

**ASSOCIATION BETWEEN BREAKFAST CONSUMPTION PATTERN WITH
BODY MASS INDEX (BMI) AND PHYSICAL ACTIVITY AMONG
UNDERGRADUATE STUDENTS IN UNIVERSITI SAINS MALAYSIA,
HEALTH CAMPUS, KUBANG KERIAN, KELANTAN.**

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ASSOCIATION BETWEEN BREAKFAST CONSUMPTION PATTERN WITH
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UNDERGRADUATE STUDENTS IN UNIVERSITI SAINS MALAYSIA, HEALTH
CAMPUS, KUBANG KERIAN, KELANTAN.

By

IWANI AFIFAH BINTI ZULKIFFLEE

Dissertation submitted in partial fulfilment
of the requirements for the degree
of Bachelor of Health Sciences (Honours) (Dietetics)

JULY 2024

CERTIFICATE

This is to certify that the dissertation entitled “ASSOCIATION BETWEEN BREAKFAST CONSUMPTION PATTERN WITH BODY MASS INDEX (BMI) AND PHYSICAL ACTIVITY AMONG UNDERGRADUATE STUDENTS IN UNIVERSITI SAINS MALAYSIA, HEALTH CAMPUS, KUBANG KERIAN, KELANTAN” is the bona fide record of research work done by Ms IWANI AFIFAH BINTI ZULKIFFLEE during the period from October 2023 until July 2024 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and in quality, as a dissertation to be submitted in partial fulfilment for the degree of Bachelor of Health Science (Honours) (Dietetics).

Main supervisor



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DECLARATION

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



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IWANI AFIFAH BINTI ZULKIFFLEE

Date: 4th July 2024

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In the name of Allah, the Most Gracious and the Most Merciful.

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
CPG	Clinical Practice Guidelines
IPAQ	International Physical Activity Questionnaire
IJT	<i>Indeks Jisim Tubuh</i>
MET	Metabolic Equivalents
NHMS	National Health and Morbidity Survey
PAL	Physical Activity Level
SPSS	Statistical Package for Social Science Software
USM	Universiti Sains Malaysia

**HUBUNGKAIT ANTARA CORAK PENGAMBILAN SARAPAN PAGI DENGAN
INDEKS JISIM TUBUH DAN AKTIVITI FIZIKAL DALAM KALANGAN
PELAJAR PRASISWAZAH DI UNIVERSITI SAINS MALAYSIA, KAMPUS
KESIHATAN, KUBANG KERIAN KELANTAN.**

ABSTRAK

Sarapan pagi merupakan hidangan yang paling penting dalam kehidupan seharian kerana sarapan pagi dapat membekalkan tenaga sepanjang hari dan mempunyai banyak kebaikan termasuk dari aspek fizikal, mental dan juga fungsi kognitif. Amalan gaya pemakanan yang sihat, seperti pengambilan sarapan pagi masih dilaporkan rendah dalam kalangan orang muda terutamanya pelajar universiti. Oleh itu, kajian ini bertujuan untuk menentukan hubungan antara corak pengambilan sarapan pagi dengan indeks jisim tubuh (IJT) dan aktiviti fizikal dalam kalangan pelajar prasiswazah di USM Kampus Kesihatan, Kubang Kerian, Kelantan. Kajian rentas ini melibatkan 116 pelajar prasiswazah yang dipilih melalui kaedah pensampelan mudah. Kertas soal selidik yang diisi sendiri mempunyai 4 bahagian iaitu ciri sosio-demografi, pengukuran antropometri, *International Physical Activity Questionnaire* (IPAQ) dan soalan berkaitan corak pengambilan sarapan pagi. Majoriti responden merupakan pelajar perempuan (81.0%), berusia dari 19 hingga 23 tahun (90.5%) dengan purata umur 21.90 ± 1.40 tahun. Kebanyakan responden merupakan pelajar Tahun 3 (32.8%), pelajar PPSK (87.1%) dan berbangsa Melayu (64.7%). Majoriti responden, 58.6% membelanjakan antara RM10 hingga RM15 untuk belanjawan harian makanan mereka, dengan purata $RM14.66 \pm 6.03$ dan menerima antara RM500 hingga RM1000 untuk elaun bulanan dengan purata $RM553.73 \pm 261.78$. Sebanyak 38.8% menerima pinjaman sepanjang pengajian dan 97.4% responden tinggal di asrama kampus. Berdasarkan klasifikasi IJT, 11.2% adalah kurang berat badan, 43.9% normal, 29.3% adalah berlebihan berat badan dan 16.4%

adalah obes. Mengenai tahap aktiviti fizikal, 45.7% mempunyai tahap aktiviti fizikal sederhana, dan 55.2% responden diklasifikasikan sebagai pengelak sarapan. Walau bagaimanapun, tiada hubungan yang signifikan antara corak pengambilan sarapan pagi dan IJT ($p=0.267$). Penemuan juga mendedahkan bahawa tiada hubungan yang signifikan antara corak pengambilan sarapan pagi dan aktiviti fizikal yang dilaporkan dalam kajian ini ($p=0.279$).

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ABSTRACT

Breakfast is widely acknowledged as the most important meal of the day because it provides energy throughout the day and offers many benefits, including physical, mental, and cognitive functions. However, the practice of healthy eating habits, such as consuming breakfast, is still reported to be low among young adults, especially university students. Therefore, this study aimed to determine the association between breakfast consumption pattern with body mass index (BMI) and physical activity among undergraduate students at the USM Health Campus, Kubang Kerian, Kelantan. This cross-sectional study involved 116 undergraduate students selected through a convenience sampling method. The self-administered questionnaire consisted of four sections: socio-demographic characteristics, anthropometric measurements, the International Physical Activity Questionnaire (IPAQ), and questions related to breakfast consumption patterns. The majority of respondents were female (81.0%), aged between 19 and 23 years (90.5%) with a mean age of 21.90 ± 1.40 years. Most respondents were third-year students (32.8%), PPSK students (87.1%), and of Malay ethnicity (64.7%). More than half of respondents, 58.6%, spent between RM10 to RM15 on their daily food budget, with a mean of $RM14.66 \pm 6.03$ and received between RM500 to RM1000 for their monthly allowance, with mean of $RM553.73 \pm 261.78$. A total of 38.8% received loans as sponsorship throughout their studies and 97.4% of the respondents stayed in campus hostel. Based on BMI classification, 11.2% were underweight, 43.9% were normal weight, 29.3% were overweight, and 16.4% were obese. Regarding physical

activity levels, 45.7% had moderate physical activity levels, and 55.2% of respondents were classified as breakfast skippers. However, there was no significant association between breakfast consumption patterns and BMI ($p=0.267$). The findings also revealed that there was no significant association between breakfast consumption patterns and physical activity reported in this study ($p=0.279$).

CHAPTER 1 INTRODUCTION

1.1 Background of Study

Body mass index (BMI) is a measure of an individual's current body weight status. BMI is calculated using the formula weight (kilograms) divided by height squared (meters) and classified as underweight, normal weight, overweight, or obese (Zierle-Ghosh & Jan, 2022). The BMI of an individual is a significant determinant in identifying potential long term health problems as BMI can show the proportion of body fat, however BMI cannot determine body fat percentage directly (Zierle-Ghosh & Jan, 2022). Based on Clinical Practice Guidelines (CPG) for Obesity (2023), the classification of BMI for adults is below than 18.5 kg/m² (underweight), 18.5 – 22.9 kg/m² (normal), 23.0 – 27.4 kg/m² (pre-obese or overweight), 27.5 – 32.4 kg/m² (obese class I), 32.5 – 37.4 kg/m² (obese II) and 37.5 kg/m² and above (obese III). BMI measurement are useful screening tools for overweight and obesity in adults (WHO, 2021).

Physical activity is defined as any movement requiring energy expenditure arising from skeletal muscle (WHO, 2022). Regular physical activity has been shown to help prevent and manage non-communicable disease, maintain healthy weight, and provide good life quality and well-being (WHO, 2022). WHO (2022) recommends adults aged 18 – 64 years, should practice at least 150 minutes of moderate- intensity aerobic physical activity throughout the week or at least 75 minutes of vigorous-intensity physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity physical activity for additional health benefits.

Breakfast is widely regarded as one of the most important meals of the day. Breakfast consumption time is normally consumed within 2 hours after waking up, before or when daily activities begin, or before 10:00 a.m. in the morning. Eating breakfast is

linked with improved outcomes for weight status, micronutrients intake, diet quality and lifestyle aspects (Adolphus et al., 2015). Moreover, skipping breakfast can cause metabolic alteration that affect certain aspects of cognitive function and academic performance of students (Fitri Mat Ludin et al., 2016).

1.2 Problem Statement

Based on study done by Radzi et al., (2019) the prevalence of overweight and obesity among undergraduate students in 5 public universities in peninsular Malaysia is 40.6%. University students are prone to be overweight and obese due to unhealthy lifestyle behaviors such as low to moderate physical activity level and skipping breakfast in both genders (Telleria-Aramburu & Arroyo-Izaga, 2022). The factors for poor breakfast consumption pattern happens among students include not having enough money, time constraints with unfavorable academic schedule, not in good mood and heavy workload from university (Adonu et al., 2023). Students with unhealthy breakfast consumption pattern are at higher risk for weight gain as they may increase their intake in other mealtimes and excessive consumption of snacks (Moy et al., 2009). Meanwhile, having low energy and lack of willpower are said to be common barriers in university students to do physical activity (DiSerio et al., 2021). This is due to insufficient energy intake throughout the day as daily breakfast increases physical activity whereas breakfast skipping promotes higher energy consumption later in that day and may lead to unwanted weight gain (Chowdhury et al., 2016). Therefore, this study is intended to examine the association between BMI and physical activity level with breakfast consumption pattern in order to see the relevancy and potential practicality of healthy breakfast habit interventions in campus setting.

1.3 Significance of Study

The finding of this study will help to understand better about breakfast consumption pattern of the undergraduate students in health campus. Therefore, the findings can be used to raise awareness regarding healthy breakfast consumption patterns among undergraduate students. Moreover, this study will aid to determine body mass index status and level of physical activity among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan. Based on data collected, prevalence of overweight and obesity among undergraduate students can be determined and may lead to planning proper interventions such as developing healthy eating habits, physically active daily routine and encourage healthy lifestyle among undergraduate students.

Besides that, the finding of this study will assist us to determine and have an in-depth understanding on the association between breakfast consumption pattern and its effect on body mass index status of undergraduate students. This will help us to assess the importance and practicability of breakfast consumption habits in a university setting. This cross-sectional study is expected to provide a stronger rationale for practicing healthy breakfast consumption pattern as one of the solutions to overcome overweight and obesity problem among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.

1.4 Study Hypotheses

1.4.1 Hypothesis I

Null hypothesis (H_0):

There is no significant association between breakfast consumption pattern with body mass index (BMI) among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.

Alternative hypothesis (H_A):

There is a significant association between breakfast consumption pattern and body mass index (BMI) among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.

1.4.2 Hypothesis II

Null hypothesis (H_0):

There is no significant association between breakfast consumption pattern and level of physical activity among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.

Alternative hypothesis (H_A):

There is a significant association between breakfast consumption pattern and level of physical activity among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.

1.5 Study Objectives

1.5.1 General Objectives

To determine association between breakfast consumption pattern with body mass index (BMI) and level of physical activity among undergraduate students in Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.

1.5.2 Specific Objectives

1. To determine body mass index (BMI) status of undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.
2. To determine level of physical activity of undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.
3. To determine breakfast consumption pattern of undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.
4. To determine the association between breakfast consumption pattern and body mass index (BMI) of undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.
5. To determine the association between breakfast consumption pattern and level of physical activity of undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan.

1.6 Research Questions

1. What is the body mass index (BMI) status of undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan?
2. What is the level of physical activity among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan?
3. What is the breakfast consumption pattern of undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan?

4. Is there any association between breakfast consumption pattern and body mass index (BMI) among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan?

5. Is there any association between breakfast consumption pattern and level of physical activity among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan?

1.7 Conceptual Framework

Breakfast consumption has been found to be associated with body mass index (BMI) and level of physical activity (Figure 1.1). As for the objective of determining the association between body mass index (BMI) and breakfast consumption pattern, body mass index is dependent variable whereas breakfast consumption pattern is independent variable. Based on observational evidence suggests that regular breakfast consumption pattern has been associated with a lower BMI status and reduced risk of obesity (Sievert et al., 2019).

Meanwhile for the objective of determining the association between level of physical activity and breakfast consumption pattern, level of physical activity is dependent variable whereas breakfast consumption pattern is independent variable. Frequent breakfast intake is associated with higher moderate-to-high physical activity (MPVA) as compared to infrequent breakfast consumption (Zakrzewski-Fruer et al., 2019).

Breakfast consumption patterns also have been linked to academic achievement among undergraduate university students. The independent variable is breakfast consumption patterns meanwhile the academic performance is dependent variable. Based on study done by Thamarai & Radhai (2022), students who skipped breakfast reported

had difficulty during lectures which include having hard time to concentrate on lecture and experiencing headaches which may disturb the academic performance. Breakfast consumption is also linked to improve understanding, cognition, and attention span in students, all of which have a positive impact on their academic performance (Javaid, 2020).

On the other hand, socio-demographic characteristics also have an association with breakfast consumption patterns. The socio-demographic characteristics are independent variables whereas dependent variable is breakfast consumption pattern. Based on several studies which are done by Altamimi et al. (2022) and Jayaveelo et al. (2021) suggests that some socio-demographic characteristics such as ethnicity, age, gender and monthly income are associated with breakfast consumption patterns.

In addition, sleep quality is also associated with breakfast consumption patterns. The sleep quality is an independent variable, whereas breakfast consumption is a dependent variable. Individual with poor sleep quality have irregular eating patterns and more likely to skip breakfast as they lack sleep (Xian et al., 2023). Sleep irregularities can disturb daily routines, including eating habits like consuming breakfast (Ashley, 2018; Escobar et al., 2011).

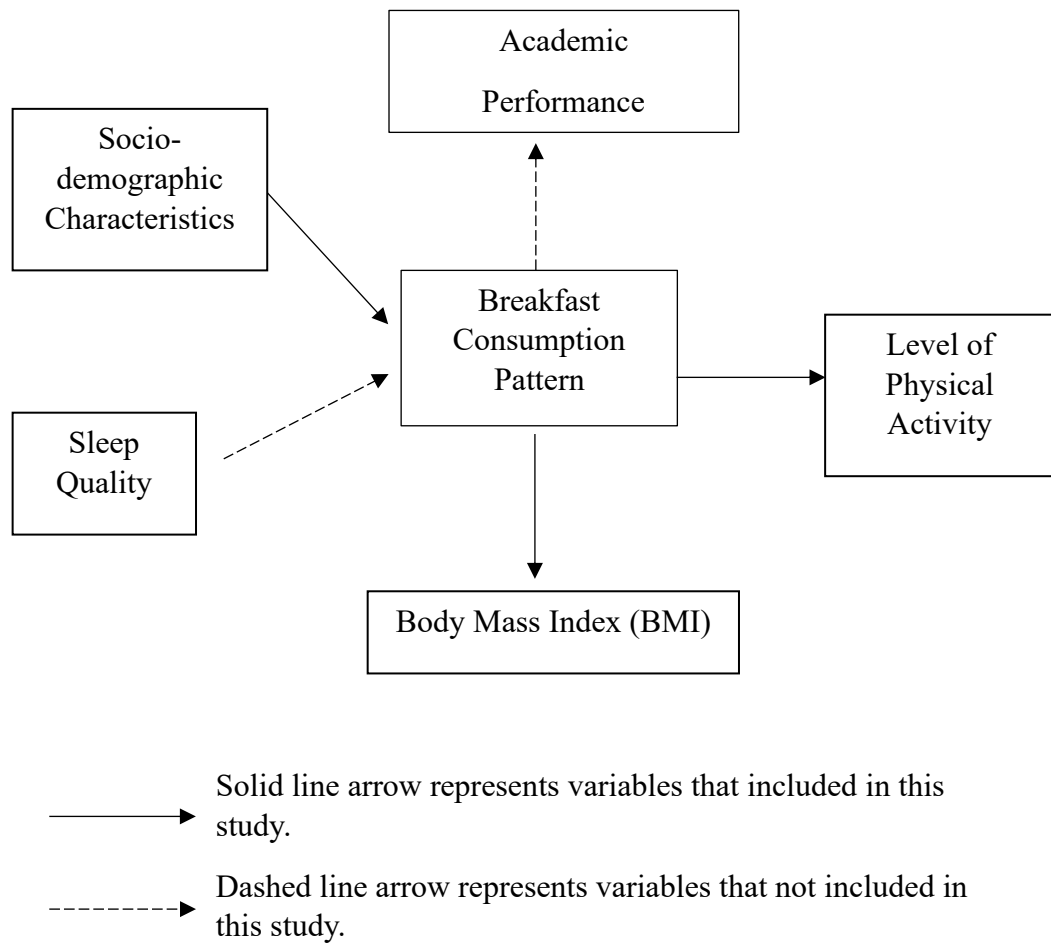


Figure 1.1: Conceptual Framework

CHAPTER 2 LITERATURE REVIEW

2.1 Prevalence of Obesity

Obesity is defined as accumulation of unwanted and excessive body fat or adiposity that can negatively affect health status and increase risk of morbidity and mortality (WHO, 2021). Individuals who are obese not only struggle with physical issues that lead to a poor quality of life and overall wellbeing, but their psychosocial functioning and perceptions of health are also significantly impacted by this disease (CPG, 2023).

There was an estimated one billion people of all ages who are obese with 650 million of them being adults (WHO, 2022). Meanwhile in Malaysia, The National Health Morbidity Survey (NHMS) 2019 found that the prevalence of obesity was 33.7% among 16,688 respondents and keep increasing in alarming rate.

Young adults, particularly higher education students, are becoming progressively overweight and obese, regardless of their gender (Grasdalsmoen et al., 2019). There was a study conducted among undergraduate students in 5 public universities in Malaysia found that the prevalence of overweight was 23.0% and obesity was 17.6% (Radzi et al., 2019). In the same study, the percentage of obesity is higher in bachelor's students compared to higher education level students. This was supported by a study done in 2 public university in Sarawak, Malaysia that showed undergraduate students have higher BMI with prevalence of overweight and obesity were 22.19% and 16.88% respectively based on Asian cut-off point (Pitil & Ghazali, 2022).

2.2 Prevalence and Level of Physical Activity

WHO's Global Status Report of Physical Activity (2022) has shown that 1.4 billion persons worldwide—or 27.5% of the adult population—do not engage in the required

amount of physical activity for enhancing and maintaining their health. According to the 2019 National Health and Morbidity Survey (NHMS), Malaysia had a higher prevalence of physical inactivity among adults (24.6%) compared with other Asian countries.

Level of physical activity can be measured by determining the duration and intensity of the physical activity. Based on WHO guidelines it is recommended for adult aged 18-64 years old to do at least 150-300 minutes of moderate-intensity aerobic physical activity or at least 75-150 minutes of vigorous-intensity aerobic physical activity or an equivalent combination of moderate and vigorous intensity throughout the week (WHO, 2020). It is also recommended to do some muscle-strengthening activity at moderate or greater intensity that involves major part of muscle up for 2 or more days per week to get additional health benefits (WHO, 2020).

A total of 39% students are not physically active regularly (NHMS, 2019). Based on study done among university students, 13.9% of undergraduate students have low physical activity level, nearly same proportion in both female and male students (Verma et al., 2022). Meanwhile according to a study conducted in Malaysian university, 14% of male students have low level of physical activity compared to female students with high prevalence of low level of physical activity which is 30% (Rajappan et al., 2015). In another study done in public university in Malaysia, the data showed that 25.9% of undergraduate students have low level of physical activity (Stephen et al., 2021).

There are several questionnaires that can be used to assess physical activity. These include self-reported questionnaire that relies on participant's recall ability such as International Physical Activity Questionnaire (IPAQ), Modifiable Activity Questionnaire (MAQ), Previous Week Modifiable Activity Questionnaire (PWMAQ), Recent Physical Activity Questionnaire (RPAQ), Previous Day Physical Activity Recall (PDPAR), and 7-

day Physical Activity Recall (PAR) (Sylvia et al., 2014). IPAQ is the most widely questionnaire used as it exists in both short and long version and can assess physical activity among 18 to 65 years old adult. Based on study done to test validity and reliability of IPAQ short version among college students, IPAQ has moderate to high reliability coefficient, ranging from 0.71 – 0.89 which is an acceptable reliability. Hence, IPAQ short version can be used in study to assess physical activity level among college students (Dinger et al., 2006). The IPAQ short form is also commonly utilized among university students in Malaysia (Hakim et al., 2021; Saat et al., 2021; Tan et al., 2021).

2.3 Breakfast Consumption Pattern

University students around the world reported a wide range of breakfast consumption trends, from 48.1% to 87.6% (Javaid, 2020). Breakfast is the first meal of the day, and it provides energy for the brain. (Fitri Mat Ludin et al., 2016). Frequent breakfast consumption is linked to improve overall dietary quality that reduce risk of unhealthy lifestyle behaviors such as lack in physical activity (Fitri Mat Ludin et al., 2016). Regular breakfast consumption may act as a protective factor, influencing individuals to adopt healthier habits and avoid sedentary behavior, contributing to a lower risk of obesity (Pengpid & Peltzer, 2020).

Based on study done in a Malaysia public university, the prevalence of undergraduate students who did not consume breakfast in a week is 33.7% (Jayaveloo et al., 2021). In the same study, it stated that the relatively low prevalence of daily breakfast consumption, particularly among university students, may be caused by financial problems, unhealthy eating habits and unfavorable food choices. Besides that, the data in

another study showed that 56.8% bachelor's students in one of public university in Malaysia, did not take breakfast every day (Nuur Fazliza Wan Zakaria et al., 2021).

2.4 Association Between Breakfast Consumption and BMI

Breakfast consumption was found to be inversely related to the risk of being overweight or obese in university students (Mansouri et al., 2020). In addition, a study reported that BMI status among students who skipped breakfast was significantly higher than other undergraduate students that consume breakfast (Anandaraj et al., 2019). Besides that, a systemic review and meta-analysis study confirmed that skipping breakfast is associated with overweight and obesity, and that skipping breakfast can also increase the risk of being overweight or obese (Ma et al., 2020).

In Malaysia, a cross-sectional study reported that frequent breakfast consumption pattern was linked to a lower body weight status (Tee et al., 2018). Based on a study done among undergraduate students in public university, the prevalence of overweight is 66.7% which is relatively higher in students who skipped breakfast compared to breakfast consumer (Ramli, 2018). The findings from the same study indicate that breakfast skipper is highly associated with having higher body fat percentage compared to breakfast consumer.

2.5 Association Between Breakfast Consumption and Level of Physical Activity

Saleem et al. (2018) had revealed that undergraduate students have low physical activity level due to their busy schedule, tiredness and exhaustion from daily routine, and lack of motivation to do physical activity. Physical activity is highly linked to breakfast consumption as it provides the body with the energy and nutrients needed for sustained

physical activity (Ashfaq et al., 2023). Breakfast consumption among university students is due to increase nutritional values, to increase satiety, remain alert, prevent tiredness, and to maintain energy levels to do activity (Seedat & Pillay, 2020).

Kennedy et al., (2015) had found that there was a significant positive correlation between level of physical activity using PAQ-A scores and breakfast frequency ($r = 0.2$; $p < 0.05$). As breakfast consumption pattern is being practiced, a person has more energy to do their daily activities while actively engaging in physical activities. In addition, based on randomized controlled trial study, daily breakfast significantly boosts physical activity, as opposed to skipping it, which increases calorie intake later in the day (Chowdhury et al., 2016).

However, in another cross-sectional study done by (Ramli, 2018) among university students, the findings showed no significant association between breakfast consumption and level of physical activity. The data from same study reported that breakfast skippers are more prone to do physical activities in mild to moderate exercise compared to breakfast consumers. However, Jumi & Md Yusof (2023) stated that there is no association between undergraduate students' breakfast consumption with their physical activity level.

CHAPTER 3 METHODOLOGY

3.1 Study Design

This was a cross-sectional study that employed a self-administered questionnaire. The questionnaire consists of 4 section which include Section A, provides sociodemographic information, Section B is anthropometry measurement specifically height, weight and BMI of the participants, Section C is a set of items from the International Physical Activity Questionnaire (IPAQ) and Section D is breakfast consumption pattern related questions. The hard copy form of questionnaire was distributed to the participants. A consent form was given before the participants' anthropometric measurement was taken. The estimated duration taken to complete the questionnaire was approximately 10 - 15 minutes for each participant including anthropometry assessment done by researcher.

The study design was a cross-sectional study with usage of a set of self-administered questionnaires. The questionnaire was used to assess body mass index status, level of physical activity and breakfast consumption pattern among undergraduate students of Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan. The sampling method used was convenience sampling and cross-sectional study design was chosen because it enables researchers to collect data in a short amount of time as the data is collected in present time and it is relatively cheaper and simpler compared to other studies' design (Wang & Cheng, 2020).

3.2 Study Area

This study was conducted in 3 schools which were Pusat Pengajian Sains Kesihatan (PPSK), Pusat Pengajian Sains Pergigian (PPSG) and Pusat Pengajian Sains Perubatan (PPSP) of University Sains Malaysia (USM) Health Campus in Kubang Kerian, Kelantan.

This location was chosen in this study because USM included students from different backgrounds including age, ethnicity, and programs.

3.3 Study Population

This study target population involves respondents among undergraduate students in University Sains Malaysia (USM) Health Campus in Kubang Kerian, Kelantan. The students must be from Year 1 until Year 5 from PPSK, PPSP or PPSG of USM Health Campus.

3.4 Selection Criteria

3.4.1 Inclusion Criteria

The selection criteria are based on:

- Participants must be aged 18 and above.
- Currently enrolled as undergraduate students of Health Campus (PPSK, PPSG and PPSP), Universiti Sains Malaysia (USM).
- Malaysian.

3.4.2 Exclusion Criteria

Participants are excluded if:

- Medically diagnosed with mental health issues (anxiety, depression or eating disorders) or chronic health diseases (diabetes, hyperlipidemia or hypertension).

3.5 Sample Size Calculation

3.5.1 Sample size estimation I: Body mass index (BMI)

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

n= sample size

Z= value representing the desired confidence level

Δ = precision

p = anticipated population proportion

For this study, Δ value is 0.05 and confidence level is set to be 95%. The Z-score value for 95% confidence level is 1.96. Based on previous study, the percentage of obesity among university students is 3.8% (Talib et al., 2023). Thus, the anticipated population proportion is 0.038.

$$n = \left[\frac{1.96}{0.05} \right]^2 0.038 (1 - 0.038)$$

$$= 56.2 + 20\% \text{ dropout rates}$$

$$= 67.4 \sim \mathbf{67 \text{ participants}}$$

3.5.2 Sample size estimation II: Level of physical activity

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

n= sample size

Z = value representing the desired confidence level

Δ = precision (percentage true value)

p = anticipated population proportion

For this study, Δ value is 0.05 and confidence level is set to be 95%. The Z-score value for 95% confidence level is 1.96. According to previous study, the percentage of physically active students are 5.2% (Yusoff et al., 2018). Thus, the anticipated population proportion is 0.05.

$$\begin{aligned}n &= \left[\frac{1.96}{0.05} \right]^2 0.05 (1 - 0.05) \\&= 72.9 + 20\% \text{ dropout rates} \\&= 87.5 \sim \mathbf{87 \text{ participants}}\end{aligned}$$

3.5.3 Sample size estimation III: Breakfast consumption pattern

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

n = sample size

Z = value representing the desired confidence level

Δ = precision (percentage true value)

p = anticipated population proportion

For this study, Δ value is 0.05 and confidence level is set to be 95%. The Z-score value for 95% confidence level is 1.96. From previous study, the percentage of breakfast

skipping among students is 6.8% (Jayaveloo et al., 2021). Thus, the anticipated population proportion is 0.068.

$$\begin{aligned}
 n &= \left[\frac{1.96}{0.05} \right]^2 0.068 (1 - 0.068) \\
 &= 97.4 + 20 \text{ dropout rates} \\
 &= 116.9 \sim \mathbf{116 \text{ participants}}
 \end{aligned}$$

3.5.4 Sample size estimation IV: Association between breakfast consumption pattern and BMI

$$n = \frac{p_1 (1 - p_1) + p_2 (1 - p_2)}{(p_1 - p_2)^2} (Z_\alpha + Z_\beta)$$

n = sample size

p = proportion

Z_a = level of statistical significance

Z_B = power of study

The level of confidence for this study is set at 95%. The 95% confidence level Z-score is 1.96 ($\alpha = 0.05$), and the power of this study has been set at 80%.

- Based on a study conducted among Malaysia university student showed that 40.6% of the bachelor's students were classified as overweight and obese. So, the anticipated population proportion is 0.41 (Radzi et al., 2019). Meanwhile, based on study done among

Malaysian university students, it is reported that 6.8% of respondents were classified as breakfast skippers. Therefore, the anticipated population proportion is 0.068 (Jayaveloo et al., 2021).

- For p_1 = prevalence of overweight and obese among Malaysian bachelor's students (from previous study, $p_1 = 40.6\%$).
- For p_2 = prevalence of skipping breakfast in Malaysia undergraduate students (from previous study, $p_2 = 6.8\%$).

$$\begin{aligned}
 n &= \frac{0.41(1 - 0.41) + 0.068(1 - 0.068)}{(0.41 - 0.068)^2} (1.96 + 0.84)^2 \\
 &= 20.5 \text{ per group} + 20\% \text{ dropout rates} \\
 &= 24.6 \times 2 \\
 &= 49.2 \sim \mathbf{49 \text{ participants}}
 \end{aligned}$$

3.5.5 Sample size estimation IV: Association between breakfast consumption pattern and level of physical activity

Using Z_α is 1.96 ($\alpha = 0.05$) and power of study, Z_β is 0.84 (80% power),

$$n = \frac{p_1(1 - p_1) + p_2(1 - p_2)}{(p_1 - p_2)^2} (Z_\alpha + Z_\beta)^2$$

n = sample size

p = proportion

Z_α = level of statistical significance

Z_β = power of study

The level of confidence for this study is set at 95%. The 95% confidence level Z-score is 1.96 ($\alpha = 0.05$), and the power of this study has been set at 80%.

- Based on a study conducted among students of one university in Malaysia showed that 54.6% of the students were classified as physically inactive. So, the anticipated population proportion is 0.55 (Abdul Radzak et al., 2020). Meanwhile, based on study done among Malaysian university students, it is reported that 6.8% of respondents were classified as breakfast skippers. Therefore, the anticipated population proportion is 0.068 (Jayaveloo et al., 2021).

- For p_1 = prevalence of physical inactivity among Malaysian university students (from previous study, $p_1 = 55\%$).

- For p_2 = prevalence of skipping breakfast in Malaysia undergraduate students (from previous study, $p_2 = 6.8\%$).

$$\begin{aligned}
 n &= \frac{0.55(1 - 0.55) + 0.068(1 - 0.068)}{(0.55 - 0.068)^2} (1.96 + 0.84)^2 \\
 &= 10.5 \text{ per group} + 20\% \text{ dropout rates} \\
 &= 12.6 \times 2 \\
 &= 25.2 \sim \mathbf{25 \text{ participants}}
 \end{aligned}$$

Based on the calculations above, the sample size is estimated to range from 25 to 116. The highest sample size will be selected. Thus, a total of 116 participants who are eligible to participate in the study will be selected.

3.6 Sampling Method and Subject Recruitment

The samples were recruited by using convenience sampling method. Convenience sampling is a non-probability sampling method. All subjects were voluntarily recruited. The undergraduate students who meet all the inclusion criteria, absence of exclusion criteria, voluntary and interested to participate in the study were selected to take part in the research, to read the research info, approved the consent form, came for anthropometry measurement session, and completed the questionnaire. The first 116 undergraduate students who met the all the criteria were chosen as research participants.

3.7 Study Tools & Parameters

There are 4 sections in the questionnaire and each section contains various questions related to respective parameters. Respondents were expected to answer all questions accordingly. The 4 sections are:

3.7.1 Section A (Sociodemographic Data)

This section consists of questions regarding respondent's personal information such as gender, age, race, academic years of study, school enrolled, daily budget on foods, monthly allowance, sponsorship during study and living arrangements.

3.7.2 Section B (Anthropometric Measurements)

The measurement of weight and height of each respondent were performed according to standard procedures. The weight and height are taken using SECA 803 digital weighing scale and SECA 206 wall mounted body meter. Participants' weight and height were measured twice, and mean was taken as the final value. This was done to minimize inaccuracy. Body mass index (BMI) was determined by the researcher using the data that

has been collected. The classifications of BMI are based on cut off points guidelines from CPG for Obesity (2023).

3.7.3 Section C (International Physical Activity Questionnaire)

International Physical Activity Questionnaire (IPAQ) is developed by International Consensus Group (1998-1999). There are two versions available: short and long. The short version of IPAQ is used in this study (Craig et al., 2003). It comprised of only 7 items that assess 3 specific types of activity which are walking, moderate-intensity activities and vigorous-intensity activities. The classification of physical activity level is determined by total physical activity MET (minutes/week). High physical activity is represented by at least 3 days of vigorous-intensity activity which achieve at least 1500 MET (minutes/week) or 7 or more days of any combination of walking, moderate-intensity and vigorous-intensity activities which achieve at least 3000 MET (minutes/week). Moderate physical activity is represented by at least 20 minutes of vigorous-intensity activity in 3 or more days or at least 30 minutes of moderate-intensity activity and/or walking in 5 or more days or more days of any combination of walking, moderate-intensity and vigorous-intensity activities which achieve at least 600 MET (minutes/week). Low physical activity is defined as not meeting any of the criteria for high and moderate physical activity categories. IPAQ is an open access tool, publicly available and no permissions are required to use it.

3.7.4 Section D (Breakfast Consumption Pattern)

This set of question was adopted from research done by Jayaveelo et al. (2021) and Ho. (2022). There were 5 questions in this section that were related to breakfast eating habits of the respondents. The questions assessed participants' breakfast consumption pattern in terms of their frequency of breakfast consumption in a week, time of breakfast

consumption, daily amount of money spent on breakfast, location consumed breakfast, and with whom having breakfast.

The breakfast consumption category is then determined by 1 single item which was “the frequency of breakfast consumption”. There were two categories, breakfast consumers and breakfast skippers. Respondents who consumed breakfast for three days or more were classified as "breakfast consumers," while those who consumed breakfast for two or less days were classified as "breakfast skippers". The classification of the breakfast consumption category was based on 2 previous studies (Ho, 2023; Smith, 2013).

3.8 Operational Definition

1. Body mass index (BMI):

The ratio of weight (kg) over height (m) to the power of two (WHO, 2021).

2. Physical activity (PA):

Any bodily movement produced by skeletal muscles that requires energy expenditure (WHO, 2022).

3. Breakfast:

Any foods or beverages that been taken between 7:00 a.m. until 10:00 a.m. in the morning (Anandaraj et al., 2019).

4. Breakfast consumption pattern

The frequency of breakfast consumption in a week, consume breakfast for 3 days and above considered as breakfast consumer, less than 3 days is breakfast skipper (Xiao, 2023).

3.9 Data Collection Method

This cross-sectional study was conducted among undergraduate students at the Universiti Sains Malaysia, Health Campus in Kubang Kerian, Kelantan. The data collection process started after receiving ethical approval from the Human Research Ethics Committee USM (USM/JEPeM/KK/24010048) and Dean of USM PPSK, PPSP and PPSG (Appendix A).

The data collection process was carried out from March 2024 until May 2024. The recruitment poster has been shared through WhatsApp group together with message template and registration link via Google Form to invite participation in this study. Furthermore, representatives from another course were asked to help in posting and sharing the poster in the WhatsApp group chat with their batch mates. Participants that were interested in joining can register through the link provided. The registration link consists of participants' personal information such as name, age, year of study, contact number and participants are given three places of choice for study to be conducted. The set places are PUMA hall, Nurani hall and Murni hall. Those who meet the inclusion criteria, absence of exclusion criteria, interested and voluntary to take part in the research came on data collection day. This study used questionnaire and consent form both in hard copy. During data collection day, participants were needed to fill in the consent form before anthropometric measurements were taken. Participants' anthropometric measurement section was filled by researcher to avoid any misreport right after measurement have been taken. After the anthropometric measurements have been taken, participants proceeded to answer the other sections of the questionnaire. The researcher aid and guided throughout the process if needed. Since there were not enough responses received on the data collection day, any undergraduate students that meet the inclusion criteria and absence of exclusion criteria were approached to participate in this study. This process was repeated until the researchers receive a total of 116 responses. There was no