

**FRUITS AND VEGETABLES CONSUMPTION AND ITS ASSOCIATION
WITH SOCIODEMOGRAPHIC FACTORS, BODY MASS INDEX, AND WAIST
CIRCUMFERENCE AMONG UNDERGRADUATE STUDENTS IN THE
SCHOOL OF HEALTH SCIENCES, UNIVERSITI SAINS MALAYSIA.**

IZZATUL AZZAHRAH BINTI IDRIS

SCHOOL OF HEALTH SCIENCES

UNIVERSITI SAINS MALAYSIA

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By

IZZATUL AZZAHRAH BINTI IDRIS

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

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.



.....

Izzatul Azzahrah Binti Idris

Dietetics Student

School of Health Sciences

Universiti Sains Malaysia

Health Campus

16150 Kubang Kerian

Kelantan, Malaysia

Date: 1st July 2025

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
MDG	Malaysia Dietary Guidelines
NCCFN	National Coordinating Committee on Food and Nutrition
NHMS	National Health and Morbidity Survey
PPSG	School of Dental Sciences
PPSK	School of Health Sciences
PPSP	School of Medical Sciences
SPSS	Statistical Package for the Social Sciences Software
USM	Universiti Sains Malaysia
WHO	World Health Organization

**PENGAMBILAN BUAH-BUAHAN DAN SAYUR-SAYURAN SERTA
HUBUNGANNYA DENGAN FAKTOR SOSIODEMOGRAFI, INDEKS JISIM
BADAN DAN LILITAN PINGGANG DALAM KALANGAN PELAJAR IJAZAH
SARJANA MUDA DI KAMPUS KESIHATAN, UNIVERSITI SAINS
MALAYSIA.**

ABSTRAK

Pengambilan buah-buahan dan sayur-sayuran yang mencukupi memainkan peranan penting dalam mencegah penyakit tidak berjangkit dan menggalakkan kesihatan jangka panjang. Walau bagaimanapun, pengambilan buah-buahan dan sayur-sayuran dalam kalangan pelajar universiti, sering berada di bawah tahap yang disyorkan di Malaysia. Kajian ini bertujuan untuk menilai pengambilan buah-buahan dan sayur-sayuran serta mengkaji hubungannya dengan faktor sosiodemografi, indeks jisim badan (BMI), dan lilitan pinggang dalam kalangan pelajar sarjana muda Pusat Pengajian Sains Kesihatan, Universiti Sains Malaysia. Satu tinjauan rentas telah dijalankan dalam kalangan 220 pelajar menggunakan kaedah pensampelan mudah. Responden melengkapkan pengukuran antropometrik seperti ukuran berat, tinggi dan lilitan pinggang dan soal selidik yang dikendalikan sendiri melalui borang Google, yang merangkumi item mengenai ciri-ciri sosiodemografi dan pengambilan buah-buahan serta sayur-sayuran harian. Majoriti responden adalah wanita (85.9%) dan Melayu (87.7%). Kebanyakan responden melaporkan hanya mengambil satu hidangan buah-buahan (60.9%) dan sayur-sayuran (58.2%) sehari. Analisis menunjukkan tiada kaitan yang signifikan secara statistik antara pengambilan buah-buahan dengan umur ($p = 0.532$), jantina ($p = 0.396$), etnik ($p = 0.299$), dan elaun bulanan ($p = 0.898$). Bagi pengambilan sayur-sayuran, tiada hubungan signifikan ditemui dengan umur ($p = 0.509$), jantina ($p = 0.714$), atau elaun bulanan ($p = 0.350$). Walau bagaimanapun, perkaitan yang signifikan telah dikenal pasti

antara etnik dan pengambilan sayur-sayuran ($p = 0.015$). Selain itu, tiada perkaitan signifikan diperhatikan antara pengambilan buah-buahan atau sayur-sayuran dan BMI (masing-masing $p = 0.075$ dan $p = 0.769$), mahupun dengan lilitan pinggang (masing-masing $p = 0.478$ dan $p = 0.475$). Kajian ini menunjukkan bahawa pengambilan buah-buahan dan sayur-sayuran dalam kalangan pelajar universiti masih berada di bawah tahap yang disyorkan oleh Garis Panduan Diet Malaysia 2020. Adalah dicadangkan agar kajian masa depan menggabungkan penilaian yang lebih terperinci mengenai pengambilan buah-buahan dan sayur-sayuran yang merangkumi jenis dan bentuk buah-buahan dan sayur-sayuran yang dimakan seperti mentah, masak, beku, atau diproses serta merangkumi kepelbagaian kaedah penyediaan.

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ABSTRACT

Adequate intake of fruits and vegetables plays a critical role in preventing non-communicable diseases and promoting long-term health. However, consumption of fruits and vegetables among university students in Malaysia often falls below recommended levels. This study aimed to assess fruit and vegetable consumption and examine its association with sociodemographic factors, body mass index (BMI), and waist circumference among undergraduates from the School of Health Sciences, Universiti Sains Malaysia. A cross-sectional survey was conducted among 220 students using convenience sampling. Participants completed anthropometric measurements and a self-administered questionnaire via Google Form, which included items on sociodemographic characteristics such as height, weight, and waist circumference, as well as daily fruit and vegetable intake. The majority of respondents were female (85.9%) and Malay (87.7%). Most participants reported consuming only one serving of fruit (60.9%) and one serving of vegetables (58.2%) per day. The analysis revealed no statistically significant associations between fruit consumption and age ($p = 0.532$), gender ($p = 0.396$), ethnicity ($p = 0.299$), and monthly allowance ($p = 0.898$). For vegetable consumption, no significant relationships were found with age ($p = 0.509$), gender ($p = 0.714$), or monthly allowance ($p = 0.350$). However, a significant association was identified between ethnicity and vegetable intake ($p = 0.015$). Additionally, no significant associations were observed between fruit or vegetable consumption and BMI ($p = 0.075$ and $p = 0.769$, respectively), nor with waist circumference ($p = 0.478$ and $p = 0.475$, respectively). The

findings of this study indicate that the intake of fruits and vegetables among university students remains below the recommended levels by the Malaysia Dietary Guidelines 2020. It is suggested that future studies should incorporate more detailed assessments of fruit and vegetable intake, including the types and forms of fruits and vegetables consumed (raw, cooked, frozen, or processed), as well as a variety of food preparation methods.

CHAPTER 1: INTRODUCTION

1.1 Background of Study

Fruits and vegetables are widely recognized as part of a healthy diet that can prevent chronic diseases. According to Ahmad Sirfan *et al.* (2020), a healthy, balanced diet and overall well-being can be achieved through adequate consumption of fruits and vegetables. In addition, fruits and vegetables not only help prevent chronic diseases but also contain a wealth of vitamins, minerals, electrolytes, phytochemicals, antioxidants, and fibre (Slavin & Lloyd, 2012). The rich nutritional profile of fruits and vegetables, which includes dietary fibre, vitamins, minerals, especially electrolytes such as potassium, calcium, and magnesium, and a variety of phytochemicals that vary greatly between fruits and vegetables, makes them universally acknowledged as vital parts of a healthy diet (Liu, 2013).

Vegetables are known to be low in calories but abundant in fibre, vitamins, and minerals, which can benefit consumers. Maximized consumption of different vegetables can yield a lot of nutrients. Different colours of vegetables can offer different nutrients. For example, green leafy vegetables are rich in potassium, vitamin K, and folate, while red and orange vegetables contain vitamin A. In addition, high-fibre vegetables can help with constipation (NCCFN, 2021). Fruits are also a good source of vitamins, minerals, and fibre, and are low in calories, fat, and sodium. In addition to being rich in antioxidants and flavonoids, a daily intake of adequate amounts of fruits can strengthen the immune system and help prevent constipation and other chronic diseases (NCCFN, 2021).

Despite these known benefits, fruit and vegetable consumption worldwide does not meet recommendations. According to the Institute for Public Health (2024), 95.1% of adults in Malaysia do not eat enough fruits and vegetables, consuming an average of only

2 servings per day. In a study by Lee et al. (2022), 12% of adults met the fruit intake recommendation, while only 10.0% met the vegetable intake recommendation. This trend is very worrying as the World Health Organization has reported that 3.9 million deaths worldwide in 2017 were due to inadequate fruit and vegetable consumption, which can be linked to increased risk of non-communicable disease as well as poor health conditions (World Health Organization, 2023).

The prevalence of overweight and obesity is increasing rapidly. In 2022, there were 43% of adults around the world were overweight, while 16% suffered from obesity (World Health Organization, 2024). Recent findings from the National Health and Mobility and Survey indicate that 1 in 2 adults are either overweight or obese, with 30.5% classified as overweight, 23.1% as obese, and 52.1% experiencing abdominal obesity (Institute of Public Health, 2024). According to a study conducted in the United States, fruit and vegetable consumption is lower among overweight and obese people than in normal weight people (Heo *et al.*, 2011). According to Albenberg and Wu (2014), fruits and vegetables can promote healthy intestinal function, which helps maintain body weight due to their fiber, vitamin, and mineral content.

The consumption of fruits and vegetables is a major concern for university students, as their food preferences shift when they transition from home to campus. According to Alibabic *et al.* (2014), students adjust to their new surroundings, alter their eating and lifestyle choices, and settle in while studying. Students had to establish new routines and habits as they moved from their parents' regulated home environment to the university setting. Therefore, this study aims to determine the association between fruit and vegetable consumption, sociodemographic factors, BMI, and waist circumference among undergraduate university students. By examining these relationships, this study

can offer a deeper understanding of university students' dietary habits and their connections to weight status and central adiposity.

1.2 Problem Statement

Consuming fruits and vegetables can promote a healthy, balanced diet and offer various health benefits. The World Health Organization (WHO) (2023) recommended consuming 400 grams of fresh fruits and vegetables daily to improve health and reduce the risk of non-communicable diseases. Accordingly, the Malaysian Dietary Guidelines 2020 recommend consuming three servings of vegetables and two servings of fruit daily (NCCFN, 2021). The 2020 Malaysian Food Pyramid underwent key changes to emphasize the importance of fruit and vegetable consumption by positioning them at the bottom of the pyramid, indicating the most important food groups to be consumed daily. It is recommended to align fruit and vegetable consumption with the Malaysia Healthy Plate, where fruits and vegetables make up half of the plate (NCCFN, 2021). 95.1 % of Malaysian adults consume 2 servings of fruits and/or vegetables daily, which is lower than the recommendations (Institute for Public Health, 2024).

In Malaysia, the trend toward overweight and obesity, based on the BMI, has increased from 2011 to 2023 (Institute for Public Health, 2024). 44.5% of adults were overweight and obese in 2011, and 54.4% in 2023 (Institute for Public Health, 2024). Based on waist circumference, the prevalence of abdominal obesity among adults in Malaysia also increased from 45.1% in 2011 to 54.5% in 2023 (Institute for Public Health, 2024). A large-scale study conducted in Iran involving 29,123 adults found that fruit consumption was associated with a 36% reduction in the odds of being overweight and a 21% reduction in the odds of obesity. Similarly, consuming at least two servings of vegetables per day was linked to a 40% lower risk of being overweight and a 36% lower risk of obesity. These findings are consistent with the growing body of evidence

suggesting that higher consumption of fruits and vegetables is inversely associated with the risk of overweight and obesity (Nouri *et al.*, 2023). Hence, this study aims to determine fruit and vegetable consumption and its relationship with sociodemographic factors and anthropometric measurements.

1.3 Study Rationale

Following educational efforts on the importance of fruit intake, there has been a modest increase in fruit consumption (Wagner *et al.*, 2016). However, health campaigns and interventions aimed at promoting fruit consumption have generally been insufficient to produce sustainable behavioural change (Duthie *et al.*, 2017). In Malaysia, the "Healthy Plate" initiative recommends that half of the plate be filled with fruits and vegetables. In line with this recommendation, the revised Malaysian Food Pyramid emphasizes fruit and vegetable servings as the largest portion, followed by other food groups. This initiative reflects growing concerns over the rising prevalence of non-communicable diseases such as cardiovascular disease, obesity, and diabetes, which can also cause morbidity and mortality worldwide. Inadequate intake of fruits and vegetables can cause poor health. These habits, especially among university students, can affect their later adult life and contribute to the rising prevalence of non-communicable diseases.

Previous research has explored the role of fruit and vegetable consumption in relation to health outcomes, as well as the relationship between fruit and vegetable intake and body mass index and waist circumference in other countries. There is limited research discussing both waist circumference and body mass index among university students in Malaysia. Furthermore, this study examines sociodemographic factors to provide a deeper understanding of the students included, which can also help to develop targeted nutrition education and health promotion strategies within university settings. Hence, the findings from this study could be used to determine the influence of sociodemographic factors on

fruit and vegetable consumption, not only on BMI and waist circumference. Additionally, this study could promote healthy eating habits and a healthy lifestyle, including increased consumption of fruits and vegetables.

1.4 Research Question

Is there any association between fruit and vegetable consumption with sociodemographic factors, BMI, and waist circumference among undergraduate students in the School of Health Sciences at Universiti Sains Malaysia?

1.5 Objective

1.5.1 General:

To determine the association between fruit and vegetable consumption with sociodemographic factors, BMI, and waist circumference among undergraduate students in the School of Health Sciences, Universiti Sains Malaysia.

1.5.2 Specific:

- i) To assess the fruits and vegetables consumption among university students.
- ii) To determine the association between fruit and vegetable consumption and sociodemographic factors.
- iii) To determine the association between fruit and vegetable consumption and BMI.
- iv) To determine the association between fruit and vegetable consumption and waist circumference.

1.6 Hypothesis

- i) **Null Hypothesis (H_0):** There is no association between fruit and vegetable consumption and sociodemographic factors.
- Alternative Hypothesis (H_A):** There is an association between fruit and vegetable consumption and sociodemographic factors.
- ii) **Null Hypothesis (H_0):** There is no association between fruit and vegetable consumption and BMI.
- Alternative Hypothesis (H_A):** There is an association between fruit and vegetable consumption and BMI.
- iii) **Null Hypothesis (H_0):** There is no association between fruit and vegetable consumption and waist circumference.
- Alternative Hypothesis (H_A):** There is an association between fruit and vegetable consumption and waist circumference.

1.7 Conceptual Framework

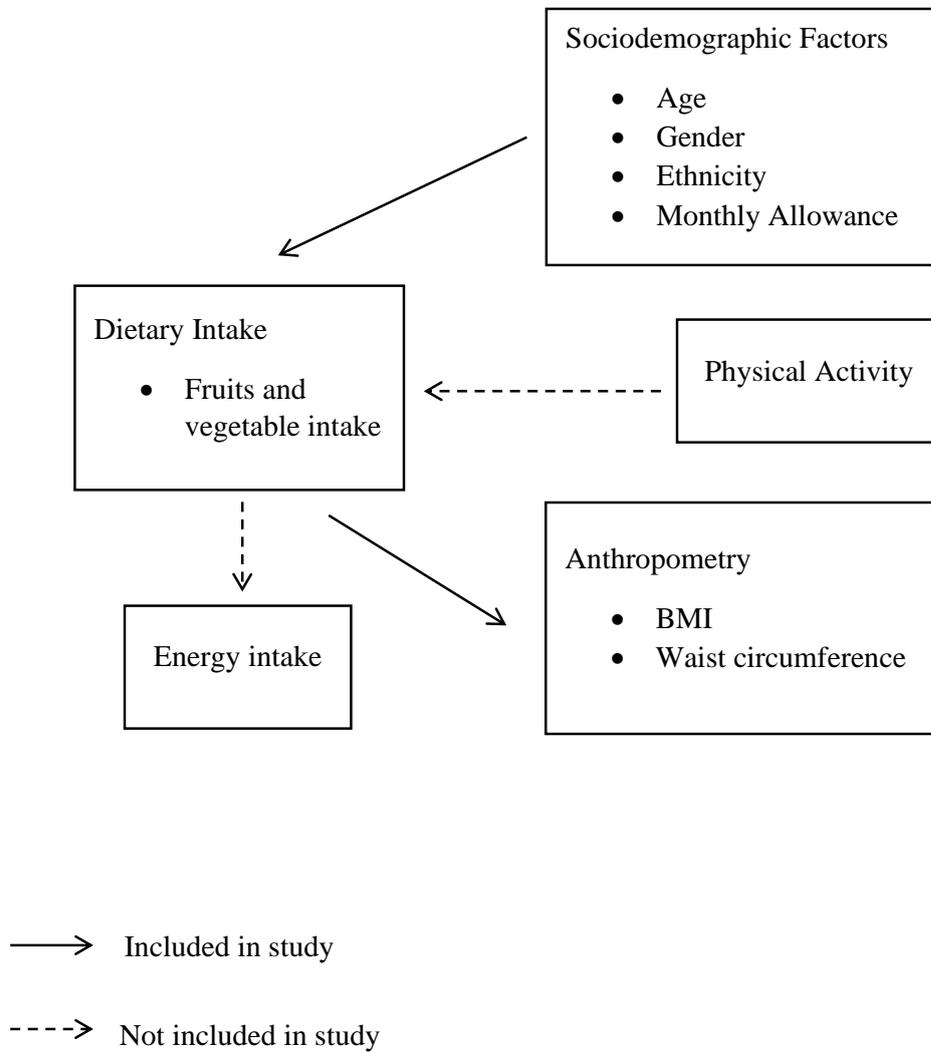


Figure 1: Conceptual Framework

This conceptual framework is adapted from Aounallah-Skhiri *et al.* (2011). Fruit and vegetable intake may be influenced by sociodemographic factors, energy intake, anthropometric measurements, and physical activity. This study aims to examine the association between fruit and vegetable consumption with sociodemographic factors and anthropometric measurements. The sociodemographic factors include age, gender, ethnicity, and monthly allowance, while the anthropometric measurements include BMI and waist circumference. A study reports that a high intake of fruits and vegetables is associated with lower calorie intake due to their low-calorie density and improves satiety due to their satiating properties (Nour *et al.*, 2018). Feeling full early can prevent individuals from overeating, which can lead to weight gain. In addition, people who eat a healthier diet, such as eating a lot of fruits and vegetables, are also more physically active (Van der Avoort *et al.*, 2020). Although this study does not examine the association between energy intake and physical activity, they still play an important role in high fruit and vegetable consumption.

CHAPTER 2: LITERATURE REVIEW

2.1 Fruits and Vegetables Consumption

Fruits and vegetables are included, along with rice, other cereals, whole grains, cereal-based products, and tubers; fish, poultry, eggs, meat, and legumes; milk and milk products, as part of the five food groups recommended for a healthy and balanced diet. These groups provide a wide range of nutrients and promote positive health outcomes (NCCFN, 2021).

The trend of fruit and vegetable consumption from 2006 to 2019 did not change substantially. The prevalence of adequate fruit and vegetable intake among young adults aged 18 to 29 years remained consistently low across the years, with rates of 1.9% in 2006, 1.2% in 2011, 0.6% in 2014, 1.7% in 2015, and 0.6% in 2019 (Chee Cheong *et al.*, 2023). This finding is consistent with the National Health and Morbidity Survey (NHMS) 2024, which reported that only 17.1% of adults met the recommended two servings of fruits, and 12.2% met the recommended three servings of vegetables (Institute for Public Health, 2024).

This trend is consistently low due to limited knowledge of fruit and vegetable consumption. According to Mat Zin *et al.* (2023), participants had a positive attitude toward fruit and vegetable consumption but moderate knowledge about them. This can be proved by the fact that half of the participants do not know the recommended number of fruits and vegetables but do know their benefits. Despite the reasons for low consumption of fruits and vegetables, taste, health benefits, and maintaining a healthy bowel were key determinants of fruit intake among young adults, with 97.3%, 96.3%, and 90.0% respectively, agreeing with these reasons.

2.2 Sociodemographic Factors of Fruits and Vegetables Consumption

Sociodemographic factors can be categorized into several domains, such as gender, age, and financial status. It is also an essential predictor of fruit consumption (Yen & Tan, 2012). It has been reported that adequate fruit intake is less common among individuals aged 18 to 29. Young adults aged 18-30 years and 31-50 years have a low proportion that meet the vegetable recommendations, at 7.1% and 8.7% respectively (Institute for Public Health, 2024).

According to Abdul Hakim *et al.* (2018), females consume more fruits than males. This finding has been supported by Tan *et al.* (2022), who found that males have a lower fruit and vegetable intake than females. Among ethnic groups in Malaysia, the highest mean intake of fruits was reported among Malays (Abdul Hakim *et al.*, 2018). However, Tan *et al.* (2022) demonstrated that the Chinese have a higher prevalence of adequate fruit and vegetable intake than Malays.

Financial status could be related to the consumption of fruits and vegetables. Yen & Tan (2012) demonstrated that wealth has a greater impact on fruit and vegetable consumption, as wealthy people can afford to buy them than low-income people. Affordability and consumption of fruits and vegetables can be demonstrated by differences in financial stability (Miller *et al.*, 2016). The study conducted by Lee *et al.* (2022) showed that adults in the highest-income household category met the vegetable intake recommendation at 12.2%, which was higher than those in middle-income households (7.7%) and lower-income households (6.8%). The study by French *et al.* (2019) supports this finding, showing that lower-income households tend to spend a large share of their grocery money on less healthy foods, such as frozen desserts, rather than on recommended healthy foods, such as vegetables.

2.3 Waist Circumference and Fruits and Vegetables Consumption

According to the World Health Organization (2011), waist circumference is a sign of abdominal obesity. The waist circumference cut-off limit is less than 90 cm for men and less than 80 cm for women (Institute for Public Health, 2024). Increased fruit and vegetable intake is inversely associated with body adiposity and abdominal fat (Yu et al., 2018), meaning that those with higher intake tend to have lower waist circumference. In contrast, a study by Lee and Song (2020) found that high waist circumference among adolescents increases the risk of cardiovascular disease.

In a meta-analysis of 95 published retrospective studies from around the globe, Aune *et al.* (2017) demonstrated that consuming 500 g of fruits and vegetables daily reduced the risk of coronary heart disease, stroke, and cardiovascular disease by 16%, 28%, and 22%, respectively. A narrative review of prospective cohort studies, however, found that no correlation or an inverse association between consumption of different vegetable groups and cardiovascular disease (Blekkenhorst *et al.*, 2018).

According to Wallace *et al.* (2019), eating more fruits and vegetables was associated with lower inflammation and a decreased risk of developing chronic illnesses such as diabetes, heart disease, stroke, and cancer, as well as all-cause mortality. There is evidence that consuming more fruits and vegetables lowers the incidence of stroke events, coronary heart disease (CHD), and cardiovascular disease by 7% to 27% (Aune *et al.*, 2017). Additionally, eating them may protect against the consequences of cardiovascular disease, diabetes mellitus, and obesity (Zhang *et al.*, 2015).

2.4 BMI and Fruits and Vegetables Consumption

The BMI is one of the anthropometric measures used to measure obesity. It can be calculated using the formula weight in kg divided by the square root of height in meters. According to the World Health Organisation (2011), a body mass index (BMI) of less

than 18.5 kg/m² is considered underweight, a BMI between 18.5 kg/m² to 24.9 kg/m² is considered normal, a value between 25.0 to 29.9 kg/m² is considered overweight and a BMI of more than 30.0 kg/m² is considered obese. Obesity can be divided into several classes: 30.0-34.9 kg/m² is class 1, 35.0-39.9 kg/m² is class 2, and more than 40 kg/m² is class 3.

However, this classification slightly differs from the suggested BMI for the Asian population, as morbidity and mortality tend to occur at lower BMI and waist circumference. The Ministry of Health (2023) suggested that underweight is less than 18.5 kg/m², normal is between 18.5 kg/m² to 22.9 kg/m², overweight is between 23.0 to 27.4 kg/m² is overweight, obesity class 1 is between 27.4-32.4 kg/m², obesity class 2 is between 32.5-37.4 kg/m² and obesity class 3 is more than 37.5 kg/m² is classified as obesity class 3.

Wang *et al.* (2019) suggested that the relationship between genetics and long-term weight gain can be weakened by increasing the intake of fruits and vegetables. The study also emphasizes the importance of fruit and vegetable consumption, especially for those who are genetically predisposed to obesity. The findings of Wall *et al.* (2018) also support this, showing that children and adolescents who consume fruits and vegetables 3 or more times a week tend to have a lower BMI than those who eat them infrequently or never.

2.5 Barrier to Fruits and Vegetables Consumption

University students are particularly affected by inadequate consumption of fruit and vegetables. They constantly struggle to maintain a healthy, balanced diet, with poor intake of fruits and vegetables (Poobalan *et al.*, 2014). The struggle of fruits and vegetables may be due to several barriers. The barriers to eating fruits and vegetables can be divided into different categories, such as difficulty, affordability, taste, availability, fear of pesticides, quality, and lack of time (Ahmad Sirfan *et al.*, 2020).

Several studies have identified limited access to fruits and vegetables as a major barrier to consumption (Perera & Madhujith, 2012; Othman *et al.*, 2012; Hainida *et al.*, 2019; Ahmad Sirfan *et al.*, 2020). Price is also one of the factors that influences the consumption of fruits and vegetables, particularly among students. Many students do not prioritize purchasing fruits and vegetables, often viewing them as optional additions rather than essentials, due to limited monthly food budgets (Perera & Madhujith, 2012; Hainida *et al.*, 2019; Ahmad Sirfan *et al.*, 2020). Moreover, fresh fruits and vegetables are often perceived as expensive. As a result, students tend to choose staple foods such as rice and protein sources, which are perceived as more filling and cost-effective than fruits and vegetables.

Studies have reported that students often consume insufficient amounts of fruits and vegetables due to busy schedules or a general dislike for certain vegetables (Kaewpradup *et al.*, 2024). Hakim *et al.* (2012) found that students' tendency to consume fruits and vegetables is closely linked to individual preferences. Similarly, Ahmad Sirfan *et al.* (2020) highlighted that personal dislike is one of the barriers to vegetable consumption. Access to healthy food options is essential for individuals to meet dietary guidelines. However, taste preferences significantly influence food choices. Many people tend to prefer foods with pleasant flavours, such as sweet, salty, or sour. When vegetables are perceived as bland or unappealing, individuals are more likely to choose other, more palatable food options.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research Design

A cross-sectional study was conducted to investigate the association between fruit and vegetable consumption and BMI, waist circumference, and sociodemographic factors among Undergraduate Health Science Students at Universiti Sains Malaysia, Kubang Kerian, Kelantan. Although a cross-sectional study cannot measure incidence and is difficult to draw causal conclusions, this research design is chosen because it is relatively quick and inexpensive to conduct (Wang & Cheng, 2020).

3.2 Study Area

This study was conducted at Universiti Sains Malaysia, Kubang Kerian. This campus consists of students with health science backgrounds. This area was chosen to conduct the study because there was limited research specifically about this topic conducted in Kelantan, as the previous study was conducted in Selangor and Pahang (Hainida *et al.*, 2019; Ahmad Sirfan *et al.*, 2020)

3.3 Study Population

The study population consists of students from the School of Health Sciences, which offers various programmes, including Audiology, Biomedical Sciences, Exercise and Sports Sciences, Forensic Science, Medical Radiation, Nursing, Environmental and Occupational Health, and Speech Pathology. Undergraduate students aged 19 to 25 were selected. In addition, Malaysian students were selected because their eating habits may be more similar to those of foreign students. In addition, dietetics and nutrition programmes were excluded from this study to avoid bias, as they typically have greater nutritional knowledge and greater exposure to the benefits of fruits and vegetables than other students. This study also excluded students diagnosed with gastrointestinal diseases,

as these conditions could affect their dietary habits, especially intake of fruits and vegetables.

3.4 Subject Criteria

3.4.1 Inclusion

- i) Undergraduate students from the School of Health Sciences.
- ii) Age from 19-25 years old.
- iii) Malaysian.

3.4.2 Exclusion

- i) Diploma students.
- ii) Dietetics and nutrition students.
- iii) Students who have been diagnosed with gastrointestinal disease.

3.5 Sample Size Estimation

The formula for two proportions was used to determine the sample size estimation with the level of statistical $\alpha = 0.05$ and the power of the study at 80%. The proportions used from the previous were 0.438 and 0.562.

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

Fruits

$$\begin{aligned} n &= \frac{0.562(1 - 0.562) + 0.438(1 - 0.438)}{(0.562 - 0.438)^2} \times (1.96 + 0.84)^2 = 251.02 \\ &= 251 \text{ participants} \end{aligned}$$

Vegetables

$$n = \frac{0.438(1 - 0.438) + 0.562(1 - 0.0562)}{(0.438 - 0.562)^2} \times (1.96 + 0.84)^2 = 251.02$$

$$= 251 \text{ participants}$$

The highest number was 251 participants, with a 10% non-response rate. Thus, the sample size was estimated at **279 participants**.

However, the participants in this study are 220. The participants cannot be reached due to the time constraint.

3.6 Sampling Method

The sampling method used was convenience sampling. Convenience sampling was chosen for its lower cost, ease of implementation, and minimal effort. It requires little time investment since the sample is readily accessible (Alvi, 2016).

3.7 Research Tool

3.7.1 Anthropometry measurement

BMI

Participants' body weight was measured using a Seca 813 weighing scale, and height was measured with a Seca 213 portable stadiometer. Both measuring tools originated in Germany. Participants were asked to wear light clothing and remove their shoes. The respondent was then required to stand on the scales. The measurements were taken twice, and the average was calculated. Respondents must also remove their shoes to measure their height. The respondent must stand upright, inhale, and then the height is measured. The measurements were taken twice, and the average was calculated. Then, the BMI was calculated using the formula weight divided by the square of height, in centimetres squared.

Classification	Body Mass Index (kg/m²)
Underweight	<18.5 kg/m ²
Normal	18.5 kg/m ² -22.9 kg/m ²
Overweight	23.0-27.4 kg/m ²
<i>Obese</i>	>27.5 kg/m ²

Note 1. The Ministry of Health, 2023

Waist Circumference

The waist circumference was measured with a measuring tape. The participant must stand upright with feet shoulder-width apart. The participant's hands are crossed and relaxed in front of the chest. The waist circumference was measured at the point on the body that is naturally narrow and is located midway between the lowest rib and the top of the ileum. The measurements were taken at the end of a normal exhalation, with the measuring point parallel to the measuring tape.

Gender	Waist Circumference Cut-Off Points
Male	≥90 cm
Female	≥80 cm

Note 2. Institute for Public Health, 2024

Institute for Public Health (2024)

After completing the anthropometric measurements, the participant receives the online questionnaire via a Google Form link generated from a QR code provided by the researcher.

3.7.2 Online Questionnaire

The self-administered online questionnaire was used to obtain the data for this study. The questionnaire for this study is to determine fruit and vegetable consumption, socio-

demographic factors, BMI, and waist circumference. This validated questionnaire was adopted from a previous study by Ahmad Sirfan *et al.* (2020), and permission was obtained from the author via email prior to the start of the study. The questionnaire consists of three sections. Section 1 is the question related to socio-demographic factors, Section 2 is anthropometric data, and Section 3 is related to fruit and vegetable consumption.

Section 1: Sociodemographic Factors

- i. Age
- ii. Gender
- iii. Ethnicity
- iv. Monthly Allowance

For section 1, the questions focused on sociodemographic factors such as gender, age, ethnicity, and monthly allowance. The question regarding monthly allowance was asked as “ \leq RM500”, “RM500-RM1000”, and “ \geq RM1000” (Jayaveloo *et al.*, 2021). The monthly allowance is included whether they obtain it from a scholarship, an education loan, or their parents.

Section 2: Anthropometry Data

- i. Waist circumference
- ii. Height
- iii. Weight
- iv. BMI

For section 2, respondents need to complete this section with assistance from the researcher, as the researcher measures their anthropometry.

Section 3: Fruits and Vegetables consumption

- i. The serving of fruits consumed each day
- ii. Frequency of fruits consumed
- iii. Meal's time of fruits consumed
- iv. Type of fruits consumed
- v. Barrier to fruit consumption
- vi. Serving of vegetables consumed each day
- vii. Frequency of vegetables consumed
- viii. Meal's time of vegetables consumed
- ix. Type of vegetables consumed
- x. Barrier to vegetable consumption

In section 3, questions about fruit and vegetable consumption were asked. For the serving question, the response categories were “none”, “1 serving”, “2 servings”, “3 servings”, and “others”. For the frequency question, the response categories were “once or more a day”, “4 to 6 times a week”, “1 to 3 times a week”, or “never”. Next, questions about the timing of fruit and vegetable consumption can be answered by specifying whether it was breakfast, morning tea, lunch, afternoon tea, dinner, or supper. The types of fruits and vegetables consumed were asked in an open-ended question. Lastly, barriers to fruit and vegetable consumption were assessed using the listed barriers, such as difficulty eating the required servings per day, expense, lack of taste, unavailability, fear of pesticides and other chemicals on fruits and vegetables, poor quality, time constraints, and others.

3.8 Data Collection Method

After receiving approval from the Human Research Ethics Committee (JEPeM), data collection was conducted. First and foremost, a poster containing the study's details, such as the study's purpose, inclusion, and exclusion criteria, and a WhatsApp group link was

shared via student channels. The students who voluntarily participate in this study must join the WhatsApp group created by the researcher. Participants must ensure they meet the inclusion and exclusion criteria. Information on exclusion was clearly stated in the poster to inform individuals who are not eligible to participate in the study. In the WhatsApp group, the researcher and participants discussed suitable times and places to conduct the anthropometry measurements and complete the questionnaire. The Seca 813 was used for weight measurement, and the Seca 213 for height measurement. After measuring body weight, height, and waist circumference, the researcher calculated the BMI. Participants were provided a QR code link to the online questionnaire and asked to complete it. This ensures that the data obtained from the anthropometric measurements were correctly entered into the Google form. The questionnaire included the consent form. The consent form contains disclosures about the study's purpose, procedures, objectives, risks, potential outcomes, and the confidentiality of their responses. Participants were informed of the consent requirements before any research was conducted. However, to indicate that they have read the consent form and voluntarily participated in the study, participants should tick "agree" in the Google form. The participants can choose to continue or leave this study at any time, as their rights are protected. Furthermore, participants who withdraw from the study will not be penalised or lose any benefits. On the other hand, participants who refuse to sign the consent form are not required to take part. The survey can be completed within 5 to 10 minutes. All data obtained from this study are strictly confidential. To protect respondents' privacy, participants were assigned consecutive labels 001, 002, and 003. The data file was password-protected to ensure that only the researcher can access it.

3.9 Study Flowchart

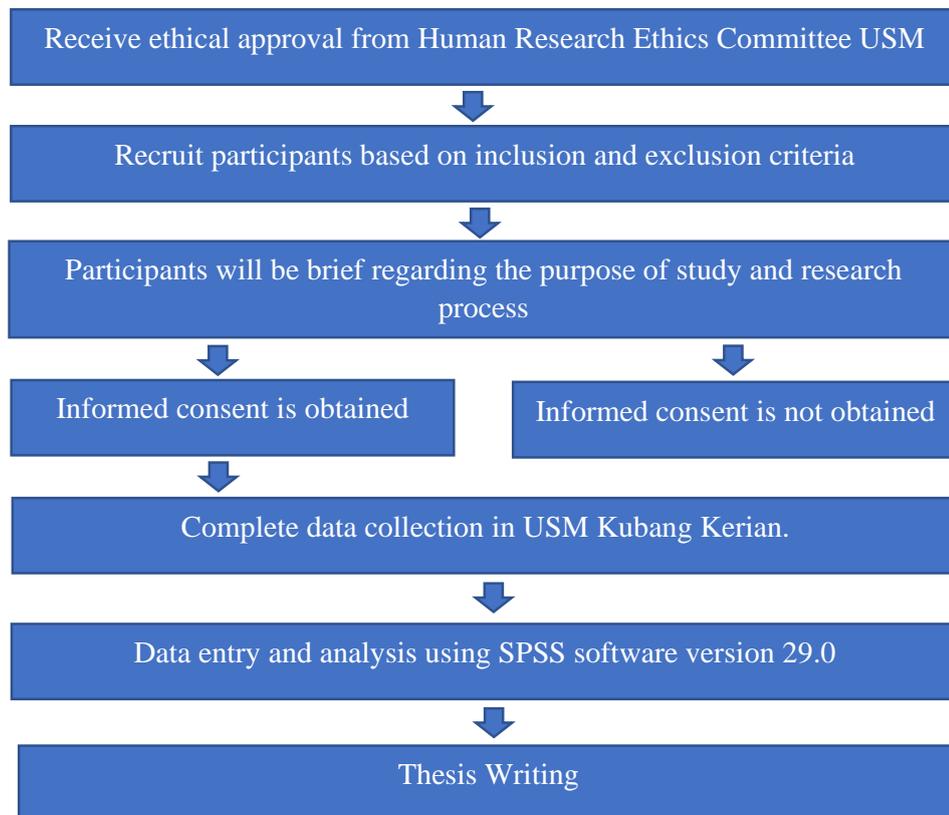


Figure 2: Study Flowchart

3.10 Data Analysis

All data obtained from the Google Form were downloaded into an Excel file and then analysed using the Statistical Package for the Social Sciences (SPSS) version 29.0, with descriptive and inferential statistics.

Descriptive statistics

These statistics were used to analyse the sociodemographic information and fruit and vegetable consumption among health science students. The frequency and percentage of fruit and vegetable consumption were presented in a table.

Inferential statistics

The association between fruit and vegetable consumption and the sociodemographic factors, BMI, and waist circumference was determined using Pearson's chi-square test if the expected count in <5 is less than 20% of the cells. However, the Fisher Exact Test was used to analyse the association when the expected count is <5 and the proportion of cells with expected count $> 20\%$ is $> 5\%$.

CHAPTER 4: RESULT

4.1 Fruits Consumption among University Students

Table 4.1 showed that the majority of students consumed 1 serving of fruit per day (60.9%), followed by no servings (27.7%), 2 servings (10.9%), and 3 servings (0.5%). In terms of consumption frequency, 41.8% of students consumed fruits one to three times per week, followed by less than once per week (29.1%), once or more per day (12.7%), four to six times per week (14.5%), and never (1.8%). Regarding the time of consumption, most students ate fruits during lunch (32.2%), followed by dinner (24.0%), teatime (21.8%), breakfast (10.7%), supper (8.5%), and mid-morning (2.8%).

The most commonly consumed fruit among students was watermelon (24.7%), followed by apple (14.2%), mango (13.0%), banana (11.0%), papaya (8.7%), orange (5.7%), guava (5.5%), grape (4.7%), and pear (4.0%). Less frequently consumed fruits were honeydew (3.0%), pineapple (2.0%), and melon (1.0%). Rarely consumed fruits included strawberry and dates (0.5% each), as well as dragon fruit, raisin, mangosteen, blueberry, lemon, and avocado (0.2% each). As for the reasons students did not consume fruits, the most cited barrier was non-availability (36.1%), followed by price (26.0%), time constraints (14.6%), poor quality (7.8%), difficulty eating two servings per day (7.3%), other reasons (4.1%), not delicious (2.7%), and fear of pesticides or chemicals (1.4%).

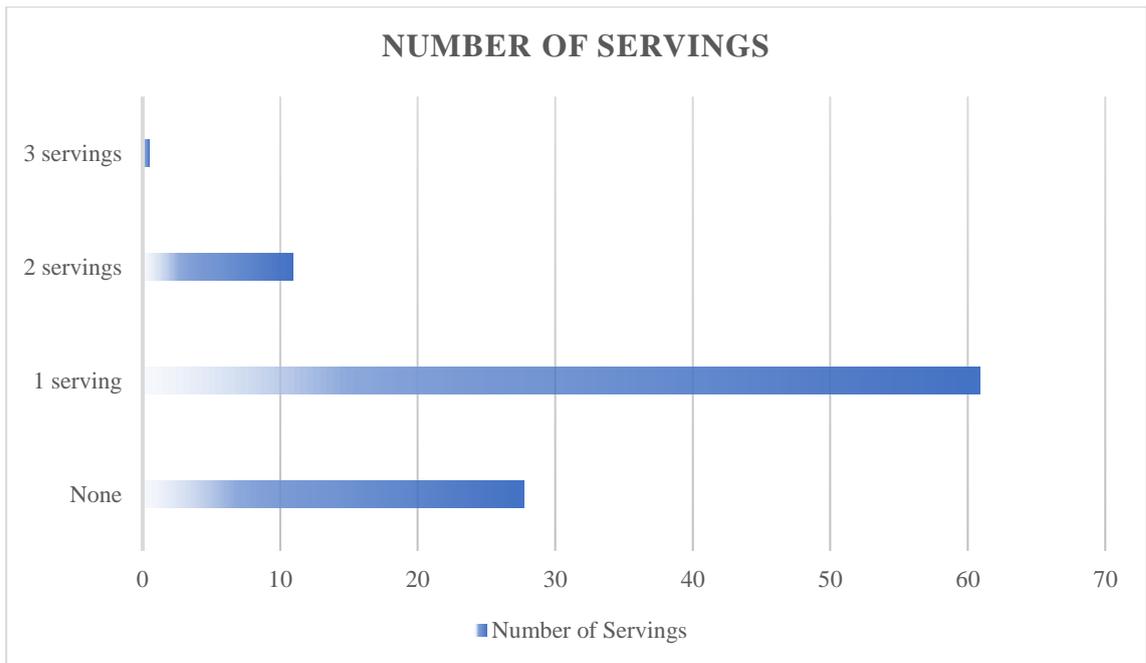


Figure 3: Number of fruit servings (n=220)

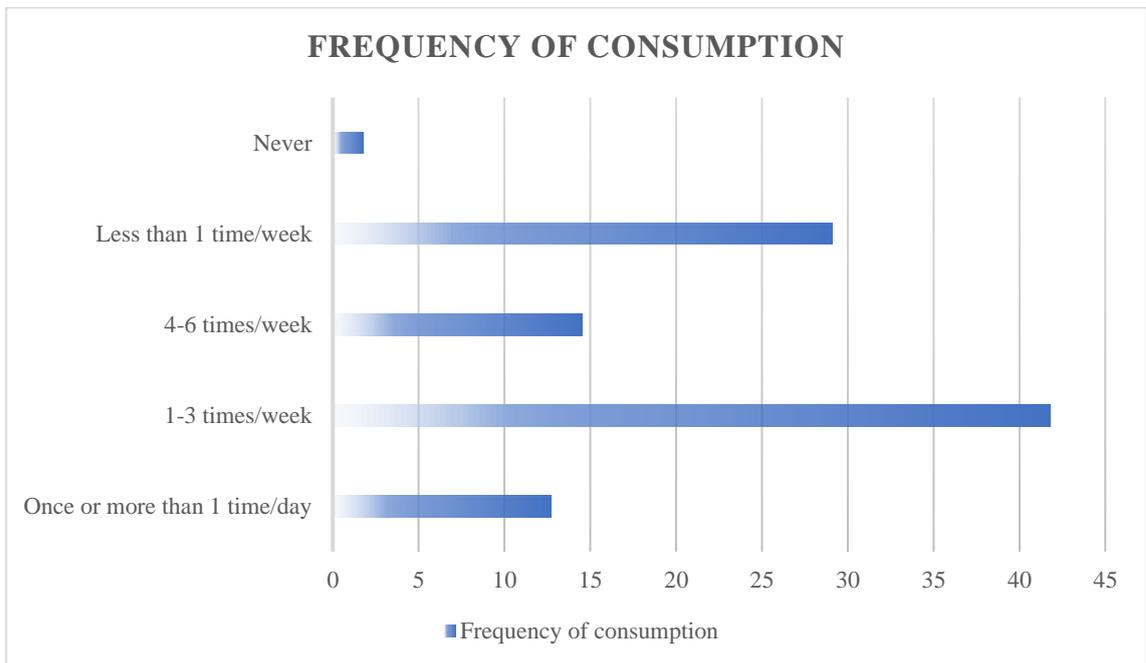


Figure 4: Frequency of fruit consumption (n=220)