ASSOCIATION BETWEEN ADDED SUGAR INTAKE AND BODY MASS INDEX (BMI) WITH SLEEP QUALITY AMONG UNDERGRADUATE STUDENTS AT UNIVERSITI SAINS MALAYSIA KAMPUS KESIHATAN, KELANTAN.

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ASSOCIATION BETWEEN ADDED SUGAR INTAKE AND BODY MASS INDEX (BMI) WITH SLEEP QUALITY AMONG UNDERGRADUATE STUDENTS AT UNIVERSITI SAINS MALAYSIA KAMPUS KESIHATAN, KELANTAN.

By

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DECLARATION

I hereby declare that this dissertation is the result of my 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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SOFIA INSYIRAH BT MUHAMMAD HAABIL

Date: 1/7/2025

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LIST OF ABBREVIATION

BMI	Body Mass Idex
PSQI	Pittsburgh Quality Sleep Index
FFQ	Food Frequency Questionnaire
USMKK	Universiti Sains Malaysia Kampus Kesihatan
IJT	Indeks Jisim Tubuh
SPSS	Statistical Package for Social Sciences

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HUBUNGAN ANTARA PENGAMBILAN GULA TAMBAHAN DAN INDEKS JISIM BADAN (BMI) DENGAN KUALITI TIDUR DALAM KALANGAN PELAJAR PRASISWAZAH DI UNIVERSITI SAINS MALAYSIA KAMPUS KESIHATAN, KELANTAN.

ABSTRAK

Kajian ini meneroka hubungan antara pengambilan gula tambahan, indeks jisim badan (IJT), dan kualiti tidur dalam kalangan pelajar prasiswazah di Universiti Sains Malaysia, Kampus Kesihatan, Kelantan. Melihat kepada tahap kebimbangan yang semakin meningkat mengenai kesan kesihatan berpunca daripada pengambilan gula yang tinggi, kajian ini bertujuan untuk menilai bagaimana tabiat pemakanan, terutamanya pengambilan minuman bergula dan makanan manis lain, mempengaruhi IJT dan kualiti tidur. Kajian ini adalah penting kerana ia mengisi jurang dalam literatur mengenai kesan gabungan gula tambahan, BMI, dan kualiti tidur dalam kalangan pelajar universiti Malaysia, yang mungkin lebih terdedah kepada tabiat pemakanan dan tidur yang tidak sihat akibat tekanan akademik dan gaya hidup yang tidak teratur. Menggunakan reka bentuk rentas-seksyen, data dikumpulkan daripada pelajar (n=140) melalui soal selidik kekerapan makanan (FFQ), Indeks Kualiti Tidur Pittsburgh (PSQI), dan pengukuran antropometrik. Keputusan kajian mendapati bahawa kebanyakan peserta mempunyai pengambilan gula tambahan pada tahap sederhana, dengan sebahagian besar mengalami kualiti tidur yang buruk. Klasifikasi IJT menunjukkan bahawa sebahagian besar peserta mempunyai berat badan normal, manakala sebilangan kecil pula tergolong dalam kategori berat badan berlebihan atau obes. Kajian ini mendapati tiada hubungan statistik yang signifikan antara pengambilan gula tambahan dan kualiti tidur ($\chi^2(2) = 2$, $p = 0.073$). Turut tiada, kajian statistik yang signifikan antara Indeks Jisim Tubuh (IJT) dan kualiti tidur ($\chi^2(2) = 3$, $p = 0.438$). Hal yang sama diperoleh di mana tiada kaitan signikan antara pengambilan gula tambahan dan IJT ($\chi^2(2) = 2$, $p = 0.073$). Oleh itu,

perkara ini memberi makna bahawa hubungan antara pembolehubah ini adalah kompleks dan dipengaruhi oleh pelbagai faktor. Tambahan lagi, hasil kajian ini menekankan keperluan untuk intervensi kesihatan yang disasarkan di kalangan pelajar universiti bagi memperbaiki pemilihan pemakanan dan kebersihan tidur. Kajian ini menyediakan pandangan asas yang boleh membantu merangka program promosi kesihatan pada masa hadapan yang bertujuan untuk meningkatkan kesejahteraan pelajar universiti dan mengurangkan risiko kesihatan jangka panjang yang berkaitan dengan tabiat pemakanan dan tidur yang tidak sihat.

ASSOCIATION BETWEEN ADDED SUGAR INTAKE AND BODY MASS INDEX (BMI) WITH SLEEP QUALITY AMONG UNDERGRADUATE STUDENTS AT UNIVERSITI SAINS MALAYSIA KAMPUS KESIHATAN, KELANTAN.

ABSTRACT

This study explores the association between added sugar intake, body mass index (BMI), and sleep quality among undergraduate students at Universiti Sains Malaysia, Kampus Kesihatan, Kelantan. This research aims to assess the dietary habits, specifically in cariogenic food and beverages, the influence of BMI, and the sleep quality, due to the concern of high sugar consumption over health implications that are rising nowadays. The study is crucial as it addresses gaps in the literature regarding the combined impact of added sugar, BMI, and sleep quality in Malaysian undergraduates which is a group that may be particularly vulnerable to unhealthy eating and sleep habits due to academic pressures and irregular lifestyles. Using a cross-sectional design, data were collected from students (n=140) through a Cariogenic Food Frequency Questionnaire (FFQ), Pittsburgh Sleep Quality Index (PSQI), and anthropometric measurements. The results revealed that most participants had moderate levels of added sugar intake, with a significant proportion experiencing poor sleep quality. BMI classifications indicated that majority of students in USMMK had a normal weight, while a smaller group was either overweight or obese. The study found no significant statistical associations between added sugar intake and sleep quality ($\chi^2(2) = 2$, $p = 0.073$). There are also no significant statistical associations between Body Mass Index (BMI) and sleep quality ($\chi^2(2) = 3$, $p = 0.438$). Also, similar results obtained where no significant association between added sugar intake and BMI ($\chi^2(2) =$, $p = 0.073$). Thus, this suggest that the relationship between these variables is complex and influenced by multiple factors. Additionally, the findings in this study mention the importance for targeted health interventions in

university settings to improve dietary choices and quality of sleep among students. This research gives foundational insights that could guide future health promotion programs aiming to improve the well-being of students in universities and reduce the risk of long-term health which associated with issues of poor dietary and sleep patterns.

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CHAPTER 1: INTRODUCTION

1.1 Background Studies

Sugar, a carbohydrate necessary for energy, is frequently added to food and drink to improve flavor (MOH, 2020). Added sugar refers to sugars that are not naturally found in the food product and are added during food production (Erickson & Slavin, 2015). Added sugar has numerous functions, including sweetness, energy, preservation, fermentation, and food's conception of texture and color (Zaitoun et al., 2018). It was found by Bakar et al. (2020) that half of the students (n=350) consumed 2 cups (500 mL) of SSBs on average days (49.4%), whereas 21.7% of them consumed at least 3 cups daily. Moreover, the sweetened tea was the students' most preferred SSB and there was also an association between the SSB consumption and the BMI. Various kinds of added sugars, both liquid and solid, are being utilized. According to Amarra et al. (2016), sugar-sweetened beverages (such as cordial syrup, tea, coffee, and chocolate-flavored beverages), fizzy drinks, jam, local kuih, and "ABC shaved ice" are among the sugar-containing foods that Malaysian adults are most likely to consume. In addition, consuming above 25 grams of sugar-sweetened beverages (SSBs) daily raises the risk of being overweight or obese (Yu et al., 2022).

Excessive sugar consumption has caused global concern for public health due to its association with obesity and increased risk for some noncommunicable diseases, like T2DM, cardiovascular disease, and certain cancers (Shetty, 2021). Increase of energy due to the higher intake of added sugar become a major contributor to weight gain and the emergence of obesity. Body mass index (BMI), is a matric that is used to quantify anthropometric height and weight features of an individual, indicating the index of individual fatness which is also used to acquire risk factor of specific health concerns (Nuttall, 2015). It can be clasify into certain categorise which is underweight (BMI under 18.5 kg/m²), normal (BMI 18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), and obese (≥30 kg/m²) (Garikapati et al., 2021). The frequency of overweight and obesity in Malaysia has been consistently rising. As per the National Health Screening Initiative (2023), 53.5% of those screened in the country were either overweight (31.3%) or obese (22.2%). The increase was from 15.1% in 2011 to 19.9% in 2019 during a country-wide survey (Chong et al., 2023). Excess weight is linked to serious health-related problems including cardiovascular diseases, Type 2 diabetes, and chronic diseases such as musculoskeletal and respiratory ailments (Safaei et al., 2021).

The body need adequate sleep to maintain proper physiological health and cognitive function. Sleep quality refers to sleep characteristics, ease of falling asleep, duration,

continuity of sleep, and energy upon waking and is a major pillar of good health and wellness (Rachlin, 2013). Adequate sleep duration, effectiveness, and few disruptions are characteristics of good sleep quality, however insufficient sleep can result in weariness, irritation, and an increased risk of health issues like hypertension and type 2 diabetes (Nelson et al., 2022). Approximately 20% to 40% of college students say they fail to obtain the necessary 7 to 9 hours of sleep per night for their age group, often attributed to academic, irregular schedules and social pressures (Schmickler et al., 2023). Without adequate sleep, the brain struggles to function properly and the brain neurons become overworked and less capable of optimal performance in various types of thinking (Suni & Suni, 2023). Evidence from multiple studies has implicated poor sleeps in increased food intake and unhealthy eating patterns, while irregular sleep patterns may exacerbate obesity by interfering with metabolic processes (Zaffyr et al., 2021).

Although significant research exists on added sugar (cariogenic food and beverages) intake, BMI, and sleep quality, there is limited literature on how added sugar (cariogenic food and beverages) intake, BMI, and sleep quality might interrelate among Malaysian undergraduates. This group may be at high risk for poor dietary habits, disrupted sleeping patterns, and stress from academic workloads, each adding to their health risks. Furthermore, Malaysian cultural dining practices, such as the intake of traditional sweet snacks and beverages, had little or no emphasis in studies on their collective impact on health.

This study addresses these gaps by assessing the interrelationship between added sugar (cariogenic food and beverages) intake, BMI, and sleep quality among undergraduates in Universiti Sains Malaysia, Kampus Kesihatan, Kelantan. The findings may offer important information for creating wellness programs and public health plans to improve students' and the youth's eating and sleeping patterns.

1.2 Problem Statement

University life is sometimes characterized as a fast-paced, dynamic setting where students balance their academic obligations, social lives, and personal development. Academic stress, unstructured schedules, and increased use of electronic devices often lead university students to undervalue the importance of sleep in their daily lives (Nakie et al., 2024). Such changes in sleep patterns during the shift of these students to university often cause sleep deprivation in terms of duration and quality (Schmickler et al., 2023). A study conducted on medical students at King Saud bin Abdul Aziz University in Saudi Arabia reported high rates of poor sleep quality (76%) (Almojali et al., 2017). Studies suggest that

sleep deprivation leads to an escalated risk of gaining weight, possibly because of hormonal alteration which increases appetite coupled with shifting metabolic rates (Fry & Fry, 2024).

Furthermore, more recent studies have shown a strong correlation between students' poor sleep and their intake of added sugar. Poor sleep outcomes have been linked to high intakes of added sugars in term of cariogenic food and beverages. According to Alahmary et al. (2019) only 17% of participants, for instance, reported having adequate sleep, and there were significant correlations between higher sugar intake and poorer sleep quality (P =0.014). This demonstrates how eating habits, particularly those involving sugary foods and beverages, might impair the quality of sleep.

University students are not only characterized by their food choices but also by limitations in their budgets and dietary modifications reflected in their consumption patterns. A cross-sectional study (n=150) in a private university in Bangladesh found that most students (95.4%) consume sugared beverages with 53.6% reporting more than two days in a week intake. According to it also, the good taste and price were the most important factor in choosing beverages (Bipasha et al., 2017). Futhermore, limited budgets send students to cheap, highly calorific, available fast foods, and sugary snacks instead of healthier options. These high-sugar foods are more alluring due to their affordability and ease of use especially around exam periods, when students want quick energy instead of nutritional value. Lack of culinary skills and motivation for preparing balanced meals, thus pushing students closer toward processed and sweetened foods (Medina et al., 2024). This cycle of poor dietary choices would not only affect their health at a given instant but also affect their body mass index (BMI) and general being at a later time.

Apart from that, the link between added sugar consumption and BMI is significant. Consumption of these excess added sugars causes overweight and obesity, both conditions which have poorer sleep quality as an outcome-related risk purpose. A prior study in Malaysia noted that about 37.5% of university students qualified as overweight or obese, where soft drink consumption was found to contribute as one of the factors for this high percentage of overweight or obese students (Wan Mohamed Radzi, 2019). Similarly, an adverse finding from a research found that overweight and obese university students had a tendency towards the intake of sugary drinks, where 54.8% and 51.8% of them consumed carbonated and energizing drinks on a daily basis (Bakar et al., 2020).

The fact that college students are a population going through significant lifestyle changes sets them apart from other demographic groups in this regard as well. Living independently exposes students to unhealthy food habits and erratic sleeping schedules, which may ultimately lead to serious health issues. This study's main goal is to fill in knowledge gaps about the relationships between these variables in higher education so that customized treatments can be developed in enhancing the students' health outcomes.

1.3 Significance of the Research

The relationship between sugar intake, Body Mass Index, and sleep quality is the main theme of this study, and hence it is of particular significance as it deals with undergraduate students at the Universiti Sains Malaysia Kampus Kesihatan. The conclusions will be the key to unlock all dietary and lifestyle habits including this one associated to the target group, who are more prone to develop ungrateful rages because of the academic stress and social influences for some reasons. The study by determining the association between increased sugar consumption and both BMI and sleep quality, it will give practical suggestions for inculcating healthier eating habits and ensuring quality sleep which will, in the end, lead to individuals experiencing better physical and mental health.

The outcomes of this research are not only relevant to the students but also to the broader university community. They can guide the development of holistic health promotion initiatives, integrating nutritional education with sleep management strategies to support a healthier and more productive campus environment. Moreover, the study contributes to addressing larger public health concerns, particularly the growing prevalence of obesity and lifestyle-related diseases. By investigating how sugar consumption and sleep quality interplay, the research provides insights into behavioral and metabolic pathways that could influence the prevention of conditions like insulin resistance and cardiovascular issues.

In addition, this paper sets the stage for future research by providing a model for further investigation into the linkage between dietary consumption, body composition, and sleeping overall. It paves the way for additional studies that could branch out to consider other elements like stress, exercise or cultural factors. This research not only aims to enhance the quality of university campus life, but also adds to public health and well-being literature by addressing these critical dimensions of well-being.

1.4 Research Question

1. What is the frequency of added sugar (cariogenic food and beverages) intake among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan?
2. What is the Body Mass Index (BMI) among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan?
3. What is the sleep quality status of undergraduate students at Universiti Sains Malaysia Kampus Kesihatan?
4. Is there any association between added sugar (cariogenic food and beverages) intake, and sleep quality among undergraduate students in Universiti Sains Malaysia, Kampus Kesihatan, Kelantan?
5. Is there any association between BMI and sleep quality among undergraduate students in Universiti Sains Malaysia, Kampus Kesihatan, Kelantan?
6. Is there any association between added sugar intake and Body Mass Index (BMI) among undergraduate students in Universiti Sains Malaysia, Kampus Kesihatan, Kelantan?

1.5 Research Objectives

General Objectives

To investigate the association between added sugar intake, Body Mass Index (BMI), and sleep quality among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan, Kelantan.

Specific Objectives

1. To determine the frequency of added sugar (cariogenic foods and beverages) intake among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan.
2. To determine the Body Mass Index (BMI) of undergraduate students at Universiti Sains Malaysia Kampus Kesihatan.
3. To determine the sleep quality status of undergraduate students at Universiti Sains Malaysia Kampus Kesihatan.
4. To determine the association between added sugar intake and sleep quality among undergraduate students in Universiti Sains Malaysia, Kampus Kesihatan, Kelantan.
5. To determine the association between BMI and sleep quality among undergraduate students in Universiti Sains Malaysia, Kampus Kesihatan, Kelantan.

6. To determine the association between added sugar intake and Body Mass Inex (BMI) among undergraduate students in Universiti Sains Malaysia, Kampus Kesihatan, Kelantan.

1.6 Research Hypothesis

1.6.1 Hypothesis I

Null Hypothesis (HO): There is no significant association between added sugar (cariogenic foods and beverages) intake and sleep quality among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan, Kelantan.

Alternative Hypothesis (HA): There is a significant association between added sugar (cariogenic foods and beverages) intake and sleep quality among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan, Kelantan.

1.6.2 Hypothesis II

Null Hypothesis (HO): There is no significant association between Body Mass Index (BMI) and sleep quality among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan, Kelantan.

Alternative Hypothesis (HA): There is a significant association between Body Mass Index (BMI) and sleep quality among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan, Kelantan.

1.6.3 Hypothesis III

Null Hypothesis (HO): There is no significant association between added sugar (cariogenic foods and beverages) intake and Body Mass Index (BMI) among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan, Kelantan.

Alternative Hypothesis (HA): There is a significant association between added sugar (cariogenic foods and beverages) intake and Body Mass Index (BMI) among undergraduate students at Universiti Sains Malaysia Kampus Kesihatan, Kelantan.

CHAPTER 2: LITERATURE REVIEW

2.1 Added Sugar (cariogenic foods and beverages) Intake

There are two kinds of sugar exist which are natural sugars and added sugars. Brown sugar, corn syrup, dextrose, fructose, glucose, sucrose, honey, and molasses are added sugars added to foods and beverages during manufacturing, preparation, or at the table. Conversely, naturally occurring sugars are those found in entire, unprocessed foods like dairy, fruits, and vegetables (Mela & Woolner, 2018). A rising trend in added sugar intake among students are concerning as it is associated with various health effects. Petchoo et al. (2024) study revealed that 79.2% of the students consumed more added sugar than recommended by the World Health Organization (WHO) with the majority of added sugar consumption being beverages (46.5%). Sugar-sweetened beverages are any drinks added with added sugar or other sweeteners recognized as a major source of added sugar in many people's. The global SSB intake among adults from 187 countries was 137.2 ml per day, with men and younger adults having the highest SSB intake (Singh et al., 2015). Based on a cross-sectional study, it is said that sweetened beverages followed by fruits, traditional kuih, and ready-to-eat food such as sweets, cookies, and biscuits are the highest sources of sugar consumption among Malaysian adults (Zainuddin et al., 2018). On average, students in Malaysia consumed 59.14 grams of sugar per day from sugar-sweetened beverages which is roughly equivalent to 12 teaspoons of sugar per day (Cheng & Lau, 2022). The health effects of added sugars are known to be mediated by their contribution to increased energy intake and subsequent weight gain. There is strong evidence that calorically sweetened foods and beverages contribute to obesity through the caloric load and visceral adipose tissue quality and quantity. Young adults frequently form lifelong habits throughout their college years, including eating patterns. During this period, consuming excessive amounts of sugar can lead to serious health problems including higher risk of metabolic syndrome, cardiovascular diseases and certain cancers (Huang et al., 2023). Moreover, people also will be susceptible to type 2 diabetes mellitus, dyslipidaemia and hypertension. Additionally high-sugar diet enhances impulsive behaviour, stress, anxiety, depression as well as dysregulation of metabolism in the body (Witek et al., 2022). Apart from that, the American Heart Association (AHA) claimed that sugar-sweetened beverages including sodas, sports drinks, and fruit drinks might be associated with approximately 180,000 deaths around the world each year (Ma et al., 2016).

Therefore, in order to lower the risk of chronic illnesses, regulations have been set by the health organizations around the world. Huang et al. (2023) in his studies stated that

according to the World Health Organization (WHO) guidelines, people should consume no more than 25 g (about six tablespoons) of added or free sugars per day. Meanwhile, the 2015-2020 Dietary Guidelines for Americans set limits of less than 10% of energy from added sugar (DeSalvo et al., 2016). This corresponds to a maximum of 50 grams of added sugar per day on a diet of 2,000 calories (Amarra et al., 2016). Furthermore, the American Heart Association (AHA) suggests a more stringent daily limit for added sugar consumption, proposing that adult women consume no more than 100 calories per day and men consume no more than 150 calories per day (L. Zhang et al., 2017). Thus, the potential risk of developing chronic health problems is greatly increased when amounts consumed exceed these recommendations.

2.2 Cariogenic Food Frequency Questionnaire (FFQ)

Food frequency questionnaires are nutritional assessment instruments that have been used extensively since the early 1990s in epidemiological research examining the connection between dietary consumption and risk factors or disease (Pérez et al., 2015). The list of foods, frequency of consumption, and portion size are the three primary parts of these surveys. The research population's eating habits at the time the data is gathered should be reflected in the food list. Either open-ended questions or frequency categories can be used to gauge consumption frequency. Other versions add an open part with questions regarding certain food habits and practices and allow changes to the food list for foods and beverages consumed that are not included, while other versions solely feature closed-ended questions in a standardized format. The approach can be self-administered, conducted in-person or over the phone, or it can be conducted online or on paper. FFQs are very cost-effective due to their standard structure, particularly closed-ended variants, and administration manner, which promotes their widespread usage in large-scale epidemiological cohort studies as well as other study designs. FFQs are especially valid for use in extensive samples from diverse conditions when fast and easy methods will estimate the consumption of specific nutrients. This has made them reliable means of conducting practical and cost-effective long-term dietary habit examinations and further assessment of just how large populations can be probed in the dietary field (Fatihah et al., 2015). In this research, FFQ is designed to evaluate the frequency of cariogenic or sugar-rich food intake among the students to assess the dietary behavior and impact on health including BMI and sleep quality.

2.3 Body Mass Index (BMI)

Body Mass Index (BMI) formerly called the Quetelet index, is a measure to access weight status and associated health risk in adults. It is defined as a person's weight in kilograms divided by the square of their height in metres (kg/m2). The BMI is classified into categories of underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), pre-obese or overweight (25.0-29.9 kg/m²), obesity class I (30.0-34.9 kg/m²), obesity class II (35.0-39.9 kg/m²), and obesity class III (> 40 kg/m²) according to the World Health Organization (Weir & Jan, 2023).

University students are young adults navigating a transformative phase in their lives, where they embrace newfound independence and begin shaping their futures. They often face greater freedom and self-responsibility in deciding on various issues (Low et al., 2015). In addition, frequent intake of unhealthy food choices coupled with sedentary contributes to overweight or obese conditions among students (Saad et al., 2024). Based on the WHO cutoff scale, 14.31% of students were overweight and 10.13% were obese, which is lower compared to the Asian cutoff scale, where 22.19% were overweight and 16.88% were obese and most commonly occur among male students (Pitil & Ghazali, 2022). A study conducted at Universiti Sains Malaysia involving 125 undergraduate students found that 16% of subjects were underweight, 19.2% were overweight and 11.2% were obese (Azhar et al., 2023). Meanwhile, 19.1% of students were overweight, 8.5% were obese, and the majority (64.9%) had a normal BMI according to a study at South Africa University (Nakhooda & Wiles, 2018). Wan Mohamed Radzi et al (2019) reported that the collection involving body mass index data from five local universities in Malaysia revealed the highest percentage of overweight and obesity among undergraduate students (23%, 17.6%) as compared to the Masters (21.9%, 14.3%) and PhD students (17.8%, 18.4%). Apart from that, Khawaja et al. (2019) a study at Emirates University, found that students linked sugar consumption to emotional triggers, such as stress and boredom. This emotional connection to food is a common behavior among students, particularly when coping with the pressures of academic life. Stress and the demands of university frequently cause students to make convenience-driven choices, which raises the intake of processed snacks (Cheng & Kamil, 2020). In the context of added sugar intake of university students, the University of the Free State found that 77% of students drank carbonated soft drinks and 75.2% consumed 100% fruit juices weekly. Nakhooda (2016), found that a large portion of students (78.8%, n = 305) consumed table sugar, with 46.0% reporting daily consumption. Plus, the study in the Eastern Cape showed a higher monthly consumption of sweets and chocolates (77.0%) and cakes and biscuits (85.7%)

2.4 Sleep Quality

The term sleep quality defined as an individual's self-satisfaction with all aspects of the sleep experience. There are four attributes in the sleep quality which are sleep efficiency, sleep latency, sleep duration, and wake after sleep onset. Poor sleep quality may lead to fatigue, irritability, daytime dysfunction, slowed responses, and increased alcohol or caffeine intake (Nelson et al., 2021). Adequate sleep is crucial for a healthy and productive life as it also influences human energy during the day. For university students, sleep may influent their academic performances, problem-solving skills, emotional status, and safety in life (Pham et al., 2021). Additionally, students' sleep issues may be exacerbated by a hectic schedule, new social possibilities, and abrupt changes in sleeping patterns (Haile et al., 2017). These findings were corroborated by the fact that 149 pupils (99.3%) had a GPA below 4, and 118 of them (78.7%) had sleep deprivation (Maheshwari & Shaukat, 2019). A study conducted in the University of Africa (n=16 275) the overall pooled prevalence of poor sleep quality in Africa was 63.31% (Nakie et al., 2024). As shown by recent data, medical students are experiencing inadequate sleep, with an average sleep length of 6.3 hours each night. On top of that, according to the Pittsburgh Sleep Quality Index (PSQI), 55% of the students had poor sleep quality, and according to the Epworth Sleepiness Scale (ESS), 31% were excessively sleepy during the day (Lesińska-Sawicka & Nagórska, 2022). As indicated by Ngu et al. (2017), students at two prestigious Malaysian universities, Universiti Malaya and Universiti Putra Malaysia, are showing a worrying trend in their sleep quality. With regard to reports, the percentage of students who had trouble sleeping was 60.9% at Universiti Putra Malaysia and 67% at Universiti Malaya. Respondents' average stated sleep duration was roughly 5 hours and 30 minutes, which is much less than the 7 hours per night that is advised. Remarkably, merely 6.1% of students slept for the recommended amount of time. College students who suffer from sleep difficulties typically have delayed bedtimes and inconsistent sleep patterns due to a constantly interrupted biological clock. Unhealthy bedtime habits, such as the use of blue light-emitting devices before sleep, are significantly associated with poor sleep quality (Jniene et al., 2019). The surroundings have a big influence on how well people sleep. A warm and cozy resting environment can enhance the quality of your sleep, whereas a cold indoor atmosphere can have the opposite impact. Therefore, better sleep quality can result from improving environmental conditions (J. Liu et al., 2020). Sleep problems can trigger negative health outcomes, such as mood disturbance, fatigue, impaired concentration, and poor academic performance. Physical health is a key factor influencing sleep quality (H. Zhang et al., 2016). According to S. Wang et al. (2017), factors such as

older age, smoking, an unbalanced diet, insufficient physical activity, poor mental health, chronic illnesses, or the presence of multiple diseases are significantly linked to sleep deprivation. Among college students, especially in Asian populations, internet addiction is highly common and strongly connected to sleep disturbances as well as poor sleep quality is closely tied to stress levels and educational attainment (Oltmanns et al., 2020).

The latest guidelines from the National Sleep Foundation suggesting, that an optimal amount of sleep is 7–9 hours for young adults (Hirshkowitz et al., 2015). Although meal timing was not significantly correlated with either SOL or sleep duration, those who ate within three hours of bedtime had a higher likelihood of experiencing nocturnal awakenings (27.8%) than those who ate more than three hours before bedtime (19.2%) (Chung et al., 2020). 85% of Iranian medical students with a GPA of 2.99 or lower had poor PSQI sleep scores. A Malaysian study surveyed medical students at International Medical University and found a 35.5% prevalence of excessive daytime sleepiness (EDS), which was more common among clinical students (Almojali et al., 2017). Therefore, ultimately, a wide range of factors, such as lifestyle choices, academic stress, internet use, and physical and mental health, affect university students' sleep quality. Given that inadequate sleep can have a substantial negative influence on students' general well-being and academic performance, the interaction of these determinants emphasizes the necessity of focused treatments and measures to support good sleep patterns.

2.5 Pittsburgh Sleep Quality Index (PSQI)

One well-known instrument for evaluating sleep disruptions and quality is the Pittsburgh Sleep Quality Index (PSQI). It was created by Buysse et al. in 1989 and offers a thorough assessment of sleep problems and patterns over a month (Manková et al., 2021). The development, psychometric qualities, and use of the PSQI are the main topics of this literature review, with special attention to the Malay variant (PSQI-M), which is utilized with Malaysian populations. The PSQI consists of 19 self-rated items that yield seven component scores including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality. A global PSQI score greater than 5 is commonly used as a threshold to identify poor sleepers (Kinman, 2025). The PSQI exhibits great test-retest reliability ($r = 0.85$) and internal consistency (Cronbach's alpha > 0.80), according to a systematic study (Mollayeva et al., 2015). Furthermore, in the same study, it has demonstrated strong construct validity in

differentiating between those who sleep well and those who do not a global score above 5 denotes serious sleep problems with an 89.6% sensitivity and an 86.5% specificity. Numerous clinical populations, such as mental patients, cancer survivors, and people with chronic pain issues, have had their sleep quality evaluated using the PSQI. Higher PSQI scores, for example, were linked to higher levels of anxiety and despair, according to a study done on cancer patients. The PSQI has been used outside of clinical settings to investigate how lifestyle factors affect sleep quality in non-clinical groups. 70.5% of participants in a study evaluating nursing faculty reported having poor sleep quality across all PSQI components (Cox et al., 2021). For usage in Malaysian communities, the PSQI's Malay version has been modified and approved. This modification guarantees cultural pertinence and improves the precision of sleep evaluations in these populations.

2.6 Association Between Added Sugar Intake (cariogenic foods and beverages) and Sleep Quality

As dietary patterns are becoming more widely acknowledged as important factors influencing sleep health and general well-being, the connection between added sugar consumption and sleep quality has attracted more attention in recent year. As stated by (Alahmary et al., 2019), higher added sugar intake was found to be significantly correlated with poorer sleep quality in a study conducted among university students. Only 17% of individuals said they had adequate sleep, and those who consumed more sugar had a 3.5-fold higher chance of having poor sleep than those who consumed less. In the same study, poor sleep was experienced by all subjects (100%) who derived more than 30% of their energy intake from added sugar. Besides that, adolescents who consume sugar-sweetened beverages (SSBs) are more likely to experience social jetlag and short sleep duration (K. Zhang et al., 2022). Sugar consumption can disrupt the body's regulation of sleep hormones like cortisol, melatonin, and serotonin, leading to sleep disturbances. Research by St-Onge et al. (2016) and Franco-Pérez et al. (2018), shows that high-sugar diets reduce slow-wave and REM sleep which are both crucial for restorative rest, and linked to poor overall sleep quality, leaving individuals feeling fatigued despite adequate sleep duration.

2.7 Association Between BMI and Sleep Quality

People who are overweight or obese are more likely to experience a number of sleep disorders, such as insomnia and obstructive sleep apnea (OSA), which is characterized by frequent breathing pauses while you sleep (Pagán, 2024). People with higher body mass indices (BMIs) are more likely to have these disturbances, which can result in poor sleep

quality. The National Health and Nutrition Examination Survey (NHANES) found that sleep problems are significantly more common in obese people (19.6%), compared to 9.4% in overweight people and just 6.3% in normal weight people (Wang et al., 2024). This information makes it evident that having a higher BMI increases the risk of having sleep problems. Abdallah et al. (2021) study supports this by showing that those who are overweight or obese have considerably higher Pittsburgh Sleep Quality Index (PSQI) ratings than people who are normal weight, which indicates that their sleep quality is worse. Specifically, those who were overweight or obese were more likely to experience poor sleep quality than those who were normal weight, with 36.1% experiencing serious problems compared to 22.5%. An average PSQI score of 8.37 was found in a study with 402 medical professionals, indicating significant sleep disruptions among people with higher BMI levels (H. Huang et al., 2024). This implies that being overweight makes it harder to get a good night's sleep. A common cause of weight gain is a regular intake of high-sugar foods and beverages, which can worsen sleep disorders. Given the correlation between poor sleep quality and greater BMI, it is conceivable that dietary practices involving excessive sugar consumption could indirectly affect sleep. High sugar intake has also been linked to increased BMI. This link emphasizes how crucial it is to control sugar consumption as part of a plan to enhance weight and sleep quality.

2.8 Research Gaps and Importance

This is the depth of the research that has been done on the connections between sugar and sleep as well as between BMI and sleep. Very little research has been devoted to studying all three factors as a whole. This becomes very relevant to university-going students who are prone to high-sugar diets, unpredictable changes in their weight, and poor quality of sleep due to lifestyle changes. Lots of the research on sugar consumption among undergraduate Malaysian students has focused on sugar-sweetened beverage (SSBs) consumption as a major contributor to extra sugar consumption. However, very little complete data exist on the total intake of added sugar from other dietary sources.

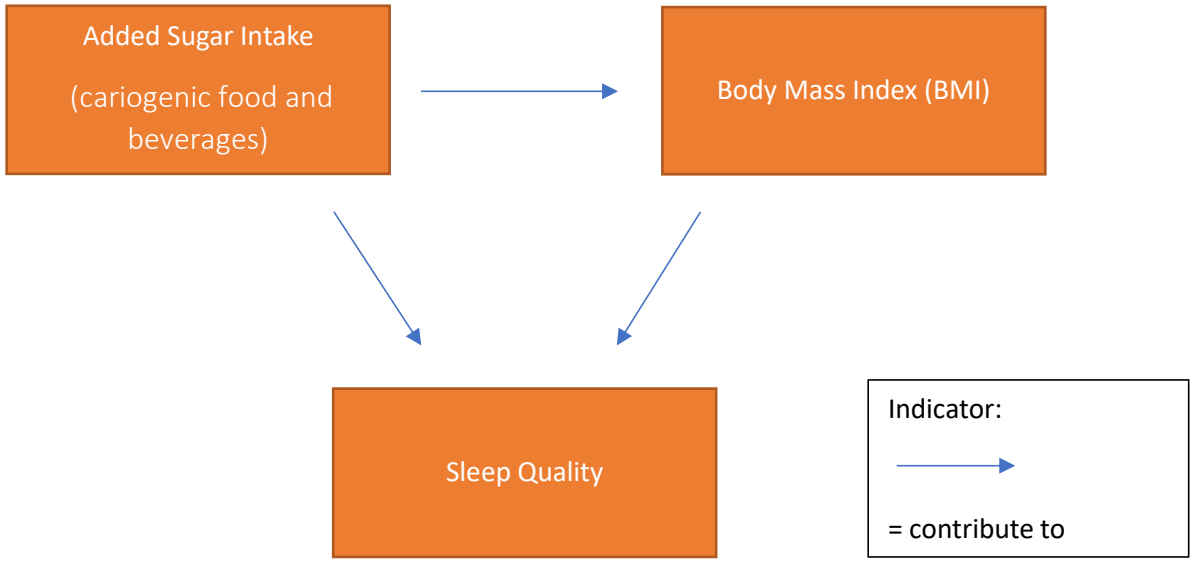
Therefore, one cannot fully understand how added sugar will exert its effect on health outcomes like sleep quality. This study hopes to fill that gap by establishing the relationship between total added sugar (cariogenic food and beverages) intake and sleep quality. There is no prevalence data concerning the overall added sugar intake of the population; therefore, the SSB consumers' category is taken as a proxy for added sugar intake. This can be justified given that SSBs are one of the major food sources of added sugar intake

among university students. With these gaps filled by the study, it would be able to provide better understanding in terms of the interaction between diet, body weight, and sleep quality, which may then act as a basis for interventions in improving the holistic health and well-being of students.

Individual studies were conducted to examine the relationship between sleep and BMI and sleep and sugar. However, little research has been done on how they interact with university students, who are the main target demographic that is most affected by the potential hazards of extremely high-sugar diets, as well as weight gain and poor sleep due to lifestyle changes. This study, therefore, tends to address a wider notion concerning diet-body weight-sleep quality, which might then lend some justification to interventions aimed to improve holistic health and welfare among students.

2.9 Conceptual Framework

Figure 1: Conceptual Framework



This conceptual framework explains the interaction between added sugar (cariogenic foods and beverages) intake, Body Mass Index (BMI), and sleep quality. The interaction between added sugar (cariogenic food and beverages) intake, Body Mass Index (BMI), and sleep quality forms a complex and interrelated cycle that significantly impacts the well-being of undergraduate students at Universiti Sains Malaysia Kampus Kesihatan. High added sugar intake, from sugary food and particularly from sugar-sweetened beverages (SSBs), contributes to excessive calorie consumption, leading to increased Body Mass Index (BMI) when energy expenditure is insufficient. This weight gain is further exacerbated by a sedentary lifestyle common among students, ultimately elevating the risk of obesity. Additionally, excessive sugar intake disrupts sleep quality by causing fluctuations in blood sugar levels, reducing deep sleep stages, and increasing the likelihood of insomnia or fragmented sleep, especially when sugary foods or drinks are consumed late in the evening. Elevated BMI also negatively impacts sleep quality, with conditions such as obstructive sleep apnea (OSA) being more prevalent in individuals with higher body weight. This interplay of poor dietary habits, elevated BMI, and disrupted sleep patterns can negatively affect academic performance, mental health, and overall well-being for undergraduate students. In turn, poor sleep quality leads to hormonal imbalances, such as increased ghrelin and decreased leptin levels, which drive overeating and intensify sugar cravings, creating a vicious cycle that perpetuates weight gain and further deteriorates sleep quality. By understanding these relationships, targeted interventions can be made to promote healthier dietary habits, encourage physical activity, and improve sleep hygiene, ultimately fostering better health outcomes for students.

CHAPTER 3: METHODOLOGY

3.1 Research Design

This study is designed as a cross-sectional study that involves the use of two kinds of questionnaires used to determine sleep quality and to assess the intake of added sugar (cariogenic food and beverages) as well as includes the observation to assess the anthropometric data among Malaysia's university students. The participants in this study will be selected based on the inclusion and exclusion criteria. Cross-sectional studies only collect data once, thus these studies are less costly and less time-consuming than other types of research. Cross-sectional studies allow data to be collected from a large number of subjects and group differences to be compared. Apart from that, monitoring and intervention planning may gain insight from a cross-sectional study.

Role of Sugar-Sweetened Beverages (SSBs) in Sample Size Estimation

Due to the lack of precise statistics regarding Malaysian university students' consumption of total added sugar (cariogenic food and beverages), hence the present study took the SSBs consumption term as a means of estimating the required samples. For university students, household consumption of SSBs forms one of the important areas of added sugar intake. Estimating the sample size for the study becomes easier based on SSB consumption data. Based on specific total added sugar intake, it shall be assumed that with the guideline consumption of SSBs, an adequate sample size will be defined to correlate added sugar intake with BMI and sleep quality and provide a solution to the issue of limited data availability regarding total added sugar (cariogenic food and beverages) intake in such population.

3.2 Study Location

Undergraduate students at the Universiti Sains Malaysia Kampus Kesihatan in Kelantan are the subjects of the study. This area is selected considering it is convenient and time-efficient for gathering data, which means it is an excellent place to do research. The study population can be represented by a wider spectrum of students due to their wide range of backgrounds.

3.3 Study Population

The subjects involved in this study are undergraduate students of Universiti Sains Malaysia Kampus Kesihatan, Kelantan including students in the School of Health Sciences, School of Medical Sciences, and the School of Dental Sciences. Due to their accessibility and suitability for this research issue, undergraduate students are selected as research participants. They are also frequently more open to taking part in research investigations than other groups.

3.4 Selection Criteria

3.4.1 Inclusion Criteria

The selection of subjects is based on:

- Participants must be aged 18 and above.
- Currently enrolled as undergraduate students in School of Health Sciences, School of Medical Sciences, and the School of Dental Sciences of Universiti Sains Malaysia Kampus Kesihatan (USMKK).
- Able to understand and read Malay and English language.

3.4.2 Exclusion Criteria

- Currently having underlying health concerns and chronic health diseases.
- Anyone with Diabetes Mellitus (type 1 and type 2), chronic kidney diseases (CKD), gastrointestinal disorders (Irritable Bowel Syndrome or Celiac disease), and eating disorders (anorexia nervosa, bulimia nervosa, and binge eating disorder).

3.5 Sample Size Calculation

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

n = estimated sample size

Z = value representing the desired confidence level, Cl = 95% (z-score = 1.96)

Δ = margin error set at 5% = 0.05

p = anticipated population proportion

3.5.1 Sample Size Estimation for Added Sugar Intake (cariogenic food and beverages)

For this sample size calculation, there is a 95% confidence level with a Z-score of 1.96 and a 5% (0.05) precision level. (Ahmad et al., 2019) reported that 89.3% of respondents consumed at least once daily SSB intake among undergraduates in Universiti Putra Malaysia (UPM) (n=515). Thus, the anticipated population proportion of at least once daily SSB intake among undergraduate students is 0.89. The respondents for this sample size will be 165 participants in total.

$$n = [\frac{1.96}{0.05}]^2\, 0.89(1-0.89)$$

$$n = 150 + 10\%\ (dropout\ rate)$$

$$n = 165 \text{ respondents}$$

3.5.2 Sample Size Estimation for BMI

For this sample, there is a 95% confidence level with a Z-score of 1.96 and a 5% (0.05) precision level. Azhar et al. (2023) reported that among undergraduate students, 19.2% were

overweight. Therefore, 0.912 is the anticipated population proportion. The respondents for this sample size will be 135 participants in total.

$$n = [\frac{1.96}{0.05}]^2\ 0.912\ (1 - 0.912)$$
$$n = 123 + 10\%\ (dropout\ rate)$$
$$n = 135 \text{ respondents}$$

3.5.3 Sample Size Estimation for Sleep Quality

For this sample, there is a 95% confidence level with a Z-score of 1.96 and a 5% (0.05) precision level. It is found that 13.3% of participants experienced poor sleep duration (Suhaimi et al., 2020). Therefore, 0.13 is the anticipated population proportion. The respondents for this sample size will be 191 participants in total.

$$n = [\frac{1.96}{0.05}]^2\ 0.13\ (1 - 0.13)$$
$$n = 173.8 + 10\%\ (dropout\ rate)$$
$$n = 191 \text{ respondents}$$

3.5.4 Sample Size Estimation for Association of Added Intake and Sleep Quality

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

n = sample size

p = anticipated population proportion

α = significance level

1-β = power of study

$\boldsymbol{z_\alpha}$ = 1.96 (α = 0.05)

$\boldsymbol{z_\beta}$ = 0.84 (80% power)

For this sample, there is a 95% confidence level with a Z-score of 1.96 and a 5% (0.05) precision level with the power is set at 80%.

p_1 = Anticipated population proportion of added sugar intake daily among Malaysians is 0.622 (Cheah et al. (2023), reported that 62.2% of Malaysian people used added sugar daily based on a Nationwide health survey in 2019)

p_2 = Anticipated population proportion of poor sleep quality among Malaysian university students is 0.504. It is found that 50.4% of Malaysian university students experience poor sleep quality (Suhaimi et al., 2020).

$$n = \frac{0.622_1(1 - 0.622_1) + 0.504_2(1 - 0.504_2)}{(0.622_1 - 0.504_2)^2} + (1.96_\alpha + 0.84_\beta)^2$$

$$n = 42.7 + 10\% \ (dropout\ rate)$$
$$n = 47 \times 2$$
$$n = 93.94 \sim 94\ respondent$$

3.5.5 Sample Size Estimation for Association BMI and Sleep Quality

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

n = sample size

p = anticipated population proportion

α = significance level

1-β = power of study

$\boldsymbol{z_\alpha}$ = 1.96 (α = 0.05)

$\boldsymbol{z_\beta}$ = 0.84 (80% power)

For this sample, there is a 95% confidence level with a Z-score of 1.96 and a 5% (0.05) precision level with the power is set at 80%.

p_1 = Estimated proportion of overweight status undergraduate students is 0.912 (Studies by Azhar et al (2023) found that 19.2% of undergraduate students are overweight)

p_2 = Estimated proportion of poor sleep quality among Malaysian university students is 0.504. It is found that 50.4% of Malaysian university students experience poor sleep quality (Suhaimi et al., 2020).

$$n = \frac{0.912_1(1 - 0.912) + 0.504(1 - 0.504)}{(0.912_1 - 0.504_2)^2} + (1.96_\alpha + 0.84_\beta)^2$$

$$n = 9.8 + 10\% \ (dropout\ rate)$$

$$n = 10.8 \times 2$$

$$n = 21.6 \sim 22 \text{ samples}$$

Based on the calculation, the range of sample size is between 22 to 191 participants. However, considering practical limitations and ensuring data reliability, a total of 135 subjects will be required for this study.

3.6 Sampling Method and Subject Recruitment

The convenience sampling method, which is non-probability, is used to collect samples. The recruitment of all participants is optional. The study is chosen to be conducted by Universiti Sains Malaysia Kampus Kesihatan undergraduate students who fit the inclusion requirements, have no exclusions, and voluntarily indicate an interest in taking part. After reading the research material, sign the consent form, and agree to participate before asked to complete the questionnaire.

3.7 Ethical Consideration

Subject Vulnerability

Participants have a free choice to participate in the study. They will be given all research information and will be required to sign a consent form before participation. Participant recruitment will take place after obtaining informed consent from the individual. The research information will be presented in summary on Google Forms. Participants have the right to refuse participation and can withdraw at any point of the study without penalty or loss of benefits.

Declaration of Absence of Conflict of Interest

The researcher maintains impartiality and lacks any emotional connections or conflicts of interest with the individuals involved in this study.

Privacy and Confidentiality

The inclusion and exclusion criteria were used to select the subjects. Before the process of data collection, participants' consent forms will be obtained. The participant's information will be protected and kept private. It will be used solely for the research and evaluated only by the researchers involved in the study.

Community sensitivities and benefits

Participants in the study may experience slight unease or anxiety when engaging with questionnaires covering various sections related to sleep quality, waist circumferences, weight, height, and eating behavior. To alleviate this discomfort, respondents are encouraged to take breaks during the questionnaire. Participants stand to gain from this research as it

enables them to assess their current waist circumferences, weight, and height measurements. Additionally, the study holds community-wide benefits by contributing information on whether an individual's sleep quality may impact their eating behavior. The insights from the study can enhance the healthcare system, as future healthcare professionals can incorporate individual diurnal preferences into providing personalized services for patients.

Honorarium and incentives

Respondents will not be provided with an honorarium for their participation in this study.

3.8 Research Tools and Materials

Each set of surveys has four sections. The participants are expected to respond appropriately to the different kinds of questions that are included in each segment. The sections including:

Section A: Sociodemographic data

The focus revolves around individuals' personal details, encompassing factors like age, gender, ethnicity, duration of education, household income, and financial support received during the academic period.

Section B: Body Mass Index (BMI)

Body Mass Index (BMI) Body Mass Index (BMI) is an index to determine whether an individual is uederweight, normal weight, overweight, or obese. It is defined as a person's weight in kilograms divided by the square of their height in meters (kg/m2). The BMI is classified into categories of underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), pre-obese or overweight (25.0-29.9 kg/m²), obesity class I (30.0-34.9 kg/m²), obesity class II (35.0-39.9 kg/m²), and obesity class III (> 40 kg/m²) according to the World Health Organization (WHO, 2021). As part of the evaluation procedure, participants will be measured for their height and weight, which will be used to determine their Body Mass Index (BMI). OMRON HBF-214, bioelectrical impedance analysis (BIA) method used in measuring the participant weight as it is a suitable, easier, and reliable tool for assessing weight. Meanwhile, the Seca 213 portable stadiometer is widely to measure the height of an individual as it can be dismantled into several pieces and set up quickly which is convenient, easy to transport as well as provides precise results.

Section C: Cariogenic Food Frequency Questionnaire (FFQ)

The FFQ is a semi-quantitative tool that is used to examine habitual dietary intake among participants during a specific time frame. This questionnaire has been validated from a study regarding “Keberkesanan Intervensi Pendidikan Kesihatan Mulut berasakan Video dan Permainan Interaktif dalam Kalangan Murid Sekolah Berusia 11 Tahun di Pulau Pinang.” It is made up of open-ended questions where respondents indicate the frequency and portion sizes of their consumption of such commonly consumed food items like sugary snacks, desserts, and beverages, and also allow participants to list additional food that is not been mentioned. The collected data would be categorized in terms of added sugar contribution from these foods, mainly on sweet-tooth items like cakes, pastries, and chocolates. This would further categorize the foods based on how they add to total sugar intake, focusing on added sugars from desserts and chocolates fine print in understanding sugar in dietary consumption. Then convert such frequencies into equivalent daily consumption rates to analyze the data. For instance, "Sekali seminggu" (Once a week) means once every 7 days, will gives 1/7=0.14 serving per day. By the same token, "2-3 kali sehari" (2-3 times daily) is the mean equivalent of 2.5 servings a day. As for other frequency types: "Sekali sebulan" (Once a month) would be given as $1/30 \approx 0.033$ servings per day, while "2-3 kali seminggu" (2-3 times weekly) is averaged into 2.5 servings per week and divided by 7, giving $2.5/7 \approx 0.36$ servings per day. Hence, it standardizes measures for the average daily intake of food items to give an accurate figure for total added sugar and energy intake. This information conversion from sample frequency data will be multiplied with the sugar interface for each food item to get the daily sugar intake contributed from each food item.

Standard serving sizes of the Malaysian food composition database will be used for portion estimates, or participants will be asked to provide the amount they usually consume. All of this information will then be crunched from the database to get per-person nutrients in grams daily for sugar and kilocalories for energy. This will then be compared across people in determining the individual sugar intake against the recommended figures concerning this specific type of sugar. The data will also help in studying the correlation of total intakes of added sugars in grams per day with total energy intakes in kilocalories per day, which then can explain dietary patterns at the same time correlate it with the FFQ's internal consistency.

Thus, to really check whether it is both clear and reliable, the FFQ will be pilot tested with a small sample of the students to ascertain if the language is clear (e.g., whether

participants understand “Sekali sebulan” etc., among others) and if the items listed as food are culturally relevant. Amendments will then be made using feedback from the pilot test to address all the ambiguous and unclear sections. FFQ is culturally relevant as it comprises typically Malaysian foods like kuih tradisional and kerepek, and therefore be relevant to the target population. After data collection, all responses from the FFQs will undergo digitization and transformation to a format compatible with accurate nutrition calculations with the Malaysian food composition database. A strong positive correlation between total energy and added sugar intake will reflect the FFQ's reliability and consistency as an instrument in gauging dietary intake of sugar. This allows for proper and culturally relevant data collection on diet that also aids the specific aim of the study.

Section D: Pittsburgh Sleep Quality Index (PSQI) – Malay Version

The Pittsburgh Sleep Quality Index (PSQI) is a psychometric instrument, revered internationally, for assessing the overall quality of sleep, mostly in clinical populations. The Malay version of the PSQI has been validated for use among Malaysian communities to secure the cultural applicability and easy cognitive grasp of this tool. It is obtained from a study conducted in Universiti Kebangsaan Malaysia (UKM) by Dr Nor Farah Mohamad Fauzi. The major components include subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, medication used to sleep, and daytime dysfunction. Each of these components is rated between 0 and 3, where a higher score indicates poorer quality sleep or worse sleep disturbance. The total PSQI score is derived by summing the component scores and ranges from 0 to 21, with greater than 5 (PSQI>5) referring to poor sleep quality.

Additionally, the PSQI includes questions about sleep patterns such as bedtime, sleep-onset latency, waking up time, and total sleep duration. It also examines how frequent certain disturbance events occurring during sleep, which medications have been used for sleeping problems, and the associated effects on daytime activities. Besides, it examines aspects of participants' perceptions of their sleep quality concerning their well-being and functioning. This holistic appraisal therefore gives an exhaustive assessment of sleep quality and its numerous dimensions-making it very reliable and effective for research and clinical purposes.