THE ASSOCIATION BETWEEN SLEEP QUALITY, BODY MASS INDEX (BMI), AND NIGHT EATING SYNDROME (NES) AMONG UNDERGRADUATE STUDENTS IN UNIVERSITI SAINS MALAYSIA.

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By

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LIST OF ABBREVIATION

BMI	Body Mass Index
NES	Night Eating Syndrome
NEQ	Night Eating Questionnaire
PSQI	Pittsburgh Sleep Quality Index
PPSK	School of Health Sciences
PPSP	School of Medical Sciences
PPSG	School of Dental Sciences
SD	Standard Deviation
USM	Universiti Sains Malaysia
SPSS	Statistical Package for Social Sciences

PERKAITAN ANTARA KUALITI TIDUR, INDEKS JISIM BADAN, DAN SINDROM PEMAKANAN WAKTU MALAM DALAM KALANGAN PELAJAR PRASISWAZAH DI UNIVERSITI SAINS MALAYSIA (USM)

ABSTRAK

Kajian ini bertujuan untuk menentukan prevalens Sindrom Pemakanan Waktu Malam (Night Eating Syndrome, NES) dan mengenal pasti hubungannya dengan kualiti tidur serta Indeks Jisim Badan (BMI) dalam kalangan pelajar prasiswazah di Universiti Sains Malaysia (USM). Kajian keratan rentas ini melibatkan 196 orang pelajar prasiswazah daripada Pusat Pengajian Sains Kesihatan, Pusat Pengajian Sains Perubatan dan Pusat Pengajian Sains Pergigian di Kampus Kesihatan USM, Kubang Kerian, Kelantan. Data dikumpulkan menggunakan soal selidik tadbir sendiri yang merangkumi maklumat sosiodemografi, Night Eating Questionnaire (NEQ), Pittsburgh Sleep Quality Index (PSQI), serta berat badan dan ketinggian yang dilaporkan sendiri untuk pengiraan BMI. Statistik deskriptif digunakan untuk merumuskan data, manakala ujian Khi Kuasa Dua dan Ujian Tepat Fisher digunakan untuk menentukan hubungan antara pemboleh ubah. Dapatan kajian menunjukkan bahawa prevalens NES dalam kalangan responden adalah sebanyak 13.3%, manakala 63.8% pelajar melaporkan mempunyai kualiti tidur yang kurang baik. Majoriti responden mempunyai BMI dalam kategori normal. Analisis menunjukkan terdapat hubungan yang signifikan antara NES dan kualiti tidur, di mana pelajar yang mengalami NES lebih berkemungkinan mempunyai kualiti tidur yang kurang baik ($\chi^2 = 13.603$, $p < 0.001$). Walau bagaimanapun, tiada hubungan yang signifikan ditemui antara NES dan kategori BMI (Ujian Fisher's Exact, $p = 0.313$).

Kesimpulannya, NES mempunyai hubungan yang signifikan dengan kualiti tidur tetapi tidak mempunyai hubungan yang signifikan dengan kategori BMI dalam kalangan pelajar prasiswazah yang terlibat dalam kajian ini. Kajian ini menekankan kepentingan saringan awal bagi mengenal pasti pelajar yang berisiko mengalami NES serta kepentingan mengamalkan tabiat tidur yang sihat dalam kalangan pelajar universiti. Dapatan kajian ini juga dapat membantu perkhidmatan kesihatan universiti merancang intervensi yang lebih khusus bagi meningkatkan corak pemakanan dan kualiti tidur pelajar.

THE ASSOCIATION BETWEEN SLEEP QUALITY, BODY MASS INDEX (BMI), AND NIGHT EATING SYNDROME (NES) AMONG UNDERGRADUATE STUDENTS IN UNIVERSITI SAINS MALAYSIA.

ABSTRACT

This study aimed to determine the prevalence of Night Eating Syndrome (NES) and examine its association with sleep quality and Body Mass Index (BMI) among undergraduate students at Universiti Sains Malaysia (USM). A cross-sectional study was conducted among 196 undergraduate students from the School of Health Sciences, School of Medical Sciences, and School of Dental Sciences at the USM Health Campus, Kubang Kerian, Kelantan. Data were collected using a self-administered questionnaire comprising sociodemographic information, the Night Eating Questionnaire (NEQ), the Pittsburgh Sleep Quality Index (PSQI), and self-reported weight and height for BMI calculation. Descriptive statistics were used to summarise the data, while Chi-square and Fisher's Exact tests were used to determine associations between variables. The prevalence of NES among respondents was 13.3%, while 63.8% of students reported poor sleep quality. Most respondents had normal BMI. A significant association was found between NES and sleep quality, with students who had NES being more likely to experience poor sleep quality ($\chi^2 = 13.603$, $p < 0.001$). However, no significant association was observed between NES and BMI categories (Fisher's Exact Test, $p = 0.313$). In conclusion, NES was significantly associated with sleep quality but not with BMI categories among undergraduate students in this study. These findings highlight the importance of early screening for NES and the promotion of healthy sleep habits among university students. The findings may also assist university health services in developing targeted interventions to improve students' eating behaviours and sleep quality.

CHAPTER 1: INTRODUCTION

1.1 Background Of Study

Changes in lifestyle, academic demands, and daily routines can affect eating habits and sleep patterns among university students (Alwafa et al., 2024). Irregular schedules, academic anxiety, studying late at night, and greater control over food choices may contribute to irregular eating patterns and poor sleep quality among university students.

Night Eating Syndrome (NES) is a circadian related eating disorder where excessive eating in the evening and/or frequent nocturnal food ingestion is accompanied by sleep disturbances, mental distress, and daytime malfunction (Allison *et al.,* 2008; Allison *et al.,* 2010). It has been reported that NES is also related to increased body mass index (BMI), depressive symptoms, and disturbed sleep, and thus NES is a significant but less well-known health issue among young adults (Aloi *et al.,* 2023; Alwafa *et al.,* 2024).

The quality of sleep is an important element of health and well-being among university students. The inadequate quality of sleep, which is characterised by problems with sleep initiation, frequent night awakenings and the inability to rest during sleep, has been linked to poor academic performance, low levels of concentration, mood swings, and later mental health issues (Alwafa *et al.,* 2024; Palagini *et al.,* 2024). Pittsburgh Sleep Quality Index (PSQI) is a generally validated and much used instrument in the measurement of subjective sleep quality and sleep disturbances within a one month interval (Buysse *et al.,* 1989). In Asia and the Middle East, a higher prevalence of poor sleep quality has been

reported among university students and has been linked to stress, poor dietary habits, inconsistent eating habits, and high body weights (Alwafa *et al.,* 2024; Chin *et al.,* 2020).

There is increasing evidence of a strong association between NES, quality of sleep, and BMI. Research performed among Palestinian university students proved that greater NES scores were closely linked with worse sleep quality, assessed by PSQI, and daytime dysfunction (Alwafa *et al.,* 2024). The contributions of night eating behaviours to elevated body mass index have also been proposed in other studies to include excessive nocturnal caloric intake, metabolic dysregulation, and decreased energy expenditure that may then lead to sleep disturbance (Allison *et al.,* 2010; Gallant *et al.,* 2014). These results demonstrate the two-way and intricate interaction between eating behaviour, body weight, and sleep quality.

Body mass index (BMI) is one of the most common measures of nutritional status that has been proven to be strongly interrelated with eating behaviours as well as sleep patterns. It has been indicated that people who have night eating habits have a higher probability of gaining higher BMI because of caloric intake in the evening and night, metabolic disturbances, and a decrease in energy expenditure (Allison *et al.,* 2010; Gallant *et al.,* 2014). Unhealthy eating patterns and sedentary lifestyles have led to the growing number of overweight and obese university students, which may adversely impact the quality of sleep by increasing the incidence of sleep apnea, sleeping pains, and dysregulation of hormones (Aloi *et al.,* 2023; Palagini *et al.,* 2024). Hence, BMI is a significant health outcome in the study of the effects of night eating behaviours among this group.

The evidence of these associations at the regional level has mostly been obtained in studies of the Asian and Middle East regions, such as university-based research in Palestine and other Middle East countries, and the Asian population with similar academic and lifestyle conditions (Alwafa *et al.,* 2024; Chin *et al.,* 2020). The studies emphasise the fact that NES, high BMI, and low quality of sleep are frequently comorbid in young adults, which makes the study of these variables relevant.

However, although there is growing international and regional evidence on the subject, there is a lack of empirical research that specifically investigates the relationship between NES and sleep quality, alongside BMI, among Malaysian undergraduates. Such incompleteness of the local data makes the necessity of additional investigation obvious. Hence, the purpose of the study is to determine the association between NES and sleep quality and BMI in undergraduate students with the use of validated assessment measures.

1.2 Problem Statement & Study Rationale

Night Eating Syndrome (NES), poor sleep quality, and excess body weight are significant issues faced by Malaysian university students, where the prevalence of NES is reported to be 12.2-23.4% (Gan *et al.,* 2019; Sariman & Poh, 2015), the quality of sleep is poor and occurs in about 50-70% of students (Chin *et al.,* 2020), and the proportion of overweight or obesity lies in the range of 25-35%. Such health issues have been blamed on accelerated urbanisation, the growing academic requirements, and lifestyle changes among young adults. The prevalance of Night Eating Syndrome among university students is highly variable internationally, with a range of 4.2% in the United States and 28.6% in Palestinian university students, and the incidence of the condition has been linked to poorer sleep quality, high BMI, and daytime dysfunction (Allison *et al.,* 2010; Alwafa *et al.,* 2024).

It has been shown through regional studies of Palestinian students at universities, among others, that the Night Eating Syndrome is a critical predictor of worse sleep quality, greater PSQI scores, and greater daytime dysfunction (Alwafa *et al.,* 2024). In the face of this accumulating body of international and regional evidence, however, limited studies have been conducted to identify the interrelationship between NES, sleep quality, and BMI among undergraduate students of USM health sciences. This gap is of particular significance because the USM health sciences students are in health-related programmes and are often subjected to heavy academic loads, clinical training demands, and irregular timetables, which can make them more susceptible to disordered eating patterns and sleep disorders.

Lack of context-specific evidence restricts the capacity of the USM health services and university administrators to formulate specific screening, nutrition counselling, and sleep-related measures for this group. In the absence of local data, the students who are at risk of academic burnout, metabolic health issues and poor well-being might go undiscovered. Thus, this study aims to fill this critical gap by identifying the association between NES, sleep quality, and BMI among undergraduate students of the USM health sciences with validated instruments, such as the Night Eating Questionnaire (NEQ), Pittsburgh Sleep Quality Index (PSQI), and BMI categories based on Asian-specific cut-off points recommended in the Clinical Practice Guidelines on the Management of Obesity, Ministry of Health Malaysia.

1.3 Research Questions

1. What is the prevalence of NES among undergraduate students of USM?
2. What is the BMI status and level of sleep quality among undergraduate students of USM?
3. Is there a significant association between NES and sleep quality among undergraduate students of USM?
4. Is there a significant association between NES and BMI among undergraduate students of USM?

1.4 Study Objectives

A) General Objective:

To determine the association between sleep quality, BMI, and NES among undergraduate students at USM

B) Specific Objectives:

1. To determine the prevalence of NES among undergraduate students of USM.
2. To determine the BMI status and level of sleep quality among undergraduate students of USM.
3. To determine the association between sleep quality and NES among undergraduate students of USM.
4. To determine the association between BMI and NES among undergraduate students of USM.

1.5 Study Hypothesis

Hypothesis I

Null Hypothesis (H_0): There is no significant association between NES and sleep quality among undergraduate students of USM.

Alternative Hypothesis (H_1): There is a significant association between NES and sleep quality among undergraduate students of USM.

Hypothesis II

Null Hypothesis (H_0): There is no significant association between NES and BMI among undergraduate students of USM.

Alternative Hypothesis (H_1): There is a significant association between NES and BMI among undergraduate students of USM.

1.6 Significance of Study

This study aims to provide essential information on the prevalence of Night Eating Syndrome (NES) and its association with sleep quality and Body Mass Index (BMI) among undergraduate students, as students may be highly vulnerable to lifestyle-related health issues (Chin et al., 2020). These findings can help university administrators, health services, and counsellors plan targeted screening, education, and behavioural interventions to improve students' eating and sleeping habits as well as weight-related health outcomes. In the longer term, such information may contribute to preventing weight problems, psychological distress, and academic difficulties related to disrupted eating and sleep patterns and unhealthy BMI status among undergraduates. For example, the results can be used to identify students who may be at risk of night eating behaviours, poor sleep quality, and abnormal BMI, and therefore proactive educational interventions can be provided by university health services and counsellors on meal timing, sleep quality, and weight management, along with individual counselling support.

Furthermore, this investigation will contribute to the limited literature on NES in Malaysia and add to the existing evidence linking night eating with sleep quality, psychological distress, and BMI (Alwafa et al., 2024). The use of validated instruments such as the Night Eating Questionnaire (NEQ), the Pittsburgh Sleep Quality Index (PSQI), and BMI classification will also demonstrate the feasibility of assessing NES, sleep quality, and weight status among local student populations and may support future research in this area.

CHAPTER 2: LITERATURE REVIEW

2.1 Night Eating Syndrome

The Night Eating Syndrome (NES) is a disorder that has initially been defined as a form of morning anorexia, evening hyperphagia, and insomnia, and is currently being defined as an eating disorder, marked by a delayed food intake throughout the 24-hour day (Allison *et al.,* 2010). Some of the diagnostic characteristics that are proposed are the intake of a large percentage of daily energy that is ingested following the evening meal and/or repeated nocturnal awakenings with eating along with awareness of these events and the related distress or impaired functioning (Allison *et al.,* 2010).

The Night Eating Questionnaire (NEQ) is a widely used self-report measure to determine the severity of NES symptoms and has demonstrated good reliability and validity in both clinical and community samples (Allison *et al.,* 2008). NES has been reported in the case of university students in Malaysia. A survey of a group of female undergraduates in a state university found that NES and high consumption of energy-dense snacks at night (Nurh Dzkalfli *et al.,* 2020).

The other Malaysian undergraduate study established that night eating and NES symptoms were linked to increased psychological stress and worse sleep quality (Chew Yeen *et al.,* 2023). It has also been shown that NES is likely to cause mental health issues and unhealthy eating habits at late hours by international and regional students and young adults (Alwafa *et al.,* 2024; Palavras *et al.,* 2013). This literature indicates that NES can be applied in university population and it needs to be investigated alongside other health outcomes like sleep quality and body mass index (BMI) especially among undergraduates in Malaysia.

2.2 Sleep Quality

Sleep quality is a complex, multidimensional measure that includes sleep duration, sleep latency, sleep continuity, subjective perception of restfulness, and daytime functioning after sleep. The Pittsburgh Sleep Quality Index (PSQI) is a widely used and validated instrument comprising seven components that assess sleep quality. A global PSQI score of greater than five is generally considered indicative of poor sleep quality. (Buysse *et al.,* 1989).

Eating disorders and disordered eating behaviours have been demonstrated to be associated with poor sleep quality, greater levels of insomnia, and greater sleep fragmentation than healthy controls (Palagini *et al.,* 2024).

The prevalence of poor sleep quality has been documented in studies involving Malaysian adults and university students and it is related to irregular bedtime schedules, screen exposure at night, academic necessities and psychological pressure (Farah *et al.,* 2019; Ong *et al.,* 2023; Lakshme *et al.,* 2025). Sleep quality has also been identified to be a major health problem in the university environment with poor sleep quality being associated with daytime sleepiness, psychological distress, and poor academic performance among university students.

The above findings warrant the exploration of sleep quality with regard to night eating behaviours, including Night Eating Syndrome (NES) among undergraduate students of Universiti Sains Malaysia, Health Campus.

2.3 Association Between Night Eating Syndrome and Sleep Quality

There has been evidence of a two-way relationship between NES and sleep quality. Individuals with NES often report problems in falling asleep and staying asleep, recurrent nocturnal awakenings and daytime fatigue, while the sleep problems may promote eating late at night as a coping mechanism (Allison *et al*, 2010; Gallant *et al*, 2014). Proposed mechanisms include circadian misalignment, suppression or enhancement of secretion of appetite and sleep regulatory hormones such as melatonin, leptin, and increased stress or adverse affect in the evening (Allison *et al*, 2010; Palagini *et al*, 2024).

A recent cross-sectional study in Palestine showed that those students who scored high on the NEQ had a significantly worse quality of sleep and experienced more dysfunction during the day, despite the researchers controlling for possible confounding factors (Alwafa *et al*, 2024). Other studies have reported that night-eating habits and NES are associated with shorter sleep duration and less subjective sleep quality among young adults (Gallant *et al*, 2014; Lundgren *et al*, 2022).

A study of NES in Malaysia indicated that NES had a significant negative impact on sleep quality, and students who satisfied the criteria of NES were more likely to be classified as poor sleepers (Kwan *et al.,* 2021). In another study in Malaysia, it was revealed that sleep quality was associated with night eating behaviour in university students (Norhafizah *et al.,* 2024). Collectively, these results suggest that NES and night eating are significant predictors of sleep disturbance in university samples, which validates the need to investigate this relationship in more detail in undergraduates at Universiti Sains Malaysia, Health Campus.

2.4 Association Between Night Eating Syndrome and Body Mass Index (BMI)

The Body Mass Index (BMI) is a simple anthropometric index based on the weight in kilograms divided by height in metres squared that is usually used to determine the underweight, normal weight, overweight and obesity in adults. Since Night Eating Syndrome (NES) is characterized by a rise in caloric consumption during the evening and night, usually in the form of snack foods rich in energy, it was hypothesised that NES may be the associated with an increase in the BMI and obesity risks (Allison *et al.,* 2010; Palavras *et al.,* 2013). The data on the NES-BMI association is however inconclusive. The results of a narrative review have indicated that out of studies conducted in a five year period, approximately half of the studies have identified a positive correlation between NES and increased BMI, with the remainder of the studies obtaining no definitive relationship between the two factors, indicating that age and emotional consumption may mediate the link (Palavras *et al.,* 2013).

In Malaysia, a cross-sectional study on female university students revealed that NES measured by the NEQ was not significantly related to BMI, but the respondents regularly consumed sweet, salty and high fat foods at night which they thought might contribute to weight gain in the future (Nurh Dzkalfli *et al.,* 2020).

Recent Malaysian research in mixed-gender university students has also extrapolated these results by looking at night eating in a more extensive theory. According to one of the studies, night eating was connected to BMI, stress and sleep quality among Malaysian university students (Emmy *et al.,* 2024). A second study carried out in the COVID 19 era

discovered that there were substantial relationships between NES and lower sleep quality, and increased BMI in the case of students in private universities (Kwan *et al.,* 2021).

Further Malaysian studies have also started to examine NES and BMI in combination with physical activity level, suggesting that eating habits among students can be associated with weight status, which is their lifestyle approach (Saari *et al.,* 2024). Combined, the international and Malaysian research indicates that NES and night eating behaviour may be associated with increased BMI among certain populations at the university, although the results are not always positive across the samples (Palavras *et al.,* 2013; Nurh Dzkalfli *et al.,* 2020; Kwan *et al.,* 2021).

This inconsistency emphasizes the need to explore the relationship between NES and BMI in undergraduates at Universiti Sains Malaysia by determining whether night eating experiences correlate with weight status in the specified environment.

2.5 Conceptual Framework

Figure 1 shows the conceptual framework of the study. The dependent variable is Night Eating Syndrome (NES), and the independent variables are sleep quality (good or poor), and Body Mass Index (BMI). The Pittsburgh Sleep Quality Index (PSQI), the self-reported measure of sleep quality, will be used, and BMI will be computed from the self-reported weight and height data. The Night Eating Questionnaire (NEQ) will be used to measure NES.

In Malaysia, previous studies reported that the prevalence of Night Eating Syndrome (NES) among university students was associated with poor sleep quality, while abroad, it was observed that NES was also linked to poor sleep quality. Furthermore, BMI was found to be one of the factors associated with night eating behaviours, with those who had a higher BMI having more symptoms of NES. From this evidence, the framework suggests that there is a relationship between sleep quality and BMI that relates to Night Eating Syndrome (NES) among undergraduate students.

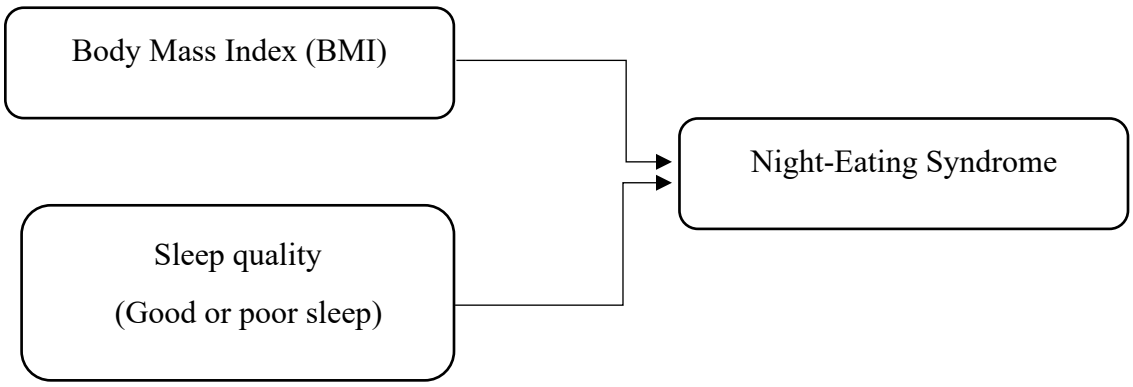


Figure 1: Conceptual Framework of the Study

CHAPTER 3: METHODOLOGY

3.1 Study Design

This study is designed as a cross-sectional study using a self-administered questionnaire to assess Night Eating Syndrome (NES), sleep quality, and Body Mass Index (BMI) among undergraduate students at Universiti Sains Malaysia, Kubang Kerian, Kelantan. Data were collected at a single point in time, making this design less time-consuming and cost-effective while allowing the assessment of current eating behaviours, sleep quality, and body weight status without follow-up.

This design also enables data collection from a relatively large number of participants and allows comparison of variables within the study population, as well as the determination of prevalence and the examination of associations.

3.2 Study Area

This study was conducted among university students at Universiti Sains Malaysia (USM), Health Campus, Kubang Kerian, Kelantan. This location was chosen because USM consisted of students from various health-related fields and diverse backgrounds and ethnicities. It was also considered a suitable setting for conducting the study due to its accessibility and convenience, which facilitated efficient and time-saving data collection.

3.3 Study Population

The target population will be undergraduate students from the School of Health Sciences (PPSK), School of Medical Sciences (PPSP) and School of Dental Sciences (PPSG) at USM Health Campus, Kubang Kerian, Kelantan, aged 18 to 25 years old.

3.4 Selection Criteria

3.4.1 Inclusion Criteria

a) Age range between 18 to 25 years old.
b) A Malaysian.
c) Willing to provide informed consent.

3.4.2 Exclusion Criteria

a) Have a self-reported history of a serious mental illness, such as schizophrenia, bipolar disorder, or major depression, that can strongly affect their eating or sleep.
b) Have a self-reported history of a diagnosed sleep disorder.
c) Have serious medical illnesses that substantially affect eating or sleep (for example, chronic kidney disease, cancer, uncontrolled diabetes mellitus, severe gastrointestinal disorders, or sleep apnea).
d) Are currently taking regular prescription medication for sleep (for example, sleeping pills or sedative drugs) that may significantly change their usual sleep pattern.

3.5 Sample Size Estimation

In this research, the sample size was calculated using the formula from Daniel (1999):

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

n= sample size

Z= value representing the desired confidence level

ρ = anticipated prevalence (proportion)

Δ= precision

3.5.1 Sample Size Estimation for NES

According to a study by Gan et al. (2019), Night Eating Syndrome (NES) was found to have a prevalence of about 12.2% among university students and the figure was used as the expected proportion (p = 0.122) of the population in the current study. The confidence level chosen was 95% and the Z value was 1.96 and the level of precision was decided to be 5%, which is normally used in the estimation of sample size based on prevalence. Based on these parameters and the standard formula in a single proportion, the necessary sample size needed to estimate the proportion of the students with NES was calculated and an extra sample size was considered to cover the possibility of non-response.

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

n= sample size

Z= 1.96 (value representing the desired confidence level 95%)

ρ = 12.2% proportion

Δ= 5% precision

$$n = \left[\frac{1.96}{0.05}\right]^2 0.122\ (1 - 0.122)$$

$$n = 164.6\ \approx\ 165 \text{ Samples}$$

An additional 20% of subjects was included to account for non-response and missing data. Hence the final minimum sample size of N=200 was determined for this study.

3.5.2 Sample Size Estimation for Sleep Quality

In a past study, sleep quality was estimated based on data on the prevalence of inadequate sleep. According to that study, the proportion of the US population who sleep 5 hours or less was found to be 7.75, and it was rounded to 8 and utilized as the expected proportion of the population (p = 0.08) in the current study (Grandner, 2019). A 95% confidence level was chosen, a Z value was 1.96, and a precision was decided, 5%, which is typically used in the calculation of sample size by prevalence. Using these parameters and the standard formula of a single proportion, the sample size needed to estimate the proportion of students with poor quality of sleep was estimated to be 136 participants.

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

n= sample size

Z= 1.96 (value representing the desired confidence level 95%)

ρ = 7.75% proportion (round off 8.0%)

Δ= 5% precision

$$n = \left[\frac{1.96}{0.05}\right]^2 0.08\ (1 - 0.08)$$

$n = 113.1 \approx 113$ Samples + 20% dropout added to sample

$n = 135.6 \approx 136$ Samples

3.5.3 Sample Size Estimation Association NES and Sleep Quality.

G*Power software was used to calculate the required sample size for this study. For correlation analysis, the effect size (r) was set at 0.3, the alpha error probability was set at 0.05, and the statistical power was set at 0.80. The required sample size was 84 participants.

Effect size, r = 0.3

α error probability $= 0.05$

Power ($1 - \beta$ err $prob$) $= 0.80$

Total sample size = 82

= 82 + 20% dropout added to the sample

= 98.4 $\approx$ 99 sample.

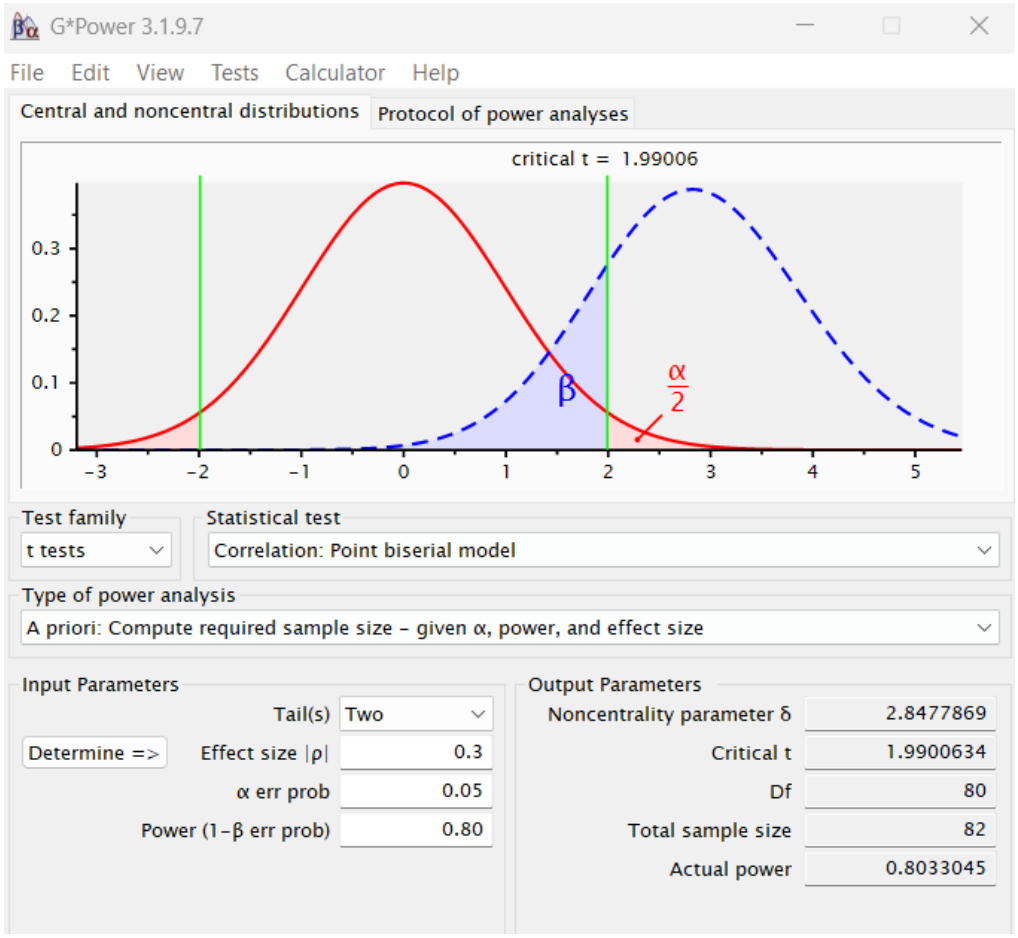


*Figure 2: G*Power output for sample size calculation*

The sample size was primarily calculated to fulfil the main objectives of estimating the prevalence of Night Eating Syndrome (NES) and examining its association with sleep quality. A final sample size of 200 participants was selected as it satisfied the minimum required sample size for these objectives and was considered adequate to support secondary analyses, including the association between NES and BMI.

3.6 Sampling Method and Subject Recruitment

A simple random sampling method was used in this study. The sampling frame comprised lists of all the undergraduate students from School of Medical Sciences (PPSP), School of Dental Sciences (PPSG) and School of Health Sciences (PPSK), Universiti Sains Malaysia (Health Campus). Participant selection was based on the student lists that were obtained from the respective Academic Offices.

All students in the sampling frame had a unique identification number. Participants were then selected using a simple random sampling method until the number of participants required was obtained. This provided all undergraduate students in PPSP, PPSG and PPSK the same opportunity to participate in the selection, thus minimising selection biases and enhancing representativeness of the study sample.

The research further reached out to the class representatives of the various programmes in order to initiate communication with the chosen students. They were sent through communication platforms used by classes like WhatsApp and Telegram to a Google Form link to participate in the study. The Google Form contained the participant information sheet, informed consent form and the study questionnaires. Prior to completing the questionnaire, students who consented were given informed consent electronically. There was complete voluntary participation and participants were allowed to withdraw from the study whenever they wished without any consequences or penalty.

3.7 Research Tool and Materials

The questionnaire consisted of four sections: Sections A, B, C, and D.

In section A, the socio-demographic factors include age, gender, ethnicity, year of study, field of study and financial support during the academic period.

In Section B, the Night Eating Questionnaire (NEQ) was a 14-item self-report questionnaire that used a Likert-type scale ranging from 0 to 4 for each item to screen for symptoms of Night Eating Syndrome (NES), with higher scores indicating greater severity of night eating symptoms. In this study, NEQ scores were analysed continuously as a measure of symptom severity and categorically, with a total score of ≥25 used as the cut-off point for probable NES. Questions 1–9 were required to be answered by all participants. Participants who scored 0 on Question 9 were instructed to skip to Question 15. Participants who scored 0 on Question 12 were instructed to skip Questions 13 and 14 (Allison *et al*., 2008).

For the scoring calculation, Questions 1, 4, and 14 were reverse-scored. Questions 1–12 and 14 were summed to obtain the total NEQ score, with Question 13 excluded because it was used to screen for parasomnia. Question 15 was not included in the total NEQ score but was used to identify additional symptoms. Questions 16 and 17 were used to assess distress related to night eating. The total NEQ score ranged from 0 to 52, with higher scores indicating greater severity of night eating symptoms (Allison *et al*., 2008).

The original NEQ has demonstrated good internal consistency and test–retest reliability in clinical and community populations (Allison *et al.,* 2008). In Malaysia, the NEQ has been used among female university students and mixed-gender undergraduate samples, showing acceptable internal consistency (Cronbach's alpha > 0.70) and clear differentiation

of night-eating symptoms in student populations (Nurh Dzkalfli *et al.,* 2020; Kwan *et al.,* 2021). This supports the suitability of the NEQ for assessing NES in Malaysian undergraduates.

In Section C, sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a widely used 19-item questionnaire that measures sleep quality and sleep disturbances over the previous month. The questionnaire consists of seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Component scores ranged from 0 (no difficulty) to 3 (severe difficulty), and the sum of these components produced a global PSQI score ranging from 0 to 21, with higher scores indicating poorer sleep quality and lower scores indicating better sleep quality. A global PSQI score of more than 5 (PSQI > 5) was classified as poor sleep quality, whereas a score of 5 or less (PSQI ≤ 5) was classified as good sleep quality (Buysse et al., 1989). Additionally, the PSQI includes five supplementary questions intended for clinical assessment, which are completed by the respondent's roommate or bed partner. However, these questions were not included in the scoring process (De Vito et al., 2025).

The PSQI has demonstrated good internal consistency and validity across many populations (Buysse *et al.,* 1989; Farah *et al.,* 2019). Although the English PSQI will be used, its suitability in the Malaysian context is supported by validation work on the Malay version. The Malay version of the PSQI (PSQI-M) has shown acceptable internal consistency (Cronbach's alpha around 0.74), good test–retest reliability and meaningful correlations with daytime sleepiness and related constructs in Malaysian adults (Farah *et al.,* 2019). These findings indicate that the PSQI construct performs adequately in local populations,

supporting the use of PSQI-based assessment in this study among undergraduates at Universiti Sains Malaysia, Health Campus.

In Section D, BMI was used as an indicator of nutritional status among undergraduate students. BMI was calculated from self-reported body weight and height using the standard formula: weight (kg) divided by height in meters squared (kg/m^2).

Students will be asked to report their current body weight in kilograms and height in centimeters, with brief instructions provided to improve accuracy using recent scale readings. Self-reported weight and height have been shown to give reasonably accurate BMI estimates in Malaysian adults for group-level analysis (Tan *et al.,* 2023). Then, the BMI will be classified according to the Clinical Practice Guideline Management of Obesity (Ministry of Health Malaysia *et al.,* 2023). BMI was used to classify people's weight. The formula was BMI = kg/m^2, where kg was a person's weight in kilograms and m^2 was their height in meters squared. The BMI ranges used in this study were according to the Asian population, where a BMI of less than 18.5 kg/m^2 indicated underweight, 18.5 – 22.9 kg/m^2 was normal, 23 – 27.4 kg/m^2 was overweight, and above 27.5 kg/m^2 was classified as obese.

3.8 Operational Definition

3.8.1 Night Eating Syndrome (NES)

NES is an eating disorder characterised by consuming a significant portion of daily food intake in the evening or during nocturnal awakenings, often accompanied by insomnia and morning anorexia (Allison *et al.,* 2010). In this study, NES is defined operationally using the NEQ. Participants with a NEQ total score of 25 or higher (NEQ ≥ 25) will be classified as having probable NES, while those with NEQ < 25 will be classified as not having NES. This cut-off has been used in previous studies among university students (Allison *et al.,* 2008; Gan *et al.,* 2019).

3.8.2 Sleep Quality

Sleep quality refers to an individual's subjective experience of sleep, including aspects such as sleep duration, sleep latency, night-time awakenings and daytime functioning (Buysse *et al.,* 1989). In this study, sleep quality is defined using the Pittsburgh Sleep Quality Index (PSQI). The PSQI produces a global score from 0 to 21, with higher scores indicating poorer sleep. A PSQI global score greater than 5 (PSQI > 5) will be classified as poor sleep quality, whereas a score of 5 or less (PSQI ≤ 5) will be classified as good sleep quality, consistent with the original validation study (Buysse *et al.,* 1989).