IMPACT OF ACADEMIC STRESS ON EXECUTIVE FUNCTIONS AND SLEEP QUALITY AMONG UNIVERSITY STUDENTS: AN OBSERVATIONAL STUDY

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By

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ABSTRACT

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Background: Research shows that stress can impair executive function, but the effects of academic stress specifically remain underexplored. Academic stress, prevalent among university students, is also linked to poor sleep quality. While stress's impact on executive function and sleep has been studied separately, limited research examines their combined effects, highlighting a critical gap.

Objective: This study aims to study the impact of academic stress on executive functions and sleep quality among university students. The specific objectives are to investigate the impact of academic stress on working memory, cognitive flexibility, and sleep quality among university students.

Method: A total of 401 participants of full-time university students were recruited from Universiti Tunku Abdul Rahman (UTAR) Sungai Long Campus. Then, participants filled up the informed consents form and demographics information. Next, Perception of Academic Stress Scale was used to examine student's perceived academic stress, Pittsburgh Sleep Quality Index was used to measure sleep quality, Trail Making Test Part B was used to assess executive functions. Spearman's correlation is used to examine the correlation between academic stress, sleep quality, and executive function.

Results: Academic stress was positively correlated with poorer sleep quality ($r = 0.375$, $p < 0.001$) and marginally associated with impaired executive functions ($r = 0.107$, $p = 0.032$). Sleep quality also showed a weak positive correlation with executive functions ($r = 0.185$, $p < 0.001$). No significant differences in academic stress or sleep quality were found across demographic variables, but females demonstrated better executive function than males.

Conclusion: Academic stress has a significant correlation with executive functions and sleep quality. Executive functions also significant correlated with sleep quality.

Keywords: Academic Stress, Sleep Quality, Executive Function, Working Memory, University Students, Trail Making Test (TMT-B), Pittsburgh Sleep Quality Index (PSQI), Perceived Academic Stress Scale (PAS).

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APPROVAL SHEET

This Research project entitled "**IMPACT OF ACADEMIC STRESS ON EXECUTIVE FUNCTIONS AND SLEEP QUALITY AMONG UNIVERSITY STUDENTS: AN OBSERVATIONAL STUDY**" was prepared by LAI YU WEI and submitted as partial fulfilment of the requirements for the degree of Bachelor of Physiotherapy (HONOURS) at Universiti Tunku Abdul Rahman.

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PERMISSION SHEET

It is hereby certified that **LAI YU WEI** (ID No: **21UMB03932**) has completed this Research project entitled "IMPACT OF ACADEMIC STRESS ON EXECUTIVE FUNCTIONS AND SLEEP QUALITY AMONG UNIVERSITY STUDENTS: AN OBSERVATIONAL STUDY" under the supervision of **Mr. Nizar Abdul Majeed Kutty** (Supervisor) from the Department of Physiotherapy, M. Kandiah Faculty of Medicine and Health sciences.

Yours truly,

(LAI YU WEI)

DECLARATION

I hereby declare that the Research project is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

Name: LAI YU WEI

Date: 20/12/2024

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LIST OF ABBREVIATIONS

TMT-B	Time Trail Making Test Part B
PSQI	Pittsburgh Sleep Quality Index
PAS scale	Perceived Academic Stress Scale
PFC	Prefrontal cortex
EF	Executive Functions
WM	Working memory
M	Mean
SD	Standard deviation

CHAPTER 1

1.0 INTRODUCTION

1.1 Chapter Overview

The first part of this chapter discussed about the background of the study. The content included stress, executive function, sleep quality, and relevance of study to provide a brief introduction to this study. Then, the chapter was continued with the research objectives, problem statement, hypothesis, as well as the operational definition.

1.2 Background of the study

1.2.1 Stress

Psychological stress, typically arises when individuals think that environmental demands exceed their ability to cope effectively, thus impacting their mental and physical well-being (Cohen et al., 2007). Extensive research reveals that both acute (Shields et al., 2016) and chronic stress (Girotti et al., 2018) significantly affects executive functions, including motor memory, cognitive flexibility, and inhibitory control. Academic stress is a special form of stress experienced by students, which comes from a series of factors in the educational environment. It defined as the psychological tension caused by the continuous social and self-imposed pressure in the school environment, which exhausts students' psychological resources (Zhang et al., 2022). Sources of academic stress often include high academic expectations, heavy workloads, examinations, self-perceptions, and the desire for success and they often impede students' academic performance. It is evaluated by Perceived of Academic Stress (PAS) Scale. PAS scale consists of three subscales to examine different sources of academic stress (Bedewy & Gabriel, 2015).

1.2.2 Executive Function

According to Diamond (2013), Executive Function comprises of a set of key psychological processes, which is very important for tasks that require concentration, attention, and decision-making, especially in the case of insufficient automatic or instinctive response. These cognitive functions are characterized by efforts and conscious efforts to transcend automatic response, resist temptation, and adapt to dynamic environment. It is worth noting that EF is different from self-regulation and other related concepts. Self-regulation mainly involves emotional control and cognitive control, covering a wider range of cognitive processes, while EF consists of three core components, which is inhibition control, working memory and cognitive flexibility.

Working memory in executive functions is the ability to hold temporary information and utilize it while a person is doing a mental task. A person may actively process information in current consciousness through it (Hester &

Garavan, 2005). Working memory is different from short-term memory because working memory need to hold information in mind and manipulate it, while short-term memory only needs to hold the information in mind (A. Diamond, 2013). Cognitive flexibility is the ability to change one's behaviour and thoughts in response to changing circumstances. It entails planning to switch between distinct mental processes and produce appropriate behavioural responses (Dajani & Uddin, 2015). The word cognitive flexibility often used interchangeably with set set shifting and task-switching (A. Diamond, 2013). In this study, Trail Making Test Part B (TMT-B) is utilized to measure the working memory and cognitive flexibility.

1.2.3 Sleep Quality

According to (Nelson et al., 2022), sleep quality is a subjective evaluation of the overall satisfaction and effectiveness of personal sleep experience. It analyses many problems, including the length, depth, continuity and recoverability of sleep, and the existence of sleep disorders or obstacles. The positive effects of good sleep quality include feeling well-rested, functioning normally, and having happy relationships. Fatigue, irritation, daytime dysfunction, slowed reflexes, and increased caffeine/alcohol consumption are all results of poor sleep quality. Therefore, sleep is an important part of overall health, which can have a significant impact on physical and mental health. Self-reporting measures are usually used for evaluation, such as Pittsburgh Sleep Quality Index (PSQI) to examine multiple dimensions of sleep quality.

1.2.4 Importance and relevance of study

The importance and relevance of this study lie in its focus on academic stress, a distinct and increasingly significant form of stress experienced by university students. Unlike general stress, academic stress is specifically tied to the pressures of academic performance, deadlines, and expectations, making it a critical area of exploration as it directly impacts students' mental health and cognitive functioning (Barbayannis et al., 2022). By targeting this unique stressor, the study addresses a gap in the literature and provides insights into how academic stress affects executive functions, a key cognitive domain essential for decision-making, problem-solving, and self-regulation.

Moreover, the study highlights the intricate relationship between academic stress, sleep quality, and executive function, factors that are often studied in isolation but rarely examined in an integrated framework. Sleep quality plays a vital role in cognitive processes, and its bidirectional relationship with stress and executive function adds complexity to the understanding of these interactions (Sutter et al., 2012). By exploring these dynamics, the research sheds light on how poor sleep quality exacerbates the negative effects of academic stress on cognitive performance, contributing to a downward spiral that can undermine academic and personal outcomes for students.

Given the rising prevalence of academic stress among university populations (Ramachandiran & Dhanapal, 2018), this research is highly relevant for educational institutions. By addressing this critical gap, the study has the potential to enhance students' overall academic experiences and foster resilience, thereby promoting long-term success and well-being in an increasingly competitive academic environment.

1.3 Research Questions

1. What is the association between academic stress and executive functions among university students?

2. What is the association between academic stress and sleep quality among university students?

3. What is the association between executive functions and sleep quality among university students?

1.4 Problem Statement

While substantial evidence shows that both acute (Shields et al., 2016) and chronic stress (Girotti et al., 2018) can impair executive function. There is limited research specifically examining the effects of academic stress. Academic stress, which is prevalent among Malaysian university students (Ramachandiran & Dhanapal, 2018), represents a significant and distinct form of stress in their lives.

Moreover, academic stress has been consistently linked to poor sleep quality (Cheong & Tan, 2021; Deng et al., 2023; Nakie et al., 2024; Wang & Fan, 2023). Despite these connections, the interplay between academic stress, executive function, and sleep quality remains poorly understood. This study aims to address this gap by investigating how academic stress impacts executive functions and sleep quality among university students, thereby contributing to a more comprehensive understanding of these critical factors.

1.5 Research Objectives

1. To determine the association between academic stress and executive functions among university students.

2. To determine the association between academic stress and sleep quality among university students.

3. To determine the association between executive functions and sleep quality among university students.

1.6 Hypothesis

Null hypothesis (H0)

1. There is no significant association between academic stress and executive function among university students.

2. There is no significant association between academic stress and sleep quality among university students.

3. There is no significant association between executive function and sleep quality among university students.

Alternate hypothesis (HA)

1. There is a significant association between academic stress and executive function among university students.

2. There is a significant association between academic stress and sleep quality among university students.

3. There is a significant association between executive function and sleep quality among university students.

1.7 Operational Definition

1. Academic stress

Refers to level of perceived stress related to academic activities, as measured by the Perception of Academic Stress (PAS) Scale.

2. Executive functions

Refers to working memory and cognitive flexibility, measured by Trail Making Test Part B

3. Working memory

Holding information (connect 1 to A to 2 to B…) in mind and manipulating it (connect it).

4. Cognitive flexibility

Cognitive flexibility = set shifting = task-switching ability, is the ability of an individual to shift between two different types of information (numbers and letters) quickly and efficiently.

5. Sleep quality

Individual's satisfaction about his or her sleep, measured by Pittsburgh Sleep Quality Index.

6. University students

Any full-time students registered for any programme in UTAR Sungai Long Campus.

1.8 Rationale of Study

Although multiple studies have shown that acute and chronic stress have an impact on executive function, there is a distinct dearth of study devoted to academic stress. Most previous research has focused on general stress; thus, it is crucial to study how academic stress, which is common among university students in Malaysia and an important element of students' life, affects executive function.

Additionally, academic stress has an impact on sleep quality. Although there is evidence that academic stress is associated with poor sleep quality, the two-way relationship between academic stress, executive function, and sleep quality is unclear. To fill up the gap in the research, this study will examine into the impacts of academic stress on executive functioning and sleep quality among university students. Therefore, this study will enrich the existing knowledge system about academic stress and its influence on executive functions and sleep quality, thereby providing a useful insight for future research and clinical practice.

1.9 Scope of Study

This study focuses on impact of academic stress on executive function and sleep quality among university students.

1.10 Structure of Research Project

In this research paper, Chapter 1 introduced the background of the study, including the research questions, objectives, and its importance and relevance. Chapter 2 focused on reviewing prior studies in the literature. Chapter 3 outlined the methodology, detailing the research design, sampling approach, research instruments, data collection procedures, and data analysis methods. Chapter 4 presented the results obtained from the data, including descriptive and inferential analyses as well as hypothesis testing. Finally, Chapter 5 provided a discussion of the findings, addressed the study's limitations, offered recommendations for future research, and end with a conclusion.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Chapter Review

A review of past literature and journals were presented in this chapter, thereby providing blueprints for this research study.

2.2 Prevalence of academic stress among university students

Stress has become the main concern of higher education institutions all over the world. The prevalence rate of stress among college students in Bangladesh is 25% to 71%, which shows that the burden is heavy and tailor-made intervention measures and mental health support programs are needed (Kamruzzaman et al., 2024). According to Iranian research (Raiesifar et al., 2024), the prevalence rate of college students' stress is 53.2%, among which 23.2% people experience mild stress, 13.3% people experience moderate stress and 16.7% people experience severe stress. Locally in Malaysia, It is reported that the prevalence rate of college students' stress is 18.6% moderate stress and 5.1% severe or extremely severe stress (Shamsuddin et al., 2013). This has showed that even in the same university, individuals perceive different stress ranges.

While if only focusing on academic stress, the study by Jayasankara Reddy et al. (2018), explored academic stress levels among undergraduate students, as well as gender and stream-wise differences in India. The mean total academic stress score was 53.46 (SD=25.70), with approximately 48.80% of students reported average to high levels of academic stress. Gender analysis revealed no significant difference in overall stress between males (Mean=53.01, SD=26.75) and females (Mean=53.87, SD=24.75), though females reported significantly higher fear of failure. Across streams (Humanities, Commerce, Management, Science), Commerce students reported the highest stress (Mean=61.24, SD=21.34), followed by Management, Science, and Humanities. Various dimensions of stress differed significantly among streams, highlighting disparities in personal inadequacy, interpersonal difficulties, teacher-pupil relationships, and inadequate study facilities.

Locally in Malaysia, 78% of university students reported experiencing a moderate level of stress, while 88% of the participants identified academic studies is the main cause of their stress (Ramachandiran & Dhanapal, 2018). Another research in Malaysia done by Omar et al. (2020) revealed that the average mean score of academic stress perceived by students of University Teknologi Malaysia (UTM) was 3.51, which indicates that the perceived academic stress level is high. Then, the study examines the sources of the students' perceived stress and results showed that students suffer from high academic stress primary due to tests, followed by peers and result, and then self-inflicted stress, stress from lecturers and group work. The study also compared the average mean scores according to the year of study, showing that students in year three experienced the highest perceived academic stress.

2.3 Impact of stress on executive functions

The impact of acute stress on core executive functions has been a subject of extensive research, with numerous studies indicating significant effects on executive function (working memory, inhibition, and cognitive flexibility). Shields et al. (2016) conducted a comprehensive meta-analysis, revealing that acute stress impairs working memory and cognitive flexibility, while its effects on inhibition are more variable. Working memory, crucial for temporary storage and manipulation of information, is significantly impaired under acute stress conditions. The meta-analysis identified a consistent detrimental effect of stress on working memory across 34 studies involving 1,353 participants (Shields et al., 2016). However, the extent of this impairment can depend on factors like the delay between stress onset and assessment, sex differences, and the working memory load (Henckens et al., 2011; Shields et al., 2016). For example, stress may impair working memory more in women than in men(Schoofs et al., 2013), and the impairment might be more pronounced when the working memory load is high (Oei et al., 2006). This is because stress triggers the release of stress hormones like cortisol, which can disrupt the prefrontal cortex that crucial in working memory. As a result, under stress, it becomes harder to concentrate, solve problems, or make decisions that require holding multiple pieces of information in mind (Shields et al., 2016).

Unlike working memory, which can vary depending on factors, cognitive flexibility, the ability to adapt to changing rules or environment, consistently shows a decline in cognitive flexibility after exposure to acute stress across six studies (280 participants). Inhibition, which involves the ability to suppress irrelevant responses, showed mixed effects under stress. The effects of acute stress on inhibition are less consistent. Some studies suggest that stress enhances inhibition (Schwabe et al., 2013), while others indicate it impairs it (Sanger et al., 2014). The variability in these findings might be moderated by factors like cortisol reactivity to stress (Henckens et al., 2011).

This impairment is often thought to occur because acute stress activates various brain regions involved in sensory processing and environmental scanning, such as amygdala and cingulate cortex. This activation will enhance functions such as sensory gain and attention, which are essential for coping with stress immediately (Cousijn et al., 2010; Oei et al., 2012; van Marle et al., 2010). However, this state of high tension comes at a price: processes that require higher cognitive participation, such as working memory and cognitive flexibility, will be negatively affected (Girotti et al., 2018).

Apart from negative impact of acute stress on executive functions, some researchers also reveal that acute stress will have positive impaction on executive function. Acute stress enhances working memory by modulating glutamatergic transmission in the prefrontal cortex (PFC). Specifically, acute stress will stimulate hypothalamic-pituitary-adrenocortical (HPA) axis to produce cortisol, a major stress hormone in human (de Kloet et al., 2005). This will lead to the activation of glucocorticoid receptors (GRs) in PFC pyramidal neurons, resulting in a significant increase in the surface expression of NMDA (NMDAR) and AMPA (AMPAR) receptors. This receptor potentiation enhances synaptic currents and promotes long-term potentiation (LTP) within the PFC, which is crucial for executive functions like working memory (Yuen et al., 2009). Interestingly, acute stress has different effects on working memory of men and women. In men, acute stress enhances the performance of working memory, which is measured by faster task response time. This improvement may be due to stress-induced attention enhancement and the ability of disabling some brain networks to interfere with working memory tasks. On the other hand, women's working memory is impaired and their reaction time is slowed down under acute stress. The damage of women may be related to the difference in the interaction between stress hormones such as cortisol and neurotransmitter systems related to working memory in the brain. Also, studies have shown that prefrontal cortex (PFC) works differently between men and women in coping with stress (Schoofs et al., 2013)

Chronic stress has a significant detrimental impact on executive function. Unlike acute stress, which can have both enhancing and impairing effects on executive functions depending on the timing and context, chronic stress consistently leads to impairments of executive functions, including working memory and cognitive flexibility in both humans and animal models (Girotti et al., 2018). This means that individuals under chronic stress have difficulty retaining and manipulating information, and they struggle to adapt to new situations or change strategies when needed. This happens due to chronic stress leads to morphological changes in the PFC, including a reduction in dendritic branching and spine density, particularly in the medial prefrontal cortex (mPFC) (Michelsen et al., 2007). Also, chronic stress biases individuals towards more automated and habitual responses rather than flexible, goal-directed behaviors. This shift is linked to structural changes in the brain, such as atrophy in the dorsomedial striatum-prefrontal circuitry and hypertrophy in the sensorimotor networks (Soares et al., 2012). Chronic stress is also proven that affects various neurotransmitter systems, including dopamine, norepinephrine, and serotonin, which are crucial for executive function. These alterations further contribute to the decline in cognitive flexibility and working memory (Girotti et al., 2018).

In vice versa, the reverse association, which is the executive function affecting the stress response is also possible. This study by Grimm et al. (2021)shows that executive function, especially attention control and working memory, plays a vital role in predicting acute stress response. Attention control is always related to adaptive stress response, which shows that people with stronger attention control ability can manage and relieve stress more effectively. In addition, it is found that there is a significant negative correlation between working memory and cortisol response, which indicates that people with higher working memory capacity tend to show lower physiological stress response. These findings show that executive function is helpful to cognitive evaluation of stressors and emotional regulation, which ultimately leads to the decrease of the intensity and duration of stress response.

Although extensive studies have discussed the effects of acute and chronic stress on executive function, there is still a gap in the literature about the specific effects of academic stress on these executive functions. Most studies focus on general stress, ignoring the uniqueness and universality of stress in academic environment. Academic stress is characterized by the pressure of exams, deadlines and performance expectations. It is a unique stress encompassing acute and chronic stress, which is particularly related to students' executive function and overall mental health. Although acute and chronic stress has been proved to damage working memory, attention, reaction inhibition and cognitive flexibility, it is not clear whether these findings are fully applicable to academic stress environment. Therefore, it is urgent to carry out more targeted research to understand how academic pressure specifically affects executive function.

2.4 Impact of executive dysfunction on learning

Poor executive function, especially in working memory, inhibition control and cognitive flexibility, may have a significant impact on academic performance. Among this, working memory has the highest prevalence rate (k = 14, n = 3,740) and has a substantial predictive weight for academic success. This is the part involves the ability to save information in mind and manipulate it when performing various tasks (Cortés Pascual et al., 2019).In addition, working memories have a major role to play in the processing of data, manipulation, and transformation of information, as well as facilitating behavior associated with fundamental brain processes such as language comprehension, reasoning and arithmetical calculations (Anderson & Reidy, 2012).A large number of studies show that working memory defects can lead to poor academic performance. López (2013)explored the relationship between the components of working memory and the language and math scores of 8-and 9-year-old children. Academic performance was assessed by three quarters of final grades, and the results showing that the working memory was a significant factor that led to poor academic performances in both language and mathematics among students in 3rd year of primary school.

2.5 Correlation of academic stress and sleep quality

Wang & Fan (2023) conducted a correlation study to test the relationship between academic stress and sleep quality of adolescents in Jiangsu Province in China. Their research results show that academic stress has a direct negative impact on sleep quality, which is manifested as difficulties in falling asleep, insomnia, dreaminess and low sleep efficiency. It is believed that the pressure of exams, homework and high expectations will directly lead to difficulties in falling asleep and maintaining sleep, as well as the overall decline in sleep quality. This kind of stress often leads to negative emotions such as anxiety and depression, which further aggravates sleep disorders (Deng et al., 2023). In addition, anxiety and school burnout are considered as the intermediary factors of this relationship, which shows that academic stress can indirectly affect sleep quality through these psychological factors (Wang & Fan, 2023). This is because when students are too worried about their academic performance, they may find it difficult to "turn off" their thoughts at night, which may lead to insomnia and other sleep problems. In addition, stress can also lead to bad sleep habits, such as staying up late or staring at the screen for a long time, thus further reducing the quality of sleep (Deng et al., 2023).

In the local area, Cheong & Tan (2021) conducted a study to explore the relationship between academic stress and sleep quality of Malaysian undergraduates. Studies show that students with poor sleep quality report a higher level of stress perception. In addition, the stress level of female students is higher than that of male students. First-year students usually have poor sleep quality compared with the students in the final year. The study emphasizes that students' stress level is increasing, especially during exams, which has a negative impact on their sleep quality. It is worth noting that students often sacrifice their sleep time to allocate more time for study. This finding is consistent with Nakie et al. (2024), who suggested that stress related to academic requirements, such as preparing for exams and finishing homework, often leads to psychological distress, which in turn has a negative impact on sleep. Therefore, students with high academic pressure are more likely to suffer from poor sleep quality, which is characterized by difficulty in falling asleep, maintaining sleep and feeling full of energy after waking up. Stress-induced sleep interruption can lead to a series of health problems, including emotional adjustment problems, cognitive impairment and even physical health complications (Sutton, 2014).Also, the release of stress hormones such as cortisol will interfere with sleep patterns, reduce sleep efficiency and lead to sleep discontinuity(Lemma et al., 2012). In conclusion, this kind of sleep interruption will not only affect students' academic performance, but also affect their overall health.

2.6 Psychometric Properties of Perception of Academic Stress (PAS) Scale

The Perception of Academic Stress (PAS) Scale is a tool developed to measure perceived sources of academic stress among university students. PAS Scale demonstrates strong validity through multiple facets, including content, face, and convergent validity. Content validity was ensured by expert reviews, where seven professors, two associate professors, and three PhD lecturers provided feedback on the relevance and appropriateness of the scale's items, resulting in high agreement on their relevance to measuring academic stress. Face validity was supported by the clarity of items, as verified through pilot testing with students, which confirmed that the scale accurately reflects their experiences and perceptions of academic stress. Convergent validity was established through significant positive correlations between the PAS's factors, indicating that the scale effectively measures related constructs of academic stress. The Perception of Academic Stress

(PAS) Scale exhibits robust reliability, reflecting its consistency and accuracy in measuring academic stress. Internal consistency reliability was confirmed with a Cronbach's alpha of 0.7 for the entire 18-item scale, indicating a high level of coherence among the items. Each of the four identified factors—Pressures to Perform, Perceptions of Workload and Examinations, Academic Self-Perceptions, and Time Restraints—demonstrated acceptable internal consistency, with alpha values ranging from 0.5 to 0.6 (Bedewy & Gabriel, 2015).

2.7 Psychometric Properties of Trail Making Test Part B

Trail Making Test composed of part A (TMT-A) and part B (TMT-B). TMT-B is a neuropsychological assessment tool used to measure executive function in an individual (Arbuthnott & Frank, 2000). Working memory is the primary indicator of TMT-B, followed by task-switching ability (Sánchez-Cubillo et al., 2009).

The validity of TMT-B as a measurement of executive function has been tested. Especially in the aspect of cognitive flexibility, Arbuthnott & Frank (2000)carried out a comparison between TMT-B with the set switching task with low movement and perceptual selection requirements. The results show that there is a significant correlation between the performance of TMT-B and the cost of alternate switching in setting switching tasks, which shows that TMT-B is able to measure executive function. In the aspect of the working memory, Pérez-Parra &

Restrepo-de-Mejía (2023) carried out concurrent validity by using the linear correlation coefficient between TMT-B and neuropsychological and electrophysiological tests of working memory. A total of 56 subjects participated, and their cognitive function was normal, ranging from 19 to 55 years old. The results show that there is a significant correlation between TMT-B score and all subtests. These findings preliminarily prove the validity of TMT-B in evaluating adults' working memory.

The test-retest reliability testing on 384 neurological stable participants demonstrated a high correlation ($r=0.89$) between measurements obtained and the result was significant ($p=0.001$) (Dikmen et al., 1999). Another retest of reliability on 55 patients with major depressive disorder was found in range of 0.86 and 0.94 (Wagner et al., 2011). This suggests that TMT B has a high degree of reliability and may be measured over time with consistency.

2.8 Psychometric Properties of Pittsburgh Sleep Quality Index (PSQI)

Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire for evaluating sleep quality (Buysse et al., 1989).

Backhaus et al. (2002) demonstrated high test-retest reliability and validity for patients with primary insomnia in PSQI. It has a test-retest reliability score of

0.87, indicating good reliability. A high correlation between PSQI and sleep log data is indicated by validity analysis, suggesting good validity. PSQI has been adapted in many countries using their own languages, and different countries have tested the PSQI in their own languages and shown high validity and reliability. For reliability, Cronbach's alpha to measure of internal consistency, showing result of 0.69 in Portuguese, 0.835 in Italian, 0.84 in Korea, indicates a high reliability. After that, test-retest correlation coefficients for the seven components of the PSQI is 0.65 in Korea (Becker & de Neves Jesus, 2017; Curcio et al., 2013; Sohn et al., 2012). Concerning validity, Portuguese researchers found out that PSQI was highly correlated with Insomnia Severity Index, indicating its good validity (Gomes et al., 2018).

2.9 Gap of Studies

Although extensive studies have confirmed that acute and chronic stress will have an impact on executive function, there is an obvious gap in the research focusing on academic stress. Most existing studies involve general stress, so it is urgent to explore how academic stress, an increasingly prevalent and important factor in university students' life, affects executive function. Besides executive function, academic stress also affects sleep quality. Conversely, poor sleep will further worsen executive function, resulting in complex interactions among stress, executive function and sleep. Although there is evidence that academic stress is related to the decline of sleep quality, the two-way relationship among academic stress, executive function and sleep quality is not well understood. This gap in the literature emphasizes the necessity of studying how these factors interact.

CHAPTER 3

3.0 METHODS

3.1 Chapter Overview

This chapter outlined the methodologies employed in this study. It began by describing the study design and setting, followed by an explanation of the study population and the sampling method used to select participants. The calculation of the sample size, as well as the inclusion and exclusion criteria, were included. The chapter also elaborated on the outcome measures and instruments that were used to assess academic stress, executive function, and sleep quality. Furthermore, the procedures undertaken during data collection, along with the analytical methods applied to interpret the data. Lastly, the ethical considerations were included in the end of this chapter.

3.2 Study Design

The study design used is Observational Study.

3.3 Study Setting

Physiotherapy center at Universiti Tunku Abdul Rahman (UTAR), Sungai Long Campus.

3.4 Study Population

Male and female university students

3.5 Sampling Method

A convenience sampling method was used. It is a form of non-probability sampling approach that collects data from population participants who are willing to participate in the study (Dudovskiy, n.d.). It is also a method in which the first accessible primary data source is used for the study with no extra restrictions (Dudovskiy, n.d.).

3.6 Sample Size

The sample size of this study is 367, calculated using Krejcie & Morgan (1970) Formula. N is represented by 7944 students enrolled in UTAR Sungai Long campus in 2024. The formula of Krejcie and Morgan (1970):

$s = x^2\ NP(1\text{-}P) + d^2(N\text{-}1) + x^2P(1\text{-}P)$

Whereby:

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population sizes.

P = the population proportion (0.50).

d = the degree of accuracy expressed as a proportion (0.05).

3.7 Inclusion Criteria

1. Male and female enrolled as full-time students in any programme in UTAR Sungai Long
2. Able to understand English.

3.8 Exclusion Criteria

1. Part time students in UTAR Sungai Long
2. Diagnosed with neurological disorders

3.9 Outcome Measure and Instrumentation

3.9.1 Perception of Stress (PAS) Scale

Perception of Academic Stress (PAS) Scale is a psychometric instrument created to assess undergraduate university students' perceptions of the causes of their academic stress. The PAS Scale contains of 18 items which divided into three subscales: Academic Expectations (4 items), Workload and Examinations (8 items), and Students' Academic Self-Perceptions (6 items). Each question was answered on a 5-point Likert scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree." All questions must be answered by participants. The higher the

PAS score indicating the higher the academic stress. The scale takes about five minutes to complete on average (Bedewy & Gabriel, 2015).

3.9.2 Trail Making Test Part B (TMT-B)

The Trail Making Test (TMT) is a timed, neuropsychological test that involves visual scanning and working memory. The TMT has two parts: the TMT-A (rote memory) and TMT-B (executive functioning). TMT-B alternates between numbers and letters, so the participants must switch between them in a sequential manner as fast as possible (Ciolek & Lee, 2020). For example, consider drawing lines to join the numbers and letters in the sequence 1-A-2-B (Arbuthnott & Frank, 2000). The time it takes to finish the exam determines the TMT score. An average score is 75 seconds, if exceeding 273 seconds, means there is a deficient in executive function. If the participants unable to finished it within 5 minutes, then the exam will stop (Ciolek & Lee, 2020). Also, TMT-B is considered validated as it exhibits construct validity as a measure of task-switching ability and working memory (Sánchez-Cubillo et al., 2009).

3.9.3 Stopwatch

The time taken for the participants to complete the TMT-B was calculated by stopwatch.

3.9.4 Pittsburgh Sleep Quality Index (PSQI)

Pittsburgh Sleep Quality Index (PSQI) is a self-reported questionnaire to evaluate sleep quality and interference. It consists of 19 different elements, involving seven parts: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep interruption, sleeping pills use and daytime dysfunction. Participants must answer items from 0 to 3 every other month, and it takes about 5-10 minutes to complete this questionnaire. The higher the PSQI score, the worse the sleep quality. The global score is the sum of the scores of seven components. If the global score is higher than 5, then it is considered poor sleep quality (Buysse et al., 1989).This instrument has a high validity and reliability. The score of test-retest reliability is 0.87. Validity analysis also show a high correlation between PSQI and sleep log data (Backhaus et al., 2002).

3.10 Procedure

The design of this study is observational study which requires 367 participants. The individuals that enrolled in any UTAR programme and able to understand English were recruited. Through convenience sampling method, participants were recruited in UTAR Sungai Long Campus by face-to-face method. They were given one questionnaire which consists of 3 parts:

a) Demographic part (refer to appendix C)

This demographic data form will include the individual's name, age, gender, faculty, current level of study, year of study, and course of study plus a few questions to ensure that the participants met inclusion criteria

b) Informed consent form (refer to appendix B)

Consent form will be given to the participants if they met the inclusion criteria

c) PAS scale (refer to appendix D)

This questionnaire will take around 5 to 10 minutes to complete.

d) PSQI (refer to appendix E)

This questionnaire will take around 5 to 10 minutes to complete.

After completing the questionnaire, participants were asked to attend to university whenever they are free for executive function measurement. Upon arrival, Trail Making Test Part B (TMT-B) was introduced to them and ensuring their comprehension, a printed TMT-B (refer to appendix F) and a pencil was provided for connecting numbers and letters in alternating order. A practice round helps participants familiarize themselves with the task. Once ready, start the stopwatch when the actual test begins, record the time taken to complete the sequence. If the participant makes a mistake during the test, the examiner will point it out immediately and allow the participant to correct it. These errors will affect the participant's score, because correcting errors is included in the task completion time. Stop the stopwatch once the participant has completed the TMT-B. Scoring was the time taken to complete the TMT-B. The test is discontinued if the participant exceeds the 5-minute time limit. After the test is done, participants were dismissed. All the data collected from the participants were analyzed by using IBM Statistical Package for Social Science (SPSS) and the report was written.

3.11 Data Analysis

The data of this study was analyzed by using Microsoft Excel and IBM Statistical Package for the Social Sciences (SPSS) software of version 27.0.1.0. To fully understand the demographic characteristics of the participants, descriptive statistical data such as age, gender, faculty, year and course of study were provided in the form of percentage (%). For analyzing the distribution of data, Kolmogorov-Smirnov test and Shapiro-Wilk method were used. For inferential statistics, Spearman correlation (r) was used to investigate the relationship between academic stress, executive function, and sleep quality. The p-value was used to evaluate whether the correlation coefficient is statistically significant, with a threshold of $p < 0.05$ indicating a significant relationship. Then, Mann-Whitney U and Kruskal-Wallis test were utilized to examine the differences in academic stress, executive function, and sleep quality based on demographics. In short, the statistical technique that was used in this study are descriptive statistics, normality testing, and inferential analysis to reveal potential connections between academic stress, executive function and sleep quality in study participants.

3.12 Ethical Consideration

This study is subjected to ethical approval by the Scientific and Ethical Review Committee (SERC) of Universiti Tunku Abdul Rahman (UTAR). Informed consent were obtained from all participants qualified for this study. Harmful effects and benefits and data confidentiality were sternly and thoroughly addressed to the participants upon receiving the consent form.

CHAPTER 4

4.0 RESULTS

4.1 Chapter Overview

This chapter discusses about the findings after the statistical analysis of the data collected. A total of 401 responses were collected. Demographic is reported in section 4.2. Descriptive statistics of academic stress, executive function, and sleep quality is reported in section 4.3, 4.4, and 4.5 respectively. Section 4.6 reported the test of normality. The correlation between academic stress, executive function, and sleep quality is reported in section 4.7, 4.8, and 4.9 respectively. Lastly, hypothesis testing is reported in section 4.11.

4.2 Demographic data of the participants

Table 4.1: Demographic Data of the Participants

Variables	Frequency (%)
N	**401 (100.0%)**
Gender	
Male	142 (35.4%)
Female	259 (64.6%)
Age group	
18-19	60 (14.9%)

Table 4.1 continued	
20-21	214 (53.4%)
22-23	99 (24.7%)
24-25	24 (6.0%)
26-27	2 (0.5%)
28-29	2 (0.5%)
Faculty	
Faculty of Accountancy and Management (FAM)	91 (22.7%)
M. Kandiah Faculty of Medicine and Health Science (MK FMHS)	152 (37.9%)
Faculty of Creative Industries (FCI)	61 (15.2%)
Lee Kong Chian Faculty of Engineering and Science (LKC FES)	59 (14.7%)
Centre for Foundation Studies (CFS)	38 (9.5%)
Current level of study	
Foundation	38 (9.5%)
Undergraduate	362 (90.3%)
Postgraduate	1 (0.2%)
Current year of study	
Foundation	38 (9.5%)
Year 1	57 (14.2%)
Year 2	110 (27.4%)

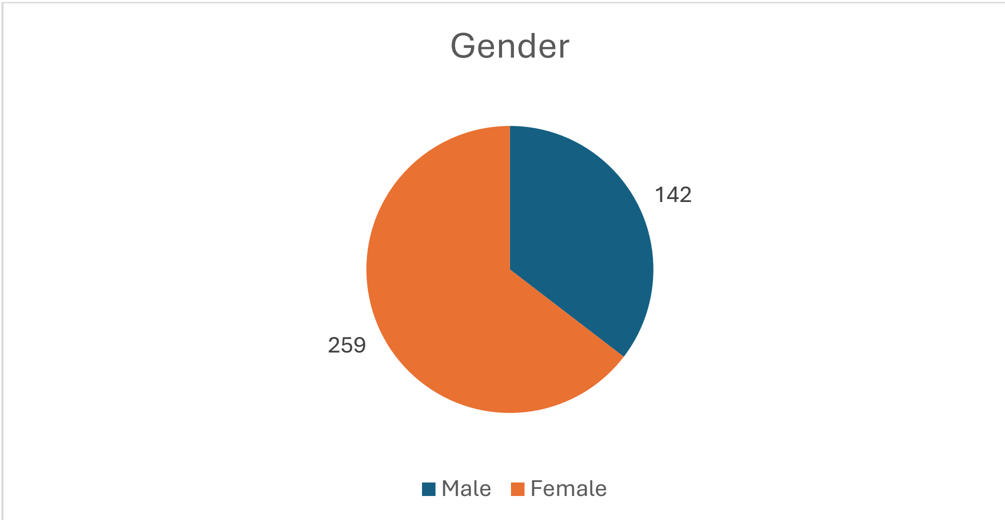
Table 4.1 continued

Year 3	164 (40.9%)
Year 4	32 (8.0%)

Note: N = total number of participants

Table 4.1 shows the frequency and percentage of responses from each participant in this study, broken down by gender, age group, faculty, current level, and year of study. After 5 weeks of data collection, 401 individuals were successfully recruited for this study. Next, IBM SPSS Software Statistics version 27 was utilized to analyze data from 401 participants, and the current study received a 100% response rate.

Figure 4.1: Pie Chart Distribution for Gender of Participants



Pie chart in Figure 4.1 above illustrates the gender distribution for the participants recruited in this study. More than half of the participants were female (64.6%) with a frequency of 259 out of 401 participants, while the percentage of male participants was 35.4% with a frequency of 142 out of 401 participants.

Figure 4.2 Bar Chart Distribution for Age Group of Participants

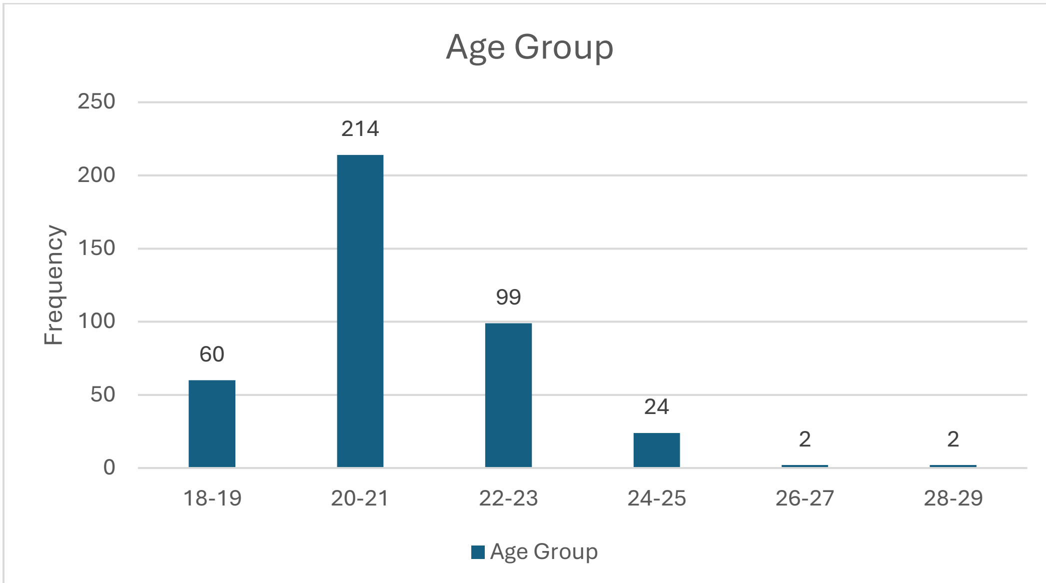


Figure 4.2 shows the distribution of age groups for the UTAR Sungai Long students in this study. 60 participants (14.9%) were in the 18-19 age group, more than half (53.4%) of the participants falls into 20-21 age group (n=214) (53.4%). 99 participants (24.7%) were in the 22-23 age group, 24 participants (6.0%) were in the 24-25 age group, and 2 participants (0.5%) were in both the 26-27 and 28-29 age groups.

Figure 4.3 Bar Chart Distribution for Faculty of Participants

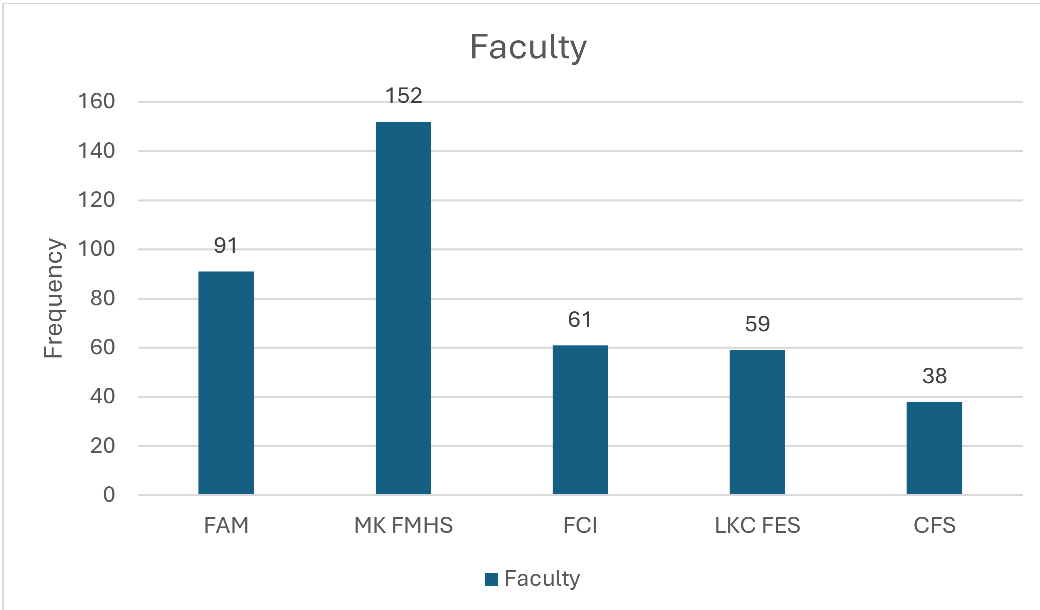


Figure 4.3 has shown that participants from MK FMHS has the highest frequency (n=152), followed by 91 participants (22.7%) from the FAM, 61 participants (15.2%) were from the FCI, 59 participants (14.7%) were from the LKC FES, and 38 participants (9.5%) were from the CFS.

Figure 4.4 Bar Chart Distribution for Current Level of Study of Participants

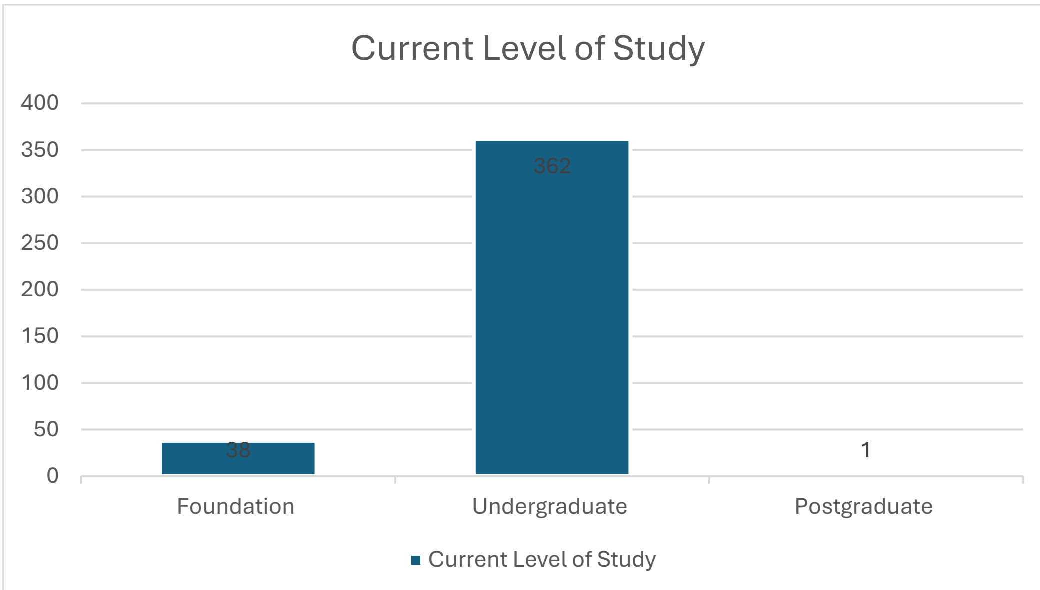


Figure 4.4 has illustrated that most of the participants (90.3%) are undergraduate students (n=362). There were 38 participants (9.5%) enrolled in the Foundation level, and just 1 participant (0.2%) was enrolled in the Postgraduate level.

Figure 4.5 Bar Chart Distribution for Current Level of Study of Participants

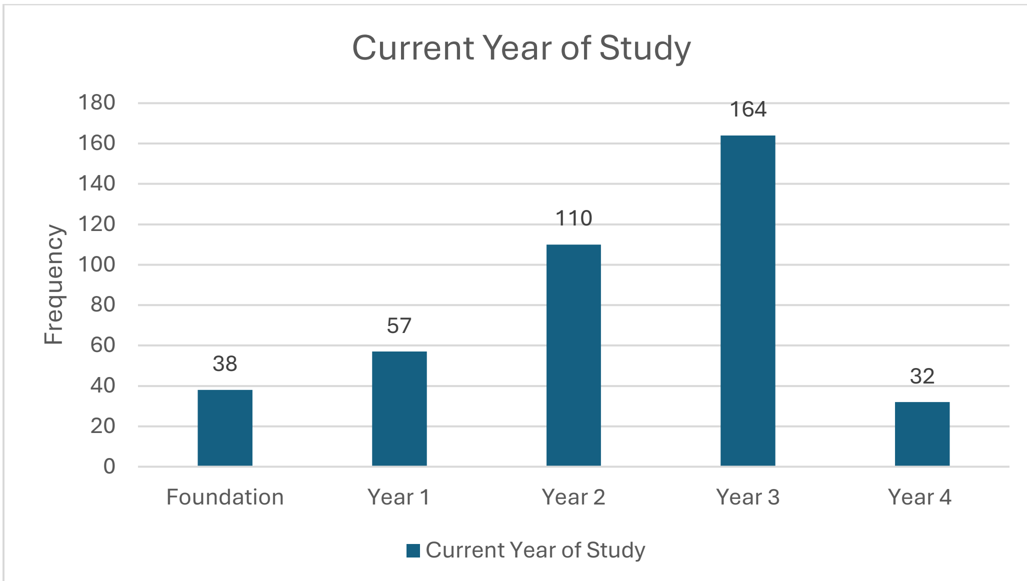


Figure 4.5 has shown that regarding the current year of study, 38 participants (9.5%) were in the Foundation year, 57 participants (14.2%) were in first year of their academic life, 110 participants (27.4%) were in Year 2, 164 participants (40.9%) were in Year 3, and 32 participants (8.0%) were in Year 4.

4.3 Academic Stress

Academic stress was measured using PAS scale. It consisted of 18 items and every items' scoring are ranging from 1 to 5. The responses are then added together to get a global score. The higher the PAS global score, the greater levels of the academic stress. PAS scale can further divide into three subscales: Academic Expectations (4 items), Workload and Examinations (8 items), and Students' Academic Self-Perceptions (6 items).

Table 4.2.1: Mean and Standard Deviation of PAS Global and Subscale Scores

Variables	Mean (SD)	Mean Item (SD)
PAS global scores	54.71 (11.1)	-
Subscales		
Academic Expectations	11.53 (3.22)	2.88 (0.80)
Workload and Examinations	25.63 (5.89)	3.2 (0.74)
Students' Academic Self-Perceptions	17.55 (4.29)	2.93 (0.72)

Table 4.2.1 has revealed that mean score of PAS global score is 54.71, with a standard deviation of 11.1. Among the subscales, the Workload and Examinations subscale had the highest mean item score (3.2, SD = 0.74), indicating that this area contributed the most to participants' academic stress. The Students' Academic Self-Perceptions subscale followed with a mean item score of 2.93 (SD = 0.72),

suggesting that this aspect of academic stress is lesser than the subscale workload and examination. Finally, the Academic Expectations subscale had the lowest mean item score (2.88, SD = 0.80), reflecting relatively less stress compared to the other subscales.

Table 4.2.2: Frequency Distribution of Academic Stress Levels

Academic Stress Levels	Frequency (%)
Low Academic Stress	10 (2.5)
Medium Academic Stress	271 (67.6)
High Academic Stress	120 (29.9

Table 4.2.2 presented the distribution of academic stress levels among the participants. Out of the total 401 respondents, the majority (67.6%) experienced medium stress, followed by 29.9% who reported high stress levels. Only a small proportion (2.5%) of participants experienced low stress. These findings indicate that academic stress is predominantly present at moderate to high levels among the participants

Table 4.2.3: Mean and Standard Deviation of PAS Subscale Items

Items of specifications and the subscale items	Mean (SD)
Stresses related to academic expectations	
Competition with my peers for grades is quite intense	3.35 (1.16)
My teachers are critical of my academic performance	2.53 (1.09)
Teachers have unrealistic expectations of me	2.52 (1.25)
The unrealistic expectations of my parents stresses me out	3.13 (1.23)
Stresses related to faculty work and examinations	
The time allocated to classes and academic work is enough	2.56 (1.11)
The size of the curriculum (workload) is excessive	2.74 (1.20)
I believe that the amount of work assignment is too much	3.22 (1.13)
I am unable to catch up if getting behind my work	3.46 (1.07)
I have enough time to relax after work	3.20 (1.19)
The examination questions are usually difficult	3.66 (1.11)
Examination time is short to complete the answers	3.16 (1.20)
Examination times are very stressful to me	3.64 (1.15)
Stresses related to students' academic self-perceptions	
I am confident that I will be a successful student	2.38 (1.02)
I am confident that I will be successful in my future career	2.39 (1.01)

Table 4.2.3 continued	
I can make academic decisions easily	2.52 (1.05)
I fear failing courses this year	3.43 (1.36)
I think that my worry about examinations is weakness of character	3.28 (1.21)
Even if I pass my exams, am worried about getting a job	3.55 (1.25)

Table 4.2.3 presents a more detailed breakdown of mean and standard deviation of each subscale and individual items of the PAS scale. For academic expectations subscale, the highest-rated item was "Competition with my peers for grades is quite intense" (M = 3.35, SD = 1.16), indicating significant stress due to competition. On the other hand, "My teachers are critical of my academic performance" and "Teachers have unrealistic expectations of me" had relatively lower mean scores (M = 2.53, SD = 1.09 and M = 2.52, SD = 1.25, respectively), suggesting that stress due to teachers' expectations was not as prominent.

In the faculty work and examinations subscale, the item "The examination questions are usually difficult" received the highest mean score (M = 3.66, SD = 1.11), followed by "Examination times are very stressful to me" (M = 3.64, SD = 1.15), highlighting significant stress due to the perceived difficulty of exams and time pressure. Other items like “The size of the curriculum (workload) is excessive”

(M = 2.74, SD = 1.20) and “The time allocated to classes and academic work is enough” (M = 2.56, SD = 1.11) reflected lower stress in this subscale.

In the students' academic self-perceptions subscale, "I fear failing courses this year" had the highest mean (M = 3.43, SD = 1.36), pointing to significant pressure about academic failure. The items regarding future success ("I am confident that I will be a successful student" and "I am confident that I will be successful in my future career") had lower mean scores (M = 2.38, SD = 1.02 and M = 2.39, SD = 1.01, respectively), suggesting lower confidence in academic and career outcomes.

4.4 Executive Function

Table 4.3: Assessment of Executive Function using TMT-B

Variables	Category	Frequency (%)	Mean	SD
TMT-B score	-	-	58.37	28.73
TMT-B category	Normal	400 (99.8%)	-	-
	Deficit	1 (0.2%)	-	-

Table 4.3 showed the mean of the TMT-B distribution is 58.37 seconds, with a standard deviation of 28.73. Since the threshold of executive function defect is defined as the completion time exceeding 273 seconds, the mean of 58.37 seconds is completely within the normal range. In addition, the standard deviation shows that even the participants at the upper end of the distribution (mean+2 SD = about 115.83 seconds) are far below the cutoff value, which proves that most participants show normal executive function. Only one participant exceeded this threshold, which indicates that there is the deficiency in executive function.

Figure 4.6: Histogram Distribution for TMT-B score of Participants

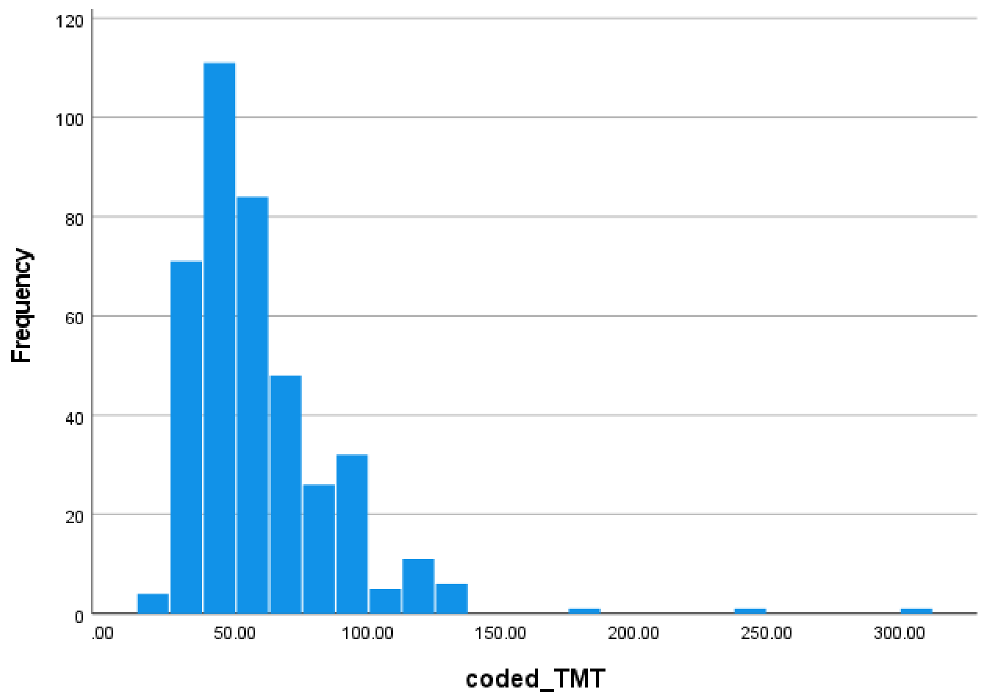


Figure 4.6 above illustrates the distribution of TMT-B completion times for 401 participants. The data generally exhibit a positively skewed distribution, with the majority of values clustered around the lower end of the range, peaking between 40 seconds to 60 seconds. While most data points are concentrated below 100, there are a few extreme values above 150, contributing to the skewness.

4.5 Sleep Quality

Sleep quality of the participants was measured by PSQI. It measures seven components of sleep. The components score are then added together to produce a global score. The poorer the sleep quality, the higher the scores obtained by the participants. The cutoff point for the poor sleeper were those obtained 6 marks and above in PSQI global score.

Table 4.4.1: Assessment of Sleep Quality using PSQI

Variables	Category	Frequency (%)	Mean	SD
PSQI global score	-	-	6.04	2.83
PSQI category	Good	184 (45.9%)	-	-
	Poor	217 (54.1%)	-	-

Table 4.4.1 depicts the general sleep quality using the PSQI and it showed a mean global score of 6.04 (SD = 2.83), indicating that participants had poor sleep quality on average. When categorized based on sleep quality, 184 participants (45.9%) were classified as having good sleep quality (PSQI ≤ 5), while 217 participants (54.1%) were classified as having poor sleep quality (PSQI > 5). These findings suggested that a slightly greater proportion of the participants had experienced a poor sleep quality.

Table 4.4.2: Frequency Table of Sleep Component Scores in PSQI

Components	**Frequency, N (%)**			
Scoring	**0**	**1**	**2**	**3**
1. Subjective sleep quality	78 (19.5%)	231 (57.6%)	83 (20.7%)	9 (2.2%)
2. Sleep latency	72 (18.0%)	161 (40.1%)	111 (27.7%)	57 (14.2%)
3. Sleep duration	142 (35.4%)	204 (50.9%)	42 (10.5%)	13 (3.2%)
4. Sleep efficiency	251 (62.6%)	101 (25.2%)	36 (9.0%)	13 (3.2%)
5. Sleep disturbance	37 (9.2%)	286 (71.3%)	71 (17.7%)	7 (1.7%)
6. Use of sleep medication	349 (87.0%)	31 (7.7%)	16 (4.0%)	5 (1.2%)
7. Daytime dysfunction	132 (32.9%)	173 (43.1%)	81 (20.2%)	15 (3.7%)

Table 4.4.2 shows the frequency distribution of the sleep component scores in the PSQI highlights the varying levels of sleep quality among participants. Higher scores indicating a poorer sleep quality.

For component 1: subjective sleep quality, the majority of the participants (57.6%) rated their sleep as "fairly good" (score = 1), while 20.7% reported "fairly bad" (score = 2), and only 2.2% indicated "very bad" (score = 3). Regarding component 2: sleep latency, 58.1% of participants reported they need to spend less than 30 minutes to fall asleep (score = 1 & score = 2), while the rest 41.9% of participants are spending more than 30 minutes in falling asleep (score = 3 & 4).

In terms of component 3: sleep duration, over half of the participants (50.9%) were having 6 to 7 hours of sleep per day (score =1), while 35.4% of participants having a sleep duration that is more than 7 hours (score = 0). In component 4: sleep efficiency, 62.6% had high efficiency (score = 0), with only 3.2% experiencing severe inefficiency (score = 3).

For sleep disturbances (component 5), the majority (71.3%) experienced mild disturbances (score = 1), and a small proportion (1.7%) reported severe disturbances (score = 3). Interestingly, the use of sleep medication (component 6) was minimal, with 87.0% scoring 0, indicating no medication use, and only 1.2% reporting frequent usage (score = 3).

Finally, in component 7, for daytime dysfunction, 43.1% experienced mild difficulties (score = 1), and 3.7% reported severe issues (score = 3). Overall, the results suggested that most participants experience mild sleep issues across components.

4.6 Test of Normality

This study had use Kolmogorov-Smirnov and Shapiro-Wilk method to test for the normality of PAS scale, TMT-B, and PSQI.

Table 4.5: Test of Normality for PAS scale, TMT-B, and PSQI

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**p-value**	**Statistic**	**df**	**p-value**
PAS global score	0.072	401	<0.001	0.985	401	<0.001
PSQI global score	0.132	401	<0.001	0.970	401	<0.001
TMT-B score	0.139	401	<0.001	0.790	401	<0.001

Note: a = Lilliefors Significance Correction

Based on the table 4.5, the PAS global score, PSQI global score, and TMT-B score had a p value less than 0.05 (p=0.000), illustrating the results obtained were not normally distributed. The p-value for PAS global score, PSQI global score, and TMT-B score is <0.001. Since the p-value is lesser than 0.05, the null hypothesis (H_0) is rejected, and alternative hypothesis (H_1) is accepted, implies that the data does not follow a normal distribution. As a result, nonparametric statistical approaches were used in the following investigations to account for the non-normal distribution of the data.

4.7 Association between Academic Stress, and Executive Function

Spearman's Rho was used in this study to investigate the relationship between academic stress and executive function. The decision to do so is based on the fact that both variables are measured as continuous data and do not follow a normal distribution, as seen by the results of the normality tests (refer to Table 4.5). The use of Spearman's Rho, a nonparametric statistical approach, guarantees that the analysis properly accounts for the data's non-normal distribution while evaluating the strength and direction of the link between these two variables.

Table 4.6 Correlation between PAS Global Score and TMT-B Score

			PAS global score	**TMT-B score**
Spearman's rho	**PAS global score**	Correlation Coefficient	1.000	0.107*
		Sig. (2-tailed)		0.032
		N	401	401
	TMT-B score	Correlation Coefficient	0.107*	1.000
		Sig. (2-tailed)	0.032	
		N	401	401

Note: *. Correlation is significant at the 0.05 level (2-tailed).

Table 4.6 revealed the correlation between academic stress (as measured by PAS global score) and executive function (as measured by TMT-B score) by using Spearman's Rho correlation analysis. The results revealed a statistically significant but poor positive correlation between the PAS global score and TMT-B score ($r = 0.107$, $p = 0.032$). This indicates that greater levels of academic stress are associated with slightly longer completion times on the TMT-B (higher TMT-B score), reflecting potentially reduced executive function. Nonetheless, since the correlation coefficient is weak, the relationship between these variables may not be strong.

The coefficient of determination (r^2), calculated as $0.107^2 = 0.0115$, indicates that academic stress accounts for just 1.15% of the variation in TMT-B score.

4.8 Association between Academic Stress, and Sleep Quality

Similar to the section 4.7, Spearman's Rho will be utilized to investigate the relationship between academic stress and sleep quality because both are continuous data and the data is not having a normal distribution (refer to Table 4.5).

Table 4.7: Correlation between PAS and PSQI Global Score

			PAS global score	**PSQI global score**
Spearman's rho	**PAS global score**	Correlation Coefficient	1.000	0.375**
		Sig. (2-tailed)		<0.001
		N	401	401
	PSQI global score	Correlation Coefficient	0.375**	1.000
		Sig. (2-tailed)	<0.001	
		N	401	401

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Table 4.7 has shown that academic stress (PAS global score) has a positive correlation, with a correlation coefficient ($r=0.375$) with sleep quality (PSQI global score), with a p-value of <0.001, which is statistically significant at 0.01 level. This indicating both result has a fair strength of positive relationship between academic stress and sleep quality, meaning that if someone's academic stress increase (higher PAS score), the sleep quality will tend to get worse (higher PSQI global scores).

Moreover, the r^2 value, which shows the percentage of variance in sleep quality (PSQI) was explained by academic stress (PAS) is roughly at 0.141 (0.375^2). This suggests that academic stress levels account for around 14.1% of the variable in sleep quality, with the remainder probably impacted by other factors that is not considered in this analysis.

4.9 Association between Executive Function and Sleep Quality

Spearman’s rho method is used to examine the association between executive function and sleep quality since both results are continuous data and they are not normally distributed.

Table 4.8: Correlation between TMT-B Score and PSQI Global Score

			TMT-B score	**PSQI global score**
Spearman's rho	**TMT-B score**	Correlation Coefficient	1.000	0.185**
		Sig. (2-tailed)		<0.001
		N	401	401
	PSQI global score	Correlation Coefficient	0.185**	1.000
		Sig. (2-tailed)	<0.001	
		N	401	

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Table 4.8 presents the Spearman's rho correlation between the TMT-B score and the PSQI global score. The results show a positive correlation coefficient (r) of

0.185, statistically significant at the 0.01 level ($p < 0.001$). This shows a weak but significant positive association between TMT-B scores and PSQI global scores, implying that poorer executive function (higher TMT-B scores) is related with poorer sleep quality (higher PSQI global scores).

The r^2 value is calculated as $0.185^2 = 0.034$ implies that approximately 3.4% of the diversity in sleep quality (PSQI scores) may be explained by differences in executive function (TMT-B scores). The remaining 96.6% of the variance is most certainly influenced by factors that are not included in this analysis.

In summary, a significant moderate positive correlation was found between academic stress and sleep quality ($r = 0.375$, $p < 0.001$), indicating that higher levels of academic stress are associated with poorer sleep quality. A weak positive correlation was also observed between academic stress and executive function ($r = 0.107$, $p = 0.032$), suggesting a slight positive association between higher academic stress and better executive function, although the relationship is relatively weak. Additionally, a poor positive correlation was found between sleep quality and executive function ($r = 0.185$, $p < 0.001$), indicating that poor sleep quality is associated with worser executive function. These findings suggest that while academic stress is more strongly linked with sleep quality, both academic stress and sleep quality have weak, positive relationships with executive function.

4.10 Hypothesis Testing

H0i) There is no significant association between academic stress and executive function among university students.

HAi) There is a significant association between academic stress and executive function among university students.

The Spearman rho test conducted reveals a significant association between the academic stress and executive function ($r = 0.107$, $p = 0.032$) among university students. Therefore, the null hypothesis was rejected as there was a significant association between academic stress and executive function among university students.

H0ii) There is no significant association between academic stress and sleep quality among university students.

HAii) There is a significant association between academic stress and sleep quality among university students.

The Spearman rho test conducted reveals a significant association between the academic stress and sleep quality ($r = 0.375$, $p < 0.001$) among university students. Therefore, the null hypothesis was rejected and the alternate hypothesis is accepted as there was a significant association between academic stress and executive function among university students.

H0iii) There is no significant association between executive function and sleep quality among university students.

HAiii). There is a significant association between executive function and sleep quality among university students.

The Spearman rho test conducted reveals a significant association between the executive function and sleep quality ($r = 0.185$, $p < 0.001$) among university students. Therefore, the null hypothesis was rejected and the alternate hypothesis is accepted as there was a significant association between academic stress and executive function among university students.

CHAPTER 5

5.0 DISCUSSION

5.1 Chapter Overview

This chapter provides a summary of findings in the beginning. After that, interpretations of the findings that match to the research objectives were presented in each section, followed by a comparison with earlier studies and justification. The chapter then discusses the limitations of the current study and recommendations for future research. Lastly, this chapter end with a conclusion.

5.2 Summary of Findings

This study examined the impact of academic stress on executive function and sleep quality among university students and significant results were found. Academic stress, measured using the PAS scale, exhibited a fair positive connection with sleep quality, shown by the PSQI ($r = 0.375$, $p < 0.001$). This suggests that increasing academic stress is linked to lower sleep quality. The study also found a weak positive relationship between academic stress and executive function, as measured by the TMT-B ($r = 0.107$, $p = 0.032$), implying that increased academic stress may marginally impair executive function. A weak positive connection ($r = 0.185$, $p < 0.001$) was found between sleep quality and executive function, suggesting that poorer sleep quality leads to lower executive function.

Demographic studies found no significant differences in academic stress or sleep quality by gender, age, faculty, or year of study. However, gender and faculty differences had a significant impact on executive function, with females obtaining a better executive function than males, and FAM performing the worse executive function across the faculties.

5.3 Correlation between Academic Stress & Executive Function

The findings revealed a weak but statistically significant positive correlation between academic stress and executive function ($r = 0.107$, $p = 0.032$). Specifically, higher levels of academic stress were associated with poorer executive function.

The results of this study are consistent with earlier studies. For example, a previous study(Ma et al., 2025), highlighted the complex effects of academic stress on executive function. They found that different sources of academic stress (e.g., parental, teacher, and social pressure) had different predictive effects on executive function components, and these effects changed as students entered high school. For example, they found that self-imposed stress could improve certain executive function components, including interference inhibition, response inhibition, and attention switching .

The association between academic stress and executive function may be explained by the neurobiological impact of stress on the brain, particularly on the prefrontal cortex. As mentioned in the part of literature review, acute and chronic stress are known to dysregulate the hypothalamic-pituitary-adrenal (HPA) axis, leading to elevated levels of cortisol (Shields et al., 2017). Elevated cortisol, in turn, has been shown to impair synaptic plasticity and reduce neural activity in the prefrontal cortex, thereby affects the memory and learning processes (Kim et al., 2006). In-depth, acute stress affects working memory by the release of glucocorticoids and the activation of neural pathways, while chronic stress causes hormonal signaling and neurotoxic changes within the hippocampus, impacting working memory performance (Barsegyan et al., 2010). This suggests that academic stress has an impact on executive function.

Although the result of academic stress is statistically significant correlated with executive function ($p = 0.032$), the weak correlation ($r = 0.107$) indicates that academic stress explains only a small proportion of the variability in executive function outcomes. This weak correlation observed in this study contrasts with some earlier studies that have reported moderate to strong relationships between stress and executive function.

These discrepancies may be attributed to differences in population characteristics. For example, age might act as a potential confounder of this studies.

Given that all participants in this study are young adults that ranging from 18-29 years old, the relatively narrow age range may limit the generalizability of the findings to older populations, where the relationship between stress and executive function may differ. Generally, young adults exhibit a better executive function than older adults (Shields et al., 2017). They conducted a study to compare executive function, short-term memory, and coping strategies between young and older adults with normal cognitive function and no prior diagnosis of depression. The results showed that young adults performed better than older adults in executive functioning and short-term memory task. Additionally, the study found that age was associated with differences in coping strategies, with older adults using more avoidance strategies compared to young adults. Even though under stress environments, old age shows adverse effects on executive functioning (Harada et al., 2013) and a study demonstrated that stress exposure and executive functioning were negatively related in older adults (Roiland et al., 2015).

Besides coping mechanisms, young adults tend to exhibit high neuroplasticity because their executive function is still undergoing maturation (Ogilvie et al., 2020). This is supported by the findings of Tervo-Clemmens et al. (2023), that stated most executive functions develop rapidly in childhood, continuing at a decreased and more gradual rate into adolescence and early adulthood. This suggests that executive function continues to develop into early adulthood, followed by declines in both working memory and inhibitory control starting as early as age 30 to 40 and continuing into older age (Ferguson et al., 2021).

Additionally, Ferguson et al. (2021) also demonstrated that both working memory capacity and inhibitory control were greater in young adulthood than in adolescence, with working memory capacity declining in participants between the ages of 30 and 40 and inhibitory control declining in participants starting at age 35. As such, the weak correlation between academic stress and executive function observed in this study may be affected by the developmental stage of the participants as the younger population in this study may buffer the negative effects of academic stress on executive function.

Besides, the relationship between academic stress and executive function should also be understood within the broader context of stress and cognitive performance. Stress is a well-documented factor in the Yerkes-Dodson law, it explains the non-linear connection between behavioral performance and arousal (Chaby et al., 2015). The link between arousal and performance is generally non-linear in the way of inverted-U shaped, indicating that performance improves with moderate increases in arousal but is impaired at the greatest levels of arousal (Nieuwenhuis, 2024). This means that as stress levels increase, cognitive performance improves, but only up to a certain point. Beyond that point, further increases in stress can lead to a decline in cognitive performance(Diamond, 2005).

However, it is important to note that the Yerkes-Dodson law is a universal principle, which may not fully capture the complexity of executive function. But the weak correlation observed in this study may reflect this dynamic, with some students experience controllable stress levels, which is helpful for executive function, while others experience debilitating stress levels, which impairs executive function.

5.4 Correlation between Academic Stress & Sleep Quality

These results align with prior research highlighting the adverse impact of academic stress on sleep patterns and overall sleep health. Study findings from other authors further support this relationship. For example, a cross-sectional study of 450 Indonesian college students revealed a significant correlation between stress levels and sleep quality, with students who had poor sleep quality being 4.7 times more likely to have greater stress levels than those who had good sleep quality ($p = 0.001$) (Herawati & Gayatri, 2019). With an emphasis on Malaysia, a study including 90 undergraduate students studying cognitive science at Universiti Malaysia Sarawak found a slight association ($r = 0.286$, $p = 0.006$) between sleep quality and felt stress, suggesting that although there is a correlation, it is not very strong. Stress levels were also higher among those who reported having trouble sleeping (Cheong & Tan, 2021). Alotaibi et al. (2020) found that 77% of medical students reported poor sleep quality and 63.5% reported psychological stress, indicating a stronger connection ($p < 0.001$). This points to a moderate association between the two variables. A meta-analysis also shown that academic stress is associated with sleep quality among urban students, supporting the idea that as academic stress increases, sleep quality deteriorates (Stephanie & Ananta Yudiarso, 2024).

The association between academic stress and poor sleep quality can be explained through various mechanisms. Stress activates the hypothalamic-pituitary-adrenal (HPA) axis and increases the secretion of cortisol, a stress hormone that plays a crucial role in the body's response to stress(Shields et al., 2017). Cortisol levels play a vital role in a circadian rhythm, it increased immediately before awakening and dropping during sleep. Elevated cortisol can disturb this cycle, contributing to difficulty in initiating and sustaining sleep quality, notably by lowering slow-wave sleep and increasing nighttime awakenings (Azmi et al., 2021).

Moreover, sympathetic nervous system activation during times of high stress can elevate heart rate and blood pressure, resulting in a physiological state of hyperarousal that is incompatible with peaceful sleep (Greenlund & Carter, 2022).

Psychological mechanisms also have a big impact. Stress-related rumination, defined as persistent negative thoughts about educational difficulties, might increase the time it takes to fall asleep and lower sleep efficiency (J. Zhang et al., 2024). These intrusive thoughts frequently occur before bedtime, resulting in increased cognitive activity at a time when the mind should be relaxing (Feng & Wang, 2022). Furthermore, the fear of failure and the pressure to satisfy academic expectations can worsen anxiety, making it difficult to relax and sleep well (Alhamed, 2023).

This connection could be influenced by behavioral factors as well. Under stress, students may engage in maladaptive coping methods such as excessive caffeine consumption, inconsistent sleep cycles, or prolonged use of electronic devices (Freire et al., 2020), all of which can impair sleep quality. Academic stress may also contribute to a lack of sleep hygiene measures, such as maintaining a consistent bedtime or generating a suitable sleep environment, exacerbating sleep problems (Khawaja et al., 2023).

Poor sleep quality is a factor that has been well established to affect cognitive performance, emotional regulation, and physical health (Mantua & Simonelli, 2019). This relationship is particularly concerning for university students because it may affect their academic performance and overall health. The findings in this study highlights the need for targeted interventions to address academic stress and sleep problems. Stress reduction strategies such as mindfulness training, time management workshops, and seeking support may help students manage academic stress more effectively (Zhang et al., 2021). At the same time, promoting sleep hygiene habits may reduce the impact of stress on sleep quality.

5.5 Correlation between Executive Function & Sleep Quality

The present study observed a weak but statistically significant positive correlation between executive function and sleep quality ($r = 0.185$, $p < 0.001$), suggesting that better sleep quality is associated with improved executive function.

This finding aligns with prior research indicating that sleep is critical for cognitive processes, including working memory, attention, and decision-making, which are integral components of executive function. For instance, (Sen & Tai, 2023) demonstrated that sleep deprivation leads to impairments in tasks requiring executive control, indicating that insufficient or poor-quality sleep can detrimentally affect cognitive performance. Similarly, studies have shown that individuals with better sleep quality tend to perform better on tasks assessing executive functions (Parra-Díaz et al., 2021).Another study by (Tai et al., 2022) has shown that the sleep duration in seven hours per day was related to the maximum cognitive performance, which dropped for every hour above and below this sleep duration.

The theory behind this is that sleep deprivation and poor sleep quality have been shown to impair prefrontal cortex activity (Verweij et al., 2014), which is essential for executive functions that required higher-order cognitive tasks like reasoning, decision-making, and working memory (Jones & Graff-Radford, 2021)., thus providing a physiological basis for this association.

During sleep, it provides essential energy and promotes synaptic plasticity in the PFC, allowing it to adapt and perform complex cognitive tasks (Frank, 2014). Therefore, when having a bad sleep quality, it will lead to decreased activation in the PFC (Drummond, 2001), which is linked to impairments in executive function tasks such as attention and memory. When sleep is disrupted, the PFC experiences reduced energy availability, impaired neuroplasticity, and weaker functional connectivity with other brain areas, such as the amygdala (Killgore, 2013). This results in diminished attention, planning, and problem-solving abilities.

Sleep is also vital for memory consolidation (Klinzing et al., 2019), which is a process of a temporary, labile memory is transformed into a more stable, long-lasting form (Squire et al., 2015). During slow-wave sleep (SWS) and rapid eye movement (REM) sleep, the brain strengthens synaptic connections and integrates newly acquired information (Paller et al., 2021). Poor sleep quality disrupts these phases, leading to fragmented memory consolidation and impaired hippocampal function (Dahat et al., 2023). Without proper memory integration, working memory and cognitive flexibility suffer, making it harder to retain and apply new information (Buschman, 2021).

However, the weak correlation observed in this study suggests that while sleep quality is an important factor influencing executive function, it is not the sole determinant. This finding resonates with the work of (Lim & Dinges, 2010), who noted that while sleep deprivation can lead to significant cognitive deficits, individual differences in resilience and compensatory strategies may mitigate these effects.

Since our study focused on university students, so most of them were young adults, ranging in age from 18 to 29 years old (refer to Table 4.1). Plus, it is noteworthy that studies has shown that young adults tend to be more resilient to the executive function of sleep deprivation than older adults. For instance, studies have shown that college students who reported less than seven hours of sleep per night displayed lower scores on working memory and executive function measures, yet the overall impact was modest (Hirshkowitz et al., 2015; Parrilla et al., 2024). This contrasts with older adults, who not only experience age-related declines in cognitive functioning but also undergo changes in sleep architecture that exacerbate the negative effects of poor sleep quality (Sen & Tai, 2023).

According to Allan et al. (2023), young adults' continuing prefrontal cortex growth, which is important for executive functions, may provide some protection against cognitive losses that commonly due to sleep disruptions. This developmental resilience provides a potential explanation for the weaker association observed in this population compared to older adults. Thus, this might be the reason for those studies that showed no association between sleep quality and executive function among young generation. For example (Zavecz et al., 2020), found that subjective sleep quality has not significantly correlated with cognitive performance in working memory, executive functioning, and procedural learning in healthy young adults.

Thus, while the existing literature supports a relationship between sleep quality and executive function, the strength of this association is modest, highlighting the complexity of cognitive function and the need for a nuanced understanding of how various factors interact.

5.7 Limitation of the Study

While our study provides valuable insights, it is not without limitations. This study on the impact of academic stress on university students' executive function and sleep quality has several limitations, which should be admitted. First of all, there is a gender imbalance in the sample, with females account for 64.6% of the participants. In addition, the high representativeness of the study for undergraduates (accounting for 90.3% of the sample) also limits the applicability of the research results to foundation students or graduate students, because they may experience different levels of academic pressure and its effects.

Besides, the cross-sectional design of this study accounts for another limitation, because it captures data at a single time point, thus causal inference of the relationship between academic stress, executive function and sleep quality cannot be examined. The longitudinal method will better understand how these factors evolve and interact with each other over time.

Besides, one limitation of this study is the lack of data on participants' academic results, such as GPA and CGPA, which could provide insights into the potential links between academic performance and academic stress. Including this data might have strengthened the analysis of stress-related outcomes.

Additionally, recall bias may have affected the accuracy of self-reported measures, as participants may not have accurately remembered or objectively assessed their academic stress levels, sleep quality, or executive function during the data collection period. This could influence the reliability of the findings and should be considered when interpreting the results. Objective methods, such as sleep activity recorders or stress physiological indicators, will supplement these self-reports and provide more reliable data.

Next, the evaluation of executive function depends entirely on the TMT-B, which mainly evaluates cognitive flexibility and working memory. Although effective, this single test cannot fully capture the multidimensional nature of executive functions, such as inhibition control and problem solving. A more comprehensive assessment such as adding Stroop test Wisconsin Card Sorting Test will yield a deeper insights.

5.8 Suggestions and Recommendations

Future research should try to expand its reach and use higher-quality procedures in order to address the shortcomings of this study. A more balanced gender representation is crucial to ensure findings reflect the experiences of both male and female students. Additionally, the results will be more broadly applicable if participants are recruited from a variety of academic backgrounds, including foundation and postgraduate students.

To enhance the understanding of the relationship between academic stress and its outcomes, future studies should include participants' academic performance indicators, such as GPA and CGPA. This would allow for an in-depth analysis of how academic results correlate with perceived academic stress and its impacts on executive functions and sleep quality.

To further isolate the effects of academic stress, potential confounders such socioeconomic status, physical activity levels, and external stressors should be properly controlled or evaluated. Future research should incorporate objective measurements to supplement subjective data, such as physiological stress markers (e.g., cortisol levels) and sleep measures like actigraphy or polysomnography. Incorporating more instruments, such the Stroop Test and the Wisconsin Card Sorting Test, into executive function testing will yield a more thorough assessment of its multifaceted nature. Longitudinal study design is recommended in the future study in order to monitor changes over time and determine causal linkages. Students could be observed over the course of a semester or academic year to see how stress, sleep, and cognitive function are affected by times of increased academic pressure, like tests or project deadlines.

5.9 Conclusion

In conclusion, this study highlights the complex relationships between academic stress, sleep quality, and executive functioning in university students. Although the relationships were weak, the results show that academic stress has a detrimental impact on executive functioning and sleep quality. In turn, executive functions and sleep quality demonstrated a weak but substantial positive link. Demographic characteristics revealed gender and faculty variations in executive functioning, but no significant differences in academic stress or sleep quality. These findings are consistent with earlier studies, but they also emphasize the complexities of these interactions, which are regulated by neurobiological mechanisms, developmental stage, and lifestyle practices.

The study's limitations, such as its cross-sectional design and dependence on self-report measures, underscore the need for more robust longitudinal research and a wider range of approaches. Future research should fill these limitations by combining objective measures, studying a larger population, and using multidimensional assessments of executive function.

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APPENDIX A – ETHICAL APPROVAL LETTER

UNIVERSITI TUNKU ABDUL RAHMAN
Wholly Owned by UTAR Education Foundation (Company No. 578227-M)

Re: U/SERC/78-363/2024

23 September 2024

Mr Muhammad Noh Zulfikri bin Mohd Jamali
Head, Department of Physiotherapy
M. Kandiah Faculty of Medicine and Health Sciences
Universiti Tunku Abdul Rahman
Jalan Sungai Long
Bandar Sungai Long
43000 Kajang, Selangor

Dear Mr Muhammad Noh,

Ethical Approval For Research Project/Protocol

We refer to your application for ethical approval for your students' research project from Bachelor of Physiotherapy (Honours) programme enrolled in course UMFD3026. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
1.	The Effect of Diaphragm Muscle Exercise on Dynamic Balance among Post-COVID-19 Older Adults in Klang Valley, Malaysi	Goh Le Yi	Ms Premala a/p Krishnan	
2.	Relationship Between Cognitive Domains, Dynamic Postural Stability and Fall Risk in Elderly Individuals with Mild Cognitive Impairment: A Pilot Study	Chaw Jade Wern		
41.	Impact of Academic Stress on Executive Functions and Sleep Quality Among University Students: An Observational Study	Lai Yu Wei	Mr Nizar Abdul Majeed Kutty	
42.	Knowledge and Awareness of Re-Warm Up Programs on Physical Performance Among University Athletes. A Cross Sectional Study	Emmanuel James Loh Kuan Hung		

The conduct of this research is subject to the following:

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

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

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

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

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

Thank you.

Yours sincerely,

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

c.c Dean, M. Kandiah Faculty of Medicine and Health Sciences
Director, Institute of Postgraduate Studies and Research

APPENDIX B – INFORMED CONSENT FROM & PERSONAL DATA PROTECTION STATEMENT

Personal Data Protection Notice

Please be informed that in accordance with Personal Data Protection Act 2010 ("PDPA") which came into force on 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

1. Personal data refers to any information which may directly or indirectly identify a person which could include sensitive personal data and expression of opinion. Among others it includes:

a) Name
b) Identity card
c) Place of Birth
d) Address
e) Education History
f) Employment History
g) Medical History
h) Blood type
i) Race
j) Religion
k) Photo
l) Personal Information and Associated Research Data

2. The purposes for which your personal data may be used are inclusive but not limited to:

a) For assessment of any application to UTAR
b) For processing any benefits and services
c) For communication purposes
d) For advertorial and news
e) For general administration and record purposes
f) For enhancing the value of education
g) For educational and related purposes consequential to UTAR
h) For replying any responds to complaints and enquiries
i) For the purpose of our corporate governance
j) For the purposes of conducting research/ collaboration

3. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

4. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.

5. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

6. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy.

7. If you do not consent or subsequently withdraw your consent to the processing and disclosure of your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in respect of the purposes and/or for any other purposes related to the purpose.

8. You may access and update your personal data by writing to us at laiyuwei@1utar.my

1. Acknowledgment of Notice *

Mark only one oval.

- ◯ I have been notified and that I hereby understood, consented and agreed per UTAR above notice.
- ◯ I disagree, my personal data will not be processed

APPENDIX C – DEMOGRAPHIC DATA

Demographic data

. Q1. Name

____

. Q2 Age

____

. Q3 Gender

Mark only one oval.

- Male
- Female

Q4 Current level of study

Mark only one oval.

- Foundation
- Undergraduate
- Postgraduate

Q5 Faculty

Mark only one oval.

- Faculty of Accountancy and Management (FAM)
- Faculty of Medicine and Health Science (FMHS)
- Faculty of Creative Industries (FCI)
- Lee Kong Chian Faculty of Engineering and Science (LKC FES)
- Institute of Chinese Studies (ICS)
- Centre for Foundation Studies (CFS)
- Centre for Extension Education (CEE)
- Institute of Management and Leadership Development (IMLD)
- Institute of Postgraduate Studies and Research (IPSR)

Q6 Current Year of Study

Mark only one oval.

- Foundation
- Year 1
- Year 2
- Year 3
- Year 4
- Year 5

Q7 current course of Study

e.g. Bachelor of Physiotherapy

____

Q8 Are you a full-time student at UTAR Sungai Long? *

Mark only one oval.

- Yes
- No

Q9 Have you been diagnosed with any neurological disorders? *

Mark only one oval.

- Yes
- No

Q10 Are u able to understand English? *

Mark only one oval.

- Option 1

APPENDIX D – PAS SCALE

1. I am confident that I will be a successful student.

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

2. I am confident that I will be successful in my future career.

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

3. I can make academic decisions easily.

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

4. The time allocated to classes and academic work is enough.

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

5. I have enough time to relax after work.

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

6. My teachers are critical of my academic performance

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

7. I fear failing courses this year.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

8. I think that my worry about examinations is a weakness of character.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

9. Teachers have unrealistic expectations of me.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

10. The size of the curriculum (workload) is excessive.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

11. I believe that the amount of work assigned is too much.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

12. I am unable to catch up if I get behind the work.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

13. The unrealistic expectations of my parents stress me out.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

14. Competition with my peers for grades is quite intense.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

15. The examination questions are usually difficult.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

16. The examination time is short to complete the answers.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

17. Examination times are very stressful to me.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

18. Even if I pass my exams, I am worried about getting a job.

Mark only one oval.

	1	2	3	4	5	
stro	◯	◯	◯	◯	◯	strongly agree

APPENDIX E – PSQI

The following questions relate to your usual sleep habits during the **past month**. Your answers should indicate the most accurate reply for the majority of days and nights in the past month.

1. During the past month, what time have you usually gone to bed at night?

e.g. 11pm

____

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

Mark only one oval.

- ◯ < 15 minutes
- ◯ 16-30 minutes
- ◯ 31-60 minutes
- ◯ > 60 minutes

3. During the past month, what time have you usually gotten up in the morning?

e.g. 8am

____

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

e.g. 7 hours

____

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

Mark only one oval per row.

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes	⬭	⬭	⬭	⬭
b. Wake up in the middle of the night or early morning	⬭	⬭	⬭	⬭
c. Have to get up to use the bathroom	⬭	⬭	⬭	⬭
d. Cannot breathe comfortably	⬭	⬭	⬭	⬭
e. Cough or snore loudly	⬭	⬭	⬭	⬭
f. Feel too cold	⬭	⬭	⬭	⬭
g. Feel too hot	⬭	⬭	⬭	⬭
h. Have bad dreams	⬭	⬭	⬭	⬭
i. Have pain	⬭	⬭	⬭	⬭

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

Mark only one oval.

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

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

Mark only one oval.

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

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

Mark only one oval.

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

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

Mark only one oval.

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

10. Do you have a bed partner or room mate?

Mark only one oval.

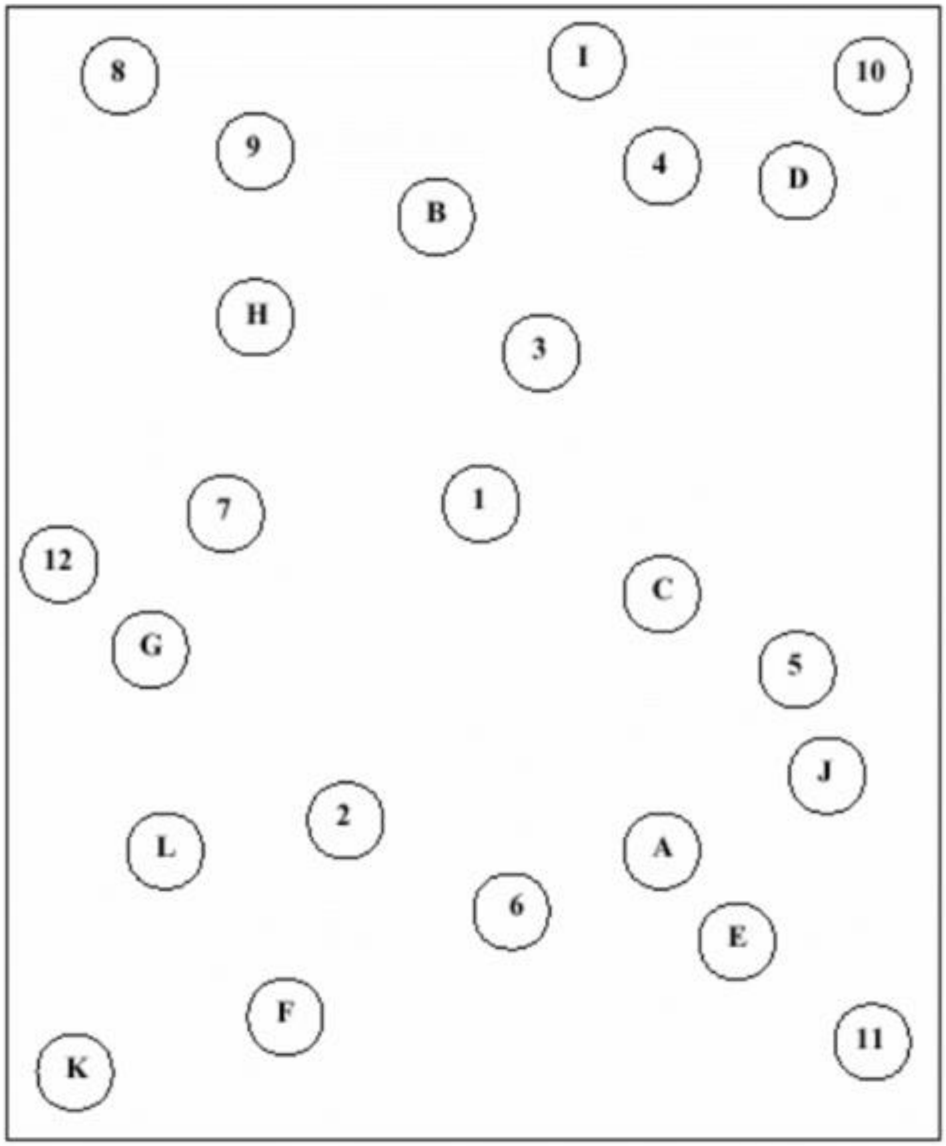
- ◯ No bed partner or room mate
- ◯ Partner/room mate in other room
- ◯ Partner in same room but not same bed
- ◯ Partner in same bed

11. If you have a room mate or bed partner, ask him/her how often in the past month you have had:

Check all that apply.

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Loud snoring	☐	☐	☐	☐
b. Long pauses between breaths while asleep	☐	☐	☐	☐
c. Legs twitching or jerking while you sleep	☐	☐	☐	☐
d. Episodes of disorientation or confusion during sleep	☐	☐	☐	☐

APPENDIX F – TMT-B



APPENDIX G – TURNITIN REPORT

IMPACT OF ACADEMIC STRESS ON EXECUTIVE FUNCTIONS AND SLEEP QUALITY AMONG UNIVERSITY STUDENTS: AN OBSERVATIONAL STUDY

ORIGINALITY REPORT

5%	4%	6%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	eprints.utar.edu.my Internet Source	2%
2	Shields, Grant S., Matthew A. Sazma, and Andrew P. Yonelinas. "The effects of acute stress on core executive functions: A meta-analysis and comparison with cortisol", Neuroscience & Biobehavioral Reviews, 2016. Publication	1%
3	ojs.amhinternational.com Internet Source	1%
4	Tianyue Cong, Yi Kuang, Yuyan Bao, Shi Yu. "Effects of perceived academic stress on sleep quality among Chinese college students: mediating effects of social comparison, bedtime procrastination, and the protective role of emotion regulation", Current Psychology, 2024 Publication	1%

5	Hafinaz, R Hariharan, R. Senthil Kumar. "Recent Research in Management, Accounting and Economics (RRMAE) - A case study on Recent Research in Management, Accounting and Economics", Routledge, 2025 Publication	1 %
6	www.huisartsenamsterdam.nl Internet Source	1 %

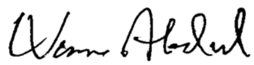
APPENDIX H

TABLE ON CORRECTION AFTER EXAMINER'S FEEDBACK

Examiner's feedback	Amendment after correction	Page & Paragraph
Differences in outcomes based on demographics is redundant because it is not meeting the objectives.	Deleted the results and discussion on this part.	None
Shorten the background and include more details about methodology. Amend the conclusion, correlation does not mean causation	- Background shortened - Added Spearman's into methodology - Conclusion amended to correlation instead of impact	II
Under the Importance and relevance of study, cite the sources to support your justification	Sources were cited	Page 4, paragraph 1
Problem statement is not communicated clearly. Write in a better way. // Write the Problem Statement with clarity	Problem statement is written in a better way	Page 5 & 6
Student has just summarized the study findings and failed to highlight the gaps to support to the importance of this study. //	"Gap of Studies" is added in section 2.9.	Page 23

Please include the 'Summary of Findings' or 'Study Gap' to highlight the previous study gaps which were addressed in this study.		
Normality test is not conducted.	Kolmogorov-Smirnov and Shapiro-Wilk method to test for the normality.	Page 42
Could divide the academic stress in categories like, low, medium and high and find its association with executive function.	Academic stress is categorized into different levels in Table 4.2.2	Page 51-52
Mentioned physical activity is related to sleep quality. You haven't investigated the effect of physical activity on sleep quality in your study, therefore can't use this justification to support your hypothesis.	Deleted the physical activity linked to sleep quality	None
Referencing – Check formatting	Format of references checked	Page 77-87

Checked by supervisor,



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Date: 2/1/2025