MEAL PATTERN OF UNIVERSITY STUDENTS AND ITS RELATIONSHIP WITH BODY MASS INDEX (BMI) AND THE RISK OF EATING DISORDERS

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By

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DECLARATION

This is to certify that the dissertation is my own independent work and research except where due regard has been taken and stated. I also declare that it has not been presented or offered before or otherwise at the same time with any other degree or qualification at Universiti Sains Malaysia or other institution. I authorize Universiti Sains Malaysia to use this dissertation in teaching, research and promotion.

…. ….
Bibi Imin Haiyin Binti Nazman

Date: 1/7/2025

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LIST OF SYMBOLS, ABBREVIATIONS AND ACRONYMS

APA	American Psychiatric Association
BMI	Body Mass Index
B40	Bottom 40% income group
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th Edition
EAT-26	Eating Attitudes Test
ED	Eating disorder
HREC	Human Research Ethics Committee
M20	Middle 20% income group
NHMS	National Health and Morbidity Survey
PPSG	Pusat Pengajian Sains Pergigian (School of Dental Sciences)
PPSK	Pusat Pengajian Sains Kesihatan (School of Health Sciences)
PPSP	Pusat Pengajian Sains Perubatan (School of Medical Sciences)
RM	Ringgit Malaysia
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
T20	Top 20% income group
USM	Universiti Sains Malaysia
USMKK	Universiti Sains Malaysia Kampus Kesihatan
WHO	World Health Organization

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MEAL PATTERN OF UNIVERSITY STUDENTS AND ITS RELATIONSHIP WITH BODY MASS INDEX (BMI) AND THE RISK OF EATING DISORDERS

ABSTRAK

Gangguan makan merupakan keadaan mental yang berlaku kepada seseorang apabila tabiat pemakanan mereka tidak teratur sejurus dapat memberikan impak negatif secara langsung atau tidak langsung kepada fizikal atau mental mereka. Kajian keratan rentas ini membincang mengenai korelasi pola makan, indeks jisim badan (BMI), dan gangguan makan atau *eating disorder* (ED) dalam kalangan 206 pelajar sarjana muda di Universiti Sains Malaysia, Kampus Kesihatan. Pengukuran antropometri telah dijalankan dan data telah direkodkan dengan menggunakan soal selidik berstruktur yang diadaptasi berdasarkan Soal Selidik Pola Makanan NHMS 2014 & EAT-26 yang telah diluluskan di dalam Bahasa Melayu. Keputusan menunjukkan bahawa sarapan pagi adalah hidangan paling banyak yang tidak diambil dengan 56.3% pelajar mengambil sarapan kurang daripada empat kali seminggu manakala makan tengahari dan makan malam diambil secara berkala. Majoriti pelajar mendapatkan makanan di kafeteria kampus dan menjamu selera secara individu. Sebanyak 90.3% yang luar biasa didapati berisiko ED dan ia lebih kerap dalam kalangan perempuan (p=0.031) dan pelajar Melayu (p=0.040). Namun begitu, keputusan statistik menunjukkan tiada korelasi yang signifikan antara kekerapan sarapan ($p=0.673$), makan tengah hari $(p=0.840)$, makan malam ($p=0.779$), atau makanan berat selepas makan malam $(p=0.111)$ dengan BMI, atau dengan risiko ED (semua nilai $p > 0.05$). Keputusan ini menunjukkan bahawa corak makanan yang tidak normal tidak semestinya mempunyai implikasi langsung dalam kesihatan melainkan faktor psikologi dan gaya hidup juga diambil kira. Penyelidikan ini membentangkan keperluan

integrasi antara pemakanan dan campur tangan kesihatan mental yang direka khusus untuk menangani pelajar universiti untuk menggalakkan tingkah laku kesihatan yang lebih baik dan membantu dalam pencegahan gangguan makan.

MEAL PATTERN OF UNIVERSITY STUDENTS AND ITS RELATIONSHIP WITH BODY MASS INDEX (BMI) AND THE RISK OF EATING DISORDERS

ABSTRACT

Eating disorders are critical psychiatric disorders that are determined by ongoing abnormalities in eating habits and associated thinking and feelings about foodstuff, body weight, and build up. This cross-sectional study examined the correlation between the meal pattern, body mass index (BMI), and risk of an eating disorder (ED) amongst the 206 undergraduate students at Universiti Sains Malaysia Health Campus. Anthropometric measurements were taken and data recorded using structured self-administered questionnaires which were developed based on NHMS 2014 Meal Pattern Questionnaire and the Malay-validated EAT-26. Results showed that breakfast was the greatest meal not consumed with 56.3% eating it less than four times a week whereas lunch and dinner were taken regularly. Majority of students accessed food in campus cafeteria and dined alone. A remarkable 90.3% were found at risk of ED and it was considerably more prevalent in females ($p=0.031$) and Malay students ($p=0.040$). Nevertheless, statistical results indicated no significant association between frequency of breakfast ($p=0.673$), lunch ($p=0.840$), dinner ($p=0.779$), or heavy meals after dinner ($p=0.111$) with BMI, or with ED risk (all *p-values* > *0.05*). These results show that abnormal meal patterns do not necessarily have direct implications in expedited health outcomes, unless other lifestyle and psychological factors are taken into account. The research presents the necessity of interaction between nutrition and mental health intervention specifically designed to address the university population to promote better health behavior and assist in the prevention of ED.

CHAPTER 1: INTRODUCTION

1.1 Background of study

Meal pattern means how frequently, when, what and how much of meal is taken. It comprises factors such as dietary habits, timing of having that meal, variety of the meal as well as the quantity of meal consumed (Saltouras *et al*., 2024). According to Fazliza *et al.* (2021), many university student from Universiti Sains Malaysia Kampus Kesihatan reported skipping breakfast (58.6%). In other study, Pengpid and Peltzer (2020) reported that 63% of students skipped breakfast during weekdays, while 37% of students missed it at weekends.

Previous study showed that university students who skipped meals tend to develop unhealthy eating behaviours such as consumption of fast foods or instant noodles (SciELO, 2017). Meals seem to be skipped quite often by university students, mainly because of hectic schedules and time constraint (Fazliza *et al*., 2021). Another observation made in another study is that university students also have a tendency of taking very large meals in the evening (Hakim *et al*., 2012). This is associated with an irregular eating pattern throughout the day, where by skipping meals may result in increased appetite at night. Hence, some students can overeat, or choose unhealthy meals during the night time (Hakim *et al*., 2012).

Chen Yun *et al.* (2018) found that irregular eating habits especially lack of breakfast intake are strongly related to high risks of overweight and obesity among university students. There was a survey carried out in Lead City University of Ibadan, Nigeria, showed that students who skip meals frequently are vulnerable to both undernutrition and overnutrition (Mobolaji

Timothy Olagunju *et al*., 2024). Skipping breakfast can lead to the consumption of more calories and exposure to weight gain (Mobolaji Timothy Olagunju *et al*., 2024).

Eating disorders (ED) are serious mental illnesses involving extreme emotions, thoughts and behaviors toward food, body weight, and body shape (National Institute of Mental Health, 2024). The disorders can result in prominent medical, psychological, and social consequences (National Institute of Mental Health, 2024). National Institute of Mental Health (2024) states that the common types of eating disorder are anorexia nervosa, bulimia nervosa and binge eating disorder. Existing study reported that 38.1% of students are at risk of ED, and the number is reported to have the highest percentage among female students which are 39.4% compared to male which are 34.4% (Azman *et al*., 2022). It is found that an individual who skips meals regularly is prone to restrictive eating, which is one of criteria of ED (De Young *et al.,* 2014). Meal skipping may be more than just a trigger of acute caloric deprivation, but may also trigger compensatory overeating behaviors that are commonly seen in ED (Betts *et al*., 2016).

1.2 Problem statement

Nutritional research has largely overlooked meal patterns of university students (Wan *et al*., 2012). Few studies have reported the meal patterns of university students like one study by Fazliza *et al.* (2021) found that many students often do not have time or a busy schedule to have breakfast. While most research has documented regarding university students skipping breakfast, fewer studies have investigated at what university students are actually eating for lunch and dinner. This gap in research has made it harder to evaluate students' overall meal

pattern and possible health effects. Poor nutrition, weight gain and other health problems, may result from irregular meal patterns (Azlan & Ali, 2011).

The research conducted by Telleria-Aramburu & Arroyo-Izaga, (2021) has investigated whether university students show association between meal patterns and risk of being overweight and obese. However, they found that their findings suggest that meal pattern, including skipping meals, were associated with a higher risk of being overweight or obese. The researchers also found that students who often skipped meals, especially breakfast, tend to make unhealthy choices with food later in the day, like overeating or eating high calorie unhealthy snacks. This will lead to weight gain over time. Regular meal pattern was identified as important considerations to support students in having healthy weight and reduce the risk of health problems associated with obesity. The results emphasise the need for tailored interventions to support this group improve eating healthy and meal regularity.

1.3 Research question

i. What is the meal pattern of students of Universiti Sains Malaysia Kampus Kesihatan?
ii. Is there any association between meal patterns and BMI of university students?
iii. Is there any association between meal pattern and the risk of eating disorders among university students?
iv. What is the prevalence of ED among student of Universiti Sains Malaysia Kampus Kesihatan?

1.4 Objectives

1.4.1 General objective:

To investigate the association between meal patterns of university students with their BMI and the risk of eating disorders.

1.4.2 Specific Objectives:

i. To describe the meal patterns of university students.
ii. To determine the association between meal pattern and BMI of university students.
iii. To determine the association between meal pattern of university students and the risk of eating disorders.

1.5 Research hypothesis

Research hypothesis for specific objective 2:

Null hypothesis (H_0): There is no association between meal pattern and BMI of university students.

Alternative hypothesis: There is association between meal pattern and BMI of university students.

Research hypothesis for specific objective 3:

Null hypothesis (H_0): There is no association between meal pattern of university students and the risk of eating disorders.

Alternative hypothesis: There is association meal pattern of university students and the risk of eating disorders.

1.6 Study rationale

This study will investigate the association of meal patterns, body mass index (BMI) and the risk of eating disorders among university students. Irregular meal patterns, like skipping breakfast and eating at irregular eating time are common among students and it may affect their BMI (irregular nutrient density or overnutrition), according to Deshmukh-Taskar *et al*. (2010) and Keski-Rahkonen *et al.* (2003). Academic pressures, social influences and the changing lifestyle of university life are all reasons for eating habits that tend to be irregular. In addition, poor BMI may be responsible for perpetuating eating disorders like anorexia nervosa, bulimia nervosa and binge eating disorder which are all serious mental health problems with serious physical and psychological consequences (Hudson *et al*., 2007).

Knowing the main factors influencing meal patterns of university students provides a good starting point to generate recommendations for interventions, corresponding educational programs aimed to improve students' consumption of healthy foods (Roshanak Roustaee *et al*., 2018). The findings of this study can add new knowledge to the literature on the meal pattern among university students in Kelantan, Malaysia. Therefore, it is important for health practitioners and researchers to program nutrition education programmes for university students based on this knowledge of these meal patterns.

Information concerning meal patterns, location and source of meals are also provided in this study besides information on the frequency of meal patterns. There are many reasons why it is important to know where students get their meals—whether it is from on campus dining services, local restaurants, or home cooked meals. Dietary choices and BMI of university students are greatly impacted by the location of meal taken. Most of the meals that students get from fast food outlets or convenience stores are often loaded with calories, unhealthy fats, and sugars than the meals prepared at or obtained from healthier dining outlets (Li *et al*., 2022). This study can assess the patterns that could contribute to poor BMI through sources and locations of meals. Health practitioners may have an insight of targeted nutrition interventions to conduct when a large number of university students solely depend on fast-foods outlet. Enhanced knowledge of meal sources also helps with campus policy in improving current food access and manage healthier food environments (Li *et al*., 2022).

In addition, it is important to understand the relationship between ED and BMI, and the existence of a meal pattern, in university students in order to develop effective nutritional strategies for this group. Research has shown that irregular meal patterns, as in skipping meal or inconsistent eating schedules, can substantially affect the BMI, and moreover, can lead to ED (Kabakuş Aykut and Bilici, 2021).

1.7 Operational definition

1.7.1 Meal pattern

Meal pattern is operationally defined as a structured and measurable component of eating behaviour of university students. The timing (when meals are consumed), frequency (in which they occur per day), type of meals (breakfast, lunch, dinner, and snacks), and portion sizes (how much food is consumed) in each was all part of meal patterns. It also includes how regular or irregular meals are meal skipping or eating meal with regular intervals. It is important to understand these patterns to evaluate the quantity of absorbed nutrients and to establish the assocation between eating patterns and BMI, and to prevent risk of developing ED (Kabakuş Aykut & Bilici, 2021). The purpose for the study is to examine these factors and give insight into some dietary habits that might lead to or prevent health risks among university students.

1.7.2 BMI

BMI is the simple and most widespread approach to estimate fat deposits in the human body. It is a measure of the health of an individual and it is calculated by dividing a person's weight in kilograms by the square of the person's height in meters. In this study, BMI between 18.5-24.9 was categorized as unusual weight, below 18.5 was underweight and above 24.9 is overweight.

1.7.3 Eating disorder

This study operationally defines eating disorders as serious mental health conditions characterized by serious and problematic eating behaviours that can severely damage physical and mental health. These disorders include excessive focusing on one's weight and body shape or an abnormal concern with eating and food and specific behaviors including restrictive dieting, binge eating and purging. Eating disorders (EDs) normally require diagnostic

assessment by a qualified medical practitioner, or psychiatrist, psychologist, or other mental-health professional. While screening tests such as the Eating Attitudes Test (EAT-26), might be able to determine people who are at risk of developing ED using symptomatic presentation and other related issues, the tests are always preliminary.The Eating Attitudes Test (EAT-26) is a validated screening tool which assesses the presence of eating disorders based on symptoms and concerns associated with anorexia nervosa, bulimia nervosa, and binge eating disorder will be used. Definition of this concept represents the diagnostic criteria according to the American Psychiatric Association in the Diagnostic and Stastistical Manual Disorders (DSM-5) as well as clinical and subclinical manifestations of these conditions (American Psychiatric Association, 2013).

1.8 Conceptual Framework

Conceptual framework

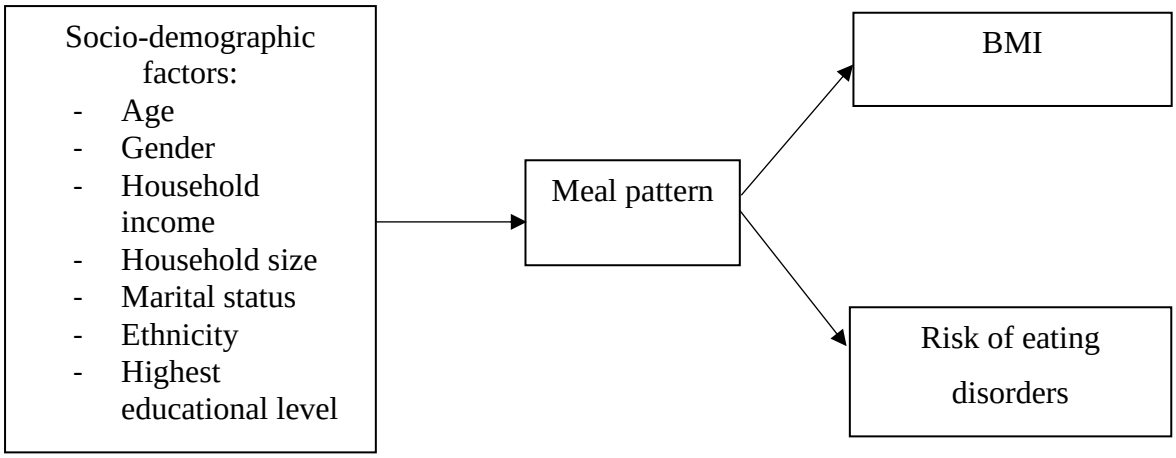

Figure 1.1 conceptual framework of this study

This study conceptualized socio demographic factors, meal patterns, BMI and the risk of the eating disorders among university students. It considered socio-demographic factor such as age, gender, household income, household size, marital status, ethnicity and highest educational level as independent variables. These factors were expected to influence the outcome of meal patterns of university students. Irregular meal pattern may lead to variations in BMI and increase risk of eating disorders.

CHAPTER 2: LITERATURE REVIEW

2.1 Meal pattern

2.1.1 Definition of meal pattern

Meal patterns can be defined as the frequency, period, and regularity of eating events that includes the way or how meal is consumed during the day (Saltouras *et al.*, 2024). The concept is important in studying food patterns and their health consequences as meal patterns have the capacity to affect the intake of nutrients and dietary quality. Meal patterns have different definitions and usually encompass regular eating such as common meals, including breakfast, lunch and dinner as well as snacks and other eating occasions (Svendsen & Forslund, 2024; Leech *et al.*, 2015)

An irregular meal pattern is marked by inconsistent meal time and meal frequency, which is harmful to health. Merten *et al*. (2009) considers irregular breakfast consumption as the intake of breakfast less than four times per week, whereas Mekary *et al*. (2013) extends the definition to those who miss breakfast fewer than seven days per week. This irregularity has been associated with poor health effects, such as, elevated risks of metabolic syndrome and mood disorders (Pot *et al*., 2016; Wilson *et al*., 2020)

2.1.2 Prevalence of irregular meal pattern

The irregular meal pattern has become more common around world especially among the students and the working adults. A cross-sectional survey among 21,958 students of 28 countries conducted by Pengpid and Peltzer (2020) revealed that 48% of the students missed breakfast, most commonly due to the fact that they lived away from the home, sleep problems, and depression. According to the cross-sectional study of M et al., 2022 on 612 undergraduate students in Coimbatore, India, it was noted that 66% of the students observed missed breakfast, but other 59% of the students acknowledged that missing breakfast is not good. Lack of time, waking up late and not feeling hungry in the morning were the most frequent mentionable reasons. Interestingly, 86% of the students preferred the idea of having ready to eat breakfast so that they do not miss on their eating habit, which could imply that convenience is a key contributor to the action of skipping meals.

In a similar vein, a study that took place in Bangladesh by Akter and Mohammad Jobayer Hossain, 2023 suggested that a quarter (23.0%) of students at the university possessed irregular the dining patterns with a wide variation between the two genders. A higher number of female students skip dinner as opposed to male students. These results highlight that academic stresses, sociocultural transitions, and socio-financial strains are some of the factors that lead to irregular meal pattern among students and youth around the world.

Irregular meal patterns have become alarming among students and adults in the Malaysian population. According to a study conducted among students in Universiti Teknologi MARA Kelantan by Fazliza *et al.,* 2021, though the majority of students consumed meals on a daily basis, a significant number of them often skipped having breakfast as they stated time

limitation and academic pressure as the factors that prevented them. In another research done by Sanusi 2020, it was pointed out that the university students of Malaysia were not able to follow the dietary guidelines very well and it was typical to skip meals and to have inconsistent and irregular meal patterns. Jayaveloo *et al*., 2021 also noted that the bad eating habits such as food omission and inconsistent timing were common among students especially non-resident ones. The combination of these results shows how common the use of irregular meal patterns is in Malaysian university students and the possible long-term health effects.

The consumption of heavy meals at night is a youthful common phenomenon practiced by young adults and university students worldwide due to lifestyle choices connected with academic requirements, social life and convenience. Kim *et al.,* 2022 state that the period of 7 PM-midnight is when young adults typically eat a large percentage of their daily calories, choosing high-energy and less nutritious options. The behavior of having heavy meals is common among individuals between the ages of 18 years and 30 years with reports that 3% to a later more than 8% of different populations eat huge quantities of food late at night, and this trend has been found to be more extensive in obese adults according to Garaulet and Gómez-Abellán (2014). The trend is associated with irregular circadian rhythms and metabolic effects, such as an elevated risk of being overweight and obese (Garaulet & Gomez-Abellan, 2014).

In Malaysia, night heavy meals among students and adults are embedded in local and social culture. The National Health and Morbidity Survey (NHMS) 2024: Nutrition also found that 41.8% of adolescents and 33.5% of adults had heavy suppers at least once a week, which is most likely after 10 p.m. It was also observed in the study that this habit prevailed more with the males, students in rural areas and during afternoon schools. These behaviors are linked to a higher obesity risk and low-quality sleep along with metabolism disorders. This eating

behavior are further strengthened by the fact that many 24-hour restaurants are available and the culture of socializing late at night (Mohamad & Hamirudin, 2023).

2.2 Eating disorders

2.1.1 Definition of eating disorders

Eating disorders are critical psychiatric disorders that are determined by ongoing abnormalities in eating habits and associated thinking and feelings about foodstuff, body weight, and build up. Eating disorders are defined in diagnostic and statistical manual of mental disorders (DSM-5) by American Psychiatric Association, 2022 as excessive and unbalanced tendencies toward food, eating and body image that physical health that significantly interferes in emotional wellbeing and social functioning. The typical ones are anorexia nervosa, bulimia nervosa, binge-eating disorder, and others. Such disorders are commonly characterized by the presence of such behaviors, as extreme food restriction, binge eating, purging, over exercising, or ritualized eating behavior (Guarda, 2023). Ritual eating behavior is an extreme self-repetitive compulsive behavior and usually rigid, compulsive patterns or routines which may be food preparation, consumption, or eating habits. Failure to act out leads to feelings of anxiety (Aimee, 2013). It is a typical behavior of people who have eating disorders, especially, anorexia nervosa. Eating disorders are associated with severe medical complications, which may include heart, digestive system, bone, and mental problems and potentially prove life-threatening unless addressed (Cost et al., 2020).

Eating disorders can be assessed in a with clinical assessment with the use of standardized screening protocols and medical assessment. The diagnostic criteria proposed in

the DSM-5 include narrowing down the behavioral symptoms which are restrictive eating, binge eating purging, and any compensatory behaviors, as well as, the psychological ones like extreme fear of gaining weight and body image dissatisfaction (Sanz Cortés, 2022). Validated questionnaires are widely used by healthcare professionals, such as the Sick, Control, One Fat, Food (SCOFF) questionnaire that consist of five item questionnaires used to screen anorexia nervosa and bulimia nervosa within clinical and primary care practices. A positive SCOFF screening (2 or more positive answer) means that additional more complex evaluation by mental health experts need to be done (Morgan *et al.*, 1999). A range of other questionnaires includes the Eating Disorder Examination Questionnaire (EDE-Q) and the Eating Disorder Assessment for DSM-5 (EDA-5) that allow very particular assessment of symptoms and severity. Eating Attitudes Test (EAT) is one of the most common self-report questionnaires created to identify symptoms, and concerns that are typical of eating disorders, including ritualistic eating behavior. The EAT questionnaires is a tool that was developed by Garner and colleagues in 1982 which measures attitudes, feelings, and behaviours of eating, dieting, body image and food preoccupation. Higher score in the Eating Attitudes Test (EAT-26) are also predictive of increased risk or occurrence of eating disorder behavior (Garner *et al.*, 1982).

2.1.2 Prevalence of eating disorders

The prevalence rates of ED have become a growing university students worldwide concern, and rates of prevalence are highly influenced by certain factors such as, gender, body mass index (BMI), psychological stress and sociocultural pressures (Ladner *et al.*, 2019). A systematic review and meta-analysis reported that the prevalence of screen based disordered eating among university students across 40 countries was alarmingly high which is approximately 20% (Alhaj *et al.*, 2022). Previous study conducted by Azam Roshandel *et al.*

(2012) and further supported by Banna *et al*. (2021) revealed that 21.5% of female students at Tehran university shows symptoms of ED and 7.8% of them are being diagnosed of having Bulimia Nervosa. Ali *et al.* (2023) also found that over 34.8% of female students in Jazan University, Saudi Arabia are at risk of developing ED and some of them were at increased risk of developing ED. A study conducted by Lipson and Sonneville (2017) in the US college reported that around 50% of female students engaged in binge eating behaviours such as purging (self-induced vomiting or misuse of laxatives) regardless of both genders. These findings suggests that ED are widespread in many countries.

In Malaysia, there has been few studies regarding eating disorders among university students as proved by Azam Roshandel et al. (2012) when 38.1% % of university students from University of Cyberjaya reported to be at risk of eating disorders and majority of them are female students. Meanwhile, a cross-sectional study by Chan *et al.* (2020) has reported students 13.9% of students were at risk of eating disorders as they exhibited few behaviours like trying to lose weight and had posttraumatic stress disorders. In one of the findings by Ghasak Ghazi Faisal *et al.*, 2023 14.9% of undergraduate students reported eating disorders, but the prevalence was higher among females. The results are consistent with broader studies by Chua *et al.*, 2022 that revealed that 14.0% of Malaysian university students are at risk of eating disorders, and the prevalence shows variation based on gender and ethnicity.

2.3 Association between meal pattern and eating disorder

Kabakuş Aykut & Bilici (2021) study noted that breakfast skipping is a considerably related with the disordered eating behaviours. Prolonged meal skipping leads to hunger and compulsive eating, which in the future leads to binge eating episodes as evidenced by Kabakuş Aykut and Bilici (2021). The authors acknowledge that people who often miss meals are most likely to develop abnormal eating habits that lead to serious forms of eating disorders including anorexia nervosa and bulimia nervosa. Skipping meals is commonly used as an approach to reduce calorie intake or manage weight issue. These behaviours may worsen or set off episodes of what food experts refer to as bulimia, where an individual goes on a regular period of starvation then consumes large portions of meal upon impulse from skipping meals (Oldham-Cooper & Semple, 2021).

It was further shown by the study conducted by Kabakuş Aykut and Bilici (2021), that a correlation exists between dieting, meal skipping and risk of eating disorders in both genders. They specifically stated that university students who skip meals to cut weight gain are 3.285 times more likely to develop ED (Kabakuş Aykut and Bilici, 2021). The impact of this might have negative effects on mental health and the need of early identification and intervention is critical among university students.

2.4 Association between meal pattern and body mass index (BMI)

The BMI of most students in the university is greatly influenced by academic demands, social pressure and move to independence which makes university students tend to have changes in meal patterns. Meal patterns (the frequency, timing and types of meals consumed) have been

shown to be important in determining both the quality of diet consumed and its health outcomes (Murakami & Livingstone 2015). The consumption of vitamins and minerals are not obtained enough and deficiency may lead to poor health because of skipping breakfast (Pereira *et al*. 2011). Irregular meal patterns and frequent snacking are related with both higher (BMI) and risk factors associated with obesity (Wang *et al*., 2005). Alternatively, for better nutritional standing and general wellbeing, regularly following meal designs with adjusted nourishment take must be implemented (Leech *et al*., 2017).

University students and their frequently hectic schedule and restricted accessibility to sensible sustenance are particularly vulnerable to this terrible meal pattern. According to studies, students living away from home consume more convenience food high in calories and low in useful nutrients than home-living students, while the latter group has better dietary habits, including more fruits, vegetables and meat (El Ansari *et al*., 2012). Living arrangements were proved to significantly determine meal pattern, as the research into four universities provided the information that those students who still live at home eat more balanced meals than those who already live independently (Mikhael *et al*., 2018). However, this shift in meal patterns can bring increased risk of getting obese and many health problems as students living separated from home are likely to take unhealthy eating habits as a result of comfort and time constraints (Papadaki *et al*., 2007). In light of this finding, the location of the meal taken is revealed as a key determinant of meal patterns and BMI.

2.5 Impacts of disordered eating behavior on university students

Disordered eating behaviors are an influential issue of the physical well-being of university students. National Institute of Mental Health (2024) states that anorexia nervosa, bulimia

nervosa, and binge eating disorder eating disorders may result in extreme medical effects such as heart failure, osteoporosis, and electrolyte imbalances. According to Azman *et al.* (2022), this is quite an alarming rate of students who are in danger of developing eating disorders, especially in the female population of students, which will predispose them to acquiring these health issues at universities. Medical comorbidities and hospitalization rates were found to be higher in students with binge eating and purging behaviors compared with their peers in studies reported by Lipson and Sonneville (2017), which is why early intervention should be based on medical support.

Murga *et al*. (2022) attribute eating disorders to its association with high anxiety, depression, and suicidal thoughts. They also emphasise that all of this is aggravated by tense family relations and a low level of social support. As stated by Murga *et al*. (2022) eating disorder and mental-health cycle can negatively impact both emotional wellbeing and grades. Similarly, Azam Roshandel et al., (2012) indicate that a large proportion of students that exhibit disordered eating experiences low self-esteem and body dissatisfaction, which increases psychological distress.

This also impairs performance in university. Claydon & Zullig, (2019) demonstrates that the student with eating disorder receiving treatment receive better grades and have increased GPA in comparison with those students who do not receive treatment, which implies that cognitive performance can be enhanced through specific interventions. Unrestrained eating disorders, in their turn, impair concentration, energy, motivation the consequences of which negatively affect learning per se. Azam *et al*. (2022) remind that malnutrition, as well as mental-health stress, negatively impacts the students in terms of studying.

The production of social relationships and quality of life is also impaired in university students possessing disordered eating behaviors. The National Institute of Mental Health (2024) reports that eating disorders frequently lead to social withdrawal and isolation as well as poor relationships with other people because of stigma and shame. Murga *et al*. (2022) stated that students have described their loneliness and alienation that adversely affected their symptoms of eating disorders and psychological conditions. According to Azam Roshandel *et al.* (2012) disruption in the social support network may complicate the healing process and cause an elevated risk of developing a chronic condition, which underlines the significance of developing supportive environments within the college campus.

All these problems have been aggravated by the COVID-19 pandemic. According to Tavolacci et al. (2021), the researchers outline the results in which pandemic-related stress, social isolation, and disturbances in routine have driven students towards the symptoms of eating disorders, and their prevalence has increased almost doubled in female students. Bulimia nervosa was the most common of them and binge experiences rose during the lockdowns. Findings present a case that there is an urgent need to increase mental-health services and targeted interventions and to step into the post-pandemic period, as Azman *et al*. (2022) conclude.

CHAPTER 3: METHODOLOGY

3.1 Study design

A cross sectional study design was conducted to explore association between meal patterns, body mass (BMI), and the risk of eating among undergraduate students at Universiti Sains Malaysia Health campus (USMKK). The main benefit of this study design is that its relative expediency and cost-effectiveness since data are gathered at one point of time, and no prolonged follow-up is required. This enables researchers to effectively determine the prevalence of outcomes and exposures thus providing a useful glimpse into the population. However, the main weakness is that, these kinds of studies cannot be used to determine causality, as the outcome and exposure are simultaneous, and thus, it becomes impossible to determine the relationships between the outcomes and the exposure. Data were collected using a self-administered questionnaires divided into three sections which are socio-demographic information, meal pattern assesment for adults by National Health and Morbidity Survey (NHMS) 2014 and Eating Attitude Test (EAT-26) (Wider *et al*, 2023).

Research approval was obtained from Human Research Ethics Committee of USM on 26th March 2025 (USM/JEPeM/KK/25010138). Data collection of this study started on April 2025 until June 2025.

3.2 Study area

This study was conducted at Universiti Sains Malaysia's Health Campus (USMKK) in Kubang Kerian, Kelantan, Malaysia. There are three schools in USMKK, that School of Health Sciences (PPSK), School of Medical Science (PPSP) and School of Dental Science (PPSG)

3.3 Study population

The study population included undergraduate students from the Universiti Sains Malaysia Health Campus, Kubang Kerian (USMKK). All students from PPSK, PPSP, and PPSG will be invited to participate in this study.

3.4 Sample size

Sample size calculation was carried by using G*power (Faul *et al*., 2009) as shown in Figure 1.2.

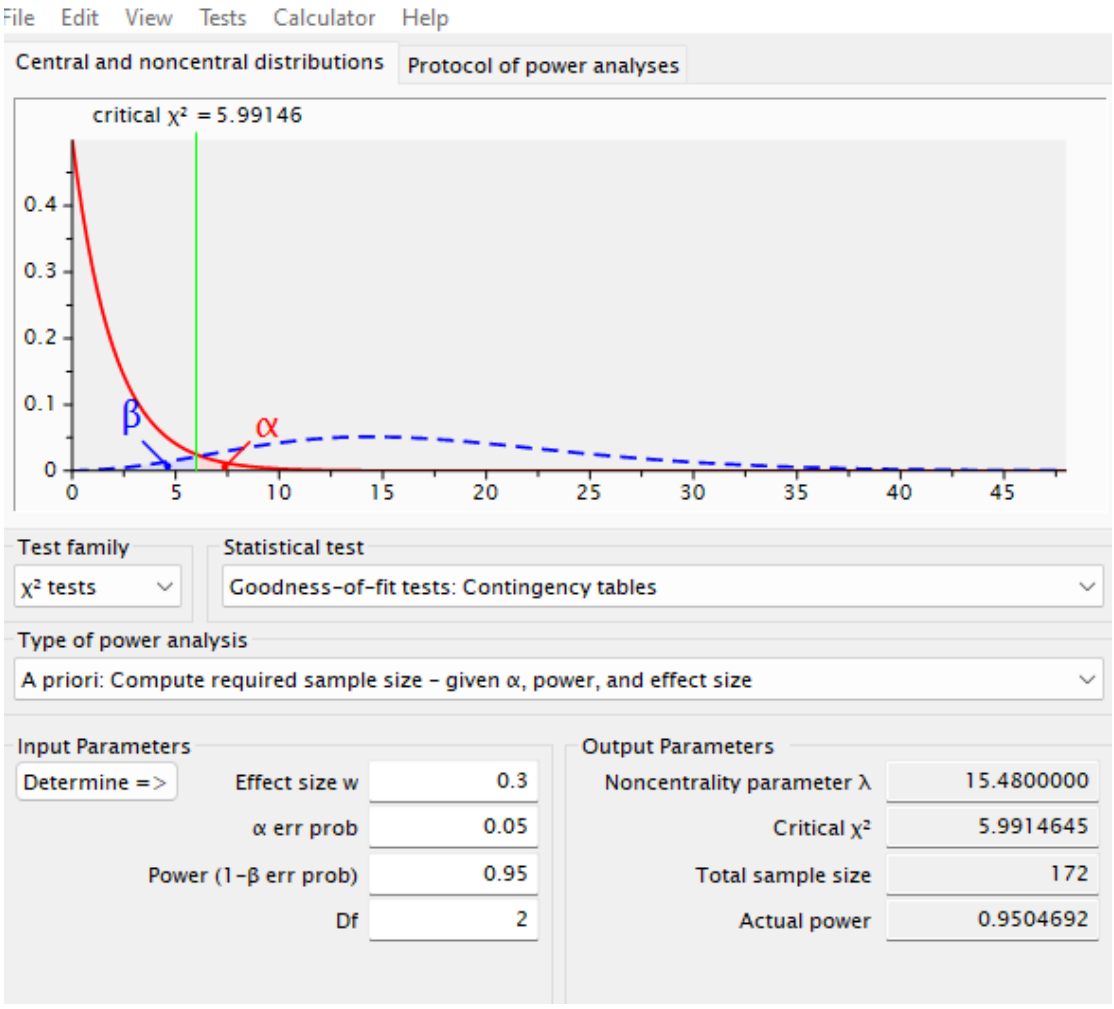

Figure 1.2 Screenshot of sample size calculation using G*Power

After including 20% of dropout compensation, the final total sample size calculated for specific objective 2 and 3 will be 206 participants. Since n=222 is the highest value obtained from the calculation, it was chosen to calculate the final sample for this study.

3.5.1. The sample size for specific objective 1:

The calculation of sample size for specific objective 1 will be calculated based on the following formula:

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

Where,

n = estimated sample size

z = standard value at 95% confidence level = 1.96

Δ = margin error set at 5% = 0.05

p = estimated proportion of university students who experience ED = 0.14 (prevalence of ED among university students according to Chan *et al*. (2020) = 13.9%)

Therefore,

$$\boldsymbol{n} = \left[\frac{\mathbf{1.96}}{\mathbf{0.05}}\right]^{\mathbf{2}} \mathbf{0.14}(\mathbf{1} - \mathbf{0.14})$$

n = 185 + 20% drop-out compensation

n = 222 participants

3.5 Study sample

The inclusion and exclusion criteria of the respondents were described as below:

a. Inclusion criteria

i. All undergraduate students aged between 19-35 in USMKK.

ii. Malaysian.

iii. Males and females

b. Exclusion criteria

i. Students who are pregnant or breastfeeding

ii. Students that are disgnosed with ED

3.6 Sampling method and subject recruitment

A convenience sampling method was applied in this study. The students were invited to participate in this study through announcement and student gatherings in Health Campus Universiti Sains Malaysia. Convenience sampling is a method where the participants are chosen depending on their easily accessible status and availability to participate. This method is widely used when expediency, cost-effectiveness, and practicality are of the utmost importance especially where time and resources are limited. The main benefit of convenience sampling is its effectiveness in gathering data concerning a sample that is easily available and, therefore, allowing researchers to make pilot research. However, this approach to sampling has its own limitations. It can cause selection bias because the sample might not reflect the entire