significant association between chronic stress with BMI ($p > 0.05$) (Sing & Shen, 2013) and similar findings also was stated in a cross-sectional study among 97 freshmen in US (Wilson et al., 2015).

2.3.3 Anxiety

The natural reaction of the body to stress could also be known as anxiety. It's a sense of anticipation or uncertainty of what's to come (Hollad, 2020). However, for anxiety disorder could also be known as the most prevalent type of mental disorder which can affect someone at any age (Holland, 2020).

Few studies had showed that there was significant association between anxiety with overweight and obesity. Based on a cross-sectional study among 311 university students in Malaysia had result in significant association between anxiety with BMI ($r = -0.152$, $p < 0.05$) (Mokhtari et al., 2015). This similar significant association could also be found in a study among medical students of Fayoum University that had been participated by 442 students that resulted in high anxiety score among students who were obese and overweight ($p = 0.002, 0.04$) (Abdel Wahed & Hassan, 2017). Besides that, a cross-sectional study among 1063 students in US had showed that anxiety was significantly associated with BMI ($r = 0.09$, $p < 0.01$) (Saules et al., 2009). On the other hand, based on a cross-sectional study among 1036 adults in US, there was a

positive association between BMI with generalized anxiety disorder ($r = 0.067$, $p < 0.01$) but no association had been found between BMI with social anxiety disorder (Herring, O'Connor & Dishman, 2014).

There were also other studies that could not find the association between anxiety and body weight status. A study among 212 nursing students in United Kingdom (UK) stated that there was no significant association between anxiety with BMI (Hawker, 2012) and this similar finding had been found in a cross-sectional study among 412 university students in Italy that showed no correlation between anxiety and BMI (Mucci et al., 2016).

2.4 Association of Lifestyle Factors with Body Weight Status

2.4.1 Sedentary behavior

Sedentary behavior could be defined as any waking behavior characterised by an energy consumption of ≤ 1.5 metabolic equivalents (METs) such as sitting, resting or lying down position (Tremblay et al., 2017). Thus, the action of sitting or lying down means involving sedentary behavior (Tremblay et al., 2017). Watching television, playing video games, using machines, driving cars, and reading are the most common sedentary behavior (Tremblay et al., 2017). Being physically inactive and having sedentary behavior were two different factors (Australian Government Department of Health, 2019). Being physically inactive means did not achieve the recommended physical activity from the guideline meanwhile sedentary means the action of sitting and lying down for long periods (Australian Government Department of Health, 2019). There were several studies had been conducted in verified the association of sedentary behavior with body weight status.

A meta-analysis study among children and adolescent in UK had been conducted and result in significant association between intervention of reducing sedentary behavior with change in BMI or BMI-Z score but the result showed very low significant (SMD = -0.060, 95% CI: -0.098 - -0.022) (Azevedo et al., 2016). Next, as watching television could also be classified as sedentary behavior, a cross-sectional study among 300 male university students in United Arab Emirates had showed a greater risk of obesity when they watched television for more than 4 hours a day ($p < 0.05$) (Musaiger et al., 2003). There was also a study among children that result in significant association of reducing sedentary behavior with reduction of BMI when the comparison been made with control groups ($g = -0.0073$, $p = 0.02$) (Liao et al., 2014). However, based on a study among 130 students in a Faculty of Medicine, University of Sumatera showed that there was no significant association between sedentary behavior with BMI ($p = 0.546$).

2.4.2 Physical activity

The definition of physical activity is any body movement that contributes in energy expenditure generated by skeletal muscles, in which energy expenditure is measured in kilocalories (WHO, 2020). The term of physical activity often been mistaken with exercise where exercise is known as a subset of physical activity as a scheduled, coordinated, daily physical activity aimed at enhancing or sustaining one or more physical fitness components (WHO, 2020). In order to get maintain body weight, improve mental health, quality of life and well-being, having regular physical activity had been recommended by WHO with different guidelines and recommendations according to age groups and specific population group. Based on global statistics, 1 in

4 adults do not achieve the recommended physical activity according to the global standards and result in 20% to 30% of the increasing risk of death for those who insufficiently active compared to sufficiently active (WHO, 2020).

There were few studies that had been done in order to determine the association between physical activity and body weight status. First, a cross-sectional study was conducted among 311 university students aged 20 to 40 years old in Malaysia (Mokhtari et al., 2015). Based on the study, there was significant negative correlation between physical activity and BMI ($p = 0.01$) by means that the increasing of physical activity could reduce BMI. Next, there was also study among 202 university students in Botswana result in significant association between physical activity with body weight and from the study showed that by having constantly engaging in physical exercise, participants were 0.40 times less likely to be obese and overweight ($p = 0.019$) (Tapera et al., 2017). Similar finding on association between physical activity with BMI was also found among 130 medical students in Indonesia by using one-way ANOVA to test the significant association ($p = 0.007$) (Surbakti et al., 2018). However, based on a study among 5475 adolescents and young adults aged 16 – 35 years old in Malaysia, no relative risk ratios of being physically inactive with BMI categories was found (Pell et al., 2016).

2.4.3 Sleep quality

Sleep is an essential aspect of the normal human life (Kline, 2013). Restoring sleep is closely linked to greater physical, cognitive and emotional well-being (Kline, 2013). Poor or disordered sleep, on the other hand, leads to potential impairments of neurological and psychological functioning and to a decline in overall physical

wellbeing (Crivello et al., 2019). There were few studies had been conducted in order to find the association between sleep quality with body weight status.

First, a prospective study had been done among 7332 adults aged 40 – 60 years for 5 – 7 years in Finland (Lyytikainen et al., 2011). Based on the self-reported sleep quality, there was significant association of sleep quality especially difficulty initiate and maintain sleep with risk of weight gain among female (AOR: 1.65; 95% CI: 1.22 – 2.22) but no significant was found among male (Lyytikainen et al., 2011). A cross-sectional study among 1515 African-American adults aged 30 – 65 had been conducted and result in significant association between low sleep quality with obesity among female (AOR: 1.08; CI: 1.03 – 1.12) but no significant association had been found among male (Bidulescu et al., 2010). Besides that, a study among 1578 college students from five universities in United State and South Korea aged 18 – 25 years had been evaluated and result in significant association of sleep quality with participants who obese among black ($p < 0.05$). Nevertheless, a study by Vargas et al (2014) among 515 students from the southwestern USA result in no significant association between sleep quality with BMI ($p > 0.05$) and also PSQI scores with BMI ($p > 0.436$).

2.4.4 Smoking

1 in 5 deaths in United States was caused by cigarette smoking (National Institutes of Health (NIH), 2018). Smoking is harmful in any kind of forms whether it is from tobacco or e-cigarette (NIH, 2018). The health effect for secondhand smoke are also the same as smokers (NIH, 2018). Smoking could cause many health problems such as cancers, lung disease, high blood pressure, stroke and vision problem (NIH, 2018).

Several studies were also had been investigated to find the correlation between smoking with body weight status.

There was a cross-sectional study had been conducted among 19 years old and older in Korea by using data from fifth (2010 – 2012) and part of sixth (2013) Korea National Health and Nutrition Examination Survey (KNHANES) (Kim et al., 2016). Total of 5254 subjects had been participated in this study to assess the association between smoking and obesity) (Kim et al., 2016). Based on multivariate regression analysis of the study, subject who obese was highly among current smokers than never-smokers (OR: 1.50; 95% CI: 1.27 – 1.77) and subject who was former smoker also likely to be obese than never-smoker (OR: 1.36; 95% CI: 1.16 – 1.61) (Kim et al., 2016). Based on the result, there was significant association between smoking with obesity but after been adjusted for age, gender, physical activity levels, alcohol consumption, existence of diabetes and hypertension, no significant association had been found between smoking and obesity (Kim et al., 2016). Aside from that, a significant association between smoking had been found with central obesity ($p < 0.05$) and this had found highly among current smokers than never-smokers (OR: 1.30; 95% CI: 1.02 – 1.67) (Kim et al., 2016).

Thenceforth, another cross-sectional study had been carried out to assess the association between smoking with obesity (Ginawi et al., 2016). This study had been done among 5000 Saudi in 30 primary health care centers in Hail Region (Ginawi et al., 2016). From the study, it appeared that the former smokers were significantly associated with obesity ($p < 0.05$) while those who current smokers were significantly associated with underweight ($p < 0.05$) (Ginawi et al., 2016). A comparison between former smokers with never-smokers been made and result in significantly higher

obesity among former smokers ($p < 0.05$) (Ginawi et al., 2016). On the contrary, based on a study among 936 Malaysian post graduate students, a significant association had been result from the study between participants who were overweight and obesity with smoking ($p = 0.03$) (Kabir et al., 2014).

Nevertheless, a study by Alexopoulos et al (2010) among 1205 students in Greece result in no association between smoking status with BMI ($p > 0.15$). Similar findings by Boo et al (2010) among 240 students of medical courses and Mokhtari et al (2015) among 310 Iranian students in Malaysia also found no significant association between smoking status and BMI ($p > 0.05$).

CHAPTER 3

METHODOLOGY

3.1 Study Design

A cross-sectional study design had been used for this study aimed to determine the associations between socio-demographic background factors, psychological factors and lifestyle factors with body weight status of students in Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM).

3.2 Study Location

The location for this study had been conducted at Universiti Kebangsaan Malaysia (UKM) that was established on May 18, 1970. Started to operate at Lembah Pantai, Kuala Lumpur in 1970, UKM then moved to present location at Bangi in October 1977. Currently, UKM has 25,525 students consist of 14,971 undergraduate students and 10,554 postgraduate students. UKM offers undergraduate students with programs in 13 faculties which are Faculty of Islamic Studies, Faculty of Science and Technology, Faculty of Social Sciences and Humanities, Faculty of Medicine, Faculty of Economics and Management, Faculty of Law, Faculty of Engineering and Built Environment, Faculty of Education, Faculty of Health Sciences, Faculty of Information Science and Technology, Faculty of Dentistry, UKM-Graduate School of Business (UKM-GSB) and Faculty of Pharmacy. Among all 13 faculties, Faculty of

Engineering and Built Environment had been chosen for this study due to its large proportion.

3.3 Sample size determination

This study was using formula designed by Cole (1997) to calculate sample size as shown below:

$$n = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2}{2r^2(1-r^2)} + 5$$

n = the calculated sample size

$z_{1-\alpha/2} = 1.96$, z score for level of significance in two sided test

$z_{1-\beta} = 0.84$, z score for power of the test

r = correlation

Table 3.1: Sample size calculation for each independent variable based on the previous studies investigating the factors associated with body mass index (BMI)

Independent variables	Correlation, r	Sample size, n
Income (Mokhtari et al., 2015)	0.22	$n = \frac{(1.96 + 0.84)^2}{2 \times 0.22^2 / (1 - 0.22^2)} + 5$ $= 158$
Physical activity (Radzi et al., 2019)	-0.38	$n = \frac{(1.96 + 0.84)^2}{2 \times (-0.38)^2 / (1 - (-0.38)^2)} + 5$ $= 51$
Stress (Radzi et al., 2019)	0.81	$n = \frac{(1.96 + 0.84)^2}{2 \times 0.81^2 / (1 - 0.81^2)} + 5$ $= 9$

As shown in Table 3.1, the highest number of sample size was selected as the final sample size of this study, which is 158 participants. Based on Table 3.2, additional adjustment had been calculated in computing sample size. It had been done in order to

achieve minimum sample size due to the possibility of dropouts, non-response and missing record of the participants.

Table 3.2: Additional adjustment in computing the sample size

Criteria	Adjustment	Sample size, n
Adjust for the estimated sample effect	nadj * DEFF DEFF = 1.3	205.0
Adjust for the expected proportion response rate	response rate = 0.80 (Aday & Cornelius, 2006)	256.0
Adjust for the expected proportion eligible	% Eligible = 0.90	285.2 ≈ 285

After considering the design effect, response rate and proportion of eligibility, the final sample size that been required for this study was 285 participants.

3.4 Respondents

The target population of this study was the university students in Universiti Kebangsaan Malaysia (UKM). The participants had been selected based on the inclusion and exclusion criteria as stated in Table 3.3.

Table 3.3: Inclusion and exclusion criteria for the selection of respondents

Inclusion Criteria	Exclusion Criteria
- Malaysian - Undergraduate students - Aged 18 years old and above	- Students who have physical disabilities - Students with chronic diseases - Pregnant

3.5 Sampling design

The sampling design is shown in Figure 3.1. This study had been using multistage sampling. Firstly, cluster sampling method had been used to categorize the departments of the faculty. Then, simple random sampling method had been used to choose 285 participants among all six departments.

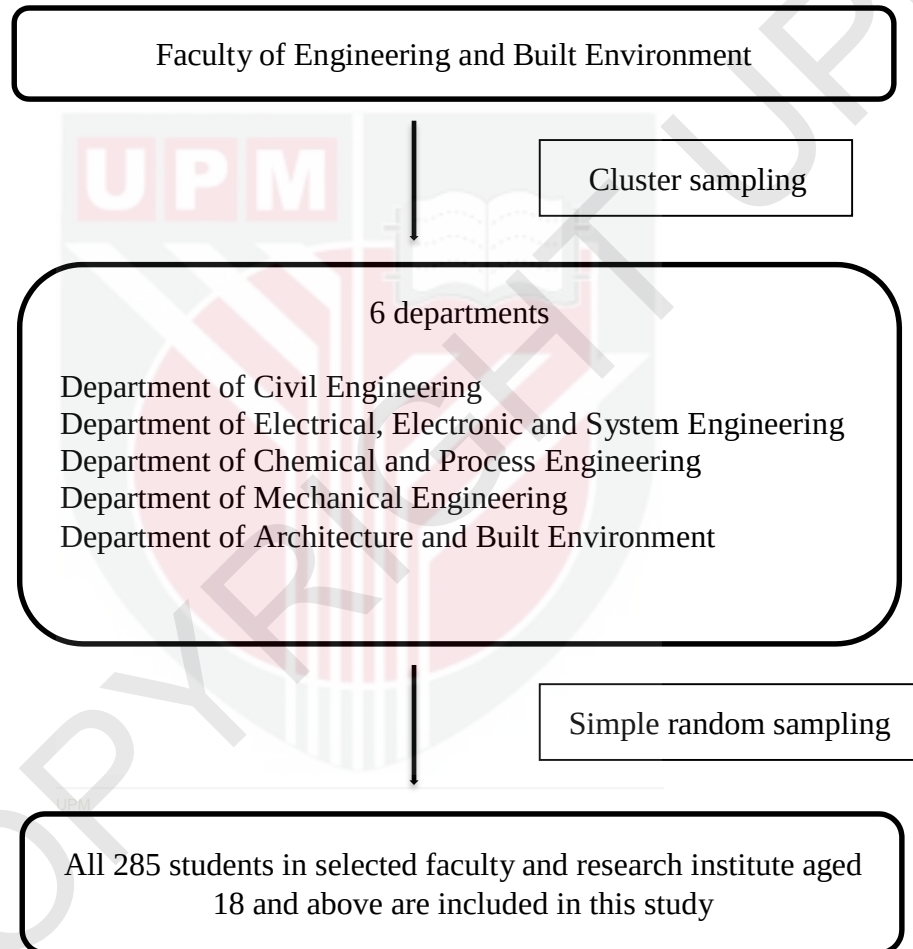


Figure 3.1: Flow chart of sampling design for selection method of subjects

3.6 Study Instruments

A self-administered questionnaire in English language had been used in this study. The questionnaire consists of socio-demographic background factors, psychological factors (Depress, Anxiety, Stress) and lifestyle factors (Sedentary Behavior, Physical Activity, Sleep Quality, Smoking). Anthropometric measurement (body weight and height) was not been measured by the researcher due to current pandemic and only be done by self-reporting. The detail of the instruments used in this study is as below:

3.6.1 Socio-demographic background factors

This part had been included participant's socio-demographic background such as age, gender, ethnicity, course and year of study and family income which had been filled by the respondent themselves.

3.6.2 Psychological factors

Psychological factors of the participants had been assessed by using The Depression Anxiety Stress Scale (DASS) questionnaire. The original version of this questionnaire contains 42-item while the short version contains 21 items. For this study, a short version of DASS questionnaire will be used to measure, identifying, recognizing, and evaluating the pervasive and clinically relevant emotional states commonly defined as depression, anxiety and stress (Psychology Foundation of Australia, 2018). There are 7 items on each of the three DASS scales. Dysphoria, hopelessness, life devaluation, self-deprecation, loss of interest or involvement, anhedonia, and inertia are measured by the Depression scale meanwhile autonomic arousal, skeletal muscle symptoms, social fear, and subjective perception of nervous influence are measured by the Anxiety scale (Psychology Foundation of Australia, 2018). Besides that, the Stress scale is susceptible to non-specific chronic arousal

conditions and it measures soothing discomfort, anxious enthusiasm, and becoming quickly frustrated, grumpy and irritated (Psychology Foundation of Australia, 2018). In Malaysia, an English and Malay version of DASS-21 item had been used in a study among 390 undergraduate students from Universiti Putra Malaysia and shows significant consistency of Cronbach's alpha from the total score when all items were used ($\alpha = 0.926$) (Ahmad et al., 2018). Other study among 240 medical students in Nigeria also result in outstanding Cronbach alpha values of 0.81, 0.89 and 0.78 for the depression, anxiety and stress subscales, respectively and had proved the reliability of DASS-21 (Ezekwe, 2018).

Participants had been asked to score each item on a scale from 0 (did not apply to me at all or never) to 3 (applied to me very much or almost always). Scores of the items per subscale had been added and multiply by factor of 2 to get the sum score of each subscale (Psychology Foundation of Australia, 2018). The meaning of each score had been assessed by using score interpretation as provided on Table 3.4 below.

Table 3.4: Scoring interpretation of DASS-42

	Depression (D)	Anxiety (A)	Stress (S)
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	12-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely severe	28 +	20 +	34 +

3.6.3 Lifestyle Factors

3.6.3.1 Sedentary behavior

The Past-day Adults' Sedentary Time (PAST) Questionnaire consists of 7-item had been used in this study to assess sedentary behavior of participants on the previous day (Clark et al., 2013). The questionnaire asked on time consumed by the participants when they might be sitting or lying down during working, travelling, watching television, using computer, internet or electronic game (not include at work), reading (not include at work), hobbies and also other purposes that not been disclosed yet based on the previous question (Clark et al., 2013). In order to provide a cumulative measure of general sitting and lying time that could also been called as sedentary time, the sum off continuous time recorded in the seven items is calculated (Clark et al., 2013). A study on validity and reliability of this questionnaire had been measured and based on the result it shows that it has small but significant responsiveness (-0.44 , 95% CI = -0.92 to -0.04) when compared with activPAL (Clark et al., 2013).

3.6.3.2 Physical activity

In order to evaluate the physical activity of the participants, the Global Physical Activity Questionnaire (GPAQ) had been used. This questionnaire was a revised version of International Physical Activity Questionnaire (IPAQ) that had been developed by WHO in the year 2002 to monitor the physical activities of many countries (de Courten, 2002). There were 19 questions in the initial iteration of the GPAQ, with a shortened version later created, removing three irrelevant questions and result in total of 16 questions for the most revised version of GPAQ comprised with physical activity at work, travel to and from places and recreational activities and also include sedentary behavior (de Courten, 2002). This questionnaire shows good to very good reliability except for one study with poor reliability ($r < 0.30$) (Keating et al.,

2019) and the Malay version of GPAQ also has fair validity characteristics and is effective in testing multiple PA domains with varying intensities among Malaysian adults (Soo et al., 2015). The calculation of total physical activity in GPAQ had been evaluated by METs (Metabolic Equivalents) by total up the MET-minutes per week for each domain. According to the analysis guide of GPAQ from WHO, participants had been classified into three categories that are highly active (≥ 3000 MET-min/week), moderately active (600 – 2999 MET-min/week) and low active (< 600 MET-min/week). Table 3.5 below shows the MET values based on the domain that are used to calculate participants' overall energy expenditure based on GPAQ data.

Table 3.5: MET values based on the domain

Domain	MET value
Work	• Moderate MET value = 4.0 • Vigorous MET value = 8.0
Transport	Cycling and walking MET value = 4.0
Recreation	• Moderate MET value = 4.0 • Vigorous MET value = 8.0

3.6.3.3 Sleep quality

To measure the sleep quality of participants over the past month, the Pittsburgh Sleep Quality Index (PSQI) questionnaire had been used (Buysse et al., 1989). Combination of 19 self-rated items in this questionnaire formed 7 component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, step disturbances, use of sleeping medication, and daytime dysfunction. Each component scores range from 0-3 points which 0 point indicates no trouble while 3 points indicate serious trouble in sleeping. The sum of all 7 components score resulted in a global PSQI score ranging from 0 (high quality of sleep) to 21 (low quality of sleep) (Buysse et al., 1989). Participants who scored ≤ 5 were rated as good sleepers while participants

who scored > 5 rated as poor sleepers based on the global PSQI score. (Buysse et al., 1989). Based on study among Malaysian adults, PSQI in Malay version shows acceptable validity and reliability to be used as tools to assess sleep quality (Farah et al., 2019).

3.6.3.4 Smoking

In order to assess the smoking status among participants, a short version of Global Adult Tobacco Survey (GATS) had been used (IPH, 2015). GATS is a new component of Global Tobacco Surveillance System that had been designed to continuously track the use of tobacco among adults aged 15 years and above and monitor the key measures of tobacco regulation (Omar et al., 2013). It was launched on February 2007 the reliability and validity had been tested in Malaysia on the year 2011 (Omar et al., 2013). Based on the study, national estimates of tobacco used, categorized by socio-demographic characteristics and valid data on different aspects of tobacco regulation, are given by the rigorous methods used in GATS Malaysia (Omar et al., 2013). The short version of GATS had also been translated into Malay and comprised with 20 items that assessed the smoking status, type and quantity of smoked tobacco product(s), second-hand smoke at home and work among smokers and non-smokers, active smokers' smoking cessation behavior, perception of anti-smoking initiatives, and cigarette advertisement and promotion awareness (IPH, 2015). The frequency of each item had been calculated to determine the prevalence of smoking among participants.

3.6.4 Body Mass Index

Due to the COVID-19, the determination of body weight and height of participants had been based on self-report. Participants had been asked to state their current body

weight to the nearest 0.1 kg and height to the nearest 0.1 cm by using suitable or available device to get the measurement. Participants also had been instructed to remove any heavy items on their body before they weight themselves. Validity of self-report body weight and height had been assessed in a study among young adults and showed significant correlation ($r_s = 0.87 - 0.92$) between self-reported with measured body weight, height and Body Mass Index (BMI) (Olfert et al., 2018). Participant's BMI will be calculated by using formula below:

$$B M I (BMI) = \frac{igh (kg)}{h igh (^2)}$$

Based on the calculated BMI, participants had been categorized into different group of body weight status according to the Clinical Practice Guideline (CPG) on Management of Obesity (2004). Table 3.6 below shows the classification of body weight by BMI.

Table 3.6: Classification of body weight by BMI

Classification	BMI (kg/m ²)
Underweight	< 18.5
Normal	18.5 – 24.9
Overweight	25.0 – 29.9
Obese	≥ 30.0

3.7 Study Approval

Study approval was obtained from JKEUPM for Research Involving Human Subjects, Head Department of Nutrition Department, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia and Deputy Dean of Students and Alumni, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM) prior data collection (JKEUPM-2020-476).

3.8 Pre-Test

The self-administered questionnaire had been distributed through Google form to 30 students of UKM from selected faculty in end of February 2021 until early March. It is because Sheatsley (1983) and Sudman (1983) stated that at least about 12 to 50 participants required for the pre-test to discover major flaws or difficulties of questionnaires. The selected students who participated in the pre-test will be excluded from the study. Pre-test important in order to ensure precision and search for continuity in the comprehension and analysis of questions by the participants. All the deceptive, complicated, frustrating and vague questions had been omitted after the pre-test, and the questionnaire had been updated based on the pre-test results.

3.9 Data Collection

Data collection of this study was carried out from end of March 2021 until May 2021 via Google form. The link for self-administered questionnaire in the Google form had been distributed through WhatsApp and email of the students in selected faculty. Participants who agreed to participate in this study had been required to fill up a consent form prior to the administration of the questionnaire. All information that had been gathered is guaranteed confidential and will not be made publicly available. The information given only to be use for this study for educational purposes. Participants were required to answer all questionnaires regarding on the information of socio-demographic background factors, psychological factors and lifestyle factors. Since this study had been done mostly through online platform and based on self-report, there had been minimal risks between participant and investigator.

3.10 Data Analysis

Statistical analysis had been carried out by using IBM SPSS Statistics 25 (IBM Corp., Armonk, NY). The normality of all variables was determined by using skewness. The hypothesis, where the degree of significance was set at $p < 0.05$, would be evaluated using inferential statistics. In the analysis, all variables had been expressed in descriptive statistics, in which categorical variables was expressed in the form of frequency and percentage, while the continuous variable was expressed in the form of mean and standard deviations. In order to determine the relationship between two continuous variables, the Pearson correlation test had been used meanwhile to determine the association between two categorical variables, Chi-Square Test had been used. On the other hand, mean difference between categorical variables and continuous variable had been determined its relationship by using Independent Sample T-Test and One-Way Anova Test. All data was determined to be normally distributed.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Socio-demographic background factors of study population

Table 4.1 shows the socio-demographic background factors of participants. A total of 285 participants took part in this study but only data from 274 participants were included in the analysis due to some missing data and not fulfilling the criteria of the questions. A total of 274 participants which 58.8% (n = 161) of them were female while 41.2% (n = 113) of them were male that involved in this study were ranging from 18 to 29 years with the mean $\pm$ SD age of 21.57 ± 1.58 years which 21.64 ± 1.58 years were female while 21.47 ± 1.59 years were male. Among female, 70.7% (n = 114) were Malay, followed by 18.0% (n = 29) Chinese, 7.5% (n = 12) Indian, 1.9% (n = 3) Sabahan and 1.9% (n = 3) Sarawakian. Among males, 54.0% (n = 61) Malay, followed by 26.5% (n = 30) Chinese, 10.6% (n = 12) Indian, 6.2% (n = 7) Sabahan and 2.7% (n = 3) Sarawakian. This study had been participated among undergraduate students from first (semester 2 to 3) to fourth year (semester 7 to 8) which 32.1% (n = 88) participants from first year, followed by 23.4% (n = 64) from second year, 19.0% (n = 52) from third year and 25.5% (n = 70) participants from fourth year. Among the courses, the highest participants were from Electrical, Electronic and Systems Engineering 36.9% (n = 101) participants, followed by Civil Engineering 24.8% (n = 68), Chemical and Process Engineering 17.2% (n = 47), Mechanical Engineering 15.6% (n = 43) and Architecture and Built Environment 5.5% (n = 15) students. The mean $\pm$ SD family income which addition of participants' parents' income were

RM6600.87 $\pm$ 12421.07. About 55.4% (n = 152) of them were categorised as M40 (RM4850 to RM10959), followed by 38.0% (n = 104) were in B40 group (less than RM4859) and 6.6% (n = 18) of them were in T20 group (more than RM10960). The categorization of the income had been based on the Department of Statistics Malaysia (DOSM, 2021). For participants' household number, the mean $\pm$ SD were 4.93 $\pm$ 2.05 number of people in the family.

Table 4.1: Distributions of participants by socio-demographic background factors (n=274)

Variables	Mean $\pm$ SD / n (%)		
	Female 161 (58.8)	Male 113 (41.2)	Total 274 (100)
Age	21.64 $\pm$ 1.58	21.47 $\pm$ 1.59	21.57 $\pm$ 1.58
Ethnicity			
Malay	114 (70.7)	61 (54.0)	175 (64.0)
Chinese	29 (18.0)	30 (26.5)	59 (21.5)
Indian	12 (7.5)	12 (10.6)	24 (8.8)
Sabahan	3 (1.9)	7 (6.2)	10 (3.6)
Sarawakian	3 (1.9)	3 (2.7)	6 (2.2)
Year of study			
First year	50 (31.0)	38 (33.6)	88 (32.1)
Second year	37 (23.0)	27 (23.9)	64 (23.4)
Third year	37 (23.0)	15 (13.3)	52 (19.0)
Fourth year	37 (23.0)	33 (29.2)	70 (25.5)

Course of study	Civil Engineering	44 (27.3)	24 (21.2)	68 (24.8)
	Electrical, Electronic and Systems Engineering	52 (32.3)	49 (43.4)	101 (36.9)
	Chemical and Process Engineering	31 (19.3)	16 (14.2)	47 (17.2)
	Mechanical Engineering	22 (13.6)	21 (18.5)	43 (15.6)
	Architecture and Built Environment	12 (7.5)	3 (2.7)	15 (5.5)
Family Income		7258.44 ± 16046.29	5663.98 ± 2593.13	6600.87 ± 12421.07
	B40	64 (39.7)	40 (35.4)	104 (38.0)
	M40	84 (52.2)	68 (60.2)	152 (55.4)
	T20	13 (8.1)	5 (4.4)	18 (6.6)
Household number		5.13 ± 2.32	4.65 ± 1.57	4.93 ± 2.05

4.2 Psychological and lifestyle factors of study population

There were two factors, psychological and lifestyle factors of participants had been described in **Table 4.2**. Based on the result of psychological factors, mean $\pm$ SD of total score for depression was 6.17 ± 9.59 , anxiety was 6.02 ± 8.47 and stress was 6.28 ± 8.97 . Participants had been categorised into five categories such as normal, mild, moderate, severe and extremely severe for each of the variable in psychological factors. For depression, about 67.5% (n = 185) of participants were not feeling depressed while 20.1% (n = 55) were having extremely severe depression. 1.8% (n = 5) of the participants were having mild depression, 5.1% (n = 14) moderately depressed and total of 5.5% (n = 15) were having severe depression. Next, about 58.0% (n = 159) of the participants were not having anxiety while 29.6% (n = 81) of the participants having extreme severe anxiety. Those who were having mild, moderate and severe anxiety were 5.8% (n = 16), 4.0% (n = 11) and 2.6% (n = 7) of the participants respectively. Then, among the participants, 67.9% (n = 186) of them were not feeling stress while 2.6% (n = 7), 5.1% (n = 14), 10.6% (n = 29) and 13.8% (n = 38) of the participants were having mild, moderate, severe and extremely severe stress respectively.

Then, lifestyle factors consist of sedentary behaviour, physical activity level, smoking status and sleep quality. The mean $\pm$ SD of sedentary behaviour was 16.48 ± 7.34 hours which result in majority of the participants, 97.8% (n = 268) out of 274 were sedentary while only 2.2% (n = 6) were not sedentary. For physical activity level, the mean $\pm$ SD of the total METs were 2349.30 ± 9019.53 METs with most of them, 60.6% (n = 166) participants were having low or no physical activity while about 21.5% (n = 59) and 17.9% (n = 49) of the participants were moderately and highly

active respectively. Based on the table showed for smoking status below, only 267 out of 274 participants gave the answers while other 7 participants refuse to answer the questions on their smoking status. About 88.0% (n = 235) of the participants were not currently or never smoke tobacco while 12.0% (n = 32) of the participants were currently smoking tobacco. On the other hand, about 91.0% (n = 243) majority of the participants were not currently or never use smokeless tobacco while only 9.0% (n = 24) of the participants who currently use smokeless tobacco. The last variable for lifestyle factor was sleep quality with the mean $\pm$ SD was 4.19 ± 2.62 of the total scores. Participants had been categorised into two groups for sleep quality which result in 77.4% (n = 212) of the participants were good sleepers while 22.6% (n = 62) of them were poor sleepers.

Table 4.2: Distribution of participants by psychological factors and lifestyle factors

Variables	Mean $\pm$ SD / n (%)		
	Female	Male	Total
Depression	7.65 $\pm$ 10.79	4.05 $\pm$ 7.09	6.17 $\pm$ 9.59
Normal	101 (62.7)	84 (74.3)	185 (67.5)
Mild	2 (1.2)	3 (2.7)	5 (1.8)
Moderate	7 (5.0)	7 (6.2)	14 (5.1)
Severe	11 (6.8)	4 (3.5)	15 (5.5)
Extremely severe	40 (25.0)	15 (13.3)	55 (20.1)
Anxiety	7.22 $\pm$ 9.242	4.32 $\pm$ 6.91	6.02 $\pm$ 8.47
Normal	85 (52.8)	74 (65.5)	159 (58.0)

	Mild	7 (4.3)	9 (8.0)	16 (5.8)
	Moderate	8 (5.0)	3 (2.7)	11 (4.0)
	Severe	6 (3.7)	1 (0.9)	7 (2.6)
	Extremely severe	55 (34.2)	26 (23.0)	81 (29.6)
Stress		7.80 ± 9.85	4.12 ± 7.04	6.28 ± 8.97
	Normal	100 (62.1)	86 (76.1)	186 (67.9)
	Mild	2 (1.2)	5 (4.3)	7 (2.6)
	Moderate	10 (6.2)	4 (3.5)	14 (5.1)
	Severe	20 (12.4)	9 (8.0)	29 (10.6)
	Extremely severe	29 (18.0)	9 (8.0)	38 (13.8)
Sedentary behaviour		17.09 ± 8.03	16.19 ± 6.50	16.48 ± 7.34
	Sedentary	155 (96.3)	113 (100.0)	268 (97.8)
	Not sedentary	6 (3.7)	0 (.0)	6 (2.2)
Physical activity level		2275.95 ± 10917.94	2453.81 ± 5290.45	2349.30 ± 9019.53
	Low or no activity	104 (64.6)	62 (54.9)	166 (60.6)
	Moderate	32 (19.9)	27 (23.9)	59 (21.5)
	High	25 (15.5)	24 (21.2)	49 (17.9)
Smoking status				
	Current tobacco smoker	1 (0.6)	31 (28.2)	32 (12.0)

	Current non-smoker or never smoke	156 (99.4)	79 (71.8)	235 (88.0)
	Current smokeless tobacco user	6 (3.8)	18 (16.4)	24 (9.0)
	Current non-user of smokeless tobacco or never smokeless tobacco	151 (96.2)	92 (83.6)	243 (91.0)
Sleep quality		4.52 ± 2.80	3.72 ± 2.28	4.19 ± 2.62
	Good sleepers	119 (73.9)	93 (82.3)	212 (77.4)
	Poor sleepers	42 (26.1)	20 (17.7)	62 (22.6)

4.3 BMI classification of participants

Figure 4.1 below presented the distributions of 274 participants by their BMI. All of the participants had been categorised into underweight, normal, overweight and obese. Among the participants, 67.2% (n = 184) of them were having normal BMI while 6.5% (n = 18), 17.9% (n = 49) and 8.4% (n = 23) of the participants were been categorised into underweight, overweight and obese accordingly with the mean $\pm$ SD were $23.55 \pm 4.16 \text{ kg/m}^2$. Then, **Figure 4.1** also shows the distributions of BMI for female with the mean $\pm$ SD were $23.62 \pm 4.56 \text{ kg/m}^2$. Among 161 female participants, about 66.4% (n = 107) of them were having normal BMI while participants that been categorised as underweight, overweight and obese were about 8.1% (n = 13), 14.9% (n = 24) and 10.6% (n = 17) of the participants accordingly. Next, figure below shows the distributions of 113 male participants by BMI with the mean $\pm$ SD were $23.44 \pm 3.52 \text{ kg/m}^2$. Among the male participants, around 68.1% (n = 77) of them were been categorised as normal BMI meanwhile 4.5% (n = 5), 22.1% (n = 25) and 5.3% (n = 6) of them were been categorised as underweight, overweight and obese respectively.

Based on a previous study that had been conducted in UKM among 200 undergraduates' students aged 20 to 25 results in majority of them 57.0% which 55% males while 59% females categorised as normal weight followed by 17.0% of them which 10.0% females and 24.0% males categorised as overweight and 16.5% of them which 22.0% females and 11.0% males categorised as underweight (Yeng & Sedek, 2012). Besides that, only a small percentage of the students 9.5% which 9.0% of females and 10.0% of males were obese (Yeng & Sedek, 2012).

There was not much difference in percentage of those categorised as overweight in the previous study (17.0%) with this study (17.9%) and slightly different in percentage of those categorised as obese in previous study (9.5%) with this study (8.4%).

However, past study showed high percentage of those categorised in underweight (16.5%) compared to this study (6.5%). More than half of the students in both study categorised as normal weight. For this study, more males (22.1%) participants had been categorised as overweight compared to female (14.9%) but more females (10.6%) categorised as obese compared to male (5.3%). This study was consistent with other study by Pell et al (2016) and Boo et al (2010) that was conducted in Malaysia which result in high percentage of male in overweight compare to female but high percentage of obese among female compare to male. Similar findings by Ghrayeb et al (2013) stated that there were high percentage of male (23.4%) compared to female (13.7%) that categorised as overweight. Percentage of female participants that categorised as underweight (8.1%) were higher than male (4.5%). in this study. Similar finding by other studies also found that high percentage of underweight among female than male (Abdul et al., 2015; Nawab Khan et al., 2011). The possible reason for this high proportion of underweight among female due to the desire to be thinner and slimmer and this could be the sign of malnutrition and determinant of the development of eating disorder (Nawab Khan et al., 2011).

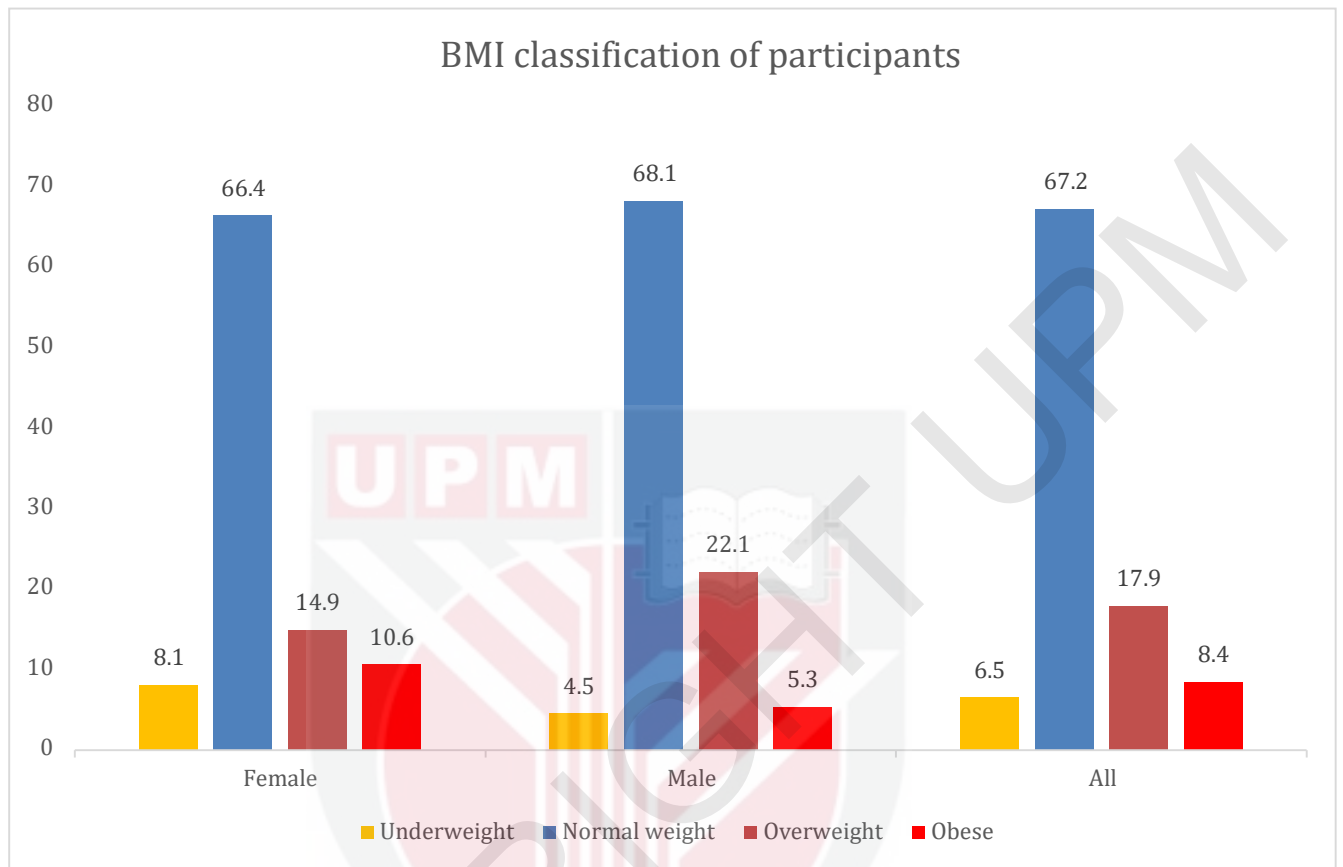


Figure 4.1: Distributions of participants by BMI (n=274)

4.4 The association between socio-demographic background factors with participants BMI (kg/m²) and BMI group

4.4.1 Age

Table 4.3 below shows the result of correlation between age of 274 participants with BMI (kg/m²) by using Pearson Correlation Test. Based on the data analysis, it shows that there was no significant correlation between participants who aged 18 to 29 years with BMI ($r = -0.044$, $p = 0.469$). Similar findings had been showed in a study by Jiang et al (2018) that result in no significant association of 11673 college students that been conducted in 50 Chinese universities aged 18 years above ($p > 0.05$). Based on a cross-sectional study that been conducted among 683 young adults in Uganda found that there were no significant associations between age with overweight and obesity ($p > 0.05$) (Baalwa et al., 2010). The age ranged of the participants were also 18 to 30 years from 14 schools in Kampala and Kamuli district (Baalwa et al., 2010). Besides that, a cross-sectional study had been done among patients aged 18 years above hospitalised at Northwestern Memorial Hospital (Bhasin et al., 2020). Association between age and BMI had been determined among 227 patients with COVID-19 and 183 patients without COVID-19 that result in no significant association between age and BMI among patients with no history of COVID-19 ($p > 0.05$) while there were significant association between age and BMI among patients with COVID-19 ($p = 0.0006$). However, based on a study by Peltzer et al (2014) among 22 countries of university students showed significant association between age pf participants with overweight and obese ($p = 0.004$).

No significant was found on age factor with BMI in this study because there was probably not much difference in terms of their height and weight currently but there was a possibility that their weight will continue to change until they age 60 to 65 years (National Institute of Diabetes and Digestive and Kidney Diseases, 2018). Highest rate

of overweight and obesity were also likely to be seen among middle-aged adults compared to young adults due to the changes in body composition, additional anatomical and structure (Institute of Medicine, 2004). A person's natural height could also be seen to decline when reaching age 30 years and above and result in small portion of increasing of BMI with the increasing of age (Institute of Medicine, 2004).

4.4.2 Gender

A mean difference between gender with BMI had been determined by using Independent Sample T-Test and result in no significant mean difference between gender with BMI ($t = -0.334$, $p = 0.738$) as per showed in **Table 4.3** below meanwhile an association between gender with BMI classification had been determined by using Chi-Square Test and result in no significant association between gender with BMI classification ($\chi^2 = 5.488$, $p = 0.139$) as per showed in **Table 4.4**. Based on the result, mean $\pm$ SD for female was 23.62 ± 4.56 kg/m² higher than male, 23.44 ± 3.52 kg/m² but due to only slightly difference of BMI between both female and male in this study, no significant mean difference could be determined. Result showed in **Table 4.4** also determined that percentage of male (51.0%) higher than female (49.0%) that classified under overweight and percentage of female (73.9%) higher than male (26.1%) that classified under obese but no significant association could be determined between gender and BMI group. Other study by Araújo et al (2007) also stated that no significantly different between 295 men and 389 women ($p > 0.05$) with the mean for men was 26.33 kg/m² while women 26.15 kg/m². Another study among 398 students attending a private university in Egypt that aged 18 to 26 years had the similar findings with this study (Genena & Salama, 2017). Based on the result, there were no significant difference between male and female with BMI ($p = 0.232$) (Genena & Salama, 2017). A cross-sectional study that had been conducted at University of

Bostwana among 202 students in the age ranged of 18 to 30 years also found no significant association between gender and BMI group ($p > 0.05$) (Tapera et al., 2017). Nevertheless, a study by Kuan et al (2011) among undergraduates' students in Sarawak showed significant association between gender with BMI classification ($\chi^2 = 18.697$, $p < 0.001$). Other study by Pell et al (2016) among adults in Malaysia showed significant association between gender with BMI ($p < 0.001$) which indicated higher percentage of overweight among male (21.0%) than female (18.7%) but higher percentage of obese among female (15.4%) than male (11.1%).

There were probably few reasons to which result in no association between gender with BMI in this study. First of all, BMI only reported the weight and height of the participants but not total body fat, muscle or bone mass among male and female. This could influence the association between gender and BMI as generally females have higher total body fat than males with similar BMI (CDC, 2011). The percentage of total body fat, muscle or bone mass of the participants could not be reported due to no face to face measurement could be done because of COVID-19 issue and all of the height and weight reported were based on self-reported only. Besides that, female would probably underestimate their weight by 2.1 kg although the accuracy of the self-reported height and weight data had been validated and could result in no significant association between gender in this study thus the changes in calculated BMI might be underestimated (Genena & Salama, 2017).

4.4.3 Ethnicity

To determine the mean difference between ethnicity and BMI, one-way analysis of variance (ANOVA) had been used followed by Tukey post-hoc test while Chi-Square Test had been used to determine the association between ethnicity which divided into Malay and Non-Malay (Chinese, Indian, Sabahan and Sarawakian) with BMI

classification. Based on the result in **Table 4.3**, the highest mean $\pm$ SD were among Sarawakian (24.00 ± 1.07 kg/m²), followed by Malay (23.90 ± 4.68 kg/m²), Indian (23.42 ± 2.50 kg/m²), Chinese (22.70 ± 3.23 kg/m²) and Sabahan (22.27 ± 3.13 kg/m²). However, there were no significant mean difference had been found among ethnicity with BMI ($F = 1.190$, $p = 0.316$). Based on the result in **Table 4.4**, there was also no association between Malay and Non-Malay with BMI classification ($\chi^2 = 8.319$, $p = 0.065$). A study by Boo et al (2010) among medical students in Malaysia result in no significant association among Chinese with BMI ($p > 0.05$) but there were significant association of BMI among Malay ($p = 0.04$) and Indian (0.005). Other study among 1765 students in Midwestern United States University also result in no significant association between Caucasian, African, African-American, Asian, Latino, Middle eastern and others ethnicities with BMI ($p > 0.05$) (Odlaug et al., 2015).

This finding was contradictory to the data from NHMS which highest prevalence of overweight was among Sabahan (35.3%) while highest obesity was among Indian (29.3%). Most of the findings from other study also result significant association between ethnicity and BMI in Malaysia and associated with significant predictors of overweight and obesity ($p < 0.05$) (Chan et al., 2017; Kabir et al., 2014; Pell et al., 2016). Other cross-sectional study among Hispanic, White, Asian, Black and other race in Southern California also showed significant association with BMI ($p < 0.001$) (Tartof et al., 2020). No significant different between ethnicity with BMI in this study might be due to the low participations and imbalance number of other race such as Chinese, Indian, Sabahan and Sarawakian. In future study, more participations of other races among undergraduate students might result in significant different of ethnicity with BMI. The significant difference that could be determine between ethnicity with body weight status would probably because of the genetic factors as well as other

environmental variables such as behavioral and cultural effects on food preparation and consumption (Chan et al., 2017). Combination of physiology, culture and behaviour could also result in significant difference between ethnicity and body weight status (Institute of Medicine, 2004).

4.4.4 Course and Year of Study

One-Way ANOVA Test had been done in order to find the significant mean different of the course and year of study with BMI while Chi-Square Test had been done to determine the association between course and year of study with BMI classification. Based on **Table 4.3**, the mean $\pm$ SD among the third year was highest ($24.33 \pm 5.14 \text{ kg/m}^2$), followed by first year ($23.81 \pm 4.28 \text{ kg/m}^2$), second year ($23.19 \pm 3.09 \text{ kg/m}^2$) and fourth year ($22.96 \pm 4.01 \text{ kg/m}^2$). Nevertheless, there was no significant difference between year of study with BMI ($F = 1.357$, $p = 0.256$). Based on **Table 4.4**, year of study had been divided into junior and senior which junior were among first year students while senior were from second to fourth year students. Based on the result, no significant association had been identified between the year of study with BMI classification ($\chi^2 = 1.392$, $p = 0.707$). Similar findings had been identified based on a study among 257 medical students in Taibah University, Medina that result in no significant association between year of study of second year to sixth year with BMI ($p > 0.05$) (Khalil et al., 2020). In addition, based on a study that had been done among 240 medical students in Malaysia, there were no significant different among junior (sixth and seventh semester) and senior (eighth and ninth semester) with BMI ($p > 0.05$) (Boo et al., 2010).

On the other hand, different findings had been identified among 1231 first year students at Brock University with BMI that result in significant difference between the male and female first year students with BMI ($p < 0.001$) (Beaudry et al., 2019). Most

of the students during first year had been identified to gaining weight and fat more ($p < 0.001$) and also showed significantly increasing in BMI ($p = 0.032$). Other studies on freshman year had been significantly associated with BMI and showed increasing in weight gain (Cilliers et al., 2006; Hajhosseini et al., 2006; Smith-Jackson & Reel, 2012; Vella-Zarb & Elgar, 2009). The possible factors that could bring the increasing of weight gain during freshman probably because of change in social and environmental (Hajhosseini et al., 2006). The influence from friends, food independence and social comparison with peers were also some other factors that influence the weight gain (Smith-Jackson & Reel, 2012).

Next, result on the **Table 4.3** showed on the mean difference of course of the study with BMI by using One-Way ANOVA Test while Chi-Square Test had been used in order to determine the course of study with BMI group. Based on the table below, there were significant mean difference between the course of study with BMI ($F = 3.426$, $p = 0.009$). The highest mean $\pm$ SD was among Mechanical Engineering (25.59 ± 5.32 kg/m²), followed by Civil Engineering (23.35 ± 4.95 kg/m²), Electrical, Electronic and Systems Engineering (23.29 ± 2.90 kg/m²), Architecture and Built Environment (22.88 ± 3.02 kg/m²) and Chemical and Process Engineering (22.71 ± 3.90 kg/m²) students. However, there was no association had been found between course of study with BMI classification ($\chi^2 = 7.724$, $p = 0.079$). The possible reason for different result between Independent Sample T-Test and Chi-Square test might be because Independent Sample T-Test only test the mean difference between the continues variables with categorical variables while Chi-Square Test measured the association of the categorical variables (Haug, 2019). There was not much study had been conducted that only focus on engineering major. Only one study among 355 engineering students at private college in Chennai that also showed significant association among engineering

students with BMI ($p < 0.05$) (Selvakumar, 2015). Other study among other universities were mostly include many courses and faculty especially among medical students (Abdalla et al., 2020; Aslani et al., 2021; Gudegowda et al., 2018; Hameed et al., 2019; Pengpid & Peltzer, 2014; Varadappa et al., 2014; Yeng & Sedek, 2012). Some studies showed no significant mean different between courses with BMI and these findings had been reported by Abdalla et al (2020), Aslani et al (2021) and Yeng & Sedek, (2012). On the other hand, other studies by Gudegowda et al (2018), Hameed et al (2019) and Varadappa et al (2014) showed significant association between medical students with BMI.

The higher in BMI that had been found among the engineering students could be due to the physical inactive, inadequate and unhealthy eating habit (Selvakumar, 2015). Most of the students also likely to consume fast food because it saves time, cost and tasteful (Nawab Khan et al., 2011). Lower consumption of fruits and vegetables also been found in most student diet and had limited access to healthy food (Nawab Khan et al., 2011).

4.4.5 Family Income

Pearson Correlation Test had been done in order to determine the correlation between family income with BMI while Chi-Square Test had been done to determine the association family income with BMI classification. As showed in **Table 4.3**, there was weak negative correlation between family income with BMI ($r = -0.227$, $p < 0.001$). This means that the higher the family income, the lower the BMI. However, based on **Table 4.4**, no significant association had been found between family income with BMI classification ($\chi^2 = 7.732$, $p = 0.258$). Different result obtained from both test probably because Pearson Correlation Test measured the strength of the association between continuous variables but Chi-Square Test only measured the

association of the categorical variables (Haug, 2019). Similar findings by Kim and Von Dem Knesebeck (2018) also found that among low-income group, they had higher risk to obesity ($p < 0.05$). A study by Singh et al (2011) among adults in the United States also result in significant correlation among those had lower family income with high BMI. There was also a study among 310 Iranian adults studied in one of university in Malaysia which result in strong positive correlation between income with BMI ($r = 0.22$, $p = 0.001$) which higher BMI were seen among those who had higher family income (Mokhtari et al., 2015). On the other hand, based on a study among 11 673 Chinese college students by Jiang et al (2018) reported that those who from higher family income were likely to be correlated with increase in body weight ($p < 0.05$). Other findings by Micklesfield et al (2017) and Baalwa et al (2010) also result in significant increase of BMI among higher family income ($p < 0.001$).

There was also other study that had showed no significant correlation between income with BMI that been conducted in Taipei ($p > 0.05$) (Hsieh et al., 2020). There were few factors that could contribute to the association of family income with BMI such as student's lifestyle and dietary intake (Yang et al., 2017). Besides that, those from low income families might have to deal with other problems and be unable to focus on their health and body weight and might be unable to join any weight loss programs (Bentley et al., 2018). Furthermore, high BMI among participants from low income families probably because they could not afford to purchase healthy and quality food due to its high cost (Andoy-galvan et al., 2020; Ellis et al., 2016; French et al., 2019).

Table 4.3: Results of association between socio-demographic factors with BMI (kg/m²)

Variables	Mean±SD	BMI (kg/m ²)
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		r/t/F	p
Age		-0.044	0.469
Gender		-0.334	0.738
	Female	23.62 ± 4.56	
	Male	23.44 ± 3.52	
Ethnicity		1.190	0.316
	Malay	23.90 ± 4.68	
	Chinese	22.70 ± 3.23	
	Indian	23.42 ± 2.50	
	Sabahan	22.27 ± 3.13	
	Sarawakian	24.00 ± 1.07	
Year of study		1.357	0.256
	First year	23.81 ± 4.28	
	Second year	23.19 ± 3.09	
	Third year	24.33 ± 5.14	
	Fourth year	22.96 ± 4.01	
Course of study		3.426	0.009**
	Civil Engineering	23.35 ± 4.95	
	Electrical, Electronic and Systems Engineering	23.29 ± 2.90	
	Chemical and Process Engineering	22.71 ± 3.90	
	Mechanical Engineering	25.59 ± 5.32	

Architecture and
Built Environment

22.88 ± 3.02

Family income -0.227 <0.001**

Table 4.4: Results of association between socio-demographic factors with BMI classification

Variable	BMI						
	χ^2	p	Under-weight n (%)	Normal weight n (%)	Over-weight n (%)	Obese n (%)	
Gender	5.488	0.139					
			Male	5 (27.8)	77 (41.8)	25 (51.0)	6 (26.1)
			Female	13 (72.2)	107 (58.2)	24 (49.0)	17 (73.9)
Ethnicity	8.319	0.065					
			Malay	11 (61.1)	114 (62.0)	29 (59.2)	21 (91.3)
			Non-malay	7 (38.9)	70 (38.0)	20 (40.8)	2 (8.7)
Year of study	1.392	0.707					
			Junior (first year)	4 (22.2)	58 (31.5)	18 (36.7)	8 (34.8)
			Senior (second to fourth year)	14 (77.8)	126 (68.5)	31 (63.3)	15 (65.2)
Course of study	7.724	0.079					
			Civil Engineering	5 (27.8)	43 (23.4)	14 (28.6)	6 (26.1)
			Electrical, Electronic and Systems Engineering	5 (27.8)	76 (41.3)	18 (36.7)	2 (8.7)

	Chemical and Process Engineering	5 (27.8)	32 (17.4)	7 (14.3)	3 (13.0)
	Mechanical Engineering	2 (11.1)	21 (11.4)	9 (18.4)	11 (47.8)
	Architecture and Built Environment	1 (5.6)	12 (6.5)	1 (2.0)	1 (4.3)
Family income		7.732	0.258		
	B40	10 (55.6)	64 (34.8)	17 (34.7)	13 (56.5)
	M40	7 (38.9)	107 (58.2)	28 (57.1)	10 (43.5)
	T20	1 (5.6)	13 (7.1)	4 (8.2)	0 (.0)

4.5 The association between psychological factors with participants BMI (kg/m²)

Depression, Anxiety and Stress

Based on **Table 4.5** below, the correlation between depression, anxiety and stress with BMI had been determined by using Pearson Correlation Test and result in no significant association between depression, anxiety and stress with BMI ($r = 0.028$, $p = 0.646$; $r = -0.001$, $p = 0.988$; $r = 0.026$, $p = 0.665$). In addition, based on **Table 4.6** below, the association between depression, anxiety and stress with BMI classification by using Chi-Square Test had also result in no significant association between depression, anxiety and stress with BMI group ($\chi^2 = 1.409$, $p = 0.710$; $\chi^2 = 1.253$, $p = 0.721$, $\chi^2 = 5.966$, $p = 0.111$). For the categories of depression, anxiety and stress, participants that categorised as absent of depression, anxiety and stress were those in normal categories while participants that categorised as present of depression, anxiety and stress were with mild, moderate, severe and extremely severe of depression, anxiety and stress. Similar findings from few studies also could not determine the association between stress with BMI (Al-Daghri, Al-Othman & Al-Attas et. al., 2014;

Diggins, Woods-Giscombe, & Waters, 2015; Economos, Hildebrandt & Hyatt, 2008; Hu, Taylor, Blow, & Cooper, 2011; Singh & Shen, 2013; Vela-Zarb & Elgar, 2010; Wilson, Darling, Fahrenkamp, D'Auria & Sato, 2015). Despite those findings, there were still other studies that able to determine the correlation of stress with BMI. One of the study was done by Khalil et al (2020) among 257 medical students and found that there was significant association between stress with BMI ($p = 0.010$). Another study among 380 medical students by Aslani et al (2021), found that there was significant association between stress with increasing in BMI ($p < 0.05$). Besides that, a study by Abdel Wahed & Hassan (2017) among medical students result in significant association between stress with overweight ($p = 0.04$) and obesity ($p = 0.002$). Two other cross-sectional studies also found that stress was significantly correlate with BMI (Fahad et al., 2018; Pelletier et al., 2015).

For this study, no association between depression and BMI been found ($r = 0.028$, $p = 0.646$) and also no association between depression with BMI ($\chi^2 = 1.409$, $p = 0.710$). This finding is similar to a cross-sectional study among Iranian students which indicated that no significant relationship between depression and BMI ($p > 0.05$) (Mokhtari et al., 2015). Another study by Abdel Wahed and Hassan (2017) among medical students found that there was no significant depression with BMI. Nevertheless, there were also few studies that found significant correlation between depression with BMI (Floriana et al., 2021; Liu et al., 2020; Odlaug et al., 2015; Pengpid & Peltzer, 2014). Besides that, a study by Odlaug et al (2015) also result in significant association between male students from the University of Mid-Western USA with major depressive disorder ($p < 0.001$).

Then, based on the result **Table 4.5** found that no significant correlation between anxiety with BMI ($r = -0.001$, $p = 0.988$) and based on result **Table 4.6**, no significant

association had been found between anxiety with BMI classification ($\chi^2 = 1.253$, $p = 0.721$). A study by Herring et al (2014) among 1035 female students attending University of Georgia found that no association between social anxiety disorder with BMI but there was significant association between general anxiety disorder with BMI. On the other hand, no significant association between anxiety with BMI also been reported in a study among 157 first year in health sciences and social sciences students (Ozenoglu et. al., 2013). Other cross-sectional studies by Pothos et al (2009) and Hawker (2012) reported the similar findings. Even so, some studies found that there was significant correlation between anxiety with BMI (Abdel Wahed & Hassan, 2017; Mokhtari et al., 2015). In a study among medical students in Egypt found that among obese and overweight student, higher score of stress and anxiety were revealed compare to normal weight students ($p = 0.002$, $p = 0.04$) (Abdel Wahed & Hassan, 2017). Study by Mokhtari et al (2015) discovered that the correlation between anxiety and BMI was significant and negative correlation ($r = -0.152$, $p < 0.05$) among university students in Malaysia.

Although there was no association of stress, depression and anxiety for this study, there were many possible factors that could lead stress, depression and anxiety toward high BMI especially among students. As few studies among medical students that had been conducted by Khalil et al (2020), Aslani et al (2021), Gudegowda et al (2018) and Adhikari et al (2015) found that students were pressured with tests, the amount of content to be acquired, social alienation, packed schedules and practical which lead them to over-eating and lack in physical exercise. Many young adults entering college or university also tend to have stress in adapting to a new environment which could lead them into consuming high fast food and ordered delivery food due to its convenience and availability factor (Fahad et al., 2018). Besides that, depression could

also lead to low physical activity and binge eating in most women (Simon et al., 2006). Furthermore, higher stress, depression and anxiety could result in biological changes such as increased in cortisol and deposition of visceral fat and behavioral changes such as elevated caloric intake which then would lead to increasing risk of obesity (Gustafson & Sarwer, 2004; Moore & Cunningham, 2012). Difference in techniques and assessment with other studies might contribute to no association of stress, anxiety and depression with BMI (Lykouras and Michopoulos, 2011). Dissimilar to the study population, various obesity perceptions and criteria of depression, anxiety and stress could also contribute towards inconsistent findings (Liao et al., 2020).

4.6 The association between lifestyle factors with participants BMI (kg/m²)

4.6.1 Sedentary Behaviour and Physical Activity

Table 4.5 below showed the result of correlation between sedentary behaviour and physical activity with BMI that had been tested by using Pearson Correlation Test while **Table 4.6** below showed the result of association between sedentary behaviour and physical activity with BMI classification that had been tested by using Chi-Square Test. Based on the result in **Table 4.5**, it showed that there was no significant correlation between sedentary behaviour with BMI ($r = -0.084$, $p = 0.165$) and based on result in **Table 4.6**, no significant association also could be determined between sedentary behaviour with BMI classification ($\chi^2 = 6.625$, $p = 0.085$). A study by Pengpid and Peltzer (2014) among 800 students in Gitam University in India found no correlation between sedentary behaviour with BMI ($p > 0.05$). This findings also similar with one cross-sectional study among 179 medical students in Malaysia that did not found any association between sedentary behavior with BMI (Sriram & Chinna, 2019). Another study among Malaysian aged 18 years above also did not found any association between sedentary behavior with BMI (Chan et al., 2017). A

study among 130 students in Faculty of Medicine, University of Sumatera Utara also result in no significant association between sedentary behaviour with BMI ($p > 0.05$) (Surbakti et al., 2018) Nevertheless, few studies by other researchers had found the significant association between sedentary behavior among university students with BMI (Al-Rethalaa et al., 2010; Gunes et al., 2012; So et al., 2012). A study by Musaiger et al (2003) identified that those who had sedentary behaviour result in higher risk of obesity ($p < 0.05$).

Based on table 4.5, Pearson Correlation Test had been used in determine the correlation between physical activity with BMI. As the result, there was weak negative correlation between physical activity with BMI ($r = -0.273$, $p < 0.001$). It showed that when participants increase their physical activity, their BMI would be reduced. However, based on **Table 4.6**, there was no significant association could be determined between physical activity with BMI classification that had been tested by Chi-Square Test ($\chi^2 = 10.453$, $p = 0.107$). The possible reason for different result obtained from both test probably because Chi-Square Test measured the association of the variables and not the strength of the association unlike Pearson Correlation Test that measured the strength of association between variables (Haug, 2019). Based on a study by Mokhtari et al (2015) found that there was weak negative correlation between physical activity with BMI ($r = -0.14$, $p = 0.009$) among university students. Then, study among Indonesian university students also uncovered that the association between physical activity with BMI was significant ($p = 0.007$) (Surbakti et al., 2018). Besides that, a study by Tapera et al (2017) among university students found significant association between physical activity with BMI group as those who active were reduce the possibility to be overweight and obese ($p = 0.019$). Few cross-sectional studies among university students also result in significant association

between physical activity with BMI (Aslani et al., 2021; Goharpei et al., 2014; Vilchis-Gil et al., 2015). Despite that, there were also few studies that could not find the association between physical activity with BMI (Boo et al., 2010; Chan et al., 2017; Pengpid & Peltzer, 2014).

There was probably no association between sedentary behaviour with BMI in this study but there was significant and negative correlation between physical activity with BMI. It is because sedentary behavior and physically inactive was not driven by similar variables and participants could be categorised into both sedentary and physically active (Chan et al., 2017). In other words, a person can engage in sufficient physical activity to fulfill the recommendations while being sedentary if they spend a significant portion of their day sitting or lying down at work or residence, for travel, study, or in their free time (Knight, 2012). Other potential explanation for the non-significant relationship between sedentary behavior with BMI in this study was probably due to the measurement errors in the duration of sedentary time, over-reporting their sedentary time and influence of food consumption (Chan et al., 2017).

4.6.2 Smoking Status

Table 4.5 below showed the result of mean difference between smoking status of participants with BMI that had been determined by Independent Sample T-Test while based on **Table 4.6** below showed the association between smoking status with BMI classification that had been tested by using Chi-Square Test. Based on the result, it stated that there was significant mean difference between tobacco smoker with BMI ($t = -1.978$, $p = 0.049$) but there was no significant mean different between smokeless tobacco smoker with BMI ($t = -1.532$, $p = 0.127$). Based on **Table 4.6**, no significant association had been identified between tobacco smoker ($\chi^2 = 3.838$, $p = 0.279$) and smokeless tobacco smoker ($\chi^2 = 2.814$, $p = 0.421$) with BMI classification. The reason

for different result between both test might be because Independent Sample T-Test only test the mean difference between the variables while Chi-Square Test measured the association of the categorical variables (Haug, 2019). The mean $\pm$ SD of current non-smoker or never smoke much higher ($23.58 \pm 3.99 \text{ kg/m}^2$) than those who currently smoke tobacco ($22.10 \pm 3.73 \text{ kg/m}^2$) and it also the same among those currently not smokeless tobacco or never smokeless tobacco user had higher mean $\pm$ SD ($23.61 \pm 4.17 \text{ kg/m}^2$) compared to those who currently smokeless tobacco user ($22.24 \pm 4.01 \text{ kg/m}^2$). This finding similar to a study among adults in Northern Saudi which found significant association between smoking status with obesity ($p < 0.05$) which those who never smoke had higher BMI than those who currently smoke (Ginawi et al., 2016). Patel et al (2011) and Jong-Hyuck et al (2012) also revealed that those who current smokers had tendencies to lose weight and lower the likelihood to getting overweight and obese. In general, smokers had been associated with low BMI compared to nonsmokers (Freathy et al., 2011; Morris et al., 2015; Munafo et al., 2009).

Contradict to one study among Indian university students that found those who currently smoke had higher BMI than never smoke (Pengpid & Peltzer, 2014). Besides that, Kim et al (2016) also found that there was significant association between those current smokers had higher central obese than past smokers and never smoke ($p < 0.05$). Moreover, study by Chen et al (2019) uncovered that most smokers categorised in obese group than those who were not in obese category. However, some studies could not find the association between smoking status with BMI since they found smoking among students were not common (Alexopoulos et al., 2010; Boo et al., 2010; Mokhtari et al., 2015).

Audrain-McGovern and Benowitz (2011) stated there seems to be a widespread assumption that smoking lessens weight due to the presence of nicotine that enhances energy expenditure and restrain desire to eat and Tian et al (2015) also suggested the similar findings. Furthermore, Tian et al (2015) in their study had proved that people who completely stop smoking raised 0.63 kg/m² in BMI on average contrast to those that still smoking indicated the causal effects of nicotine and other components of tobacco smoke on BMI. However, this statement could not be implied to every individual because every one of us is different (Piirtola et al., 2018). There was a study by Kim et al (2016) that was able to show that those who categorised as obesity were higher among current smokers because smoking had found to be attributed to poor control of diet, increased cortisol levels, resistance of insulin and lack in physical activity. Thus, assumption that current smokers had higher or lower in BMI than non-smokers need to be further investigated as many other factors such as gene, early life exposures and experiences could bring an effect into determining associations between smoking with BMI (Piirtola et al., 2018).

4.6.3 Sleep quality

Based on **Table 4.5** below, the association between sleep quality with BMI had been determined by using Pearson Correlation Test and result in no significant between PSQI score with BMI ($r = -0.078$, $p = 0.197$). This findings also similar with a study by Vargas et al (2014) that could not find the association between PSQI score with BMI ($p > 0.05$) but a study by Hameed et al (2019) found the significant association between PSQI scores with BMI ($p < 0.001$)

Although no association been found between total score of sleep quality with BMI but based on **Table 4.6** result, there was significant association after using Chi-Square Test to determine the sleep quality based on good and poor sleep quality with BMI

classification ($\chi^2 = 19.485$, $p < 0.001$). The possible reason for different result when using both test was because Pearson Correlation Test measured the strength of the association unlike Chi-Square Test that only measured the association of the variables (Haug, 2019). Based on the result, there were high number of participants who reported having poor sleep quality were classified as underweight, 61.1% ($n = 11$) participants than good sleep quality, 38.9% ($n = 7$) participants. Then for normal weight, most of the participants having good sleep quality, 81.5% ($n = 150$) participants than poor sleep quality 18.5% ($n = 34$) participants. Meanwhile for the overweight about 81.6% ($n = 40$) of the participants and obese about 65.2% ($n = 15$) of the participants were having good sleep quality that much higher compared to poor sleep quality which 18.4% ($n = 9$) of them were overweight and 34.8% ($n = 8$) of them were obese. This is contradicting with most of studies which found higher BMI and prevalence of overweight and obesity among poor sleepers (Beccuti & Pannain, 2011; Crivello et al., 2019; Krističević et al., 2018; Park et al., 2018; Pengpid & Peltzer, 2014; Rahe et al., 2015; Sa et al., 2020; Suhaimi et al., 2020). It had been proved that most of people having poor sleep quality causes changes in metabolic and endocrine function, such as in the stress response system and the production of the hormones ghrelin and leptin, which are known to play key roles in appetite control and hence impact dietary choices and calorie consumption (Zimberg et al., 2012). In addition, having poor sleep quality could have linked to drowsiness and tiredness, which can lead to physical inactivity throughout the day (Beccuti & Pannain, 2011). Thus, high number of participants having poor sleep quality were classified as underweight rather than overweight or obese were new and not much studies could contribute the explanations related to this finding.

Table 4.5: Results of association between psychological factors and lifestyle factors with BMI (kg/m^2)

Variables	Mean ± SD	BMI (kg/m ²)	
		r/t	p
Depression		0.028	0.646
Anxiety		-0.001	0.988
Stress		0.026	0.665
Sedentary behaviour		-0.084	0.165
Physical activity level		-0.273	<0.001**
Smoking status			
Tobacco smoker		-1.978	0.049**
	Current tobacco smoker	22.10 ± 3.73	
	Current non-smoker or never smoke	23.58 ± 3.99	
Smokeless tobacco smoker		-1.532	0.127
	Current smokeless tobacco	22.24 ± 4.01	
	Current non-user of smokeless tobacco or never smokeless tobacco	23.61 ± 4.17	
PSQI score		-0.078	0.197

Table 4.6: Results of association between psychological and lifestyle factors with BMI classification

Variable	BMI					
	χ^2	p	Under-weight n (%)	Normal weight n (%)	Over-weight n (%)	Obese n (%)
Depression	1.409	0.710				

Smoking status						
Tobacco smoker		3.838	0.279			
	Current tobacco smoker		1 (5.9)	25 (13.7)	6 (12.8)	0 (.0)
	Current non-smoker or never smoke		16 (94.1)	158 (86.3)	41 (87.2)	20 (100.0)
Smokeless tobacco smoker		2.814	0.421			
	Current smokeless tobacco		1 (5.6)	18 (10.0)	5 (10.6)	0 (.0)
	Current non-user of smokeless tobacco or never smokeless tobacco		17 (94.4)	162 (90.0)	42 (89.4)	22 (100.0)
Sleep quality		19.485	< 0.001**			
	Good sleepers		7 (38.9)	150 (81.5)	40 (81.6)	15 (65.2)
	Poor sleepers		11 (61.1)	34 (18.5)	9 (18.4)	8 (34.8)

CHAPTER 5

CONCLUSION, LIMITATIONS, RECOMMENDATION

5.1 Conclusion

As the conclusion, the prevalence of overweight obese was quite high among participants of this study. Based on the result, there were many possible factors that could contribute to the increasing of BMI. In this study, the factors that showed significant correlation with BMI are family income and physical activity ($p < 0.001$) while course of study and tobacco smoker showed significant difference with BMI ($p = 0.009$; $p = 0.049$). Participants that had lower number of income and lower physical activity had significant correlation with higher BMI. Higher number of BMI among Mechanical Engineering ($25.59 \pm 5.32 \text{ kg/m}^2$) and current or never smoke ($23.58 \pm 3.99 \text{ kg/m}^2$) could be seen from the result. There was also significant association between sleep quality with BMI group ($p < 0.001$) where high percentage of participants categorised as good sleepers were overweight (81.6%) and obese (65.2%). As this study found that good sleepers had higher BMI compared to poor sleepers, further study on this finding need to be done to find the explanation on the cause of it. No significant association between age, gender, ethnicity, depression, anxiety, stress and sedentary behaviour with BMI and BMI group in this study ($p > 0.05$).

5.2 Limitations of the study

There were several limitations in the present study. Firstly, this study only conducted among engineering major in UKM with a small sample size. Thus, the findings only represent engineering major in UKM but not overall in Malaysia. Secondly, the participants' height and weight were self-reported and they might be under- or over-reported especially among female which could lead to inaccurate data. As all the questionnaires were distributed and answered through online platform, some participants might have misunderstood the instructions and questions given. Lastly, this study also does not include participants' dietary intake which might give more information on the association with BMI.

5.3 Recommendations of the study

Further study could be conducted among students from different courses of other universities with larger sample sizes to get more data on factors associated with BMI. After this COVID-19, it is probably best to measure participants' height and weight face to face to get more accurate data for body weight and height for better results of BMI. Besides that, further study on participants' dietary intake should be conducted to find its association with BMI. Health awareness and intervention programs especially on the importance of physical activity should be done to prevent overweight and obesity among this group of population particularly in this current pandemic situation where most classes are using online platforms.

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APPENDICES

APPENDIX A: APPROVAL LETTER FROM ETHICS COMMITTEE RESEARCH INVOLVING HUMAN SUBJECTS (JKEUPM)

Ref. no: UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM)

Date: 3 February 2021

Dear Prof./Dr./Mr./Ms.,

APPLICATION FOR JKEUPM ETHICAL CLEARANCE: APPROVED

With reference to the above, I am pleased to inform you that your application for ethical clearance for the research project entitled '**Factors Associated with Body Mass Index among Engineering Major Students of a Public University in Selangor**' has been approved.

Please note that the official letter of approval will be issued as soon as possible. However, the ethical clearance is considered effective from the date of this email, and you may now proceed with your research.

Kindly remind the ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.

Researchers should also complete a Study Final Report upon study completion. The form can be obtained from the Ethics Committee for Research Involving Human Subjects (JKEUPM) website (<http://www.tncpi.upm.edu.my/faildokumen>).

If you have any enquiries, please contact Ms. Nurulhasanah Ishak (03-97691605) or Ms. Nor Ellia Abd Ajis (03-97691244).

Note: Please use this reference number for any transaction.

- JKEUPM-2020-476

Thank you.

Yours faithfully,

Prof. Dr. Zamberi Sekawi
Chair
Ethics Committee for Research Involving Human Subjects
Universiti Putra Malaysia

APPENDIX C: INFORMATION SHEET AND CONSENT FORM

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



FORM 2.4: RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

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

1. STUDY TITLE: Factors Associated with Body Mass Index among Engineering Major Students of a Public University in Selangor

2. INTRODUCTION: Overweight and obesity has always become a big concern in the world from year to year. According to World Health Organization (2020), overweight and obesity are characterized as the accumulation of irregular or unnecessary fat that poses a health risk. In Malaysia, data obtain based on NHMS shows that the prevalence of overweight had increase from 16.6% in 1996 (IPH, 1996) to 30.4% in 2019 (NIH, 2019) while prevalence of obesity had increase from 4.5% in 1996 (IPH, 1996) to 19.7% in 2019 (NIH, 2019). This had shown significant increases of 13.8% and 15.2% for the prevalence of overweight and obesity respectively compared to the last 24 years. Although according to recent data, the highest prevalence of overweight and obesity were mostly among middle-aged adults between age 45-49 (39.6%) and age 35-39 (25.3%) years old respectively (NIH, 2019), the prevalence of overweight and obesity among young adults also quite high (NIH, 2019). The percentage of overweight among young adults aged 18-19, 20-24 and 25-29 was 15.3%, 19.7% and 24.7% respectively while the percentage of obesity was 16.2%, 11.5% and 20.3% respectively (NIH, 2019). The main reason for this study to be conducted among UKM students was because there was no update study in determining the factors that associated with body mass index specifically being done among university students in UKM. Previous study had been done about 9 years ago and that only focused on the body weight perception and weight control behaviors of the students. Therefore, a cross-sectional study will be carried out among university students in UKM to assess factors associated with body mass index.

3. WHAT WILL YOU HAVE TO DO? Participants are required to fill all the important details and answered all the questionnaire for this study. Please read the instruction carefully. However, there is no right or wrong answers for the all the questions. Participants could answer all the questions without pressure. Participating in this study is in the form of voluntary and participants may withdraw anytime without penalty. There will be no payment, gift nor incentive for those who participating in this study.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY? Exclusion criteria for this study are students who have physical disabilities, chronic diseases and pregnant.

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

- (a) **TO YOU AS THE SUBJECT?** Participants could know and understood more on the factors that could associated with body weight status especially during this pandemic to tackle the body weight issue so that the prevalence of overweight and obesity will be reduce in the future
- (b) **TO THE INVESTIGATOR?** The present research would help by incorporating new awareness of the related variables with body weight status of university students. In addition, this study will serve as baseline data for future studies particularly on the body weight status among university students in Malaysia during this COVID-19 pandemic. Having this study also could help the health practitioners to carry out adequate and successful intervention measures to attain healthier body weight among young adults, especially university students, during this pandemic, which may lead most students to reduce physical activity due to online classes and stay-at-home policies.

6. WHAT ARE THE POSSIBLE RISKS? Since this study will be mostly to be done through online platform and based on self-report, there will be minimal risks between participant and investigator.

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL? Yes. All the information that participant provided and their identity will be confidential and this study only conducted for educational purposes.

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

Any additional questions could refer to

Principle investigator: Assoc. Prof. Dr. Hazizi Abu Saad

Email: [fazizi@upm.edu.my](mailto:hazizi@upm.edu.my)

Contact no: 03-97692434

Co-investigator: Nur Azznizza binti Mohd Abd Razak

Email: 194819@student.upm.edu.my

Contact no: 018-7836557

Please initial here if you have read and understood the contents of this page_____

9. CONSENT

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

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

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

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

* delete where necessary

Signature Signature
(Respondent) (Witness)

Date :..... Name :.....
I/C No. :.....

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

Date Signature
(Researcher)

APPENDIX D: QUESTIONNAIRE



**UNIVERSITI PUTRA MALAYSIA FACULTY OF
MEDICINE AND HEALTH SCIENCES
DEPARTMENT OF NUTRITION**

RESEARCH QUESTIONNAIRE

**Research Title: Factors Associated with Body Weight Status among
Engineering Major Students of a Public University in Selangor**

Prepared by: Nur Azznizza Binti Mohd Abd Razak (194819)

Supervisor's Name: Assoc. Prof. Dr. Hazizi Abu Saad

This questionnaire is only for research purposes. Please complete ALL items in EVERY section by choosing answer that best applies to you. All information gathered is guaranteed confidential. Please submit this questionnaire after you have completed all the sections. Your participation and cooperation are highly appreciated.

Section A: Socio-Demographic Background Factors

1. Age: _____(years)
2. Date of birth: ___(MM) / ___(DD) / _____(YYYY)
3. Gender:

Male	☐
Female	☐
4. Ethnicity:

Malay	☐
Chinese	☐
Indian	☐
Sabahan	☐
Sarawakian	☐
Others: _____	
5. Year of study:

1 st year	☐
2 nd year	☐
3 rd year	☐
4 th year	☐
6. Course of study: _____
8. Family income (per month): _____
9. Household number: _____

Section B: Psychological Factors (Depression, Stress and Anxiety)

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all

1 Applied to me to some degree, or some of the time

2 Applied to me to a considerable degree, or a good part of time

3 Applied to me very much, or most of the time

1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (eg, in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3

17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

Section C: Lifestyle Factors

I. Sedentary behavior

Next I will ask you about particular activities you did yesterday while sitting down or lying down. Please note that this does not include sleeping, either in bed or if you fell asleep while doing another activity, for example watching television.

I am going to ask you about different times when you may be sitting or lying down: when working, travelling, watching TV, using the computer, and when doing other activities. For each of these, only count the time when this was your main activity. For example, if you watched TV and ate dinner at the same time, this might be TV or meal time, but not both. Your answers can be given in hours and minutes. Try to report only the time you spent sitting or lying down and not time you spent getting up for breaks (e.g. coffee, bathroom).

ST 1. The next question is about sitting for work. Did you work in a paid position yesterday?

	Yes
	No

If you did not work yesterday, skip to ST 4. If you did work yesterday continue to ST 2.

Time spent for work

ST 2. How long **in total** did you spend at your workplace or working from home yesterday, including meal and snack breaks?

		hours			minutes
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Sitting for work

ST 3. **How long** were you **sitting** at your workplace or working from home yesterday, including during meal and snack breaks?

		hours			minutes
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If you have difficulty, your best estimate will be OK.

****The time for ST3 cannot be longer than ST2.**

Sitting for Transport

ST 4. Thinking again of yesterday, please estimate the **total** time that you spent **sitting** to travel from one place to another. Please include sitting and waiting for transport. Do **not** include any time you were standing up while travelling or waiting.

		hours			minutes
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Transport includes public and private, waiting for any type of transport and travel to all locations. This would not include time spent travelling as part of work which was reported in ST3 e.g. taxi driver

Television Viewing

ST 5. Please estimate the **total time** you spent sitting or lying down to watch TV or DVDs or play games on the TV, such as play station yesterday? This includes if you watch TV in bed.

Remember, your answer can be given in hours and/or minutes.

		hours			minutes
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Computer, Internet, Electronic Games

ST 6. Please estimate the total time yesterday that you spent sitting or lying down and using the computer. For example, include time spent playing games, internet activities.

<table border="1"><tr><td></td><td></td></tr></table>			hours	<table border="1"><tr><td></td><td></td></tr></table>			minutes

Do not include time spent doing paid work on the computer as this should have been included in the previous question about sitting for work.

Reading

ST 7. Please estimate the total time yesterday that you spent sitting or lying down while reading during your leisure time. Include reading in bed but do not include time spent reading for paid work.

<table border="1"><tr><td></td><td></td></tr></table>			hours	<table border="1"><tr><td></td><td></td></tr></table>			minutes

Hobbies

ST 8. Please estimate the total time yesterday that you spent sitting or lying down for hobbies. For example, doing art, craft or cross words.

<table border="1"><tr><td></td><td></td></tr></table>			hours	<table border="1"><tr><td></td><td></td></tr></table>			minutes

Sitting/lying for other purposes

ST 9. We are interested in any other sitting or lying down that you may have done that you have not already told us. For example, this could include socializing with friends or family including time on the telephone; eating meals; or listening to music.

Again thinking of yesterday, please estimate the **total time** that you spent sitting or lying down **NOT** including time that you have told us about in the previous answers.

--	--

hours

--	--

minutes

If you have difficulty, your best estimate will be OK.

II. Physical activity

Section A			
No.	Questions	Response	Code
1.	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like (carrying or lifting heavy loads, digging or construction work) for at least 10 minutes continuously?	Yes 1 No 2 <i>If No, go to P4</i>	P1
2.	In a typical week, on how many days do you do vigorous- intensity activities as part of your work?	Number of days	P2
3.	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes : . hours minutes	P3
4.	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking (or carrying light loads) for at least 10 minutes continuously?	Yes 1 No 2 <i>If No, go to P7</i>	P4

5.	In a typical week, on how many days do you do moderate- intensity activities as part of your work?	Number of days	P5
6.	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes : . . hours minutes	P6

Section B			
No.	Questions	Response	Code
7.	Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 If No, go to P10	P7
8.	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days	P8
9.	How much time do you spend walking or bicycling for travel on a typical day?	Hours : minutes : hours minutes	P9

Section C			
No.	Questions	Response	Code

10.	Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like (running or football,) for at least 10 minutes continuously?	Yes 1 No 2 <i>If No, go to P13</i>	P10
11.	In a typical week, on how many days do you do vigorous- intensity sports, fitness or recreational (leisure) activities?	Number of days	P11
12.	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours : minutes : hours minutes	P12
13.	Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate such as brisk walking, (cycling, swimming, volleyball) for at least 10 minutes continuously?	Yes 1 No 2 <i>If No, go to P16</i>	P13
14.	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?	Number of days	P14
15.	How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?	Hours : minutes : hours minutes	P15

Section D			
No.	Questions	Response	Code

16.	How much time do you usually spend sitting or reclining on a typical day?	Hours : minutes <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;"></td><td style="width: 20px; height: 20px;"></td></tr></table> : <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;"></td><td style="width: 20px; height: 20px;"></td></tr></table> . hours minutes					P16

III. Sleep quality

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month.

Please answer all questions.

1	During the past month, when have you usually gone to bed at night?	Usual bed time: _____			
2	During the past month, how long (in minutes) has it usually take you to fall asleep each night?	Number of minutes: _____			
3	During the past month, how long (in minutes) has it usually take you to fall asleep each night?	Usual getting up time: _____			
4	During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)	Hours of sleep per night: _____			
5	For each of the remaining questions, check the one best response. Please answer all questions. During the past month, how often have you had trouble sleeping because you...				
		Not during past month	Less than once a week	Once or twice a week	Three or more times a week
	(a) Cannot get to sleep within 30 minutes				
	(b) Wake up in the middle of the night or early morning				

	(c) Have to get up to use the bathroom				
	(d) Cannot breathe comfortably				
	(e) Cough or snore loudly				
	(f) Feel too cold				
	(g) Feel too hot				
	(h) Had bad dreams				
	(i) Have pain				
	(j) Other reason(s), please describe: _____				
	How often during the past month have you had trouble sleeping because of this?				
6	During the past month, how would you rate your sleep quality overall?	Very good	Fairly good	Fairly bad	Very bad
7	During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	Not during the past months	Less than once a week	Once or twice a week	Three or more times a week
8	During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	Not during the past months	Less than once a week	Once or twice a week	Three or more times a week

9	During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem

IV. Smoking

Eligibility criteria: 15 years and above	
H1	Current tobacco smoking status Do you currently smoke tobacco on a daily basis, less than daily, or not at all? 1. Daily (go to question H3) 2. Less than daily (go to question H2a) 3. Not at all (go to question H2b) -7. Don't know (go to question H3) -9. Refuse to answer (go to question H3)
H2a	Past daily smoking status Have you smoked tobacco daily in the past? 1. Yes 2. No -7. Don't know -9. Refuse to answer All go to question H3
H2b	Past smoking status In the past, have you smoked tobacco on a daily basis, less than daily or not at all? 1. Daily 2. Less than daily 3. Not at all

	-7. Don't know -9. Refuse to answer If answer 3, -7 or -9, go to question H4						
H3	Number of tobacco products smoked per day Administered to respondents who are currently smokers (H1 = 1 or 2). Go to item question in H3 and each item part (a through g). For current daily smokers (H1 = 1), the questions should ask about daily use (number per day). For current less than daily smokers (H1 = 2), the question should ask about weekly use (number per week) On average, how many of the following products do you currently smoke each (day/week)? The question is about number of each cigarette, not packs If you don't know write TT, if refuse to answer write EJ						
		Per day			Per week		
a	Manufactured cigarettes On average, how many manufactured cigarettes do you smoke each week?						
b	Hand-rolled cigarettes On average, how many hand-rolled cigarettes do you smoke each week?						
c	Kretek On average, how many kretek do you smoke each week?						
d	Cigars, cheroots or cigaritos On average, how many cigars, cheroots or cigaritos do you smoke each week?						
e	Pipes full of tobacco On average, how many pipes full of tobacco do you smoke each week?						
f	Bidis On average, how bidis do you smoke each week?						

g	Others On average, how many _____ do you smoke each week?						
H4	Current smokeless tobacco use Do you currently use smokeless tobacco on a daily basis, less than daily, or not at all? 1. Daily (go to question H6) 2. Less than daily (go to question H5a) 3. Not at all (go to question H5b) -7. Don't know -9. Refuse to answer If answer -7 or -9, go to question H6						
H5a	Past daily smokeless tobacco Have you use smokeless tobacco use in the past? 1. Yes 2. No -7. Don't know -9. Refuse to answer All go to question H6						
H5b	Past smokeless tobacco use In the past, have you used smokeless tobacco on a daily basis, less than daily or not at all? 1. Daily 2. Less than daily 3. Not at all -7. Don't know -9. Refuse to answer						
H6	Frequency of smoking in the home How often does anyone smoke inside your home? Would you say daily, weekly, monthly, less than monthly, or never? 1. Daily 2. Weekly 3. Monthly						

	4. Less than monthly 5. Never -7. Don't know -9. Refuse to answer
H7	Current working location Do you currently work outside of your home? 1. Yes (go to question H8) 2. No/Don't work (go to question H10) -7. Don't know (go to question H10) -9. Refuse to answer (go to question H10)
H8	Currently working indoors or outdoors? Do you usually work indoors or outdoors? 1. Indoors (got to question H9) 2. Outdoors (got to question H10) 3. Both (go to question H9) -7. Don't know (go to question H10)
H9	Smoking at the workplace During the past 30 days, did anyone smoke in indoor areas where you work? 1. Yes 2. No
H10	Question H10 is to be answered by respondents who answered daily (choice No 1) or less than daily (Choice no 2) for question H1 (H1 = 1 or 2) Attempting to quit smoking During the past 12 months, have you tried to stop smoking? 1. Yes 2. No -7. Don't know -9. Refuse to answer
H11	Question H11 is to answered by respondents who answered daily (choice No 1) or less than daily (choice No 2) for question H1 (H1 = 1 or 2)

	Visiting a doctor Have you visited a doctor or other health care provider in the past 12 months? 1. Yes (go to question H12) 2. No (go to question H13) -7. Don't know (go to question H13) -9. Refuse to answer (go to question H13)
H12	Question H12 is to answered by respondents who answered daily (choice No 1) or less than daily (choice No 2) for question H1 (H1 = 1 or 2) Receiving cessation advice from doctor During any visit to a doctor or health care provider in the past 12 months, were you advised to quit smoking tobacco? 1. Yes 2. No -7. Don't know -9. Refuse to answer
H13	Noticing anti-cigarette information in newspapers or magazines 1. Yes 2. No 3. Not applicable -7. Don't know -9. Refuse to answer
H14	Noticing anti-cigarette information on television In the last 30 days, have you noticed information about the dangers of smoking cigarettes or that encourages quitting on television? 1. Yes 2. No 3. Not applicable -7. Don't know -9. Refuse to answer
H15	Question H15 is to answered by respondents who answered daily (choice No 1) or less than daily (choice No 2) for question H1 (H1 = 1 or 2)

	Noticing health warnings on cigarette packs In the last 30 days, did you notice any health warnings on cigarette packages? 1. Yes 2. No (go to question H17) 3. Did see any cigarette packages (go to question H17) -7. Don't know -9. Refuse to answer
H16	Question H16 is to answered by respondents who answered daily (choice No 1) or less than daily (choice No 2) for question H1 (H1 = 1 or 2) and answered 'Yes' to H15 (H15 = 1) Thinking about quitting because of health warnings on cigarette packs In the last 30 days, have warning labels on cigarette packages led you to think about quitting 1. Yes 2. No -7. Don't know -9. Refuse to answer
H17	Cigarette advertising in stores In the last 30 days, have you noticed by advertisements or signs promoting cigarettes in stores where cigarettes are sold? 1. Yes 2. Notion 5 3. Not applicable -7. Don't know -9. Refuse to answer
H18	Cigarette promotions In the last 30 days, have you noticed any of the following types of cigarette promotions? Read each item:
1	Free samples of cigarettes? 1. Yes 2. No -7. Don't know -9. Refuse to answer

2	Cigarettes at sale prices? 1. Yes 2. No -7. Don't know -9. Refuse to answer
3	Coupons for cigarettes? 1. Yes 2. No -7. Don't know -9. Refuse to answer
4	Free gifts or special discount offers on other products when buying cigarettes? 1. Yes 2. No -7. Don't know -9. Refuse to answer
5	Clothing or other items with a cigarette brand name or logo? 1. Yes 2. No -7. Don't know -9. Refuse to answer
6	Cigarette promotions in the mail? 1. Yes 2. No -7. Don't know -9. Refuse to answer

H19	Question H19 is to answered by respondents who answered daily (choice No 1) or less than daily (choice No 2) for question H1 (H1 = 1 or 2). And answered H3a (H1 = for 2 and H3a = 1) Last cigarette purchase – quantity The last time you bought cigarettes for yourself, how many cigarettes did you buy?
1	Cigarettes:
2	Packet:
3	Carton:
4	Other- Specify: _____ How maybe cigarettes were in each (fill)?
5	Never bought cigarettes (End. Go to next modul) -7. Don't know (go to question H20) -9. Refused to answer (go to question H20)
H20	Question H20 is to answered by respondents who answered daily (choice No 1) or less than daily (choice No 2) for question H1 (H1 = 1 or 2). And answered H3a (H1 = for 2 and H3a = 1) Total expenses _____ In total, how much money did you pay for this purchase Specify: RM_____ -7. Don't know (go to question 21) -9. Refused to answer (go to question 21)
H21	Question H21 is to answered by respondents who answered daily (choice No 1) or less than daily (choice No 2) for question H1 (H1 = 1 or 2). And answered H3a (H1 = for 2 and H3a = 1) How much is the price of 1 pack of cigarette in your last purchase Specify: RM_____ End. Go to next modul

Section D: Self-report weight and height

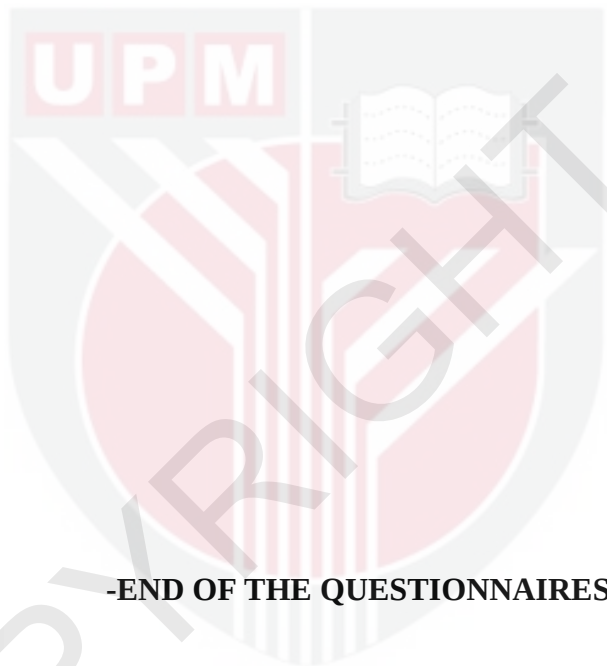
By using suitable or available measuring device, please write your weight and height in the nearest 0.1 kg and 0.1 cm respectively.

Do remove any heavy items on your body before weight yourself.

Weight (kg): _____

Height (cm): _____

Please state when the last time you measure your weight and height yourself:
dd/mm/yyyy



-END OF THE QUESTIONNAIRES-