

## Stress and Sleep Quality among Engineering Students

Nurhamizah Hasim, Junaidah Yusof\*, Farah Adibah Ibrahim, Mohd Sharial Bungsu, Nur Asyikin Yakub, Nurul Izzah Shari

*School of Human Resource Development and Psychology, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia*

\*Corresponding author: junaidahy@utm.my

**Article history:** Received: 01 January 2023 Received in revised form 13 April 2023 Accepted: 18 May 2023 Published online: 31 August 2023

### Abstract

Stress is a normal occurrence in human lives, and university students can never escape from experiencing stress at least once during their university years, during which they have to face a variety of stressors. Poor sleep quality happens to people of all ages worldwide, particularly university students. Numerous studies have reported that stress significantly correlates with sleep quality among university students from various courses. However, these variables were less explored by past researchers, specifically on engineering students. In order to explore more information on these variables among engineering university students in Malaysia, a cross-sectional, quantitative, correlational study is conducted to identify the relationship between stress and sleep quality among engineering students in Malaysia. A total of 272 undergraduate engineering students from three public universities in Malaysia were involved in the study. The Perceived Stress Scale (PSS-10) and Pittsburgh Sleep Quality Index (PSQI) were used. The result from the correlational analysis shows that there is a significant negative relationship between stress and sleep quality among engineering students. The study's findings could be used as a reference for future studies and recommend interventions to improve students' stress and sleep quality levels.

*Keywords:* engineering students; sleep quality; stress

### Abstrak

Tekanan adalah perkara biasa dalam kehidupan manusia dan pelajar universiti tidak pernah dapat lari daripada mengalami tekanan sekurang-kurangnya sekali dalam tahun universiti mereka di mana mereka terpaksa menghadapi pelbagai tekanan. Kualiti tidur yang buruk berlaku kepada semua peringkat umur di seluruh dunia, terutamanya pelajar universiti. Banyak kajian telah melaporkan bahawa tekanan mempunyai hubungan yang signifikan dengan kualiti tidur di kalangan pelajar universiti dari pelbagai kursus, namun pembolehubah ini kurang diterokai oleh penyelidik lepas khususnya terhadap pelajar kejuruteraan. Untuk meneroka lebih banyak maklumat tentang pembolehubah ini dalam kalangan pelajar universiti kejuruteraan, satu kajian keratan rentas, kuantitatif, korelasi dijalankan untuk mengenal pasti hubungan antara tekanan dan kualiti tidur dalam kalangan pelajar kejuruteraan di Malaysia. Seramai 272 pelajar sarjana muda kejuruteraan dari tiga universiti awam di Malaysia terlibat dalam kajian tersebut. Instrumen yang digunakan ialah Perceived Stress Scale (PSS-10) dan Pittsburgh Sleep Quality Index (PSQI). Hasil daripada analisis korelasi menunjukkan terdapat hubungan negatif yang signifikan antara tekanan dan kualiti tidur dalam kalangan pelajar kejuruteraan. Dapatan kajian boleh digunakan sebagai rujukan untuk kajian masa depan dan mengesyorkan intervensi yang perlu diambil untuk menambah baik tekanan dan tahap kualiti tidur pelajar.

*Kata kunci:* pelajar kejuruteraan; kualiti tidur; tekanan

© 2023 Penerbit UTM Press. All rights reserved

### 1.0 INTRODUCTION

Stress is a condition of tension arising from undesirable or challenging situations, and it can be short-term or prolonged (Scott, 2020). There are two general types of stress called eustress and distress. Eustress is a positive stress that brings good outcomes to individuals in which the stress motivates the person to reach the goals his/her desires and will consequently bring about increased prosperity, excitement, or fulfillment (Lindberg, 2019). In contrast, distress is the opposite of eustress and is the common type of stress. Distress is related to feelings of worry, anxiety, or being trapped due to the unfavorable circumstances that the individuals face and have no control over (Mayildurai et al., 2019). Stress in individuals can be caused by an internal or/and external factor. Internal stressors include psychological strain regarding the future, potentially dangerous events that may or may not occur, and physical symptoms such as sickness and illness. Outside stressors include a concerning psychological environment, such as a failed relationship and poor working conditions, or poor physical conditions, such as cold and hot weather (Gedam et al., 2020).

Stress is an everyday occurrence and undoubtedly has positive and negative effects on human behavior. Excessive stress one could handle is never favorable and advantageous, which can complicate the everyday routines of human lives and push people to depart from their ordinary social lives (Bisai & Chaudhary, 2017). Stress is frequently used interchangeably with unfavorable life circumstances, such as adjusting to new and unfamiliar environments or encountering failures. In adjusting to stress, individuals exhibit behavioral defenses, which results in a change in the individual's emotional and cognitive processes (Gedam et al., 2020).

Escaping from experiencing stress is not possible in human life, especially for university students. As they will tend to experience stress at least once in their university years in which they have to face a variety of stressors, including unpredictable future circumstances, academic pressure with the expectation of success from their parents, and challenges in integrating with the university environment (Gedam et al., 2020). These stressors and challenges may impair their learning capacity and academic achievement (Balaji et al., 2019; Gedam et al., 2020; Sridar, 2018). Academic factors (Bisai & Chaudhary, 2017; Gedam et al., 2020; Navarro-Martínez et al., 2020; Reddy et al., 2018; Sridar, 2018) and financial problems (Othman & Rashid, 2018; Negi et al., 2019; Reta et al., 2020; Gedam et al., 2020) have been identified to be the most frequent sources of stress for university students. Other than these common stressors, environmental factors, interpersonal relationships (Balaji et al., 2019), financial management issues, shifts in the living environment such as staying away from family, and challenges balancing personal and academic life also causes stress to university students (Navarro-Martínez et al., 2020; Reddy et al., 2018).

Different fields or courses taken in the university have been reported to have different levels of stress among university students (Othman & Rashid, 2018). It may be due to the different subjects and difficulty levels that are exposed to and learned by university students depending on their courses. Balaji et al. (2019) stated that studying engineering course brings about a slew of stressful adjustments in a student's life. The primary academic stressors of engineering students are hectic schedules, class duration, and physical and mental pressure after classes (Balaji et al., 2019; Bisai & Chaudhary, 2017). High parental expectations and exorbitant fees strain engineering students (Balaji et al., 2019). Besides that, societal influence is a stressor among engineering students (Mayildurai et al., 2019).

On the other hand, sleep is crucial for the brain to function correctly and efficiently and to maintain good mental health (Zou et al., 2020). Stress has been found to enhance arousal and impede humans from sleeping (Zhang et al., 2020). Lack of sleep could lead to different consequences in human functioning as sleep is fundamental for humans to function normally in their daily lives. People with depression, anxiety, and stress are more inclined than ordinary people to express problems with falling asleep or having a consistent sleeping hour and frequently awake too early the next day (Zou et al., 2020).

Poor sleep quality is typical in developing and flourishing populations (Wondie et al., 2021). According to World Health Organization, approximately 27% of people globally experience sleep difficulties (Wondie et al., 2021). Poor sleep quality happens to people of all ages worldwide, particularly university students (Zhai et al., 2020), and 62% of university students reported experiencing sleep difficulties (Wondie et al., 2021). The population of university students is more likely to have sleep difficulties and low sleep quality. It seems to be growing over time due to different biological and environmental factors such that students have a detained biological sleep rhythm. Hence, the secretion of melatonin occurs later at night compared to adults. They resulted in a decreased desire to sleep and eventually falling asleep later than ordinary people sleeping time (Navarro-Martínez et al., 2020). While young adult students are likely to have less sleep at night as they may have a lesser homeostatic sleep impulse compared to older adults. As they have a lower inclination to be asleep concerning the amount of time they have spent to be awaked (Navarro-Martínez et al., 2020).

The most frequent factor of low sleep quality among university students appears to be stress (Doolin et al., 2018; Navarro-Martínez et al., 2020; Wondie et al., 2021; Zhang et al., 2020). Stress induces neuroendocrine changes, including hyperactivation of the hypothalamic-pituitary-adrenal (HPA) axis, stimulating sleep onset interruption (Doolin et al., 2018; Navarro-Martínez et al., 2020). This interaction is generally more prominent in young adult university students, whose HPA axis has yet to fully mature, resulting in greater adrenal secretion and escalated sleep latency (Navarro-Martínez et al., 2020). The use of technology before going to bed (Al-Khani et al., 2019; Navarro-Martínez et al., 2020), affection impairment such as anxiety or depression (Al-Khani et al., 2019; Navarro-Martínez et al., 2020; Stanković et al., 2021; Wondie et al., 2021; Zou et al., 2020), low examinations results (Al-Khani et al., 2019; Almojali et al., 2017; Hargens et al., 2020; Li et al., 2020; Wondie et al., 2021) have been identified to be linked with students poor sleep quality.

Since two decades back, sleep quality has been a critical public health problem (Bo et al., 2019). Lack of sleep caused by stress can affect the students' physical and mental health (Al-Khani et al., 2019; Cho et al., 2019; Grandner, 2017; Irwin & Opp, 2017; Li et al., 2020; Zou et al., 2020). Obesity, hypertension, type 2 diabetes mellitus, and cardiovascular disease (CVD) are some of the negative health consequences that could result from sleep deprivation (Hargens et al., 2020) which could also happen to students when they ignore the importance of sleep. A healthy lifestyle, including a nutritious diet, has been shown to improve sleep quality (Jung et al., 2017). Other than that, a variety kind of sports, such as eight-section brocade (Lv et al., 2019), and aerobic exercises (El-Kader & Al-Jiffri, 2019), can enhance sleep quality, and they are less expensive and can be accessed easily (Zhai et al., 2020) which could be the best intervention for students to practice.

Numerous studies have reported that stress significantly correlates with sleep quality among university students from various courses. Thus, this present study aims to lay out more information on the relationship between stress and the sleep quality of university students from one specific course.

## ■ 2.0 LITERATURE REVIEW

### 2.1 Stress

The concept of stress in this study can be defined as a pressure that could be resulted from different factors. According to Lazarus and Folkman (1984), stress has been described as a result of the association between an individual and his/her environment that is perceived as demanding or difficult and in which the person has insufficient resources to cope with it, which then will put his/her well-being in danger. In this present study, operationally, stress refers to the evaluation of one's feelings and thoughts for the past month regarding the situations or circumstances that his/her finds stressful. According to Cohen et al. (1983), stressful situations or circumstances can be described as unpredictable, uncontrollable, and overloaded to the individual.

The transactional model of stress and coping developed by Lazarus and Folkman in 1984 was used as a reference for the stress variable in this study. This model defined stress as the result of the bidirectional relationship between the individual and his or her environment that are appraised as demanding or complicated and in which he or she does not have inadequate coping resources to tackle the situations (Lazarus & Folkman, 1986). Stress is neither derived from the individual himself/herself nor the environment solely, but

stress results from the transaction between the individuals and their environment. Based on this theory, Lazarus and Folkman (1984) explained that people are continuously appraising the experience they encounter in their environment and consequently will produce emotions when the experience encountered is perceived as a harmful threat or challenge that is considered a stressor to the person. These results in people developing coping mechanisms to handle their emotions or striving to directly tackle the stressor they are facing.

Lazarus (1991) emphasized that the importance of this theory is that how an individual perceived the experience he or she encountered contributed to stress or not, rather than the experience itself. This theory exemplifies two essential cognitive appraisals that incorporate the person and the environment (Lazarus & Folkman, 1984). Primary appraisal describes how an individual analyzes the environment he or she encountered as positive or stressful (harmful, threatening, or challenging). The secondary appraisal comes into the act when events are appraised as stressful to determine what can be done which involves analyzing coping strategies that can be applied to tackle the demands of the event. According to Lazarus (1991), these appraisals, in turn, are determined by various personal and environmental factors. To sum up, when an event is perceived as stressful for an individual (primary appraisal) and requires efforts to tackle the event (secondary appraisal), coping strategies are performed (Folkman & Lazarus, 1988).

Lazarus and Folkman (1984) described coping as cognitive and behavioral attempts to manage the internal and/or external demands that are perceived as stressful. This theory emphasizes that the coping strategies focus on directly tackling the stressor by using problem-focused coping or regulating emotions resulting from stressful events by using emotion-focused coping. Then, cognitive reappraisal occurs in which the individual analyzes the coping strategies that have been implemented as successful or unsuccessful. Unsuccessful coping strategies lead the individual to implement more coping strategies, with continuous failure leading to negative affect and physiological disturbances to the individual (Lazarus & Folkman, 1984).

In this study, engineering university students might experience higher stress due to the sudden shifting of the environment from living with family members to living with people whom they do not know in the first place. However, based on this theory, individual differences exist in perceiving the situations they encounter. Some students might appraise the shifting of an environment as stressful, but others might appraise it the other way around. Lazarus (1991) explained this as there is significant variability in the appraisals individuals formulate in the same environment due to individual differences. Insufficiency of emotional support and approaches to seeking help when experiencing stress could result in individuals developing poor coping strategies, including blaming others, consuming alcohol, or others. Individuals with sufficient resources to seek help, such as the availability of counseling services, tend to develop good coping strategies, including problem-solving or reaching out for help from friends. Nevertheless, this current study will not identify the coping strategies that the students used to tackle their stress. Still and all, university students need to have adequate and efficient coping strategies that can help them tackle their stress.

On the other hand, several studies have been conducted to identify the stress level among university students. Overall, moderate to high-stress levels have been reported among university students from various majors (Ahad, 2019; Almojali et al., 2017; Amir Hamzah et al., 2019; Bisai & Chaudhary, 2017; Gedam et al., 2020; González Salinas et al., 2020; Musiu et al., 2019; Negi et al., 2019; Reddy et al., 2018; Reta et al., 2020; Zhai et al., 2020). Apart from that, some previous studies have tried identifying the predictors of stress and its association. According to Bisai and Chaudhary (2017), stress is caused mainly by academic factors such as increased work, long class duration, frantic assignments, and mental and physical pressure after classes. Similarly, Negi et al. (2019) found that one of the six predictors of stress among engineering students was academics.

Some studies identify the association between academic performance and stress or the other way around. Gedam et al. (2020) disclosed that academic performance was found to have a relationship with stress levels among university students, such that students with lower academic performance experienced higher stress than students with good academic performance. Conversely, Balaji et al. (2019) found that stress has a significant relationship with academic performance, in which students with higher stress levels have poor academic performance. However, studies by Almojali et al. (2017) and Ahad (2019) stated that academic performance has no significant relationship with the stress levels of university students.

In addition, stress level differences among genders have been reported by a few studies. Negi et al. (2019), Reta et al. (2020), Musiu et al. (2019), and Amaral et al. (2018) found that female students have been reporting an increased level of stress compared to male students. Opposite results were reported by Sridar, (2018) and Gedam et al. (2020), saying that male students experienced elevated stress than female students. Be that as it may, Bisai and Chaudhary (2017) reported that the stress level among male and female students has no differences.

## 2.2 Sleep Quality

The sleep quality concept that can be used in this study can be described by a person's satisfaction with his/her sleeping patterns. According to Harvey et al. (2008), sleep quality can be defined through a person's sleeping patterns based on tiredness upon waking and throughout the day, feeling rested and restored upon waking, and the amount of nighttime awakenings. Ohayon et al. (2017) explained that individuals with good sleep quality would experience factors that lead to better life quality, such as strong energy, mental, health, and physiological well-being, as well as emotional, cognitive, and physical well-being. Operationally, in this present study, sleep quality refers to how an individual perceives his/her sleep quality based on sleep-related problems.

This study uses the Diathesis-stress model of insomnia to explain the sleep quality variable. Spielman, Caruso, and Glovinsky developed a diathesis-stress model of insomnia in 1987. This model is frequently recognized as the '3-P' model. This model describes three factors: predisposing, precipitating, and perpetuating factors that constitute the occurrence and continuation of insomnia. Genetic, physiological, or psychological diatheses are examples of predisposing factors. However, different humans have different vulnerabilities to these predisposing factors. Spielman (1986) stated that predisposing conditions occur before the emergence of sleep difficulties and pave the way for sleep difficulties, such as by decreasing the sleep quality to stimulate insomnia. Based on this model, predisposing factors may cause the occasional night of poor sleep, but the intensity of the predisposing factors is insufficient to cause insomnia. However, predisposing factors create a tendency or act as a causal element for insomnia.

Next, precipitating conditions are briefly contiguous with the emergence and cause insomnia to develop (Spielman, 1986). Precipitating conditions comprise physiological, environmental or psychological stressors that drive an individual over a hypothetical insomnia threshold and develop severe insomnia symptoms. For example, even when predisposing conditions occur, the person can sleep

well on certain days until the death of a loved one (precipitating condition) happens and stimulates the development of acute insomnia. The third factor, the perpetuating factors, is described as the characteristics that maintain or promote insomnia. This third factor comprises behavioral, psychological, environmental, and physiological elements that hinder a person from resuming normal sleep behavior. However, Spielman et al. (1987) stated that these three factors are not mutually exclusive.

In the current study, university students' sleep quality might worsen due to the predisposing, precipitating, and perpetuating factors that the students face. Stated in this diathesis-stress model of insomnia, predisposing factors will affect the students differently based on the students' vulnerability to the situations. Precipitating factors such as anxiety symptoms could lead the students to develop severe insomnia symptoms. Also, students who consume alcohol or frequently take naps (perpetuating factors) might prevent from practicing normal sleep behaviors. To sum up, many factors can contribute to the poor sleep quality of university students. However, students need to appropriately manage their sleep schedule to prevent them from developing severe sleep difficulties such as insomnia in the future due to their low sleep quality.

On the other hand, many studies were conducted to determine the level of sleep quality among university students. These factors affect the sleep quality of the students and its association. Generally, university students reported having experienced a low level of sleep quality (Ahad, 2019; Ahmed et al., 2020; Al-Khani et al., 2019; Almojali et al., 2017; Alotaibi et al., 2020; Amaral et al., 2018; González Salinas et al., 2020; Li et al., 2020; Musa et al., 2018; Najem et al., 2020; Nasir & Mohamad, 2020; Tien Ngu et al., 2017; Wondie et al., 2021; Zhai et al., 2020; Zhang et al., 2018). 76% of the students in the study by Almojali et al. (2017) reported experiencing low sleep quality. In addition, Tien Ngu et al. (2017) found that most Malaysian university students sleep for less than seven hours every day of the night. These findings have been supported by Wondie et al. (2021), reporting that 62% of the students have low sleep quality. Students reported taking a long time to fall asleep, an average of 30 minutes. 88.72% of the students spent less than seven hours of sleep at night, and many had bad subjective sleep quality.

A few previous studies have reported that sleep quality has a significant relationship with academic performance, in which the poorer the sleep quality, the lower the academic performance of the students (Al-Khani et al., 2019; Almojali et al., 2017; Li et al., 2020; Wondie et al., 2021). However, Alotaibi et al. (2020) and Ahad (2019) showed no relationship between sleep quality and academic performance. Besides, Wondie et al. (2021) revealed that poor social support, inadequate sleep hygiene, increased stress, and depression were predictors of poor sleep quality among the students. Moreover, Tien Ngu et al. (2017) disclosed that caffeine intake was correlated with low quality of sleep among students, such that students with a higher intake of caffeine experienced lower quality of sleep than students with no consumption of caffeine.

### 2.3 Stress on Sleep Quality

The cognitive model of insomnia can be used to understand the relationship between stress and sleep quality among engineering students in this study. This model concerns thoughts, feelings, and beliefs that can disrupt sleep and contribute to dysfunctional behavior patterns. Harvey (2002) has proposed that insomnia is caused by excessive concern about the low quality of sleep and its daylight implications. This consequently contributes to higher physiological and psychological arousal, selective monitoring of the internal environment for threatening signals, and the creation of counter-productive 'safety behaviors' aimed at improving sleep and mitigating the occurrence of insomnia. Figure 2.2 shows the cognitive model of insomnia.

Referring to this model, Harvey (2002) also emphasized that unmanageable thoughts regarding stressful experiences stimulate emotional arousal before sleeping, which leads to cognitive biases of experiences, resulting in impaired cognitive judgments of stressful experiences and a decrease in subjective sleep quality. According to this model, individuals facing stress tend to have perceptual bias and stimulate various negative emotions, significantly reducing sleep quality. For example, Najem et al. (2020) revealed that stress was negatively related to sleep quality, in which higher stress leads to decreased sleep quality. According to this theory, the students might face uncontrollable worries about any stressful encounter or experience, such as hectic assignments, meeting deadlines to submit assignments, or others. Such encounters could trigger the emotional arousal of the students and lead them to make a distorted cognitive judgment of their stressful experiences, resulting in low quality of sleep.

Past researchers have made efforts to determine the relationship between stress and sleep quality. Most of the previous studies found a significant negative relationship between stress and sleep quality (Ahad, 2019; Almojali et al., 2017; Alotaibi et al., 2020; Doolin et al., 2018; González Salinas et al., 2020; Molnar et al., 2020; Najem et al., 2020; Simone et al., 2020; Stanković et al., 2021; Wondie et al., 2021; Zhang et al., 2020; Zou et al., 2020). For instance, Najem et al. (2020) aimed to identify the relationship between stress and sleep quality among university students. 644 university students from eight different Lebanese universities and different fields of study were recruited as participants in the study. This study has disclosed that stress was negatively associated with sleep quality among Lebanese university students. González Salinas et al. (2020) have a similar finding presenting that stress is negatively related to the sleep quality of the students but was conducted on Mexican students from three different fields of study. Moreover, Najem et al. (2020) reported that students who were considered morning people have lower stress and greater sleep quality compared to those who were described as evening people.

Additionally, Molnar et al. (2020) conducted their study on Canadian and American university students examining the relationship between stress and sleep quality. This study revealed a significant negative relationship between stress and students' sleep quality in both nationalities. Doolin et al. (2018) also studied university students of different nationalities, including American and Bolivian students. Aligned with the findings reported by Molnar et al. (2020), Doolin et al. (2018) have also reported that there was a significant relationship between stress and sleep quality in both Bolivian and American students, such that the greater the level of stress, the students experienced, the poorer the quality of sleep of the students. However, there was a slight difference in stress and sleep quality levels between Bolivian and American students. Doolin et al. (2018) explained that Bolivian students also put effort and time into caring for their family members, hence the higher stress. However, they also reported that they were more flexible and had good coping strategies, thus, better sleep quality compared to American students. Even so, these studies have provided limitations to the use of the result on the relationship between stress and sleep quality cannot be generalized to all populations as the respondents in both studies were from the same culture, Western culture.

To some extent, some studies in Malaysia have supported the findings reporting that there is a significant relationship between stress and sleep quality (Ahad, 2019). The study by Ahad (2019) aimed to determine how stress and sleep quality affect students' academic



performance. The respondents were Universiti Utara Malaysia (UUM) students from various majors recruited using cluster sampling. Ahad (2019) found a negative correlation between stress and sleep quality, in which students with a higher level of stress faced low sleep quality.

Furthermore, the study conducted by Almojali et al. (2017) on university students from King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in Riyadh, Saudi Arabia, reported that there were strong negative bidirectional relationships between stress and sleep quality with the p-value of  $<0.001$  for both relationships. Zou et al. (2020) affirmed the bidirectional relationships by conducting a longitudinal study among their respondents. These findings were consistent with Stanković et al. (2021), as it was reported that there was a significant moderate negative bidirectional relationship between the variables. The respondents for Zou et al. (2020) and Stanković et al. (2021) were university students. Thus, it was indicated that students with higher stress experienced a low quality of sleep. Also, students with low-quality sleep experienced increased stress. Howbeit, Simone, et al. (2020) found no bidirectional relationships between stress and sleep quality among university students, but only a negatively strong association between stress and sleep quality.

In short, there is a consistent finding on the significant negative association among students between stress and sleep quality regardless of students' nationalities and fields of study based on the past literature being reported. Hence, there is only one hypothesis of this research.

H1 There is a significant negative relationship between stress and sleep quality among engineering students in Malaysia.

## 2.4 Conceptual Framework

The cognitive model of insomnia might be able to explain this study that is proposed to identify the relationship between stress and sleep quality among engineering university students. Based on the Cognitive Model of Insomnia by Harvey (2002), stressful circumstances that the engineering students in this study might experience, such as hectic assignments, meeting deadlines to submit assignments, or others, will likely produce uncontrollable worries among the students. Consequently, those stressful encounters will trigger the emotional arousal of the students, which could result in the distorted cognitive judgment of their stressful experiences, resulting in low quality of sleep.

Figure 1 demonstrates this study's conceptual framework of stress and sleep quality. The line from the independent variable, stress, to the dependent variable, sleep quality, exemplifies that stress is related to the sleep quality of engineering university students in Malaysia. To be precise, stress and sleep quality are assumed to have a significant negative relationship.

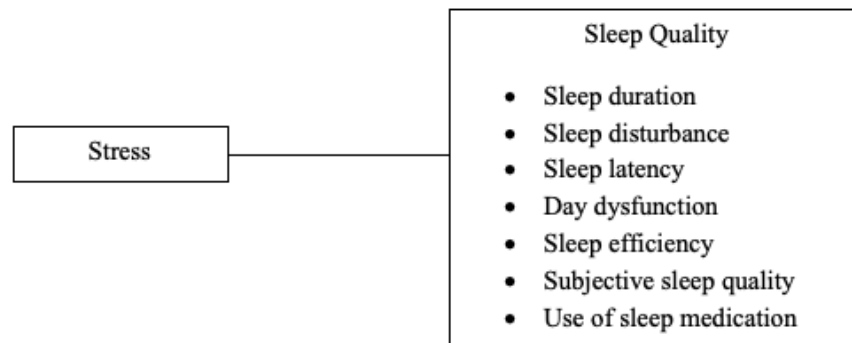


Figure 1 Conceptual Framework

## 3.0 METHODOLOGY

In order to fill in the limited amount of research on stress and sleep quality on undergraduate engineering students in Malaysia, the target population of this study was the undergraduate engineering students from three public universities in Malaysia, specifically Universiti Teknologi Malaysia (UTM), Universiti Malaya (UM), and Universiti Kebangsaan Malaysia (UKM). The samples were selected using non-probability sampling, including convenience and snowballing sampling. This cross-sectional study applied quantitative methods by distributing questionnaires to collect data. The questionnaires were distributed by inviting engineering students through various social platforms such as WhatsApp, Instagram, Facebook, Twitter, and Telegram. The first few invited individuals were then asked to invite others to participate in the study. After all, participation in this research is voluntary, without any pressure being imposed. In total, 272 returned the participants thoroughly answered questionnaires. The Perceived Stress Scale (PSS) was used to measure the stress level among engineering students. This instrument was developed by Cohen et al. (1983) that consisted of 10 questions. The Perceived Stress Scale of 10 questions uses a five-point Likert scale ranging from 0 (never) to 4 (very often) to rate their feelings and thoughts about each item. The Pittsburgh Sleep Quality Index (PSQI), created by Buysse et al. (1989), was used to measure the sleep quality levels of the respondents. It distinguishes between high and low sleep quality by assessing seven dimensions during the previous month, including subjective sleep quality, sleep latency, length of sleeping time, habitual sleep efficiency, sleep disruption, intake of medicine to sleep, and daytime dysfunction. A few items, such as the number of minutes to fall asleep or at what time they went to bed or got up in the morning are more in line with open response in which respondents will be asked to specify number of minutes that they took to fall asleep or the time at which they went to bed or got up in the morning. However, most items including items 5a to 5j, 7, 8, and 9 are rated on a four-point Likert scale ranging from 0 to 3 (not during the past month, less than once a week, once or twice a week, three or more times a week) with higher scores indicating poorer sleep. However, the four-point Likert scale for item 9 differs from the others, ranging from 0 to 3 (no problem at all, only a very slight problem, somewhat of a problem, a huge problem). Descriptive statistics (central tendency, frequency distribution, percentage, minimum, maximum, and standard deviation) and inferential statistics (correlational analysis) were conducted to

achieve the research objectives. A pilot study to test for this current research was conducted by inviting 27 undergraduate engineering students who were currently in their 4<sup>th</sup> year of study. The link to the google form that consisted of the questionnaire for this current study were shared among the 4<sup>th</sup> year undergraduate engineering students in Universiti Teknologi Malaysia (UTM). The Cronbach alpha obtained in the pilot study for PSS-10 and PSQI were 0.901 and 0.763, respectively. The results of Cronbach alpha showed that the reliability of PSS-10 was on a good level and acceptable level of reliability for PSQI based on Hulin et al. (2001) reliability rule of thumb.

#### ■ 4.0 RESULTS

Most of the respondents were female, with a total of 160 (58.8%). The youngest respondents were in the age of 18, and the oldest was 34. It showed that most respondents were 22 years old, with a percentage of 26.8%. On the other hand, the second highest number of respondents was 19 years old (22.1%). The minority respondents were between 27 and 34 years old, with only 0.4% for each age. Also, only two respondents (0.7%) were in the age of 18 years old.

Moreover, Universiti Teknologi Malaysia (UTM) has the highest number of respondents for this study, with a total of 240 (88.2%), followed by 19 respondents (7.0%) from Universiti Malaya (UM), and 13 respondents (4.8%) from Universiti Kebangsaan Malaysia (UKM).

The academic year category consisted of the first year, the second year, the third year, the fourth year, and others comprised of engineering students that were being extended for academic purposes. Respondents in the first year ranked the highest, totaling 102 (37.5%). The respondents in their third and fourth years shared almost the same percentage, constituting 23.9% and 22.4%, respectively. Meanwhile, respondents in the other category of the academic year ranked the lowest, with a total of only six respondents.

Other than that, the demographic characteristic of this study includes the caffeine intake of the respondents. Table 1 demonstrated that most of the respondents, with a percentage of 51.1%, reported weekly caffeine intake, 19.9% of respondents reported daily caffeine intake, and 28.7% reported never intake of caffeine. As for academic performance satisfaction, 179 (65.8%) respondents categorized themselves as moderately satisfied, followed by completely satisfied, 24.3%, and 9.9% as not satisfied with their academic performance.

**Table 1** Demographic Profiling of Engineering Students in Malaysia

Demographic Characteristics	Category	Frequency (f)	Percentage (%)
Gender	Male	112	41.2
	Female	160	58.8
Age	18 (min)	2	0.7
	21 (mean)	50	18.4
	34 (max)	1	0.4
Place of Study	UTM	240	88.2
	UM	19	7.0
	UKM	13	4.8
Academic Year	1 <sup>st</sup> Year	102	37.5
	2 <sup>nd</sup> Year	38	14.0
	3 <sup>rd</sup> Year	65	23.9
	4 <sup>th</sup> Year	61	22.4
	Other	6	2.2
Caffeine Intake	Never	78	28.7
	Daily	54	19.9
	Weekly	140	51.5
Academic Performance Satisfaction	Completely Satisfied	66	24.3
	Moderately Satisfied	179	65.8
	Satisfied		
	Not Satisfied	27	9.9

Moreover, Table 2 demonstrates the descriptive statistics of the PSS-10's total scores. As tabulated in the table, the respondents' total scores of PSS-10 ranged from 1 to 40. The mean of the total scores is 21.01, with an SD of 6.284. A total score of 20 appears to be the most frequent among the respondents. The score of 20 is interpreted as falling under the category of moderate stress based on the scoring of PSS-10 by Cohen et al. (1983).

**Table 2** Descriptive Analysis of the PSS-10's Total Scores

Descriptive Analysis	Total Score of PSS-10
Mean	21.01
Mode	20
Standard Deviation (SD)	6.284
Minimum	1
Maximum	40

The result illustrated in Table 3 shows the summary of the level of stress among the engineering students from UTM, UM, and UKM. Based on the table, an overwhelming number of respondents reported moderate stress (72.1%), followed by high stress (16.5%), and only 11.4% reported having low stress.

**Table 3** Level of Stress

Level of Stress	Frequency (f)	Percentage (%)
Low Stress	31	11.4
Moderate Stress	196	72.1
High Stress	45	16.5

On the other hand, cross-tabulations are used to describe the relationship between stress level variables and certain demographic factors such as gender and academic performance satisfaction of the respondents (Kumar, 2019). Table 4 interprets the results of the cross-tabulations. Females were reported to have a higher prevalence of moderate and high stress compared to males. Meanwhile, more males showed low stress than females, with a percentage of 6.9%. Other than that, it shows that respondents who are moderately satisfied with their academic performance have a high frequency of moderate stress (48.53%).

**Table 4** Cross Tabulations between Stress Levels, Gender, and Academic Performance Satisfaction

Participants Characteristics	Total (n = 272)		
	Low	Moderate	High
<b>Gender</b>			
Male	19 (6.9%)	79 (29.04%)	14 (5.15%)
Female	12 (4.41%)	117 (43.01%)	31 (11.40%)
<b>Academic Performance Satisfaction</b>			
Completely Satisfied	13 (4.78%)	47 (17.28%)	6 (2.21%)
Moderately Satisfied	18 (6.62%)	132 (48.53%)	29 (10.67%)
Not Satisfied	0 (0%)	17 (6.25%)	10 (3.68%)

A descriptive analysis of the total score of PSQI is illustrated in Table 5. The PSQI total scores among the respondents ranged from 0 to 16, with a mean of 7.11 (SD = 3.175). The total score of 7 was the most often scored by the respondents for PSQI. A total score of 7 is under the category of poor sleep quality, as indicated by Buysse et al. (1989).

**Table 5** Descriptive Analysis of Total Score of PSQI

Descriptive Analysis	Total Score of PSQI
Mean	7.11
Mode	7
Standard Deviation (SD)	3.175
Minimum	0
Maximum	16

The summary of the level of sleep quality is demonstrated in Table 6. Most respondents reported having poor sleep quality, with a total of 179 respondents (65.8%). Meanwhile, the other 93 respondents (34.2%) described their sleep quality as good.

**Table 6** Level of Sleep Quality

Level of Sleep Quality	Frequency (f)	Percentage (%)
Good Sleep Quality	93	34.2
Poor Sleep Quality	179	65.8

Adding to the finding, Table 7 showed the cross-tabulations between sleep quality and gender, caffeine intake, and academic performance satisfaction. It is shown that female respondents conquered a higher frequency of poor sleep quality, with a percentage of 36.76%. However, the difference in frequency between genders for poor sleep quality is slight, only 7.72%. Respondents with a weekly intake of caffeine have a higher prevalence of poor sleep quality (35.66%) compared to daily (13.97%) and never (16.18%) caffeine intake. Also, a total of 117 respondents (43.01%) of moderately satisfied with their academic performance and reported having poor sleep quality compared to completely satisfied (14.71%) and not satisfied (8.09%) with their academic performance.

**Table 7** Cross Tabulations between Sleep Quality, Gender, Caffeine Intake, and Academic Performance Satisfaction

Participants Characteristics	Total (n = 272)	
	Good Sleep Quality	Poor Sleep Quality
<b>Gender</b>		
Male	33 (12.13%)	79 (29.04%)
Female	60 (22.06%)	100 (36.76%)
<b>Caffeine Intake</b>		
Daily	16 (5.88%)	38 (13.97%)
Weekly	43 (15.81%)	97 (35.66%)
Never	34 (12.5%)	44 (16.18%)
<b>Academic Performance Satisfaction</b>		
Completely Satisfied	26 (9.56%)	40 (14.71%)
Moderately Satisfied	62 (22.79%)	117 (43.01%)
Not Satisfied	5 (1.84%)	22 (8.09%)

Table 8 shows a statistically significant moderate positive correlation between stress and sleep quality of engineering students in Malaysia and which illustrated the value of  $r = 0.466$ ,  $p < 0.01$ , based on the Pearson Correlation analysis done, therefore, it was found that there is a significant moderate positive relationship between PSS-10 and PSQI scores. This result indicates that respondents who scored higher on PSS-10 demonstrate higher scores on PSQI.

**Table 8** Pearson Correlation Analysis between Stress and Sleep Quality

Variables	Stress	
	<i>r</i>	<i>p</i>
Sleep Quality	0.466**	0.000



This correlation is analyzed using the total mean scores of PSS-10 and PSQI, as shown in Table 9. Operationally, based on the instrument of PSS (Cohen et al., 1983), the higher the scores for PSS refer to a higher stress level. On the other hand, the higher scores for PSQI contributed to poor sleep quality (Buysse et al., 1989). Hence, there is a significant negative relationship between stress and sleep quality, supporting this study's hypothesis.

**Table 9** Total Mean Scores and Standard Deviation of PSS-10 and PSQI

Variables	Mean	SD
Stress	2.1015	0.62842
Sleep Quality	1.0163	0.45354

## 5.0 DISCUSSION AND RECOMMENDATION

This study has found that most undergraduate engineering students in Malaysia experienced stress with a frequency of 241 from 272. Out of 272 engineering students participating in this study, 196 experienced moderate stress and 45 experienced high-stress levels. These findings are comparable with previous study's findings on undergraduate students generally (Ahad, 2019; Amir Hamzah et al., 2019; Musiu et al., 2019; Reddy et al., 2018) and undergraduate engineering students (Bisai & Chaudhary, 2017; Negi et al., 2019; Reta et al., 2020). However, previous studies that were conducted in countries such as Saudi Arabia (53%) (Almojali et al., 2017), India (29.3%) (Gedam et al., 2020), Mexico (31.56%) (González Salinas et al., 2020), China (31.3%) (Zhai et al., 2020), Ethiopia (28.7%) (Reta et al., 2020), reported lower prevalence of stress experienced by the university students. This variation could be due to samples from different backgrounds and different types of courses other than the engineering stream, or it might be due to different underlying causes.

Moreover, the findings indicated that females reported having moderate to the high level of stress compared to males, and these findings are parallel with the findings of previous studies (Alotaibi et al., 2020; Amaral et al., 2018; Musiu et al., 2019; Negi et al., 2019; Reta et al., 2020). According to Negi et al. (2019), females are more emotionally connected to their environment than males, and females often find themselves in more stressful circumstances than males. Therefore, they tend to experience more stress rather than males. Besides that, financial, family, and educational problems contributed to females' higher vulnerability to stress (Negi et al., 2019). In addition, a higher prevalence of stress among females could be because of the differences between males in the interaction of biological factors, such as the menstrual cycle, that affect hormonal changes and psychosocial factors (Reta et al., 2020).

In addition, it was found that 188 students who reported having problems with their academic satisfaction have a higher frequency of experiencing stress. Some previous studies reported that academic performance is closely related to university student's level of stress (Balaji et al., 2019; Bisai & Chaudhary, 2017; Gedam et al., 2020; Negi et al., 2019), in which the lower satisfaction of academic performance, the higher level of stress experienced by the university students. Besides that, Reddy et al. (2018) disclosed that fear of academic failure affects students' stress levels.

This study has found that many respondents experienced poor sleep quality based on the mean PSQI score. This study's finding is consistent with that of Ahmed et al. (2020), which showed that many engineering students reported poor sleep quality. In addition, the percentage of engineering students in this study having poor sleep quality was quite close to that of Al-Khani et al. (2019), Nasir and Mohamad (2020), Tien Ngu et al. (2017), and Wondie et al. (2021) which used medical students as their samples. The comparable findings between these studies show that despite different courses pursued by the students, there are no differences concerning sleep quality levels, which is supported by Ahad (2019).

It was depicted that most of the engineering students in this study slept for less than seven hours every night, and this finding is consistent with previous studies by Tien Ngu et al. (2017), Ahmed et al. (2020), and Wondie et al. (2021). Also, consistent with this current study's findings, Tien Ngu et al. (2017) and Wondie et al. (2021) disclosed that the students rated their subjective sleep quality as good despite knowing they were experiencing poor sleep quality.

Based on the findings reported in this study, a higher frequency of female students experienced poor sleep quality compared to male students. Ahmed et al. (2020) showed a significant difference between females and males in sleep quality levels. However, the cause of these differences was unknown. In contrast, Alotaibi et al. (2020) found no significant relationship between gender and sleep quality. Regardless, other variables not examined in this study, such as family support or history and physical exercises, might contribute to the differences in sleep quality among genders.

Engineering students that disclosed they have problems with their academic performance satisfaction reported suffering from poor sleep quality compared to students with completely satisfied with their academic performance. According to Wondie et al. (2021), students with poor academic performance spend more hours at night reading, often depriving them of sleep to improve their grades. Almojali et al. (2017) stated that students who are sleep-deprived because of studying believed that they will get better academic performance despite knowing that low sleep quality could decrease concentration and memory function.

Other than that, almost half of the respondents with caffeine intake reported being more likely to experience poor sleep quality. Tien Ngu et al. (2017) disclosed that caffeine intake was correlated with low sleep quality among students, such that students with higher caffeine intake experienced lower quality of sleep than students with no caffeine consumption. Nevertheless, some studies, such as those by Almojali et al. (2017), found no significant association between sleep quality and caffeine intake.

This study has found a significant moderate positive relationship between PSS-10 and PSQI scores using the Pearson Correlation analysis. Since a higher score of PSS-10 constituted higher stress (Cohen et al., 1983), and a higher score of PSQI represents poorer sleep quality (Buysse et al., 1989). Hence, a significant moderate negative relationship exists between stress and sleep quality. This study's findings are consistent with previous studies by González Salinas et al. (2020), Stanković et al. (2021), and Zou et al. (2020).

However, this study's finding appears to be lower than previous studies, which reported a significantly strong relationship between stress and sleep quality (Almojali et al., 2017; Alotaibi et al., 2020). Both of these previous studies were done on medical students in Saudi Arabia, which could explain why the correlation between these two variables was stronger. As stated by Doolin et al. (2018), different nationalities could affect the students' stress levels and sleep quality. The need to carry responsibilities such as towards family could lead to higher stress and poorer sleep quality. Almojali et al. (2017) stated that medical students tend to be more stressed due to academic demands that they are required to fulfill, which consequently causes them to sleep late and experience poorer sleep quality. They perceived that the academic requirements were more important than sleeping. Other than that, Alotaibi et al. (2020) measured stress and sleep quality during examination periods which was reported to increase the influence of stress and sleep quality levels of the students.

In addition, the findings on the correlation between stress and sleep quality of engineering students can be explained by the cognitive model of insomnia developed by Harvey (2002). In this model, Harvey (2002) explained that unmanageable thoughts related to stressful circumstances trigger emotional arousal before sleeping, resulting in lower subjective sleep quality. Concerning the cognitive model of insomnia and this current study's findings, most engineering students reported having worries and were unsatisfied on their academic-related matters, increasing their stress levels. The academic unsatisfaction of the students might be due to academic performance not meeting their expectations, and this stressful experience might have stimulated negative emotional arousal, resulting in lower sleep quality for the students.

This current study has several limitations. Firstly, this study used a self-reported questionnaire to assess the stress and sleep quality of the respondents. This could increase the possibility of recall bias affecting the study's findings. Other than that, the respondents that were successful in attracting were not equally ratioed from the targeted universities, as most of the respondents were from Universiti Teknologi Malaysia (UTM). Hence, further studies are needed to gain an equal sample size from the targeted universities to identify the differences between stress and sleep quality.

Moreover, this study's design limits detailed analysis of gender, caffeine intake, and academic performance satisfaction differences on stress and sleep quality. Therefore, future studies are suggested to examine these differences. The nature of the cross-sectional design applied in this study also limits examining the cause-effect relationship between the assessed variables. In addition, this study used convenience sampling, which limits the chances of engineering students participating in this study. Thus, further studies are suggested to use non-probability sampling to give engineering students in Malaysia equal chances to participate in the study.

## 6.0 CONCLUSION

Stress among university students is not a new occasion, and sleep is one of the most crucial things to sustain good mental and healthy well-being across every age. Studying and findings on the stress and sleep quality variables in this study will provide further understanding to future researchers in developing theories that can explain stress, sleep quality, and both variables based on engineering students. The findings could provide insights into how stress and sleep quality interact. The current study also supports the theory developed by Harvey in 2002, called the cognitive model of insomnia, on the correlation between stress levels and sleep quality levels experienced by engineering students. This study's findings have also provided empirical evidence and have been supported by previous literature. Following this, the findings of this study can contribute to future studies as a reference on the topic of stress and sleep quality variables. Besides, the finding can assist future researchers in extensively studying stress or/and sleep quality on other variables, such as eating behavior, that could contribute to or influence stress or sleep quality.

Moreover, the findings impact practical implications in terms of giving awareness to the students, especially the engineering stream, regarding stress and sleep quality levels, the lecturers, and the institutions. These parties should improve students' stress and sleep quality levels to avoid negative consequences, especially on their health. However, there are some limitations in this current study. Therefore, future studies are needed to consider the limitations to further discussed stress and sleep quality variables in detailed analysis.

## Acknowledgments

We would like to thank to Universiti Teknologi Malaysia for the opportunity given in publishing this study.

## References

- Ahad, N. A. (2019). Sleep Quality Among Undergraduates During Pre-Examination Period. *Indonesian Journal of Education Methods Development*, 6(1), 1–14. <https://doi.org/10.21070/ijemdv5i1.48>
- Ahmed, M. S., Khan, S., Hsan, K., Sen, L. C., Yunus, F. M., & Griffiths, M. D. (2020). Factors Affecting Sleep Quality Among the University Students in Bangladesh: A Cross-Sectional Structured Interview Study. *Sleep and Vigilance*, 4(2), 177–184. <https://doi.org/10.1007/s41782-020-00106-4>
- Al-Khani, A. M., Sarhandi, M. I., Zaghloul, M. S., Ewid, M., & Saquib, N. (2019). A cross-sectional survey on sleep quality, mental health, and academic performance among medical students in Saudi Arabia. *BMC Research Notes*, 12(1), 1–5. <https://doi.org/10.1186/s13104-019-4713-2>
- Almojali, A. I., Almalki, S. A., Allothman, A. S., Masuadi, E. M., & Alaqeel, M. K. (2017). The prevalence and association of stress with sleep quality among medical students. *Journal of Epidemiology and Global Health*, 7(3), 169–174. <https://doi.org/10.1016/j.jegh.2017.04.005>
- Alotaibi, A., Alosaimi, F., Alajlan, A., & Bin Abdulrahman, K. (2020). The relationship between sleep quality, stress, and academic performance among medical students. *Journal of Family and Community Medicine*, 27(1), 23–28. [https://doi.org/10.4103/jfcm.JFCM\\_132\\_19](https://doi.org/10.4103/jfcm.JFCM_132_19)
- Amaral, A. P., Soares, M. J., Pinto, A. M., Pereira, A. T., Madeira, N., Bos, S. C., Marques, M., Roque, C., & Macedo, A. (2018). Sleep difficulties in college students: The role of stress, affect and cognitive processes. *Psychiatry Research*, 260(November 2017), 331–337. <https://doi.org/10.1016/j.psychres.2017.11.072>
- Amir Hamzah, N. S., Nik Farid, N. D., Yahya, A., Chin, C., Su, T. T., Rampal, S. R. L., & Dahlui, M. (2019). The Prevalence and Associated Factors of Depression, Anxiety and Stress of First Year Undergraduate Students in a Public Higher Learning Institution in Malaysia. *Journal of Child and Family Studies*, 28(12), 3545–3557. <https://doi.org/10.1007/s10826-019-01537-y>
- Balaji, N. K., Murthy, P. S., Kumar, D. N., & Chaudgury, S. (2019). Perceived stress, anxiety, and coping states in medical and engineering students during examinations. *Industrial Psychiatry Journal*, 28(1), 86–97. [https://doi.org/10.4103/ipj.ipj\\_70\\_18](https://doi.org/10.4103/ipj.ipj_70_18)

- Bisai, S., & Chaudhary, R. (2017). Stress Among the Students of an Engineering Institution in India: An Empirical Analysis. *Jindal Journal of Business Research*, 6(2), 186–198. <https://doi.org/10.1177/2278682117727224>
- Bo, Y., Yeoh, E. Kiong, Guo, C., Zhang, Z., Tam, T., Chan, T. C., Chang, L. Yun, & Lao, X. Q. (2019). Sleep and the risk of chronic kidney disease: A cohort study. *Journal of Clinical Sleep Medicine*, 15(3), 393–400. <https://doi.org/10.5664/jcsm.7660>
- Buyse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1988). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28, 193–213.
- Buyse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28, 193–213.
- Cho, J.-G., Teoh, A., Roberts, M., & Wheatley, J. (2019). The prevalence of poor sleep quality and its associated factors in patients with interstitial lung disease: a cross-sectional analysis. *ERJ Open Research*, 5(3), 00062–02019. <https://doi.org/10.1183/23120541.00062-2019>
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24(4), 385–396.
- Cohen, S., & Williamson, G. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan & S. Oskamp (Eds.), *The Social Psychology of Health: Claremont Symposium On Applied Social Psychology* (Eds.). Sage.
- DeAngelis, R. T., Escobar, I., Ruiz, A. L., & Acevedo, G. A. (2019). Sleep quality among college students: exploring the role of a divine locus of sleep control. *Sleep Health*, 5(6), 592–597. <https://doi.org/10.1016/j.sleh.2019.08.004>
- Doolin, J., Vilches, J. E., Cooper, C., Gipson, C., & Sorensen, W. (2018). Perceived stress and worldview influence sleep quality in Bolivian and United States university students. *Sleep Health*, 4(6), 565–571. <https://doi.org/10.1016/j.sleh.2018.08.006>
- El-Kader, S. M. A., & Al-Jiffri, O. H. (2019). Aerobic exercise modulates cytokine profile and sleep quality in elderly. *African Health Sciences*, 19(2), 2198–2207. <https://doi.org/10.4314/ahs.v19i2.45>
- Everitt, B. S. (2006). *Medical statistics from A to Z: A guide for clinicians and medical students* (3rd Eds). Cambridge University Press.
- Fisher, C. B. (2013). *Decoding the ethics code* (3rd Edition). SAGE Publications.
- Folkman, S., & Lazarus, R. S. (1988). Coping as a mediator of emotion. *Journal of Personality and Social Psychology*, 54(3), 466–475. <https://doi.org/https://doi.org/10.1037/0022-3514.54.3.466>
- Gedam, S., Saklecha, P., & Babar, V. (2020). Screening of stress, anxiety, depression, coping, and associated factors among Engineering students. *Annals of Indian Psychiatry*, 4(2), 148. [https://doi.org/10.4103/aip.aip\\_6\\_20](https://doi.org/10.4103/aip.aip_6_20)
- González Salinas, S., Cruz Sánchez, R. A., Ferrer Juárez, L. E., Reyes Garduño, M. E., Gil Trejo, M. J., & Sánchez Moguel, S. M. (2020). Anxiety and Sleep Quality are Affected in Students from Social Sciences. *Acta de Investigación Psicológica*, 10(3), 33–43. <https://doi.org/10.22201/psi.20074719e.2020.3.355>
- Grandner, M. A. (2017). Sleep, Health, and Society. *Sleep Medicine Clinics*, 12(1), 1–22. <https://doi.org/10.1016/j.jsmc.2016.10.012>
- Gregory, R. J. (2014). *Psychological testing: History, principles, and applications* (7th Edition). Pearson.
- Hargens, T. A., Scott, M. C., Olijar, V., Bigman, M., & Edwards, E. S. (2020). Markers of poor sleep quality increase sedentary behavior in college students as derived from accelerometry. *Sleep and Breathing*. <https://doi.org/10.1007/s11325-020-02190-2>
- Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour Research and Therapy*, 40(8), 869–893. [https://doi.org/10.1016/s0005-7967\(01\)00061-4](https://doi.org/10.1016/s0005-7967(01)00061-4)
- Harvey, Allison G., Stinson, K., Whitaker, K. L., Moskovitz, D., & Virk, H. (2008). The subjective meaning of sleep quality: A comparison of individuals with and without insomnia. *Sleep*, 31(3), 383–393. <https://doi.org/10.1093/sleep/31.3.383>
- Hulin, C., Netemeyer, R. G., & Cudeck, R. (2001). Can a reliability coefficient be too high? *Journal of Consumer Psychology*, 10(1), 55–58. <https://doi.org/10.2307/1480474>
- In, J. (2017). Introduction of a pilot study. *Korean Journal of Anesthesiology*, 70(6), 601–605. <https://doi.org/10.4097/kjae.2017.70.6.601>
- Irwin, M. R., & Opp, M. R. (2017). Sleep Health: Reciprocal Regulation of Sleep and Innate Immunity. *Neuropsychopharmacology*, 42(1), 129–155. <https://doi.org/10.1038/npp.2016.148>
- Julious, S. A. (2005). Sample size of 12 per group rule of thumb for a pilot study. *Pharmaceutical Statistics*, 4(4), 287–291. <https://doi.org/10.1002/pst.185>
- Jung, Y. S., Chae, C. H., Kim, Y. O., Son, J. S., Kim, C. W., Park, H. O., Lee, J. H., Shin, Y. H., & Kwak, H. S. (2017). The relationship between serum vitamin D levels and sleep quality in fixed day indoor field workers in the electronics manufacturing industry in Korea. *Annals of Occupational and Environmental Medicine*, 29(1), 1–9. <https://doi.org/10.1186/s40557-017-0187-7>
- Kerlinger, F. N. (1986). *Foundations of Behavioral Research* (3rd Eds). Holt, Rinehart and Winston.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30, 607–610. <https://doi.org/https://doi.org/10.1177/001316447003000308>
- Kumar, R. (2019). *Research Methodology: a step-by-step guide for beginners* (5th Eds). SAGE Publications.
- Lazarus, R. S. (1991). *Emotion and Adaptation*. Oxford University Press.
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer.
- Lazarus, R. S., & Folkman, S. (1986). Cognitive theories of stress and the issue of circularity. In M. H. Appley & R. Trumbull (Eds.), *Dynamics of Stress. Physiological, Psychological, and Social Perspectives* (Eds, pp. 63–80). Plenum.
- Lee, C. M., & Hunsley, J. (2018). *Introduction to clinical psychology: an evidence-based approach* (4th Edition). Wiley.
- Lee, M. F., & Syaïd, S. (2017). Factors contributing towards Malaysian Technical University (MTU) students' mental health. *Pertanika Journal of Social Sciences and Humanities*, 25(May), 93–100.
- Li, Y., Bai, W., Zhu, B., Duan, R., Yu, X., Xu, W., Wang, M., Hua, W., Yu, W., Li, W., & Kou, C. (2020). Prevalence and correlates of poor sleep quality among college students: A cross-sectional survey. *Health and Quality of Life Outcomes*, 18(1), 1–11. <https://doi.org/10.1186/s12955-020-01465-2>
- Lindberg, S. (2019). *Eustress: The good stress*. Healthline.
- Lv, W., Wang, X., Liu, J., & Yu, P. (2019). Eight-section brocade exercises improve the sleep quality and memory consolidation and cardiopulmonary function of older adults with atrial fibrillation-associated stroke. *Frontiers in Psychology*, 10(OCT), 1–12. <https://doi.org/10.3389/fpsyg.2019.02348>
- Majid, U. (2018). Research Fundamentals: Study Design, Population, and Sample Size. *Undergraduate Research in Natural and Clinical Science and Technology (URNCSST) Journal*, 2(1), 1–7. <https://doi.org/10.26685/urncst.16>
- Manap, R., Hamid, S. A., & Ghani, M. A. (2019). Depression, Anxiety and Stress Among Undergraduate Students. *E-Bangi (Journal of Social Sciences and Humanities)*, 16(2), 1–7.
- Mayildurai, R., Ashokkumar, R., Karthik, K., & Shanmugaparakash, M. (2019). Research on stress among the engineering college students in Coimbatore, India. *International Journal of Engineering and Advanced Technology*, 8(6 Special Issue), 73–75. <https://doi.org/10.35940/ijeat.F1014.0886S19>
- Mohamad, N. E., Sidik, S. M., Akhtari-Zavare, M., & Gani, N. A. (2021). The prevalence risk of anxiety and its associated factors among university students in Malaysia: a national cross-sectional study. *BMC Public Health*, 21(1), 1–12. <https://doi.org/10.1186/s12889-021-10440-5>
- Molnar, D. S., Janssen, W. F., & Sirois, F. M. (2020). Sleeping perfectly? Trait perfectionism, perceived stress, and sleep quality. *Personality and Individual Differences*, 167(April), 110244. <https://doi.org/10.1016/j.paid.2020.110244>
- Musa, N. A., Moy, F. M., & Wong, L. P. (2018). Prevalence and factors associated with poor sleep quality among secondary school teachers in a developing country. *Industrial Health*, 56(5), 407–418. <https://doi.org/10.2486/indhealth.2018-0052>
- Musiun, A., Lukman, K. A., Jeffree, M. S., Robinson, F., Hassan, M. R., Ghazi, H. F., Al-abed, A. A. A., Tha, N. O., Swe, & Shamsudin, S. B. (2019). Prevalence of stress and its associated factors among medical students in Sabah, Malaysia Borneo. *Malaysian Journal of Public Health Medicine*, 19(2), 116–125.
- Najem, J., Saber, M., Aoun, C., El Osta, N., Papazian, T., & Rabbaa Khabbaz, L. (2020). Prevalence of food addiction and association with stress, sleep quality and chronotype: A cross-sectional survey among university students. *Clinical Nutrition*, 39(2), 533–539. <https://doi.org/10.1016/j.clnu.2019.02.038>
- Nasir, W. A. M., & Mohamad, M. Y. (2020). Association of sleep deprivation and neck pain among International Islamic University Malaysia (IIUM) clinical year students. *International Journal of Allied Health Sciences*, 4(4), 1619–1625. <https://journals.iiu.edu.my/ijahs/index.php/IJAHs/article/view/285>
- Navarro-Martinez, R., Chover-Sierra, E., Colomer-Pérez, N., Vlachou, E., Andriuseviciene, V., & Cauli, O. (2020). Sleep quality and its association with substance abuse among university students. *Clinical Neurology and Neurosurgery*, 188(October 2019), 105591. <https://doi.org/10.1016/j.clineuro.2019.105591>

- Negi, A. S., Khanna, A., & Aggarwal, R. (2019). Psychological health, stressors and coping mechanism of engineering students. *International Journal of Adolescence and Youth*, 24(4), 511–520. <https://doi.org/10.1080/02673843.2019.1570856>
- Ohayon, M., Wickwire, E. M., Hirshkowitz, M., Albert, S. M., Avidan, A., Daly, F. J., Dauvilliers, Y., Ferri, R., Fung, C., Gozal, D., Hazen, N., Krystal, A., Lichstein, K., Mallampalli, M., Plazzi, G., Rawding, R., Scheer, F. A., Somers, V., & Vitiello, M. V. (2017). National Sleep Foundation's sleep quality recommendations: first report. *Sleep Health*, 3(1), 6–19. <https://doi.org/10.1016/j.sleh.2016.11.006>
- Othman, M. A., & Rashid, M. A. (2018). Stress and Mental Health of Undergraduate Students At a Private Higher Learning Institution in Malaysia. *PEOPLE: International Journal of Social Sciences*, 4(2), 453–465. <https://doi.org/10.20319/pijss.2018.42.453465>
- Quacquarelli Symonds. (2021). *Engineering & technology*. <https://www.topuniversities.com/university-rankings/university-subject-rankings/2021/engineering-technology>. Retrieve on 14 September 2022
- Reddy, K. J., Menon, K. R., & Thattai, A. (2018). Academic stress and its sources among university students. *Biomedical and Pharmacology Journal*, 11(1), 531–537. <https://doi.org/10.13005/bpj/1404>
- Reta, Y., Samuel, T., & Mekonnen, M. (2020). Mental distress and associated factors among undergraduate engineering students of Hawassa University, Ethiopia. *Journal of Multidisciplinary Healthcare*, 13, 99–107. <https://doi.org/10.2147/JMDH.S238113>
- Roberti, J. W., Harrington, L. N., & Storch, E. A. (2006). Further psychometric support for the 10-item version of the perceived stress scale. *Journal of Counseling Association*, 9(2), 135–147. <https://doi.org/https://doi.org/10.1002/j.2161-1882.2006.tb00100.x>
- Said, A. H., Yusof, M. Z., Mohd, F. N., Azmi, M. A. N. H., Mohd Hanapiah, H., & Abdullah, A. W. (2020). Poor sleep quality among medical students in international Islamic university Malaysia (IIUM) and its association with mental health and other factors. *International Medical Journal Malaysia*, 19(2), 49–57. <https://doi.org/10.31436/imjm.v19i2.1564>
- Scott, E. (2020). *What is stress?* Verywellmind. <https://www.verywellmind.com> Retrieve on 21 October 2022
- Simione, L., Raffone, A., & Mirolli, M. (2020). Stress as the Missing Link Between Mindfulness, Sleep Quality, and Well-being: a Cross-sectional Study. *Mindfulness*, 11(2), 439–451. <https://doi.org/10.1007/s12671-019-01255-y>
- Spielman, A. J. (1986). Assessment of insomnia. *Clinical Psychology Review*, 6(1), 11–25. [https://doi.org/https://doi.org/10.1016/0272-7358\(86\)90015-2](https://doi.org/https://doi.org/10.1016/0272-7358(86)90015-2)
- Spielman, A. J., Caruso, L. S., & Glovinsky, P. B. (1987). A behavioral perspective on insomnia treatment. *Psychiatric Clinics of North America*, 10(4), 541–553. [https://doi.org/10.1016/s0193-953x\(18\)30532-x](https://doi.org/10.1016/s0193-953x(18)30532-x)
- Sridar, S. P. (2018). Comparative study on elements of stress which affect first and final year undergraduate students. *Scope International Journal of Science, Humanities, Management and Technology*, 4(3), 176–181.
- Stanković, M., Nešić, M., Čičević, S., & Shi, Z. (2021). Association of smartphone use with depression, anxiety, stress, sleep quality, and internet addiction. Empirical evidence from a smartphone application. *Personality and Individual Differences*, 168(June 2020), 110342. <https://doi.org/10.1016/j.paid.2020.110342>
- Taylor, R. (1990). Interpretation of the correlation coefficient: A basic review. *Journal of Diagnostic Medical Sonography*, 1, 35–39. <https://doi.org/https://doi.org/10.1177/875647939000600106>
- The Odum Institute. (2015). *Learn about Pearson's correlation coefficient in SPSS with data from the global health observatory data (2012)* (SAGE Research Methods Datasets Part 1 (ed.)). SAGE Publications, Ltd. <https://doi.org/https://www.doi.org/10.4135/9781473948167>
- Tien Ngu, S., Masalamany, K., Abd Manan, N., & Adam, S. K. (2017). Sleep Quality among Pre-Clinical Medical Students in Universiti Putra Malaysia and Universiti Malaya, Malaysia. *Education in Medicine Journal*, 9(3), 23–31. <https://doi.org/10.21315/eimj2017.9.3.3>
- Wondie, T., Molla, A., Mulat, H., Damene, W., & Bekele, M. (2021). Magnitude and correlates of sleep quality among undergraduate medical students in Ethiopia : cross – sectional study. *Sleep Science and Practice*, 5(7). <https://doi.org/https://doi.org/10.1186/s41606-021-00058-2>
- Zhai, X., Ye, M., Wang, C., Gu, Q., Huang, T., Wang, K., Chen, Z., & Fan, X. (2020). Associations among physical activity and smartphone use with perceived stress and sleep quality of Chinese college students. *Mental Health and Physical Activity*, 18. <https://doi.org/10.1016/j.mhpa.2020.100323>
- Zhang, L., Li, D., & Yin, H. (2020). How is psychological stress linked to sleep quality? The mediating role of functional connectivity between the sensory/somatomotor network and the cingulo-opercular control network. *Brain and Cognition*, 146. <https://doi.org/10.1016/j.bandc.2020.105641>
- Zhang, Y., Peters, A., & Bradstreet, J. (2018). Relationships among sleep quality, coping styles, and depressive symptoms among college nursing students: A multiple mediator model. *Journal of Professional Nursing*, 34(4), 320–325. <https://doi.org/10.1016/j.profnurs.2017.12.004>
- Zou, P., Wang, X., Sun, L., Liu, K., Hou, G., Yang, W., Liu, C., Yang, H., Zhou, N., Zhang, G., Ling, X., Liu, J., Cao, J., Ao, L., & Chen, Q. (2020). Poorer sleep quality correlated with mental health problems in college students: A longitudinal observational study among 686 males. *Journal of Psychosomatic Research*, 136(June), 110177. <https://doi.org/10.1016/j.jpsychores.2020.110177>