ASSOCIATION BETWEEN ULTRA-PROCESSED FOOD CONSUMPTION AND SLEEP QUALITY AMONG STUDENTS IN UNIVERSITI TUNKU ABDUL RAHMAN (UTAR)

By

TAN YA LE

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ABSTRACT

ASSOCIATION BETWEEN ULTRA-PROCESSED FOOD CONSUMPTION AND SLEEP QUALITY AMONG STUDENTS IN UNIVERSITI TUNKU ABDUL RAHMAN (UTAR)

Tan Ya Le

This cross-sectional study investigated the association between ultra-processed food (UPF) consumption and sleep quality among 324 undergraduate students at Universiti Tunku Abdul Rahman (UTAR) using the NOVA food classification system. NOVA categorizes foods into four groups based on processing level: unprocessed or minimally processed foods (UMPF), processed culinary ingredients (PCI), processed foods (PF), and ultra-processed foods (UPF). UPF are industrial formulations containing multiple artificial additives and minimal whole foods, typically high in refined sugars, unhealthy fats, and sodium including items like instant noodles, packaged snacks, and sugar-sweetened beverages. Using the NOVA classification system and the Pittsburgh Sleep Quality Index (PSQI), we assessed dietary patterns and sleep quality. Results revealed that UPF contributed a median of 521.84 kcal (27.87%) in daily caloric intake, which is the second largest contributor. A significant majority (n=221, 68.2%) of students exhibited poor sleep

quality (PSQI > 5). Spearman's correlation analysis demonstrated a moderate positive association between UPF consumption and poorer sleep quality ($\rho = 0.48$, $p < 0.001$), with female students reporting significantly worse sleep than males ($p = 0.044$, <0.05). Key mechanisms linking UPF to sleep disturbances included gut-brain axis dysregulation, systemic inflammation, and neurotoxic additives. Despite limitations such as self-reporting bias and a predominantly Chinese sample, this study highlights UPF as a modifiable risk factor for sleep disorders in Malaysian university students. Interventions targeting dietary habits and sleep hygiene are recommended to improve student well-being.

Keywords: Ultra-processed foods (UPF), sleep quality, NOVA classification, university students, gut-brain axis.

Subject Area: RA601-602 Food and Food Supply in Relation to Public Health

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This project was truly a team effort, and I'm thankful to everyone who contributed in big and small ways.

DECLARATION

I hereby declare that this Final Year Project titled is my original work, except for quotations and citations that have been duly acknowledged. The research and findings presented herein were conducted by me under the supervision of Ms. Nurul Aimi binti Ab Kadir. All sources used in this work have been properly referenced according to the Harvard ARU guidelines. This work has not been previously submitted for any other degree or qualification at this or any other institution.

Tan Ya Le

APPROVAL SHEET

This project report entitled "**ASSOCIATION BETWEEN ULTRA-PROCESSED FOOD CONSUMPTION AND SLEEP QUALITY AMONG STUDENTS IN UNIVERSITI TUNKU ABDUL RAHMAN (UTAR)**" was prepared by TAN YA LE and submitted as partial fulfilment of the requirements for the degree of Bachelor of Science (Hons) Dietetics at Universiti Tunku Abdul Rahman.

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LIST OF ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
COVID-19	Coronavirus Disease of 2019
CRP	C-reactive protein
FFQ	Food Frequency Questionnaire
GABA	Gamma-Aminobutyric Acid
GBA	Gut-Brain Axis
HICs	High-Income Countries
IL-6	Interleukin-6
IQR	Interquartile Range
L-MICs	Lower–Middle-Income Countries
MANS	Malaysian Adult National Survey
NCDs	Noncommunicable Diseases
NF-κB	Nuclear Factor-Kappa
PCI	Processed Culinary Ingredients
PF	Processed Foods
PSQI	Pittsburgh Sleep Quality Index
REM	Rapid Eye Movement
ROS	Reactive Oxygen Species
SPSS	Statistical Package for the Social Sciences
TNF-α	Tumour Necrosis Factor-Alpha
UKNDNS	U.K. National Diet and Nutrition Survey
U-MICs	Upper–Middle-Income Countries

UMPF	Unprocessed or Minimally Processed Foods
UPF	Ultra-Processed Food
UTAR	Universiti Tunku Abdul Rahman

CHAPTER 1

INTRODUCTION

1.1 Research Background

In today's modern world, advancements in science and technology have significantly improved healthcare and medical facilities, leading to an increase in human life expectancy. However, these technological advancements have also contributed to various lifestyle changes, including shifts in dietary habits. One of the most concerning trends in recent years is the growing consumption of ultra-processed foods (UPF), which has been linked to an increase in non-communicable diseases (NCDs). While much research has focused on the physical health implications of UPF consumption, emerging studies suggest a strong relationship between diet and sleep quality.

Sleep disturbances have become a major issue among university students worldwide, and diet is increasingly recognized as a contributing factor. Many students rely on quick, convenient, and inexpensive food options, which are often high in sugar, unhealthy fats, artificial additives, and preservatives. These ingredients have been found to interfere with the body's circadian rhythm, disrupt melatonin production, and lead to poorer sleep outcomes (Alahmary et al., 2019). In Malaysia, where academic pressure is high and irregular sleep patterns are common among students, sleep disorders are on the rise. Given the increasing prevalence of fast-food

consumption and the rising demand for ready-to-eat meals, it is important to explore how ultra-processed food consumption affects sleep quality among the young adults, particularly university students with hectic lifestyle.

Ultra-processed foods are industrially manufactured food products that undergo multiple levels of processing, often containing preservatives, artificial sweeteners, excessive sodium, and unhealthy trans-fats (Babalola et al., 2025). These foods include instant noodles, packaged snacks, soft drinks, processed meats, and fast food, all of which are widely consumed by university students due to their affordability, accessibility, and convenience. However, research has shown that a diet high in UPF negatively impacts sleep patterns in multiple ways. For instance, high sugar content in these foods leads to blood sugar fluctuations, causing difficulties in falling and staying asleep (Shahdadian, Boozari and Saneei, 2022). Additionally, consuming UPFs late at night has been associated with shorter sleep duration and increased nighttime awakenings, further affecting overall sleep quality (Hanifa, Arini and Wahyuningsih, 2024).

Another key aspect of this study is examining the dietary patterns of university students through the lens of food processing levels. Instead of making broad assumptions about "healthy" or "unhealthy" eating by collecting data on food groups consumption, this study specifically analyzing how much of students' diets consist of: (1) unprocessed or minimally processed foods like fresh produce and whole

grains; (2) processed culinary ingredients such as oil and salt; (3) traditionally processed foods like cheeses and canned fish; versus (4) ultra-processed products such as sugary snacks, and ready-to-eat food. While students may recognize that instant noodles or energy bars aren't ideal, they often underestimate how consistently these ultra-processed foods replace balanced meals and how dramatically additives, sugar, and fat content differ from minimally processed foods. By addressing these dietary patterns with sleep quality data, targeted and specific nutritional guidance could be developed to improve both sleep quality and overall wellbeing of students.

1.2 Problem Statements

Although there is growing awareness of the significant association between diet and sleep, there is limited research on sleep and its relationship with ultra-processed food consumption among Malaysian university students. Majority of the published studies on this topic were conducted in Western populations, these findings may not be directly applicable to Malaysia due to cultural, dietary, and lifestyle differences. To date, only one known study in Malaysia has examined the link between dietary habits and sleep quality, revealing a significant association between Western fast food and sweets consumption with poorer sleep among university students (Azli et al., 2023). However, this study was limited to a narrow demographic, the participants of this study are students from a single faculty. Furthermore, this study did not specifically assess UPF intake using quantitative measures, the qualitative

dietary assessment that did not collect exact serving size fail to capture the precise quantity of UPF intake (Azli et al., 2023; Rodríguez et al., 2022).

Moreover, many studies use food frequency questionnaires (FFQs) that were not designed specifically to assess UPF intake specifically, leading to potential misclassification of food items and incomplete data (De Menezes-Júnior et al., 2022; Da Silva Sousa et al., 2020). Additionally, small and homogenous sample sizes which often skewed towards specific demographics such as women, students, or higher socioeconomic groups further limit the applicability of these results to the broader population. For example, research by Duquenne et al. (2024) and Aneesh and Chaganty (2021) noted that their research is female exclusive study and highly educated, raising concerns about representativeness. Furthermore, external factors like lockdowns during the COVID-19 pandemic have confounded the interpretation of UPF's direct impact on sleep quality (De Menezes-Júnior et al., 2022).

This study therefore aims to conduct the first systematic investigation of the association between ultra-processed food consumption and sleep quality in the Malaysian population using quantitative dietary assessment methods specifically designed to measure UPF intake according to the NOVA classification system. The findings will address important knowledge gaps in understanding the Southeast Asian dietary patterns based on degree of processing, particularly UPF consumption

patterns among Malaysian university students and their relationship with quality of sleep.

1.3 General Objective

1. To investigate the impact of ultra-processed food consumption stratified by NOVA food classification on sleep quality among students in UTAR.

1.4 Specific Objectives

1. To analyze the total calorie contribution from UPF group based on the NOVA food classification system among students in UTAR.
2. To study the prevalence of poor sleep quality among students in UTAR.
3. To study the association between ultra-processed food consumption and sleep quality among students in UTAR.

1.5 Hypothesis

1. The consumption of ultra-processed foods (UPF) is higher compared to unprocessed or minimally processed foods (UMPF), processed culinary foods (PCF), and processed foods (PF) among students in UTAR.
2. There is a high prevalence of poor sleep quality among students in UTAR.

3. There is an association between ultra-processed food consumption and sleep quality among students in UTAR.

1.6 Significance of study

Poor sleep quality is a common issue among university students, often linked to stress, irregular schedules, and unhealthy lifestyle habits. At the same time, many students rely on ultra-processed foods (UPFs) like instant noodles, snacks, and fast food due to convenience, affordability, and taste. While existing research has established general connections between dietary patterns and sleep quality, there remains a significant gap in understanding how specifically UPF consumption impacts student populations. Most studies examining diet-sleep relationships have either focused on general adult populations or investigated broad dietary patterns rather than UPF consumption specifically. The unique physiological and lifestyle characteristics of university students, including their high stress levels and irregular schedules may make them particularly vulnerable to the potential sleep-disruption effects of UPFs.

Hence, by examining the association between ultra-processed food (UPF) consumption and sleep quality among university students, the findings of this study can serve as a foundation for health promotion initiatives within the university. Educational programs or workshops could be developed to raise awareness about the negative effects of ultra-processed foods on sleep and overall health. Such

interventions may encourage students to adopt healthier eating habits, ultimately improving their academic performance and well-being. The long-term value lies not just in documenting a health problem, but in providing the evidence base for practical solutions that can meaningfully improve student quality of life.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to Ultra-processed Food

2.1.1 Definition of NOVA Classification and Ultra-processed Food

The NOVA classification is a classification system for foods based on the degree and purpose of their processing rather than on their nutrient composition, developed in 2009 by Carlos A. Monteiro at the University of São Paulo, Brazil. which classifies foods by the extents and purposes of their processing rather than according to nutrients. Traditionally, the food classification systems tend to focus on macronutrients such as proteins, fats, and carbohydrates or food groups such as fruits, vegetables, sweets, etc., whereas the NOVA system introduces a new dimension by looking at the degree and the nature of industrial processing. It classifies foods into four different categories: unprocessed or minimally processed foods; processed culinary ingredients; processed foods; and ultra-processed foods (Monteiro et al., 2019). This categorization system has been extensively used in nutritional epidemiology and public health research to reveal some health impacts of dietary patterns.

According to the NOVA classification, ultra-processed foods (UPFs) are industrial formulations with five or more ingredients, including additives like colours, flavours,

and emulsifiers, as well as substances not typically used in home cooking such as hydrolyzed proteins, high-fructose corn syrup with specific processing techniques such as hydrogenation, extrusion, and molding (Medin et al., 2025). These foods are generally devoid of whole food content and designed to be hyper-palatable, ready-to-eat, and shelf-stable for convenience at the cost of nutritional value (Monteiro et al., 2017). They typically contain high amounts of calories, added sugars, unhealthy fats and sodium, and little dietary fiber, vitamins and minerals. Examples include soft drinks, packaged snacks, instant noodles, reformulated meat products, sweetened breakfast cereals, packaged breads, hamburger and hot dog buns, pre-prepared pizza, pastries, cakes, and cake mixes, sweetened juices, ice creams and frozen desserts, canned, packaged, dehydrated and other instant sauces, drink mixes and seasonings.

Moreover, UPFs contain ingredients like emulsifiers, artificial sweeteners, thickeners and flavoring agents. These artificials additives may disturb gut microbiota and affect hormonal and neurological pathways which involved in hunger, satiety and sleep (Bevilacqua et al., 2024). Hence, UPFs have been linked to a wide range of negative health consequences, including obesity, cardiovascular illnesses, type 2 diabetes, certain cancers and, more recently, poor sleep quality (Henney et al., 2024, Fatima et al., 2025).

2.1.2 Ultra-Processed Food (UPF) Consumption Trends

Ultra-processed foods consumption worldwide has risen sharply in recent decades, contributing to a considerable portion of staple diets globally. According to a cross-sectional data from the U.K. National Diet and Nutrition Survey (UKNDNS), UPFs accounted for 56.8% of the average energy intake in United Kingdom, which reflecting a trend towards more industrialized and convenience-driven food environments (Rauber et al., 2018). In Ireland, the Netherlands, Germany, and Australia, UPF consumption is much higher, with percentages between approximately 35% and 45% (Touvier et al., 2023). Even more striking are numbers for Sweden, Canada, the United Kingdom and the United States, where ultra-processed foods account for between 50% and almost 60% of the energy intake of adults (Touvier et al., 2023).

Furthermore, in Asia, the fast growth of the economy and urbanization of Asia have caused significant changes in dietary habits. In South Korea, for example, UPFs consumption trends among adults from 1998 to 2022 shown a steady increase from 17.41% to 26.71% of total energy intake, with a slight decline during the COVID-19 pandemic (Lee et al., 2025). In China, dramatic dietary shifts towards higher fast food and sugary beverage consumption have also occurred. According to the Baker and Friel (2014), total processed food consumption in lower–middle-income countries (L-MICs) increased at an average annual rate of 5.4%, and in upper–middle-income countries (U-MICs) at 5.1%, between 1999 and 2012. In contrast, high-income countries (HICs) saw only a 0.2% increase. For example, China as one

of the selected U-MICs shown consumption of processed foods per capita rose over 220% from 19.6 kg to 63.4 kg.

Focusing on Malaysia, one study found that there was a significant heterogeneity in the consumption of UPFs based on survey data among low-income Malaysian adults between different ethnic groups, with Malay adults (70.3%) reporting higher consumption of sugar-sweetened beverages (Eng et al., 2022). Furthermore, Malaysia is at particularly high levels of UPFs consumption in comparison with other Asian countries. By 2012, Malaysians were consuming one of the highest per capita intakes of oils and fats, approximately 37 kg more than more than double that of our neighbouring countries such as Thailand and Taiwan (Baker and Friel, 2014). On the other hand, Malaysia, notably, reached processed food consumption levels exceeding some high-income countries.

2.2 Sleep Quality

2.2.1 Definition of Good Sleep Quality

Good sleep quality refers to a state of sleep that leaves a person feeling refreshed, alert, and functionally restored the next day (Harvey et al., 2008). Good sleep quality also means experiencing minimal disturbances, such as waking up no more than once per night and returning to sleep quickly if awakened (National Sleep Foundation, 2024). Although every person has different needs, studies have determined that there are four essential elements of a healthy sleep pattern: duration

of sleep, sleep efficiency, latency of sleep, and wakefulness following sleep onset (Nelson et al., 2021). Firstly, sleep duration should align with age-appropriate recommendations. According to the Centers for Disease Control and Prevention (CDC), it is recommended that adults aged 18 to 60 years should aim for at least 7 hours of sleep per night to support optimal health (CDC, 2024). The second component is the sleep efficiency, which is calculated as the ratio of total sleep time to total time spent in bed, the ratio should be at least 85% for good sleep quality (Kohyama, 2021). Furthermore, the third component, sleep latency, is the time it takes from when you get into bed until you fall asleep. For adults, this ideally takes less than 20 minutes (Buysse, 2014). The consistently extended sleep latency is a symptom commonly found in insomnia and associated with fatigue during the daytime and reduced concentration capacity (Momin and Ketvertis, 2023). Finally, waking after sleep onset refers to how many times, and for how long, a person wakes up during the night after falling asleep. Frequent or long awakenings interrupt the natural sleep architecture, reducing restorative deep sleep and REM sleep. For good sleep quality, the total amount of time awakes after falling asleep should be less than 20 minutes (Ohayon et al., 2016).

2.2.2 Global Sleep Hour Epidemiology

Sleep behaviours are culturally relative, varying across countries in response to social, economic, and environmental factors. A large-scale study of self-reported sleep duration involving 730,000 adults from 63 countries identified three phases of

adult sleep: early adulthood (19–33 years), mid-adulthood (34–53 years), and late adulthood (54+ years). On average, adults sleep about 7 hours nightly worldwide, but this amount decreases during mid-adulthood and increases again in later years (Coutrot et al., 2022). The findings also revealed gender differences where women reported sleeping approximately 7.07 hours per night, averaging 7.5 minutes longer than men, who reported 6.94 hours (Coutrot et al., 2022). Additionally, people in East Asian countries, such as Malaysia, tend to report shorter sleep durations compared to other global regions. In Malaysia specifically, a cross-sectional study involving over 11,000 working adults found that more than half reported sleeping less than the recommended 7 hours per night. Factors such as high psychological distress, smoking, poor sleep environments, and mental health challenges were found to contribute to this pattern (Chan et al., 2021). Among specific populations, medical students are more likely to suffer from sleep deprivation. A meta-analysis involving 35 studies and over 18,000 medical students globally found that the average sleep duration in this group was only 6.5 hours per night (Binjabr et al., 2023). This is well below the recommended range and has serious implications for cognitive performance, learning, and emotional regulation. This may be due to the demands of academic life, irregular schedules, and stress, contributing to significantly reduced sleep.

2.2.3 Prevalence of Poor Sleep Quality in Malaysia

Poor sleep quality is emerging as a public health issue in Malaysia. A study among Malaysian adults aged between 30 and 70 years, 33.8% of them have insomnia and

12.2% reported chronic insomnia (Zailinawati et al., 2008). On top of that, respondents with insomnia were reportedly more likely to experience physical symptoms such as perceived poor health status (40.9 %), difficulty concentrating (19.1 %), feeling depressed (12.7 %), feeling tired or exhausted (17.2 %), poor memory (9.2 %) and decreased ability to work (6.4 %). One study that employed Pittsburgh Sleep Quality Index (PSQI) rating in similar settings showed that 42.7% of the Malaysian university academic staff reported poor sleep quality (Thiagarajah, Sit and Chee, 2023). Besides, Malaysian undergraduate students experienced unsatisfactory sleep quality and are at a higher risk for poor sleep quality. According to a study's findings in 2018, 70.6% of the 313 undergraduate students at the public university had poor overall sleep quality (Nurismadiana and Lee, 2018). Another more recent study in Malaysia also reported that 73.7% of university students is having poor sleep quality (Ong, Azman and Ho, 2023). Research finds that academic pressures and irregular schedules, along with too much screen time may disrupt sleep quality (Ginsberg, 2006). Additionally, a study identified that time management problems and psychological issues, and diet behaviours were among main predictors of impaired sleep, again adversely impacting academic performance among university students (Muro et al., 2020).

2.3 Mechanistic Pathways Linking Ultra-Processed Foods (UPFs) to Sleep Disruption

2.3.1 Gut-Brain Axis Dysregulation

The gut-brain axis (GBA) is a two-way communication network linking the digestive system and brain (Carabotti et al., 2015). This system is heavily influenced by the gut microbiome with trillions of bacteria, viruses and fungi residing in the intestines. The gut microbiome plays a critical role in producing neurotransmitters like dopamine, serotonin, and gamma-aminobutyric acid (GABA), which regulate mood, immunity and even sleep (Mhanna et al., 2024). When UPFs are consumed, this well-balanced microbiome environment goes out the window, triggering a domino effect that negatively impacts the quality of sleep. The gastrointestinal tract produces around 90% of a neurotransmitter called serotonin that is responsible for regulation of mood and sleep (Shah et al., 2021). Add on to that, bacteria belonging to *Streptococcus*, *Lactobacillus*, and *Escherichia coli* in our guts can express tryptophan synthetase, that convert tryptophan (an amino acid from food) into serotonin and that's later converted into melatonin which is the sleep hormone in the brain (Gao et al., 2019). UPFs are generally low in fiber and high in artificial additives will reduce the gut bacteria diversity required for serotonin synthesis (Rondinella et al., 2025). Consequently, the melatonin production drops, leading to difficulty in falling asleep.

2.3.2 Systemic Inflammation

Systemic inflammation is a persistent, low-level immune system response that impacts the whole body rather than a targeted region. Such inflammation can be triggered by unhealthy dietary habits and contributes to sleep disturbances (Giridharan et al., 2023). Inflammatory factors especially blood-borne cytokines, such as tumour necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6) can cross the blood-brain barrier (Banks, 2008). These cytokines can affect the pineal gland function in brain, suppressing the secretion of melatonin, and disrupting sleep-wake cycles (Song, 2019). UPFs are loaded with inflammation-promoting ingredients like refined sugars, trans fats, artificial additives, and lots of sodium (Asensi et al., 2023). For instance, refined sugars consumption can lead to postprandial glucose excursions, causing chronic sustained hyperglycaemia. This sudden spike of postprandial glucose is associated with short-term stress on the body, causing an increased production of reactive oxygen species (ROS) and activating pathways that lead to oxidative stress and production of inflammatory factors (Minihane et al., 2015). Moreover, trans fats, which are present in fried snacks and baked items, trigger pro-inflammatory molecules, including a protein complex known as nuclear factor-kappa B (NF-κB) that promote inflammation (Oteng and Kersten, 2019). On top of that, studies have shown that high UPFs consumption daily will elevate inflammatory marker CRP levels in blood (Mete et al., 2024). Over time, these ingredients create a state of constant alert on the immune system, even when there's no real threat, such as infection or injury. As melatonin secretion is continuously suppressed, sleep quality is disrupted.

2.3.3 Artificial Additives and Neurotoxicity

Artificial additives such as food dyes, flavour enhancers, and preservatives, are used in processed foods to enhance colour, taste and shelf life. However, growing evidence associates these chemicals with neurotoxicity effects that lead to poor sleep quality. Synthetic food dyes such as Tartrazine (E102) and Allura (E129) have been associated with behavioural disturbances. Research indicates that 7.5mg consumption of these dyes have been linked to hyperactivity and distractibility, both of which are precursors of sleep disorder (Arnold, Lofthouse and Hurt, 2012). For instance, in a large-scale trial, children exposed to mixtures of dyes were more restless and had greater trouble settling down at bedtime, even at doses comparable to those in everyday snacks (Miller et al., 2022). These effects are thought to stem from the dyes' disruption of pathways for dopamine and norepinephrine, neurotransmitters important for regulating focus and relaxation (Damotharan et al., 2024). In addition, aspartame, a widely used artificial sweetener, metabolizes into phenylalanine, aspartic acid and methanol, all of which can cross the blood-brain barrier (Czarnecka et al., 2021). Chronic consumption has been associated with microglial inflammation whereby immune cells in the brain become overactive leading to oxidative stress and neuronal damage (Dar, 2024). This inflammation affects melatonin production, in addition to causing an increase in cortisol, a stress hormone that has been shown to postpone sleep onset (Muzio, Viotti and Martino, 2021; Schramm and Waisman, 2022). Not to mention that animal studies have shown that aspartame exposure of 30 to 50mg/kg/day is associated with less REM sleep and more nighttime awakenings, which are similar to symptoms reported in humans with insomnia (Choudhary and Lee, 2017; Chen et al., 2023).

CHAPTER 3

MATERIALS AND METHODS

3.1 Methodology

This cross-sectional study was carried out from October 2024 to April 2025 among the university students in Universiti Tunku Abdul Rahman (UTAR), Kampar and Sungai Long campuses. Participants were recruited using convenience sampling through online platforms and physical outreach on campus. This study targeted the students of UTAR in all faculties to investigate the association between consumption of ultra-processed foods (UPF) on sleep quality.

3.2 Field of Sample and Targeted Population

The specific sample population targeted for this study were the undergraduate and postgraduate students who are studying in the Universiti Tunku Abdul Rahman (UTAR) campuses located in Kampar and Sungai Long, Malaysia. This served to ensure a homogenous group of subjects sharing similar institution and environmental exposure. The participants were limited to the students who enrolled in UTAR from all fields of study, including health sciences, engineering, business, and humanities, to get the characteristics of dietary intake and lifestyles across the age range of students that these academic disciplines can offer in terms of schedules and stressors. The study focused on one university, which reduced institutional

variability but allowed detailed examination of UPF consumption and sleep quality in a controlled educational context. Participants were recruited from both campuses in consideration of potential geographic variance in the accessibility of food and culture on campus; however, all respondents shared the same contextual environment of UTAR's academic setting.

3.3 Sample Size

To determine the appropriate sample size for the target population, the Cochran formula (1963) was used. This formula is suitable for estimating sample sizes when the population is large or unknown as the current population size of UTAR students were unknown.

The Cochran formula is stated as:

$$n = \left(\frac{z_a}{d}\right)^2 \times p(1-p)$$

Where:

- n = required sample size
- Z_α = Z-value corresponding to the desired confidence level (1.96 for 95% confidence)
- p = estimated prevalence of poor sleep quality among university students (0.703) (Nurismadiana and Lee, 2018)
- d = margin of error (0.07) (Asma, et al., 2019)

Substituting the values:

$$n = \left(\frac{z_a}{d}\right)^2 \times p(1-p)$$

$$n = \left(\frac{1.96}{0.07}\right)^2 \times 0.706\ (1 - 0.706)$$

$$n = 162.77$$

$$n \approx 163$$

To compensate for potential non-response or incomplete data, an additional 10% was added to the calculated sample size:

$$n = \ 163 + 10\%$$

$$= 179.3$$

$$\approx 180 \text{ respondents}$$

Thus, the final sample size determined for this study was 180 participants. Sampling was conducted using convenient sampling, and participation was voluntary with informed consent obtained from all respondents.

3.4 Inclusion and exclusion criteria

The sample size of interest is students 18 to 25. The inclusion of participants aged 18 to 25 years was consistent with the common age range of university cohorts in Malaysia. Furthermore, this age group is often referred to as "emerging adults," a developmental phase marked by increased independence, identity exploration, and lifestyle transitions. These factors are known to significantly influence both dietary habits and sleep patterns, making this age group particularly relevant for studies examining the relationship between ultra-processed food (UPF) consumption and

sleep quality. It is also a crucial period for the establishment of long-term health behaviors, including eating and sleep routines (Becker et al., 2018). On top of that, international students of UTAR were excluded. By restricting the sample to Malay nationals, we ensured that our study population was culturally and socioeconomically homogeneous, thus avoiding confounding by variations in dietary practices or lifestyles in different nations. Furthermore, individuals with pregnancy and non-communicable diseases (NCDs) such as diabetes, hypertension, cardiovascular disorders, or chronic respiratory disease were excluded from the study. Women who are pregnant were excluded because they will have potential to change their dietary habits, metabolic demands, and sleep quality, thus, confounding the relationship between UPF consumption and sleep quality (Von Ash et al., 2023). Likewise, patients with NCDs were excluded since these diseases frequently require changes in the diet such as lower salt, sugar or fat intake, and may directly impact sleep quality via symptoms or the side effects of medications. Similarly, individuals with eating disorders were excluded as such conditions are closely associated with disordered eating patterns and disrupted sleep architecture. Eating disorders can lead to both over- and under-consumption, irregular meal timing, and psychological distress, which may skew the relationship between UPF consumption and sleep quality. Their inclusion could introduce biases and undermine the internal validity of the study.

Table 3.1 Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
UTAR local students	UTAR international students
Age between 18-25	Age <18 and >25
	Pregnancy

	Non-communicable diseases (NCDs)
	Eating disorder

3.5 Ethical Approval

The study was conducted in accordance with the ethical principles and was formally approved by the Universiti Tunku Abdul Rahman (UTAR) (U/SERC/78-395/2024). All respondents received an extensive explanation of the aim and procedures of the study, as well as the potential risks and benefits prior to participation. For online participants, written informed consent was electronically obtained through JotForm; and for physically recruited participants, informed consent was obtained in hard copy. Participants' confidentiality was guaranteed, data were stored in password-protected files and presented in an anonymized manner which accessible only to the research team. Participants were also informed that they could withdraw any time without penalty. No incentive was given to minimize coercion, and all data was used for research purposes only.

3.6 Questionnaire Development

The study utilized a structured questionnaire adapted from validated instruments to assess ultra-processed food (UPF) consumption and sleep quality. The questionnaire was developed by compiling and modifying existing standardized tools, including Pittsburgh Sleep Quality Index (PSQI), a validated 19-item tool (Buysse et al., 1989) to assess sleep quality over the past month. In addition, the food frequency questionnaire (FFQ) is specially developed for this study since there is no existing

questionnaire which classify food into four groups based on NOVA classification to determine UPF consumption in Malaysia. Thus, a quantitative FFQ was created, and food items were grouped manually based on NOVA classifications into four categories.

3.6.1 Tools for Data Collection

A structured questionnaire in English created in 'Jotform' was used for data collection. The questionnaires were electronically spread via email and messaging platforms and distributed physically using printed copies on campus. The questionnaire was made up of three sections as follows.

3.6.2 Section A: Sociodemographic Questionnaire

This section is composed of five close-ended questions aimed at obtaining general sociodemographic characteristics of study subjects. These questions were related to the age of the respondent in years, gender, ethnicity, current field of study grouped by faculty, and level of study. Pre-defined options were being given to each question for the standardization of the data collection process and analysis purposes. The participants were instructed to select the single most appropriate answer for each question from the choices available.

3.6.3 Section B: Food Frequency Questionnaire (FFQ)

For this study, a validated food frequency questionnaire (FFQ) was used to obtain food consumption patterns among university students in Malaysia. Since there is no FFQ in Malaysia tailored specifically for collecting UPFs intake, the food items in Malaysian Adult National Survey (MANS) 2014 were classified manually based on the NOVA classification system into four groups according to the degree of processing: unprocessed or minimally processed foods (UMPF), processed culinary ingredients (PCI), processed foods (PF), and ultra-processed foods (UPF) based on the Brazil Dietary Guidelines and references from the Centre for Epidemiological Studies in Health and Nutrition Brazil (Monteiro et al., 2016; Ministry of Health of Brazil et al., 2014).

The serving size and calorie reference values were obtained from established Malaysian nutrition databases the Atlas of Food Exchanges and Portion Sizes (Shahar et al., 2015) and the Malaysian Food Composition Database (MyFCD, 2015). Furthermore, visual aids of the size of common household measurements were included in the FFQ to increase the accuracy of reporting the size of servings. The full details of the FFQ can be seen in **Appendix A**. Respondents were required to fill in the number of serving size eaten per time, select the most relevant frequency of consumption (daily, weekly, monthly, none) and number of frequencies eaten.

All dietary data collected were then organized in a systematic manner and analyzed by Microsoft Excel. For each food item eaten, caloric intake per food item was calculated by first obtaining the amount of food eaten in grams:

Amount of food (g)

=Serving size x Total number of servings x Weight of food in one serving x Conversion factor

The conversion factors were applied based on the frequency of food consumption according to MANS 2003 (Ministry of Health Malaysia, 2008):

Table 3.2 Conversion Factors for Intake Calculation Based on Frequency of Consumption

Variables	Choices	Conversion Factor
Per day	Once	1
	Twice	2
	3 times	3
Per week	Once	1/7
	Twice	2/7
	3 times	3/7
Per month	Once	1/30
	Twice	2/30
	3 times	3/30

Once the amount of food was determined, the total caloric intake was calculated using the formula:

$$\text{Calories of food (kcal)} = \frac{Amount\ of\ food\ (g) \times Energy\ of\ food\ per\ 100g\ (kcal)}{100}$$

The total daily caloric intake was then assessed by summing the calorie intake of food items from all food groups:

Total calorie intake= Sum of calorie intake from 98 food items (kcal/day).

Table 3.3 The List of FFQ Food Items Classified Using NOVA Classification System, Serving Size, and Calorie per Serving (kcal)

	Food Item	Serving Sizes	Energy per serving (kcal)
	Group 1		
1	White rice	Scoop 76.3g	99
2	Brown rice	Scoop 76.3g	91.03
3	Rice porridge	Cup 166g	63.08
4	Corn	Cup 222.1g	788
5	Chicken	Slice 65.5g	99
6	Meat/Beef	Match Box 30g	32.7
7	Mutton	Match Box 30g	38.7
8	Pork	Match Box 30g	56.7
9	Fresh Fish	Whole 276.0g	400
10	Prawn	Whole 6.5g	5
11	Squid	Whole 81.1g	62
12	Crab	Whole 128.4g	109
13	Chicken egg	Whole 46g	71
14	Quail egg	Whole 10.12g	17
15	Fresh milk	Glass 250ml	166
16	Leafy green (spinach, *kangkung*, *bayam*, etc.)	Tablespoon 14g	3.87
17	Cabbage, broccoli, *pak choi*, cauliflower	Tablespoon 14g	3.22
18	Tubers (potatoes, yam, sweet potatoes)	Tablespoon 14g	12.04
19	Fruit vegetables (pumpkin, baby corn, cucumber)	Tablespoon 14g	5.18
20	Fresh salad with no dressing	Tablespoon 14g	13.034
21	Fresh mushrooms	Tablespoon 14g	5.18
22	Papaya	Slice 158.9g	56
23	Mango	Slice 148.7g	103
24	Watermelon	Slice 133.5g	37
25	Dragon fruit	Slice 406.28g	209
26	Honey dew	Slice 165.75g	39
27	Guava	Slice 110.5g	51
28	Banana	Whole 100g	103
29	Apple	Whole 112.2g	63
30	Orange	Whole 77.4	38
31	Pear	Whole 157.2g	53
32	Grape	1 piece 11.01g	7.5
	Group 2		
1	Butter	Teaspoon 7.05g	37.6

2	Sugar	Teaspoon 7.05g	19.9
3	Honey	Teaspoon 7.05g	15.7
4	Salt	Teaspoon 5g	0
5	Coconut oil	Teaspoon 1.95g	44.85
6	Olives oils	Teaspoon 6.45g	44.19
7	Sunflowers oils	Teaspoon 1.65g	44.7
	Group 3		
1	Rice vermicelli/Rice noodle/*Loh shi fun*	Cup 141g	177.6
2	Wholemeal bread	Piece 30.75g	77
3	Ham	Piece 45.4g	136
4	Bacon	Piece 22.6g	52
5	Pickled fish	Piece	205
6	Canned fish	Piece 34.1g	40
7	Tempeh	Piece/slice 70.9g	112
8	Yoghurt/lassi/tairu	Cup	100.46
9	Cheese	Cup 190.4g	567
10	Salted vegetable	Tablespoon 14g	5.6
11	Canned fruit	Tablespoon 14g	10.22
12	Dried fruit	Tablespoon 14g	50.26
13	Beer/lager/ale/stout	Glass 250ml	107.5
14	Wine/cider/champagne/perry	Glass 250ml	96.8
15	Red wine/lining	Glass 250ml	81.82
	Group 4		
1	Pasta	Cup 280g	152.74
2	*Roti canai*	Piece 95g	301
3	*Tosai*	Piece 85g	203.83
4	Instant cereal	Cup 100g	379
5	Fried chicken	Piece 90g	255
6	Pizza	Slice 94.4g	268
7	French fries	Cup 90.1g	290
8	Mashed potato	Cup 93.6g	87
9	Coleslaw	Cup 74g	62
10	Chicken balls	Piece 18g	21
11	Luncheon meat	Piece 46.7g	146.17
12	*Keropok ikan, udang, sotong*	Cup 32.7g	167
13	Fish/ prawn/ squid/ crab ball or cake	Piece 28.45g	24
14	Chocolate milk	Glass 250ml	174
15	Malted milk	Glass 250ml	254
16	Cordial syrup	Glass 250ml	193
17	Fruit juice	Glass 250ml	78.81
18	Carbonated drink	Glass 250ml	50
19	Energy drink	Glass 250ml	101
20	Yoghurt drinks	Glass 250ml	87.5
21	Local *kuih*	Piece 87g	132

22	Sweets	Piece 24g	98.88
23	Chocolate bar	Slice 50g	275
24	Cake	Slice 23g	100
25	Jelly/Custard	Slice 280g	193
26	Lolly ice (no milk)	Piece 80g	53.54
27	Ice cream (milk)	Cup 100g	81
28	Flavoured/ cream/ filled cookies	Piece 9.65	45
29	Pastry	Piece 84.34	331
30	Snacks/ Crackers	Piece 28	141
31	Jam	Teaspoon 5g	15.15
32	Coconut Jam/ *kaya*	Teaspoon 5g	13.05
33	Margarine	Teaspoon 5g	36.6
34	Peanut butter	Teaspoon 5g	29.9
35	Cream cheese	Teaspoon 5g	16.25
36	Chocolate spread	Teaspoon 5g	25.9
37	*Sambal*	Teaspoon 5g	7.61
38	Soy sauce	Teaspoon 5g	3.7
39	Chili sauce	Teaspoon 5g	5.65
40	Tomato sauce	Teaspoon 5g	5.55
41	Oyster sauce	Teaspoon 5g	4.3
42	Salad dressing	Teaspoon 5g	21.64
43	Sausage/hotdog/frankfurter	Piece 32.9g	106
44	Nugget	Piece 90g	244

3.6.4 Section C: Pittsburgh Sleep Quality Index (PSQI) for Sleep Quality Assessment

PSQI is a validated self-rated questionnaire sleep assessment tool developed by Buysse, D. J., Reynolds, C. F., 3rd, Monk, T. H., Berman, S. R., and Kupfer, D. J. in 1989 to quantifies sleep quality and disturbances over a 1-month time interval. This section composed of 19 self-rated questions that are indexed into seven major components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. With a series of questions, respondents were required to fill in or choose from a list

of multiple-choice options that capture the frequency or severity of their sleep-related issues.

Each answer was assigned with a numerical value, a higher score will indicate poorer sleep quality. Each of the seven components is scored between 0 and 3, and these component scores are summed up to create a global PSQI score ranging from 0 to 21. A total score of 5 or less = good sleep quality; > 5 = poor sleep quality. In the original validation study, the PSQI showed a strong test-retest reliability (r = 0.85) over 28 days (Buysse et al., 1989). The full details of this section can be seen in **Appendix A**.

3.7 Data Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) Software version 30.0. For all statistical tests, the significance level of $p<0.05$ was considered statistically significant. The normality of the continuous data was assessed using the Anderson-Darling test. The results from the Anderson-Darling test indicated that all the continuous data was not normally distributed, with all variables yielding low p-values ($p<0.001$) and were displayed into normal Q-Q plot (**Appendix B**).

Descriptive statistics were calculated to summarize the data. Categorical variables were presented in terms of frequency (n) and percentage (%), while continuous variables were described using the median and Interquartile Range (IQR), as the data were not normally distributed. Moreover, the association between UPF consumption and sleep quality was examined using Spearman's rank correlation. This non-parametric test was chosen due to the ordinal nature of the data, allowing for the assessment of the strength and direction of a monotonic relationship between the two variables. The correlation coefficient and corresponding p-value were used to interpret the significance and strength of this association. Additionally, a Chi-squared test was used to investigate the association between gender and sleep quality as both variables were categorical.

CHAPTER 4

RESULTS

4.1 Background Information

The purposes of this study were threefold. First, it aimed to determine the total calorie contribution from NOVA food groups based on the NOVA food classification system among UTAR students. Second, the study sought to assess the prevalence of poor sleep quality within the same student population. Finally, it aimed to investigate the potential association between ultra-processed food consumption and sleep quality among UTAR students. These objectives were designed to explore dietary patterns, sleep health, and their possible interrelationships.

4.2 Sociodemographic Characteristics of Study Sample

The study sample has a total of 324 participants, who are UTAR students from both Kampar and Sungai Long campuses. The age distribution showed that the majority of participants were between 21 and 22 years old, accounting for 29.3% (n=95) and 20.7% (n=67) of the sample, respectively. Younger age groups 18–20 years represented 30.0% (n=97) of the sample, while older participants 23–25 years made up 20.1% (n=65).

In terms of gender, female participants have a larger proportion (58.6%) compared to males (39.5%). Furthermore, ethnicity data shown that the sample was predominantly Chinese (98.1%, n=318), with small representations from Malay (0.6%) and Indian (1.2%) ethnic groups.

The participants were distributed across all the faculties in UTAR, with the Faculty of Science (FSc) having the highest representation at (38.3%), followed by the Faculty of Business and Finance (FBF) at (25.9%). Regarding the education levels, participants were mainly enrolled in degree programs (91.4%), while a small percentage were in foundation (7.7%, n=25) or master programs (0.9%).

Table 4.1: Sociodemographic Characteristics of the Respondents (n=342).

Characteristics	n (%)		
	Male (n=129)	Female (n=195)	Total (n=324)
Age (years)			
18	10 (3.1)	3 (0.9)	13 (4.0)
19	12 (3.7)	22 (6.8)	34 (10.5)
20	10 (3.1)	40 (12.3)	50 (15.4)
21	32 (9.9)	63 (19.4)	95 (29.3)
22	29 (9.0)	38 (11.7)	67 (20.7)
23	12 (3.7)	20 (6.2)	32 (9.9)
24	17 (5.2)	8 (2.5)	25 (7.7)
25	6 (1.9)	2 (0.6)	8 (2.5)
Ethnicity			
Chinese	128 (39.5)	190 (58.6)	318 (98.1)
Malay	0 (0.0)	2 (0.6)	2 (0.6)
Indian	1 (0.3)	3 (0.9)	4 (1.2)
Faculty			
FEGT	8 (2.5)	2 (0.6)	10 (3.1)

FICT	8 (2.5)	6 (1.9)	14 (4.3)
FSc	43 (13.3)	81 (25.0)	124 (38.3)
FBF	34 (10.5)	50 (15.4)	84 (25.9)
FAS	6 (1.9)	24 (7.4)	30 (9.3)
CFS	16 (4.9)	12 (3.7)	28 (8.6)
FCI	1 (0.3)	5 (1.5)	6 (1.9)
ICS	0 (0.0)	2 (0.6)	2 (0.6)
FAM	3 (0.9)	5 (1.5)	8 (2.5)
LKC FES	11 (3.4)	5 (1.5)	16 (4.9)
FMHS	2 (0.6)	0 (0.0)	2 (0.6)
Education			
Foundation	13 (4.0)	12 (3.7)	25 (7.7)
Degree	112 (34.6)	184 (56.8)	296 (91.4)
Master	2 (0.6)	1 (0.3)	3 (0.9)

4.3 Total Calorie Contribution of Food Groups Based on NOVA Food Classification

Table 4.2 shows the median, interquartile range (IQR), minimum, and maximum values for calorie intake of four food groups: unprocessed or minimally processed food (UMPF), processed culinary food (PCF), processed food (PF), and ultra-processed food (UPF) based on the NOVA food classification system.

In Group 1, which is the unprocessed or minimally processed foods (UMPF), contributes the highest median caloric intake at 1113.77 kcal, accounting for 59.47% of total intake. The IQR for this group ranged from 781.69 to 1567.82 kcal, indicating a wide variability of food intake in this food group among respondents. The minimum caloric contribution from Group 1 was 307.58 kcal, while the maximum reached 3614.34 kcal.

Moving on to Group 2, consisting of processed culinary ingredients (PCI) like oils and sugars, has the lowest median contribution of 46.05 kcal or 2.46% of the total energy intake. Its IQR ranged from 16.63 to 101.09 kcal. The minimum value was 0 kcal, suggesting that some individuals may not consume this group at all, while the maximum was 959.58 kcal. However, it is highly unlikely that any respondent completely avoided food from NOVA Group 2 because these food items are used in preparation and cooking of meals. For instance, oils are commonly used for frying or cooking, and sugar and salt are added to dishes or beverages. These ingredients are rarely consumed on their own, hence, respondents may not be aware of or consider these ingredients when reporting their food intake.

In Group 3, which is processed foods (PF) such as canned vegetables or cheese, has a median caloric contribution of 191.06 kcal, representing 10.20% of total intake. The IQR was between 87.66 and 448.82 kcal. Like Group 2, the minimum caloric intake from Group 3 was 0 kcal, and the maximum reached 2996.12 kcal, indicating high variability in consumption among individuals. Some people may rely heavily on processed foods, while others may avoid them completely or consume very little, reflecting diverse dietary habits within respondents.

Finally in Group 4, representing ultra-processed foods (UPF) such as soft drinks, packaged snacks, and ready-to-eat meals, contributes a median of 521.84 kcal, which accounts for 27.87% of total calorie intake. The IQR ranged from 216.79 to

926.72 kcal. The minimum value was 0 kcal, while the maximum was the highest among all groups at 3969.18 kcal, emphasizing that some individuals rely heavily on ultra-processed foods, which may contribute significantly to their daily calorie intake.

Overall, the study found that unprocessed or minimally processed foods (Group 1) contribute the highest percentage of total calorie intake, with 59.47% (1113.7 kcal), followed by ultra-processed foods (Group 4) at 27.87% (521.84 kcal). Processed foods (Group 3) accounted for 10.20% (191.06 kcal), while processed culinary ingredients (Group 2) contributed the least, at 2.46% (46.05 kcal).

Table 4.2: Contribution of Calorie in Each Food Groups (kcal) Classified using the NOVA Classification System of Respondents.

NOVA Food Group	Median (%)	IQR	Minimum	Maximum
Group 1	1113.77 (59.47)	781.69 - 1567.82	307.58	3614.34
Group 2	46.05 (2.46)	16.63 - 101.09	0.00	959,58
Group 3	191.06 (10.20)	87.66 - 448.82	0.00	2996.12
Group 4	521.84 (27.87)	216.79 - 926.72	0.00	3969.18

4.4 Prevalence and Distribution of Sleep Quality Among UTAR Students Based on the Pittsburgh Sleep Quality Index (PSQI)

Table 4.3.1 showed the details of the distribution in various components of the Pittsburgh Sleep Quality Index (PSQI). Firstly, majority of the students (n=213,

62.7%) rated their subjective sleep quality as fairly good, followed by fairly bad (n=80, 24.7%), only a small number (n=6, 1.9%) indicated that their sleep quality was very bad. Moreover, half of the respondents (n=173, 53.4%) reported sleeping between 6 and 7 hours and nearly half of students had sleep efficiency greater than 85% (n=176, 54.3%). Most of the students (n= 247, 76.2%) reported experiencing mild sleep disturbance. On top of that, majority of the students (n=301, 92.9%) reported not using sleep medication during the past month. However, the results of the overall PSQI score demonstrated that a large number of students (n=221, 68.2%) scored more than 5, indicating poor sleep quality, showed that majority of the students do not have good quality of sleep.

Table 4.3.1: Distribution of Frequency of Each Component in the Pittsburgh Sleep Quality Index (PSQI) by score.

Component		Frequency (%)
Subjective Sleep Quality (C1)	Very Good (0 point)	35 (10.8)
	Fairly Good (1 point)	203 (62.7)
	Fairly Bad (2 point)	80 (24.7)
	Very Bad (3 point)	6 (1.9)
Sleep Latency (C2)	0 (0 point)	102 (31.5)
	1-2 (1 point)	149 (46.0)
	3-4 (2 point)	56 (17.3)
	5-6 (3 point)	17 (5.2)
Sleep duration(C3)	>7hours (0 point)	44 (13.6)
	6-7hours (1 point)	173 (53.4)
	5-6hours (2 point)	100 (30.9)
	<5hours (3 point)	7 (2.2)
Sleep Efficiency (C4)	>85% (0 point)	176 (54.3)
	75-84% (1 point)	94 (29.0)
	65-74% (2 point)	30 (9.3)
	<65% (3 point)	24 (7.4)
	0 (0 point)	45 (13.9)

Sleep Disturbance (C5)	1-9 (1 point)	247 (76.2)
	10-18 (2 point)	29 (9.0)
	19-27 (3 point)	3 (0.6)
Use of Sleep Medication (C6)	Not during the past month (0 point)	301 (92.9)
	Less than once a week (1 point)	21 (6.5)
	Once or twice a week (2 point)	2 (0.6)
	Three or more times a week (3 point)	0 (0.0)
Daytime Dysfunction (C7)	0 (0 point)	97 (29.9)
	1-2 (1 point)	156 (48.1)
	3-4 (2 point)	64 (19.8)
	5-6 (3 point)	7 (2.2)
Sleep Quality Global PSQI Score (0-21)	≤5 (Good)	103 (31.8)
	>5 (Poor)	221 (68.2)

Table 4.3.2 presented the prevalence of poor sleep quality based on sociodemographic factors. In terms of gender, the results show that a higher proportion of female students reported poor sleep quality compared to male students. Specifically, 61 female students (59.2%) reported good sleep quality, while 134 (60.6%) had poor sleep quality. On the other hand, 42 male students (40.8%) reported good sleep quality, while 87 (39.3%) experienced poor sleep quality. This suggests that female students may be more likely to experience poor sleep compared to male. Furthermore, there is an increase in the proportion of poor sleep quality as students get older. For example, 33.5% (n=74) of 21-year-olds reported poor sleep quality, the highest proportion in the age groups analyzed. This suggested that older students may experience more sleep difficulties, potentially due to academic or personal pressures.

In terms of ethnicity, data shows a very high percentage of Chinese students, which accounts for the majority of the sample. This imbalance, with 98.1% (n=101) of students reporting good sleep quality and 98.2% (n=217) reporting poor sleep quality falling into the Chinese ethnic group, limits the representativeness of the findings for other ethnicities, whose numbers were much smaller. This skewness makes it difficult to draw accurate conclusions about sleep quality across all ethnic groups at UTAR.

Similarly, data from the faculty category showed imbalances in the distribution of students across different academic departments. The Faculty of Science (FSc) and Faculty of Business and Finance (FBF) have relatively high proportions of students reporting good sleep quality, while Faculty of Medicine and Health Sciences (FMHS) and Institute of Chinese Studies (ICS), with fewer students in the sample, shows a lower proportion of good sleep quality. Small sample sizes in some faculties can result in highly variable results, which may not be representative of the trends within the university.

Finally, the education level data showed that majority of the students are enrolled in degree programs, with 96.1% (n=99) of degree students reporting good sleep quality. Foundation students make up a smaller portion of the sample, and only few students are in master's programs. This distribution highlights that majority of the

respondents are degree-level students, which may not fully represent the sleep quality of students at other education levels.

Table 4.3.2: Prevalence of Poor Sleep Quality by Sociodemographic Factors Among UTAR Students.

Characteristics	Sleep Quality	
	Good (n=103) n (%)	Poor (n=221) n (%)
Gender		
Male	42 (40.8)	87 (39.3)
Female	61 (59.2)	134 (60.6)
Age (years)		
18	5 (4.9)	8 (3.6)
19	13 (12.6)	21 (9.5)
20	16 (15.5)	34 (15.4)
21	21 (20.4)	74 (33.5)
22	19 (18.4)	48 (21.7)
23	15 (14.6)	17 (7.7)
24	10 (9.7)	15 (6.8)
25	4 (3.9)	4 (1.8)
Ethnicity		
Chinese	101 (98.1)	217 (98.2)
Malay	1 (0.95)	1 (0.4)
Indian	1 (0.95)	3 (1.4)
Faculty		
FEGT	3 (2.9)	7 (3.2)
FICT	4 (3.9)	10 (4.5)
FSc	43 (41.7)	81 (36.7)
FBF	33 (32.0)	51 (23.1)
FAS	6 (5.8)	24 (10.9)
CFS	6 (5.8)	22 (10.0)
FCI	1 (1.0)	5 (2.3)
ICS	0 (0.0)	2 (0.9)
FAM	3 (2.9)	5 (2.3)
LKC FES	2 (1.9)	14 (6.3)
FMHS	2 (1.9)	0 (0.0)
Education		
Foundation	4 (3.9)	21 (9.5)

Degree	99 (96.1)	197 (89.1)
Master	0 (0.0)	3 (1.4)

This study found that the prevalence of poor sleep quality was significantly higher among female university students compared to male. To confirm the statistical significance of this difference, a post-hoc test was conducted using the Chi-square test. The result presented in Table 4.3.3 with a chi-square value of 4.046 and p-value of 0.044 (<0.05) indicated a statistically significant association between gender and poor sleep quality, suggesting that female students are more likely to experience sleep disturbances than males.

Table 4.3.3: Association between Consumption of Ultra-Processed Food (UPF) with Sleep Quality.

Gender	Good Sleep Quality (n=103) n (%)	Poor Sleep Quality (n=221) n (%)	χ^2 (Chi-Square)	p-value
Male	42 (40.8)	87 (39.3)	4.046	0.044
Female	61 (59.2)	134 (60.6)		

4.5 Association between Consumption of Ultra-Processed Food (UPF) with Sleep Quality

Table 4.4.1 presented the results of a Spearman correlation test conducted to assess the association between total energy intake from ultra-processed foods (UPF) in kilocalories (kcal) and the PSQI (Pittsburgh Sleep Quality Index) score. The

correlation coefficient (ρ) was 0.483, indicating a moderate positive correlation between these two variables. This suggested that as total energy intake from UPF increases, the PSQI score tends to rise, which typically reflects poorer sleep quality. The p-value was reported as less than 0.001, indicating that the correlation was statistically significant at a very high confidence level. Therefore, we can conclude that there is a significant positive relationship between total energy intake from ultra-processed foods and poorer sleep quality, as measured by the PSQI score. This finding shows that higher consumption of ultra-processed foods is associated with worse sleep quality among the study participants.

Table 4.4.1: The Association between Total Energy Intake of Ultra-Processed Food (UPF) with Sleep Quality (PSQI score).

Variable 1	**Variable 2**	**ρ**	**p-value**
Total Energy Intake of UPF (kcal)	PSQI Score	0.483	<0.001

Table 4.4.2: Grading table of Spearman Correlation Coefficient (ρ) (Bhandari, 2023).

Correlation coefficient	Correlation strength	Correlation type
-0.7 to -1.0	Very strong	Negative
-0.5 to -0.7	Strong	Negative
-0.3 to -0.5	Moderate	Negative
0.0 to -0.3	Weak	Negative
0.0	None	Zero
0.0 to 0.3	Weak	Positive
0.3 to0 .5	Moderate	Positive
0.5 to 0.7	Strong	Positive
0.7 to 1.0	Very strong	Positive

CHAPTER 5

DISCUSSION

5.1 Background of Study

Recent studies have increasingly explored the role of diet in determining sleep quality, with particular attention to the intake of ultra-processed foods (UPFs). UPFs are highly processed items that are energy-dense and nutritionally poor, and their consumption has been linked to a range of health issues, including poor sleep outcomes. However, most existing research has been conducted in Western countries, female, and higher socioeconomic status, and limited studies have examined this association among young adults in Malaysia. University students are particularly more vulnerable to poor sleep quality due to academic stress and irregular dietary habits, including frequent consumption of UPFs. This study focused on the undergraduate students from Universiti Tunku Abdul Rahman (UTAR), including both male and female participants. By using the Food Frequency Questionnaire (FFQ) that classified into NOVA food groups and the Pittsburgh Sleep Quality Index (PSQI), this study aimed to explore the association between UPF intake and sleep quality. Given the increasing prevalence of poor sleep among students, identifying modifiable dietary factors such as UPF consumption may provide preventative actions for targeted interventions to improve sleep health in this population.

5.2 Patterns of NOVA Food Group Consumption Among UTAR Students

Assessing food intake using the NOVA classification provides a clear, evidence-based way to understand how food processing impacts health, instead of just tracking nutrients like calories or fats intake (Monteiro et al., 2017). By grouping foods into categories based on the degree of processing, this system reveals how heavily people rely on UPF versus UMPF. Furthermore, by quantifying the prevalence of consumption, researchers can identify populations at heightened risk, especially among studying groups like university students, who often face challenges such as limited time, budget constraints, and easy access to convenient but unhealthy options.

Studies found that most students were getting majority of their daily calories from unprocessed or minimally processed foods (UMPF), such as rice, vegetables, fruits, and fresh meat. These foods made up around 59.47% of the total calorie intake. This result was similar to the findings from other Malaysian universities, where UMPF consumption among students reaches 67.3% of daily calories, representing that UMPF is the primary dietary component (Ganesrau et al., 2023). On top of that, the findings further align with the dietary patterns revealed by MANS 2003 and MANS 2014 that white rice, which is a UMPF, is the most frequently consumed food among Malaysian (Goh et al., 2020). Furthermore, the university setting itself may influence this dietary pattern. Many Malaysian universities provide affordable campus cafeterias that serve traditional Malay, Chinese, and Indian dishes made using fresh ingredients which can be seen in UTAR. Additionally, the communal

nature of Malaysian campus dining, where students frequently eat together at food courts, supports the persistence of traditional eating habits (Bidin et al., 2024).

However, a recent study highlights that there was an increasing presence of convenience stores and Western fast-food chains on Malaysian university campuses, particularly at private institutions (Chai and Cheah, 2024). While cafeterias serving fresh foods still dominate, the second-largest median contribution of 521.84 kcal, or 27.87% of total caloric intake coming from ultra-processed foods in this study suggested that students in UTAR have a growing preference for UPF. This is similar to a study that involved 177 young adults from Malaysian universities found that UPFs contributed 38.6% of total energy intake, with a median total energy intake of 1,417 kcal/day and 74.6% of participants had poor diet quality, indicating a high reliance on processed foods (Asma et al., 2024). A study involving 250 public university students also found that 31% of their total daily caloric intake (562.27 kcal out of 1,821.74 kcal) came from UPF (Ganesrau et al., 2023). These findings suggested that Malaysian university students were increasingly dependent on UPFs, which are linked to poor diet quality and long-term health risks such as obesity and metabolic disorders.

The shift toward greater consumption of UPF among Malaysian university students can be caused by several socio-economic, environmental, and behavioral factors. University students often face demanding academic schedules, leaving little time

for meal preparation. UPF such as instant noodles, fast food, ready-to-eat foods and packaged snacks are easily accessible and require minimal effort to consume. A study by Khalid et al. (2024) found that 62% of Malaysian university students preferred ready-to-eat meals due to time constraints, with campus convenience stores, vending machines selling UPFs and fast-food outlets catering to this demand. In addition, the rapid growth of food delivery platforms like 'GrabFood' and 'Foodpanda' has significantly contributed to the increasing consumption of UPF among Malaysian university students. These apps exposed students with digital marketing strategies, including targeted advertisements, discounts, and time-limited promotions (Ilieva et al., 2025). The convenience of one-click ordering and late-night delivery options further encourages impulsive purchases of unhealthy, processed meals, contributed to the normalization of UPF intake, making it a habitual rather than occasional choice, particularly among students with irregular schedules.

On top of that, the instant dopamine boost from sugary drinks like bubble tea that classified as UPF can create a powerful stress-relief mechanism, creating a cycle of sugar dependence cravings (Jacques et al., 2019). Consequently, many students turn to sugar-sweetened beverages for temporary comfort to alleviate academic stress or fatigue, contributing to increasing consumption trend of UPF. This is evidenced by a previous study reported that 80.2% of Malaysian university students consumed bubble tea due to its good taste and stress-relief properties (Hasanah et al., 2021).

Apart from that, the growing UPF consumption is facilitated by widespread availability. In Kampar alone, multiple bubble tea outlets including Chagee, Mixue, and Bingxue operate near campus, with one even established within UTAR's cafeteria. Also, UTAR's internal infrastructure consists of multiple vending machines and the on-campus convenience store 'Panas', which offers ready-to-eat foods and snacks conveniently located throughout the campus, can unconsciously encourage UPF dependence among students.

After UPF, some studies found that processed foods (PF) represent the third largest contributor to total calorie intake with median of 191.06 kcal, accounts for 10.2% of daily energy consumption. This moderate amount of consumption aligns with global trends where PF such as canned fish, cheeses, or salted vegetables serve as convenient additions to meals rather than becoming the main part of diets (De Lacerda et al., 2022; Cattafesta et al., 2020). In Malaysia, common dishes such as *nasi lemak*, curry, and *laksa* rely on fresh herbs, spices, and vegetables rather than canned or preserved foods. While certain preserved foods, such as salted mustard greens can be seen in Chinese cooking, they remain a small part of the overall diet compared to the broader preference for fresh ingredients. Additionally, cheese, which is classified as a PF, is not commonly incorporate in Malaysian diets unlike Western countries. While Western cooking uses cheese as a fundamental ingredient such as the fondue and charcuterie board, Malaysian recipes achieve richness and creaminess through coconut milk or aromatic spices instead (Raji et al., 2017). Due

to these factors, PF consumption remains relatively low among university students compared to UPF intake.

5.3 Prevalence of Poor Sleep Quality among UTAR students

Poor sleep quality is common among UTAR students, with 68.2% scoring more than 5 on the Pittsburgh Sleep Quality Index (PSQI) that indicates poor sleep quality. This result aligned with percentages reported in several Malaysian studies among university students. For instances, a 2018 study found that 70.6% of undergraduate students in Malaysian public university reported poor sleep quality and another study in 2023 involving 403 university students found that about three-fourths (73.7%) were poor-quality sleepers (Nurismadiana and Lee, 2018; Ong, Azman and Ho, 2023). This finding also parallels with a study among Malaysia dental students where 51.6% of them suffered from poor sleep quality with only 5.72 mean hours of sleep (Khor et al., 2024).

Interestingly, despite most students reporting subjective sleep quality as “fairly good,” objective PSQI components, such as sleep latency and sleep efficiency, paint a different picture. For example, nearly half of the respondents (n=149) took longer than 15 minutes to fall asleep and 76.2% of them (n=247) reported sleep disturbance at least once a week. These are the hallmarks of disrupted circadian rhythm and psychological stress (Lo Martire et al., 2019). In addition, although the majority of students reported sleeping between 6 to 7 hours, this duration falls short of the at

least 7 hours sleep recommended by the Centers for Disease Control and Prevention (CDC) for optimal cognitive and emotional functioning (CDC, 2024).

This discrepancy between perceived and actual sleep quality may suggest a normalization of poor sleep among students, potentially due to cultural and academic expectations that prioritize productivity over rest (Bartlett et al., 2021). As discussed by Muro et al. (2020), university students often suffer from poor time management and high stress levels, along with excessive screen time, leading to higher sleep disturbances. On top of that, unhealthy lifestyle habits are the major factor in affecting sleep quality. Excessive caffeine consumption, particularly from coffee and energy drinks, is linked to difficulty falling asleep and lower sleep duration (Chaudhary et al., 2016). Another critical factor is late-night smartphone and electronic device use especially among university students. Study has found that daily electronic device usage two hours before sleep can contribute significantly to poorer sleep quality (Pham et al., 2021). Activities such as gaming, social media browsing, and watching videos before bed can disrupt melatonin production, making it harder to fall asleep (Peracchia and Curcio, 2018).

In terms of gender, this study found that female respondents reported a higher prevalence of poor sleep quality than male, with 60.6% of female reported poor sleep quality compared to 39.3% of male counterpart. This finding is similar to existing research among 3,778 young adults with mean age of 20.6 years, 65.1% of

female participants reported poor sleep quality compared to 49.8% of male participants (Fatima et al., 2016). Additionally, a meta-analysis found that females had a significantly higher prevalence of insomnia than males, with an odds ratio of 1.58, indicating a 58% higher likelihood of insomnia in females (Zeng et al., 2020). However, in contrast, a study among college students reported that male students had worse sleep quality in terms of sleep duration and use of sleep medication compared to female students (Li et al., 2020). These findings suggested that female sleep patterns are significantly influenced by hormonal changes across the menstrual cycle, pregnancy, and menopause. Estrogen and progesterone fluctuations can affect sleep architecture, a lower estrogen level can lead to increased wakefulness and sleep disturbances (Dorsey, De Lecea and Jennings, 2021). On the other hand, higher progesterone level exerts calming effect, which can promote sleep (Andersen et al., 2006).

In summary, the high prevalence of poor sleep quality among UTAR students (68.2%) reflects a significant public health issue consistent with findings from other Malaysian universities (Nurismadiana and Lee, 2018; Ong, Azman and Ho, 2023; Khor et al., 2024). The data reveals a concerning discrepancy between subjective sleep perceptions and objective PSQI measurements, suggesting normalization of poor sleep quality among university students. These findings underscore the urgent need for evidence-based interventions, including sleep hygiene education programs, institutional policy reforms regarding academic workloads, and targeted mental health support services.

5.4 Association Between UPF Consumption and Sleep Quality

The findings of this study reveal a statistically significant, moderate positive correlation ($\rho = 0.483$, $p < 0.001$) between total energy intake from ultra-processed foods (UPF) and poorer sleep quality, as measured by the Pittsburgh Sleep Quality Index (PSQI). This suggests that university students who consume higher amounts of UPF tend to experience worse sleep quality, aligning with findings linking UPF consumption with chronic insomnia (Duquenne et al., 2024). Similarly, a cross-sectional study among female college students reported that unhealthy dietary habits, including high UPF and sugary food intake is associated with shorter sleep duration and daytime dysfunction (Aneesh and Chaganty, 2021).

On top of that, the findings of this study aligned with increasing global evidence that links higher UPF intake to poorer sleep quality. For example, a systematic review by Pourmotabbed et al. (2024) concluded that high UPF intake was associated with altered sleep duration, poor subjective sleep quality, and increased risk of insomnia across multiple population subgroups. The review further highlighted that sleep disturbances often worsened with greater UPF consumption, where there is a dose-response relationship seen in our findings.

The pathophysiological mechanisms behind this relationship may be due to the high glycemic load and fats content in UPF, which can disrupt circadian rhythms and alter neurotransmitter activity, thereby impairing sleep quality (St-Onge et al., 2016).

This is aligned with studies linking UPFs to gut-brain axis dysregulation, where artificial additives such as colourings and flavourings can reduce microbial diversity and impair serotonin-melatonin synthesis (Shah et al., 2021; Rondinella et al., 2025). Moreover, systemic inflammation, driven by UPF-derived refined sugars and trans fats, further suppresses melatonin via pro-inflammatory cytokines like TNF-α and IL-6 (Giridharan et al., 2023; Song, 2019). The results underscore UPFs as a modifiable risk factor for sleep disorders, particularly in high-stress academic environments.

Additionally, neurotoxic additives that found in UPF, such as aspartame and synthetic dyes can worsen sleep fragmentation by increasing oxidative stress and cortisol levels (Damotharan et al., 2024; Schramm & Waisman, 2022). Chronic consumption of these additives, even in negligible quantities, has cumulative effects that may dysregulate sleep-wake cycles and increase cognitive fatigue (Dar, 2024). This is especially problematic for university students who are already susceptible to psychological stress and irregular sleep schedules.

However, these findings contrast with limited study reporting that there is no significant association between dietary patterns and sleep quality (Sadat et al., 2020). Several factors may explain this discrepancy. For instance, methodological differences such as variations in dietary assessment tools or sleep measurement methods could influence results of study. In addition, specific characteristics of

population, including age, baseline health status, or cultural dietary habits, may affect the diet-sleep relationship.

In summary, while existing research on this topic has primarily focused on Western and Middle Eastern populations, this study contributes critical data from a Southeast Asian context, a region with different dietary patterns and food environments. These findings may enrich the global understanding of UPF on health impacts, indicating that their adverse effects on sleep may persist across diverse cultural and geographical boundaries. As such, this study not only confirms previous observations but also fills a critical gap in local epidemiological data. It underscores the need for culturally tailored health promotion strategies focusing on dietary education and access to affordable, minimally processed foods within university environments.

5.5 Strengths and Limitations of Study

This study possesses several strengths that enhance its validity and contribution to existing literature. First, it addresses a significant research gap by examining the association between ultra-processed food (UPF) consumption and sleep quality among Malaysian university students, which is a population that is rarely studied in prior studies. Since most previous research focused on Western populations, this study provides a new understanding about diet-sleep connections in Asian university environments with different eating habits and cultural backgrounds. Furthermore,

employing validated tools such as the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality and a localized Food Frequency Questionnaire (FFQ) adapted to the NOVA classification system. This approach ensures accurate measurement of both dietary habits and sleep patterns. The use of Spearman's correlation and Chi-square tests further strengthens the analysis by accounting for non-normal data distributions and identifying significant associations.

Despite its strengths, the study is not without limitations. Firstly, its cross-sectional design limits causal inference. While significant associations were found between UPF consumption and sleep quality, longitudinal or interventional studies are required to establish temporality and causality.

Secondly, the reliance on self-reported data may introduce recall bias, particularly in dietary intake and sleep patterns, which are susceptible to social desirability effects. Additionally, while the FFQ was tailored for local consumption, there is a possibility of under- or over-reporting of certain food items. Despite the use of validated questionnaires, this is a common challenge in nutritional research that doesn't undermine the study's value but suggests caution in interpretation. Lastly, while focusing on one university allowed for controlled conditions, the predominantly Chinese sample (98.1%) means the findings may not fully represent Malaysia's diverse student population.

5.6 Recommendations for Future Studies

To strengthen future investigations of association between UPF consumption and sleep quality, researchers should consider expanding the study population to include more diverse groups. Future studies could benefit from recruiting participants from multiple universities across Malaysia, including both public and private institutions, to better represent the broader student population. Special attention should be given to achieving balanced ethnic representation among participants, as the current study's sample was predominantly Chinese. This could provide a more comprehensive understanding of how dietary patterns affect sleep quality across Malaysia's multicultural society.

Regarding study methodology, future studies can focus on longitudinal designs for establishing causal relationships between ultra-processed food consumption and sleep quality. For example, tracking dietary habits and sleep patterns of students over an extended period, such as an academic semester or year, could reveal important temporal patterns and help determine whether changes in diet precedes changes in sleep quality. In addition, incorporating objective measurement tools alongside self-reported data would significantly enhance the reliability of findings. For instance, using wearable sleep trackers such as actigraphy to monitor sleep parameters and implementing food diary methods with photographic documentation could provide more accurate data than questionnaires alone.

Finally, intervention studies could build upon these observational findings by testing practical solutions to improve sleep quality. Potential approaches might include campus-based nutrition education programs, sleep hygiene workshops, or policy changes regarding food availability in university. By addressing these various dimensions, future research can build a more comprehensive understanding of how dietary factors influence sleep quality in university populations.

CHAPTER 6

CONCLUSION

In summary, this study demonstrated a significant association between ultra-processed food consumption and poor sleep quality among students at Universiti Tunku Abdul Rahman (UTAR). The findings showed that while unprocessed and minimally processed foods make up the majority (59.47%) of students' diets, UPFs still account for a substantial 27.87% of daily calorie intake. More alarmingly, 68.2% of participants reported poor sleep quality, with higher UPF consumption correlating significantly with worse sleep quality. These results suggest that dietary choices, particularly frequent consumption of processed snacks, sugary drinks and instant meals, may be contributing to the sleep problems prevalent among university students, including increased sleep latency, reduced sleep efficiency, and overall lower PSQI scores.

Several biological mechanisms may explain this relationship. The artificial additives in UPFs appear to disrupt gut bacteria essential for producing sleep-regulating neurotransmitters. Additionally, the high sugar and unhealthy fat content in these foods likely promotes inflammation that interferes with normal sleep cycles. The study also found gender differences, with female students experiencing significantly poorer sleep quality than their male counterparts, possibly due to a combination of physiological and lifestyle factors.

While these findings are compelling, certain limitations must be acknowledged. The cross-sectional design in this study cannot definitively state that eating ultra-processed foods directly causes poor sleep quality, only that the two are associated. Also, most participants were predominantly Chinese students from UTAR, the findings may not fully represent Malaysia diverse student population with different cultural backgrounds. Furthermore, reliance on self-reported dietary and sleep data could introduce some inaccuracy due to recall bias.

These findings suggest several practical steps universities can take to decrease the dependence of students on UPF consumption. Firstly, universities should consider implementing nutrition education programs, improving the availability of healthy, affordable food options on campus and educating students on better sleep hygiene practices could make a meaningful difference. Reducing UPF consumption, along with promoting minimally processed, nutrient-dense foods, could be a feasible intervention to improve both metabolic and cognitive health. On top of that, future research should focus on longitudinal studies to confirm causation and explore whether reducing UPF intake leads to measurable sleep improvements. Additionally, future study on investigating effective ways to help students manage academic stress and develop better sleep routines, along with improving their diets could significantly benefit student health and wellbeing.

Ultimately, this study highlights how seemingly small daily choices about food can significantly impact sleep quality and overall well-being. By addressing both dietary habits and sleep quality, universities can take important steps toward supporting student health and success. The findings serve as a foundation for developing targeted programs to improve sleep outcomes through better nutritional education and campus food environment changes.

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APPENDICES

APPENDIX A

Ethical Approval Letter

UNIVERSITI TUNKU ABDUL RAHMAN DU012(A)
Wholly owned by UTAR Education Foundation Co. No. 578227-M

Re: U/SERC/78-395/2024

2 December 2024

Dr Teh Lai Kuan
Head, Department of Allied Health Sciences
Faculty of Science
Universiti Tunku Abdul Rahman
Jalan Universiti, Bandar Baru Barat
31900 Kampar, Perak.

Dear Dr Teh,

Ethical Approval For Research Project/Protocol

We refer to the application for ethical approval for your students' research projects from Bachelor of Science (Honours) Dietetics programme enrolled in course UDDN3108. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
1.	NOVA Food Groups and Its Relation with Making Healthy Food Choices Among UTAR Students	Yim Jia Tong	Ms Nurul Aimi Binti AB Kadir	2 December 2024 – 1 December 2025
2.	Association of Ultra-processed Food Consumption with Sleep Quality Among UTAR Students	Tan Ya Le		

The conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research;

(2) Confidentiality of participants' personal data must be maintained; and

(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines.

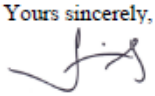
(4) Written consent be obtained from the institution(s)/company(ies) in which the physical or/and online survey will be carried out, prior to the commencement of the research.

Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 Fax: (605) 466 1313
Sungai Long Campus : Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000 Kajang, Selangor Darul Ehsan, Malaysia
Tel: (603) 9086 0288 Fax: (603) 9019 8868
Website: www.utar.edu.my

Should the students collect personal data of participants in their studies, please have the participants sign the attached Personal Data Protection Statement for records.

Thank you.

Yours sincerely,



Professor Ts Dr Faidz bin Abd Rahman
Chairman
UTAR Scientific and Ethical Review Committee

c.c Dean, Faculty of Science
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APPENDIX B

Questionnaire

Universiti Tunku Abdul Rahman
Jalan Universiti, Bandar Barat, 31900 Kampar, Perak

Title: Association between Consumption of Ultra-processed Food and Sleep Quality among Students in Universiti Tunku Abdul Rahman (UTAR)

Dear respondent,

Thank you for your participation in this study! I am Tan Ya Le, a Y3S3 Bachelor of Science (Honours) Dietetics students at the University Tunku Abdul Rahman (UTAR). This questionnaire is part of a final-year research project entitled "Association between ultra-processed food consumption and sleep quality among students in UTAR". This study aims to evaluate the association between the consumption of ultra-processed foods and sleep quality among students in UTAR.

The form consists of three sections:

Section A: Sociodemographic Analysis
Section B: Food Frequency Questionnaire (FFQ)
Section C: Pittsburgh Sleep Quality Index (PSQI)

Eligibility Criteria:

Malaysian
Aged 18-25 years
Not pregnant
No known non-communicable diseases
The survey will take approximately 10–15 minutes to complete. Your responses will be kept strictly confidential and used solely for research purposes. Your participation is truly appreciated, Thank you!
If you have any questions or require further clarification, please feel free to contact me:

Name: Tan Ya Le
Phone: 011-15107713
Email: toomanyjiajia@1utar.my

Section A: Socio-demographic Information

1. Age

   - 18
   - 19
   - 20
   - 21
   - 22
   - 23
   - 24
   - 25

2. Gender

   - Male
   - Female

3. Ethnicity

   - Chinese
   - Indian
   - Malay
   - Others: _____

4. Faculty of study e.g. FSc

   _____

5. Education

   - Foundation
   - Degree
   - Master

Section B: Food Frequency Questionnaire (FFQ)

This questionnaire will collect your food consumption data for the **past 3 months**.

Instruction: For each food item below, select how often you consume it, and state how many servings for each time eaten. (E.g. If you ate white **rice 3 times daily** and **2 scoops each time eaten**, please choose **daily** and fill in: **3, 2**) If did not consume the food item at all, select the '**None**' option.

Below are the references guidance for the portion serving size:

1 cup

1 scoop

1 tablespoon = 3 teaspoons

Group 1:

No.	Food Item	Daily	Weekly	Monthly	None	No. of frequency eaten	No. of serving
1	White rice (scoop)	○	○	○	○		
2	Brown rice (scoop)	○	○	○	○		
3	Rice porridge (cup)	○	○	○	○		
4	Corn (cup)	○	○	○	○		
5	Chicken (piece)	○	○	○	○		
6	Meat/Beef (matchbox size)	○	○	○	○		
7	Mutton (matchbox size)	○	○	○	○		

8	Pork (matchbox size)	○	○	○	○		
9	Fresh Fish (whole)	○	○	○	○		
10	Prawn (whole)	○	○	○	○		
11	Squid (whole)	○	○	○	○		
12	Crab (whole)	○	○	○	○		
13	Chicken egg (whole)	○	○	○	○		
14	Quail egg (whole)	○	○	○	○		
15	Fresh milk (glass)	○	○	○	○		
16	Leafy green (spinach, kangkung, bayam, etc.) (tablespoon)	○	○	○	○		
17	Cabbage, broccoli, pak choi, cauliflower (tablespoon)	○	○	○	○		
18	Tubers (potatoes, yam, sweet potatoes) (tablespoon)	○	○	○	○		
19	Fruit vegetables (pumpkin, baby corn, cucumber) (tablespoon)	○	○	○	○		
20	Fresh salad with no	○	○	○	○		

	dressing (tablespoon)						
21	Fresh mushrooms (tablespoon)	○	○	○	○		
22	Papaya (slice)	○	○	○	○		
23	Mango (slice)	○	○	○	○		
24	Watermelon (slice)	○	○	○	○		
25	Dragon fruit (slice)	○	○	○	○		
26	Honey dew (slice)	○	○	○	○		
27	Guava (half)	○	○	○	○		
28	Banana (whole)	○	○	○	○		
29	Apple (whole)	○	○	○	○		
30	Orange (whole)	○	○	○	○		
31	Pear (whole)	○	○	○	○		
32	Grape (piece)	○	○	○	○		

Group 2:

No.	Food Item	Daily	Weekly	Monthly	None	No. of frequency eaten	No. of serving
1	Butter (teaspoon)	○	○	○	○		
2	Sugar (teaspoon)	○	○	○	○		
3	Honey (teaspoon)	○	○	○	○		
4	Salt (teaspoon)	○	○	○	○		
5	Coconut oil (teaspoon)	○	○	○	○		

6	Olives oils (teaspoon)	○	○	○	○		
7	Sunflowers oils (teaspoon)	○	○	○	○		

Group 3:

No.	Food Item	Daily	Weekly	Monthly	None	No. of frequency eaten	No. of serving
1	Rice vermicelli/ Rice noodle/ Loh shi fun (cup)	○	○	○	○		
2	Wholemeal bread (piece)	○	○	○	○		
3	Ham (piece)	○	○	○	○		
4	Bacon (piece)	○	○	○	○		
5	Pickled fish (piece)	○	○	○	○		
6	Canned fish (piece)	○	○	○	○		
7	Tempeh (slice)	○	○	○	○		
8	Yoghurt/lassi/tairu (cup)	○	○	○	○		
9	Cheese (cup)	○	○	○	○		
10	Salted vegetables (tablespoon)	○	○	○	○		
11	Canned fruit (tablespoon)	○	○	○	○		
12	Dried fruit (tablespoon)	○	○	○	○		
13	Beer/ lager/ ale/ stout (glass)	○	○	○	○		
14	Wine/ cider/ champagne/ perry (glass)	○	○	○	○		
15	Red wine/lining (glass)	○	○	○	○		

Group 4:

No.	Food Item	Daily	Weekly	Monthly	None	No. of frequency eaten	No. of serving
1	Pasta (cup)	○	○	○	○		
2	Roti canai (piece)	○	○	○	○		
3	Topsai (piece)	○	○	○	○		
4	Instant cereal (cup)	○	○	○	○		
5	Fried chicken (piece)	○	○	○	○		
6	Pizza (piece)	○	○	○	○		
7	French fries (cup)	○	○	○	○		
8	Mashed potato (cup)	○	○	○	○		
9	Coleslaw (cup)	○	○	○	○		
10	Chicken balls (piece)	○	○	○	○		
11	Luncheon meat (piece)	○	○	○	○		
12	Keropok ikan, udang, sotong (piece)	○	○	○	○		
13	Fish/ prawn/ squid/ crab ball or cake (piece)	○	○	○	○		
14	Chocolate milk (glass)	○	○	○	○		
15	Malted milk (glass)	○	○	○	○		
16	Cordial syrup (glass)	○	○	○	○		
17	Fruit juice (glass)	○	○	○	○		
18	Carbonated drink (glass)	○	○	○	○		

19	Energy drink (glass)	○	○	○	○		
20	Yoghurt drinks (glass)	○	○	○	○		
21	Local kuih (piece)	○	○	○	○		
22	Sweets (piece)	○	○	○	○		
23	Chocolate bar (slice)	○	○	○	○		
24	Cake (slice)	○	○	○	○		
25	Jelly/Custard (piece)	○	○	○	○		
26	Lolly ice (no milk) (piece)	○	○	○	○		
27	Ice cream (milk) (cup)	○	○	○	○		
28	Flavoured/ cream/ filled cookies (piece)	○	○	○	○		
29	Pastry (piece)	○	○	○	○		
30	Snacks/ Crackers (piece)	○	○	○	○		
31	Jam (teaspoon)	○	○	○	○		
32	Coconut Jam/ kaya (teaspoon)	○	○	○	○		
33	Margarine (teaspoon)	○	○	○	○		
34	Peanut butter (teaspoon)	○	○	○	○		
35	Cream cheese (teaspoon)	○	○	○	○		
36	Chocolate spread (teaspoon)	○	○	○	○		
37	Sambal (teaspoon)	○	○	○	○		
38	Soy sauce (teaspoon)	○	○	○	○		
39	Chili sauce (teaspoon)	○	○	○	○		

40	Tomato sauce (teaspoon)	○	○	○	○		
41	Oyster sauce (teaspoon)	○	○	○	○		
42	Salad dressing (teaspoon)	○	○	○	○		
43	Sosej/hotdog/ frankfurter (piece)	○	○	○	○		
44	Nugget (piece)	○	○	○	○		

Section C: Pittsburgh Sleep Quality Index (PSQI)

This questionnaire will collect your sleep habits over the **past month.** Answer **every question**. If you are unsure about a particular item, give your best estimate.

1. During the past month, what time have you usually gone to bed at night? (E.g. 12 a.m.)

_____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

_____

3. During the past month, what time have you usually gotten up? (E.g. 10 a.m.)

_____

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)

_____

5. During the past month, how often have you had trouble sleeping because you…

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes	○	○	○	○

b. Wake up in the middle of the night or early	○	○	○	○
c. Have to get up to use the bathroom	○	○	○	○
d. Cannot breathe comfortably	○	○	○	○
e. Cough or snore loudly	○	○	○	○
f. Feel too cold	○	○	○	○
g. Feel too hot	○	○	○	○
h. Have bad dreams	○	○	○	○
i. Have pain	○	○	○	○

6. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

- ○ Not during the past month
- ○ Less than once a week
- ○ Once or twice a week
- ○ Three or more times a week

7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

- ○ Not during the past month
- ○ Less than once a week
- ○ Once or twice a week
- ○ Three or more times a week

8. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

- ○ No problem at all
- ○ Only a very slight problem
- ○ Somewhat of a problem
- ○ A very big problem

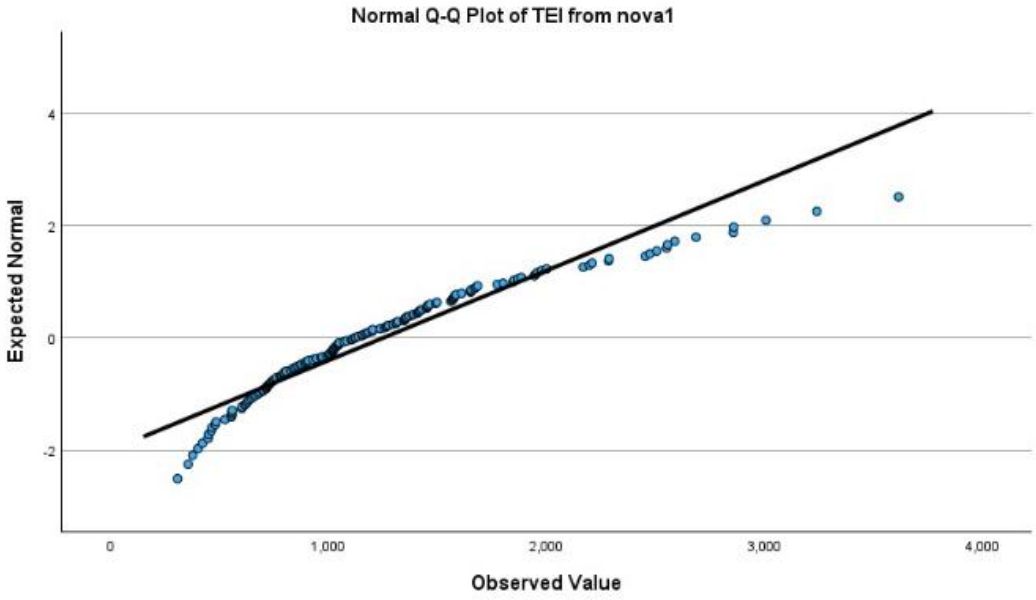
9. During the past month, how would you rate your sleep quality overall?

- Very good
- Fairly good
- Fairly bad
- Very bad

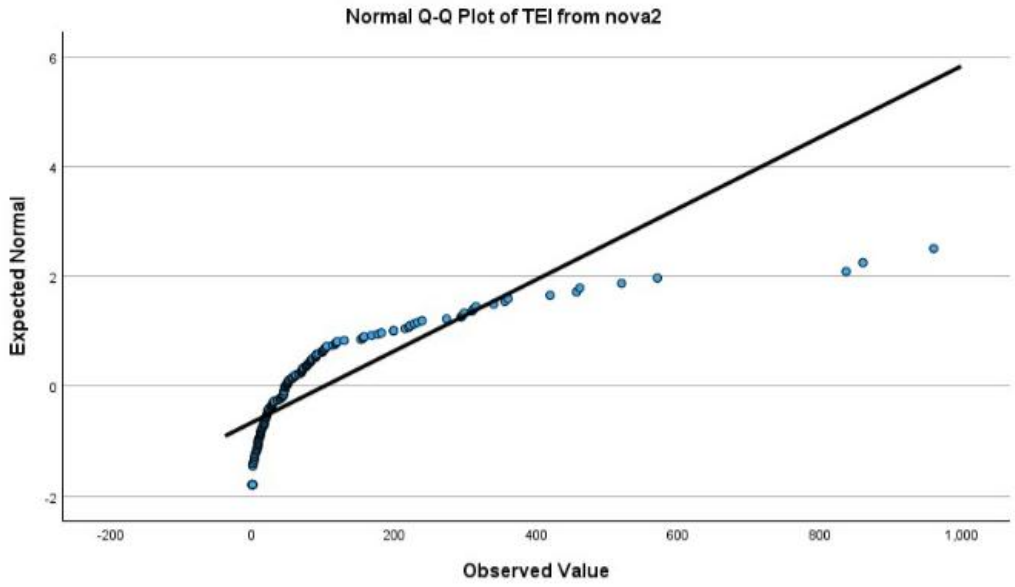
APPENDIX C

Normality Test

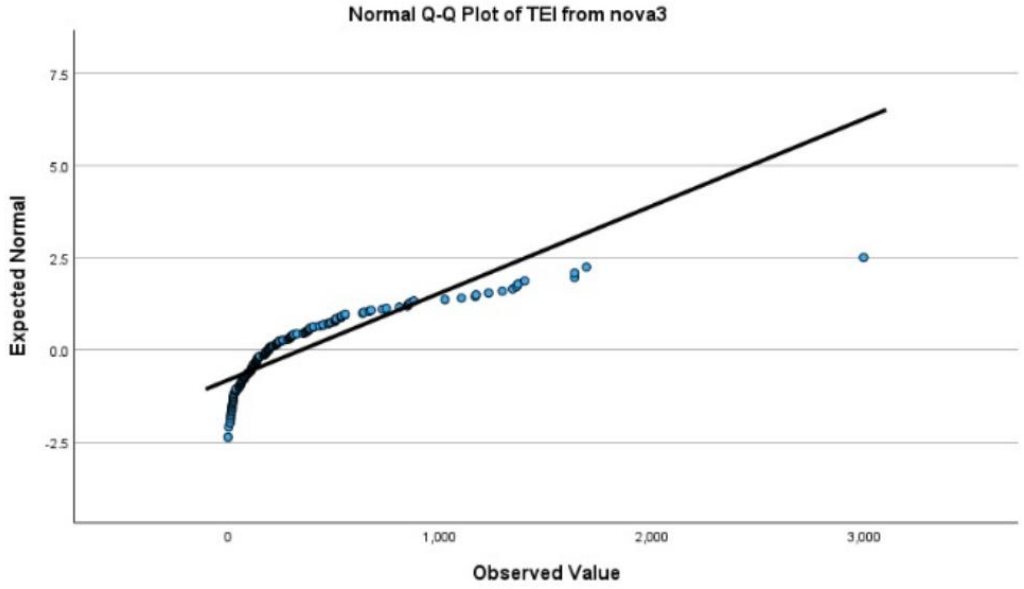
Total Energy Intake of NOVA Group 1 (UMPF)



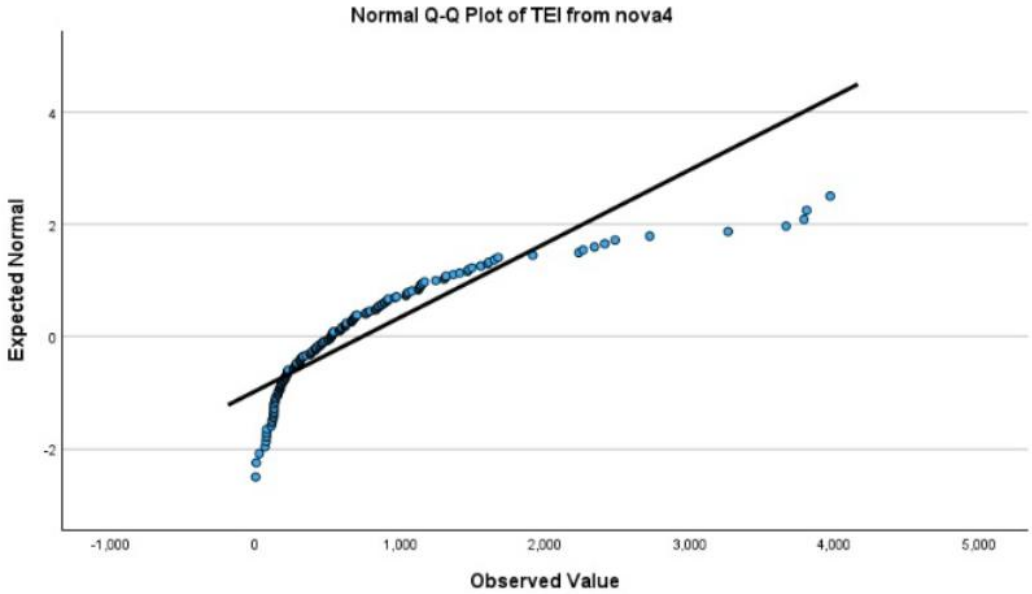
Total Energy Intake of NOVA Group 2 (PCI)



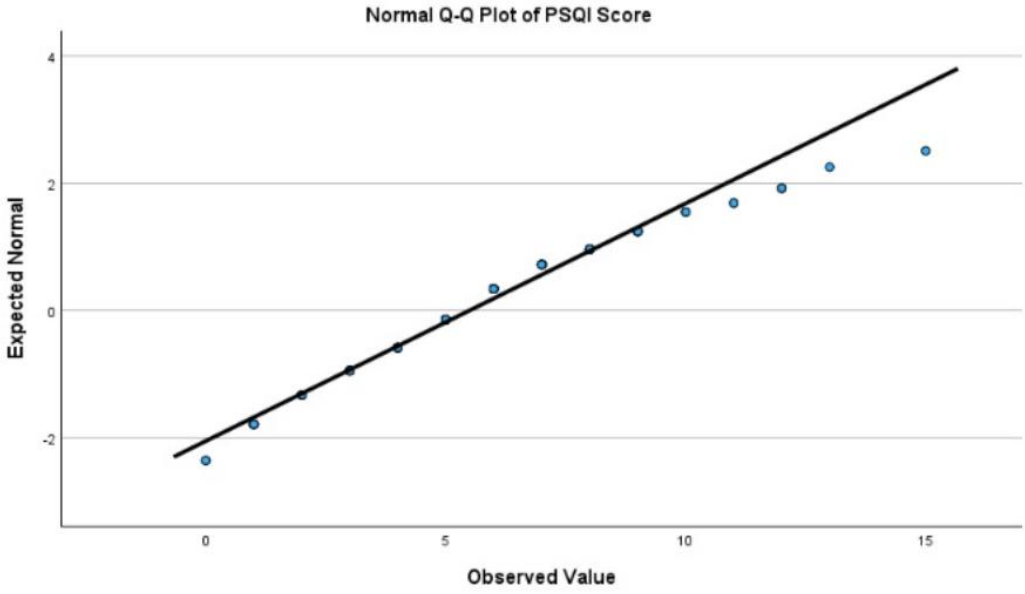
Total Energy Intake of NOVA Group 3 (PF)



Total Energy Intake of NOVA Group 4 (UPF)

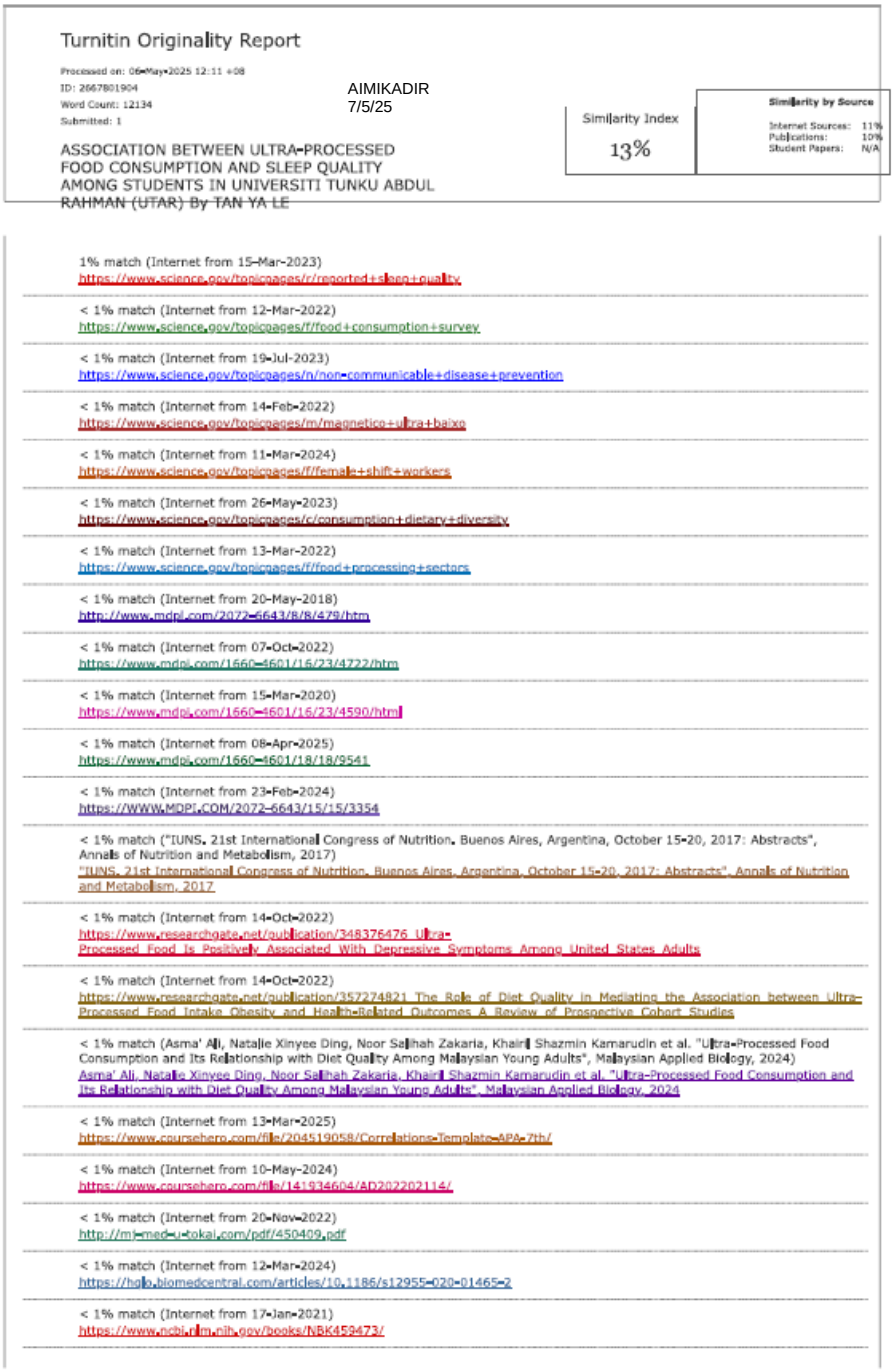


PSQI Scoring



APPENDIX D

Turnitin Originality Report



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APPENDIX E

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FACULTY OF SCIENCES

Full Name(s) of Candidate(s)	Tan Ya Le
ID Number(s)	21ADB02190
Programme / Course	DIETETICS
Title of Final Year Project	ASSOCIATION BETWEEN ULTRA-PROCESSED FOOD CONSUMPTION AND SLEEP QUALITY AMONG STUDENTS IN UNIVERSITI TUNKU ABDUL RAHMAN (UTAR)

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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

_____

Signature of Supervisor

Name: NURUL AIMI BT AB KADIR

Date: 7/5/2025