

UNIVERSITY OF EDUCATION, WINNEBA

Exploring integrated science students' sleep habits, vital statistics and academic performance in a tertiary institution in Ghana



EMMANUEL AGYARE

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**EXPLORING INTEGRATED SCIENCE STUDENTS' SLEEP HABITS,
VITAL STATISTICS AND ACADEMIC PERFORMANCE IN A TERTIARY
INSTITUTION IN GHANA**



EMMANUEL AGYARE

(202114182)

**A thesis in the Department of Science Education,
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Master of Philosophy
(Science Education)
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DECLARATION

Student's Declaration

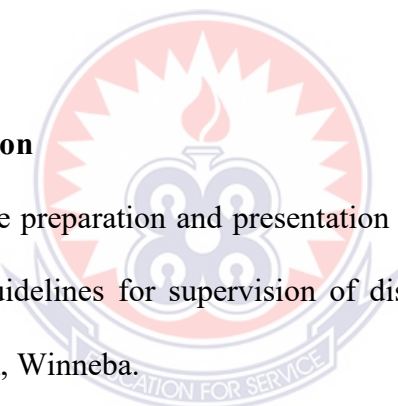
I, Emmanuel Agyare, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

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DATE:

Supervisor's Declaration

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of dissertation as laid down by the University of Education, Winneba.



SUPERVISOR'S NAME: DR. MRS. FELICITY BENTSI-ENCHILL

SIGNATURE:

DATE:

DEDICATION

To my loving mother Madam Akua Nyarko, my siblings (Dr. Enoch Agyare and Ernest Agyare, and Felicia Agyare), and deceased father Mr Enoch Kwaku Agyare.



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I give thanks to the Almighty God who gave me the wisdom and strength to successfully complete this stage of my academic journey. To him alone be all the glory. I want to express my deepest gratitude to Dr. Mrs. Felicity Bentsi- Enchill for her support, excellent advice, and kind coaching, without which this effort would not have been possible. It is through her divine patience and professional guidance that this thesis was successfully carried out.

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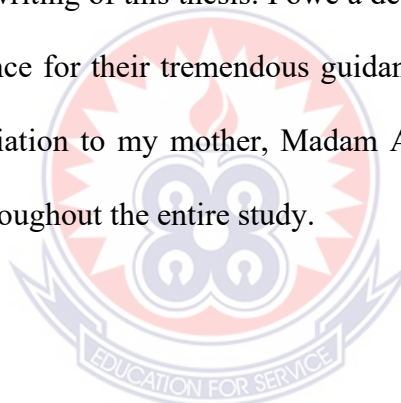
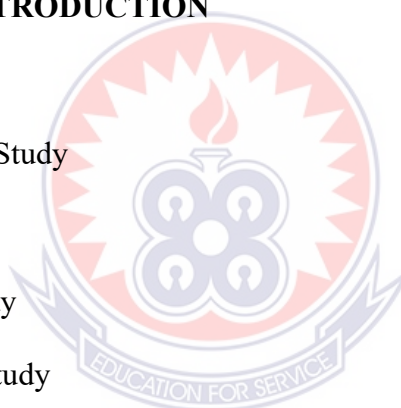


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ABSTRACT

This research investigated the sleep habits, vital statistics, and academic performance of 60 integrated science students at the University of Education, Winneba in a cross-sectional study. The findings revealed poor sleep habits, with over 70% of students reporting sleep deprivation affecting their academic performance. Students slept less during end-of-semester examinations due to heavy workload and learning activities. Academic scores were better in mid-semester examinations, with students performing better in biology and physics than chemistry. Systolic blood pressure levels exceeded threshold limits, with a strong negative correlation between sleep duration and blood pressure. A substantial association was found between sleep duration and academic scores. The study concludes that sleep habits significantly influence academic performance and health conditions. Policy makers and academic counselors should develop targeted interventions, such as sleep education programs, to promote proper sleep habits and mitigate sleep debt-related health issues among students.



CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter talks about the background to the study, statement of the problem, the purpose of the study, research questions and hypotheses.

1.1 Background to the Study

Integrated science combines multiple disciplines to tackle complex problems by merging different disciplines to solving scientific and resource management problems (Gallagher, Zhang, & Taylor, 2008). It is required of integrated science teachers to have diverse ideas to examine the linkages among single discipline perspectives to develop new methods, concepts and approaches during teaching and learning of science through inquiry to young ones (Lang & Olson, 2000). However, studies have shown that teachers have difficulty integrating science concepts during teaching and learning (Gallagher et al., 2008; Lang & Olson, 2000).

Undergraduate integrated science students are exposed to a wide range of physics, biology, and chemistry concepts. Students who understand these concepts would be able to predict and explain the outcomes of a wide range of apparently unrelated biophysicochemical phenomena. Undergraduate students perceived the integrated science programme to be difficult because of its interdisciplinary nature (Daniel et al., 2022). As a result, students face problems understanding concepts in integrated science (Lang & Olson, 2000). The poor student's conception has yielded abysmal academic performance and inability to relate lessons to real-life situations. The outcome of research that delved into the initial conception of undergraduate integrated science level 300 revealed that the prospective integrated science teachers lacked content knowledge

and had gross misconceptions (Safo-Adu, 2020). Studies that explored the academic performance of integrated science students are inadequate in literature. Evaluating the academic performance of undergraduate integrated science students at various levels is a prerequisite for developing academic counselling plan and instructional strategies.

The major factors that hinder undergraduate students understanding in integrated science include poor students' attitudes toward teaching and learning (Ali et al., 2021), inadequate instructional hours (Kebbie, 2019), inadequate sleep (Zeek et al., 2015) and stress (Brobbe, 2021) among students. Sleep is physiologically necessary for the restoration and maintenance of physical health and cognitive function (Krause et al., 2017; Herculano-Houzel, 2013; Suntsova, Szymusiak, & McGinty, 2002). According to Zohal et al. (2014), sleep is an excellent predictor of health status and a factor that favours good quality of life. Students in tertiary institutions do not seldom have enough sleep as a result have distorted sleep pattern due to intense academic work (Nunez et al., 2019; Phillips et al., 2017). Dijk and Landolt (2019) confirmed this assertion by stating that sleep deprivation is a growing concern among university students, and it is linked to poor clinical, physical and academic outcomes. Besides, Colten, Altevogt and Institute of Medicine Committee on Sleep Medicine and Research (2006) argued that inadequate sleep can ultimately affect life expectancy, day-to-day health and academic excellence.

The effects of sleep deprivation and stress on students' academic performance as well vital statistics have been explored in developed countries (LeBourgeois et al., 2017; Colten et al., 2006; Womble, 2001). Such studies include research that explored the connection between sleep habit and academic scores of university students and found that roughly one-third of the learners with bad sleep habit obtained poor academic

outcomes (Gallego-Gómez et al., 2021). Besides, the students sleep debt or deprivation was attributed to intense reading at night and typing of assignments. Furthermore, Sparano et al. (2019) showed that students with shorter sleep duration experienced elevated vital signs such as systolic blood pressure and diastolic blood pressure which is referred to as hypertension. In view of this, the adverse impact of sleep deprivation or debt on vital signs among university students cannot be compromised and need to be investigated.

The interdisciplinary nature of integrated science makes it difficult to study. However, most students relax at the beginning of the semester without embarking on intense learning. Undergraduate integrated science students stay awake all nights during the mid and end-of-semester examinations without having adequate sleep. Students become stressed during examination periods due to inadequate sleep. Consequently, students become physically inactive which affect their thinking and writing abilities during examinations resulting in poor academic achievements. Inadequate sleep is one of the major causes for human error (Stepan, Fenn, & Altmann, 2019). Sleep deprivation among students can increase vital signs (Ogugu et al., 2022; Kato et al., 2000). Studies that explored undergraduate students sleep habit characteristics, vital signs and academic performance in Sub-Sahara African countries including Ghana are insufficient in the literature. Besides, few research works looked at the connection between sleep habit dynamics and academic achievements (Kozak et al., 2019; Hangouche et al., 2018). As a result, this study was conducted to fill this void. The study explored integrated science students' sleep habit variables, vital statistics and academic performance in a tertiary institution in the Central Region of Ghana.

1.2 Problem statement

A greater proportion of integrated science students relax at the beginning of the semester without embarking on intensive academic work. These students stay awake all nights during the mid and end-of-semester examinations without having adequate sleep. Consequently, students become physically inactive which affect their thinking and writing abilities during examinations resulting in poor academic achievements. Furthermore, sleep deprivation elevates vital signs such as systolic blood pressure and diastolic blood pressure. Analysis of findings from past studies conducted in developed countries shows that sleep debt among university students influences the academic scores and vital statistics of students.

Studies that explored undergraduate students sleep habit characteristics, vital signs and academic performance in Sub-Sahara African countries including Ghana have been understudied. In addition, few research works focused on the connection between sleep habit dynamics and academic scores (Kozak et al., 2019; Hangouche et al., 2018). There is the need to investigate integrated science students' academic performance, sleep habit characteristics and vital signs in Ghanaian universities.

1.3 Purpose of the Study

The purpose of this study was to investigate integrated science students' sleep habits, vital statistics and academic performance in a tertiary institution in Ghana.

1.4 Objectives of the Study

The objectives of the research were to:

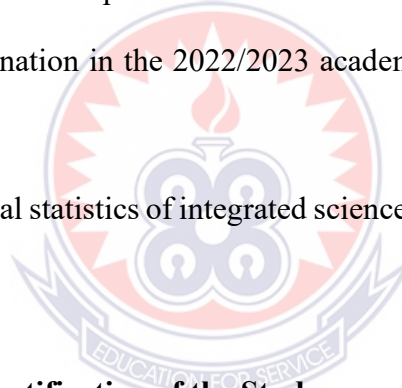
1. Evaluate the self-reported sleep habits among integrated science students in a tertiary institution in Ghana

2. Assess the performance of integrated science students in mid-semester and end of semester examinations for the 2022/2023 academic year in a tertiary institution in Ghana.
3. Assess the vital statistics of integrated science students in a tertiary institution in Ghana.

1.5 Research Questions

The following questions guided the study:

1. What are the self-reported sleep habit characteristics among integrated science students in a tertiary institution in Ghana?
2. What is the academic performance of students in mid-semester and end of semester examination in the 2022/2023 academic year in a tertiary institution in Ghana?
3. What are the vital statistics of integrated science students in a tertiary institution in Ghana?



1.6 Significance and justification of the Study

This study will highlight that academic score is a multifaceted construct which is influenced by a complex number of factors, including sleep habits and sleep duration. This research will help to raise awareness among the leadership of the tertiary institutions, students and guardians about the importance of monitoring and regulating the sleep habits of students or their wards in order to ensure better academic performance and good health. The study will inform policy makers and academic counsellors the need to develop targeted interventions such as sleep education programs, to help students establish good sleep habits. Thereby mitigating the long-term health consequences such as cardiovascular diseases among students. Again, the

study can influence university policies such as: start times for lectures, assignment workloads, and extracurricular activity schedules in order to accommodate students' sleep needs. This study would also serve as a reference document for further research studies in areas of undergraduate students sleep habit dynamics, vital signs and academic achievements.

1.7 Delimitations

The students in the tertiary institutions, particularly universities, in Ghana offer varied Bachelor of Science programmes. These programmes include but not limited to Physics, Chemistry, Biology, Integrated Science, Information and Communication Technology. This study focused on level 100 to 300 integrated science students at the University of Education, Winneba. Level 400 integrated science students were excluded from this research since they spend majority of their final year doing off-campus internship practice. Once again, this research looked at sleep habit dynamics and their influence on academic performance. This study did not include interventions to modify the sleep habits of the university students. Academic performance was limited to only mid-semester and end-of-semester exams.

1.8 Limitations

This study had limitations though it was carefully conducted. The sample size was restricted to 100, 200, and 300-level integrated science students in Ghana's Central Region, limiting the external validity. Time and resource constraints led to this focused approach, so findings should be interpreted cautiously.

1.9 Operational Definition of Terms

Sleep habits are defined as behaviours relating to bedtime, rise time, coffee consumption at night, night time sleep duration, and/or the use of sleeping pills (Sweileh et al., 2011).

Academic performance is the knowledge gained that is assessed by a lecturer's (teacher's) marks and/or educational goals set by students and teachers to be attained over a specific time period and across one or multiple subjects (Narad & Abdullah, 2016). In this study, academic performance is measured based solely on the research sample's Mid-Semester and End-of-Semester Examination scores.

Integrated Science Students as used in this research work refer to the students who study the cumulative approach that synthesises the various disciplines of science which include Biology, Physics, and Chemistry.

Vital statistics, as used in this study, refer to the quantitative measurement that provides key insights into an individual's cardiovascular health which includes one's blood pressure and heart beat rate (National Institutes of Health, 2023).

1.10 Organisation of the Study

This study is structured into five comprehensive chapters. Chapter One provides an in-depth introduction to the research problem, outlining the background, purpose, objectives, and significance of the study. This foundational chapter sets the stage for understanding the context and relevance of the research. Chapter Two reviews relevant literature, exploring theoretical and conceptual frameworks that underpin the study. This chapter establishes a connection between existing knowledge and the research's focus. Chapter Three details the methodology employed, covering research design,

study variables, target population, sampling techniques, and data collection methods. This chapter explains the systematic approach used to gather and analyse data. Chapter Four presents the study's findings, discussing the results of the data analysis. This chapter interprets the data, highlighting key insights and patterns that emerged from the research. Chapter Five concludes the study by summarising the key findings, drawing meaningful conclusions, and offering actionable recommendations. Additionally, this chapter discusses the implications of the research and suggests avenues for further investigation, contributing to the broader body of knowledge.



CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

The chapter is focused on the conceptual and theoretical frameworks, sleep and sleep durations, effects of sleep deprivation, mechanisms behind sleep loss, sleep and academic performance, and summary of the chapter.

2.1 Conceptual Framework

The conceptual framework of the study is shown in Figure 1.

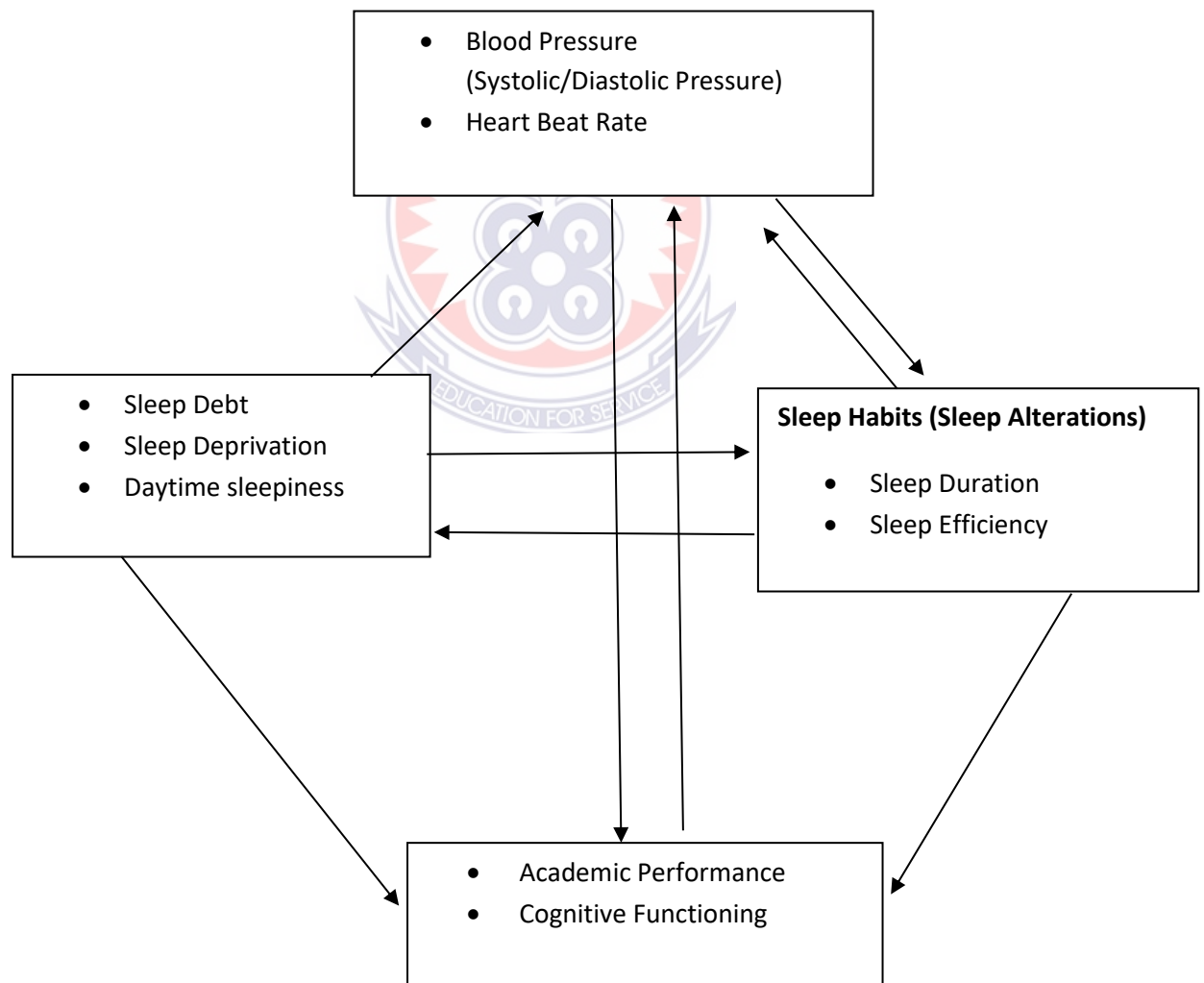


Figure 1: Conceptual framework of the study (Gallego-Gómez et al., 2021)

Sleep habits play a crucial role in maintaining physical and mental well-being, particularly in academic settings. This framework posits that sleep debt, sleep deprivation, and daytime sleepiness directly affect systolic blood pressure, academic performance, and cognitive functioning. Furthermore, blood pressure (systolic blood pressure and heart rate) directly impacts academic performance and cognitive functioning.

Habitual short (<5 hours) and lengthy (>9 hours) sleep durations are linked to a higher prevalence of hypertension (Stranges et al., 2010; Choi et al., 2008; Gottlieb et al., 2006). As shown diagrammatically in Figure 2.1, shorter sleep duration is associated with higher 24-hour systolic blood pressure (Makarem et al., 2021) and higher day time and night time blood pressure (Doyle et al., 2019).

Sleep debt, sleep deprivation, and daytime sleepiness directly affect systolic blood pressure (Makarem et al., 2021), academic performance (Hayley et al., 2017), and cognitive functioning (Krause et al., 2017). Persistent insomnia is correlated with the activation of neuroendocrine systems' sensitivity to stresses and new challenges (Palagini et al., 2013; Meerlo, Sgoifo, & Suchecki, 2008).

High systolic blood pressure reduces cognition and is a key factor in inducing hypertension (Varalakshmi, Karthick, & Jothy, 2020; Adams et al., 2010). Stress, anxiety, and hormones may also impact heart rate, which is directly linked to sleep modifications (Staner, 2003).

In conclusion, this conceptual framework highlights the interrelationships between sleep habits, blood pressure, heart rate, sleep debt, sleep deprivation, academic performance, and cognitive functioning. Understanding these relationships is crucial

for developing strategies to promote healthy sleep habits and improve academic outcomes.

2.2 Theoretical Framework

The theoretical framework underlying this study is based on the concept that sleep plays a crucial role in cognitive function and academic performance. According to Swanson (2013), a theoretical framework provides the structure for a research study (Kothari, 2004). This study draws on the theory that sleep is essential for reorganizing and storing information, with cortical neurons involved in memory and attentive learning requiring rest during sleep (Hale, Troxel, & Buysse, 2020; Ezenwanne, 2011). Sleep deprivation impairs human performance by increasing error rates and slowing down reaction times, as seen in the Psychomotor Vigilance Task (Wickens et al., 2015). Research shows that sleep debt or deficit is associated with decreased alertness, slower problem-solving, impaired psychomotor skills, and increased errors (Wickens et al., 2015). However, motivation can mitigate the negative effects of sleep deprivation for up to 36 hours (Loh et al., 2004). Sleep duration and insomnia symptoms are critical factors in students' sleep health, with 7-8 hours of sleep per day considered sufficient for cognitive performance (Watson et al., 2015). Sleep loss affects cognitive performance in areas like vigilance attention, cognitive processing speed, and working memory (Watson et al., 2015). Students who sleep fewer than 7 hours are more likely to report poor academic outcomes and self-rated academic proficiency (Hayley et al., 2017).

In conclusion, this theoretical framework highlights the importance of sleep in maintaining cognitive function and academic performance. Empirical evidence supports the notion that sleep deprivation impairs cognitive performance, while

adequate sleep is essential for academic success. Understanding the effects of sleep disruption on cognitive tasks is critical for students and professionals alike.

2.3 Sleep and Sleep Durations

Mendelson (2017) described sleep as a repeating time of behavioral inactivity characterized by a number of characteristics, including lower awareness of and response to the environment, diminished consciousness, and the regular occurrence of particular physiological rhythms (stages). Sleep is a fundamental aspect of human life, yet it remains one of the most perplexing activities (Walker, 2018). During sleep, we are unable to perform essential functions like collecting food, socializing, or reproducing, and we become vulnerable to predation. Despite its importance, sleep has historically received little attention compared to other health issues. However, growing awareness of sleep disorders and their associated risks has led to increased discussion and research in various fields. Research has shown that sleep disorders, such as sleep apnea, has highlighted their association with increased risks of stroke and heart failure (Gottlieb et al., 2006), and hypertension (Stranges et al., 2010). Moreover, insufficient sleep has been linked to various negative consequences, including workplace mistakes and accidents (Colten et al., 2006), mood swings (Harrison & Horne, 2000), increased risk of obesity (Cappuccio et al., 2008).

Sleep is characterised by reduced awareness of and response to the environment, diminished consciousness, and specific physiological rhythms (Mendelson, 2017). It is a self-regulating process that is essential for survival and found in all mammals. Mendelson (2017) speculates that sleep plays a critical role in memory consolidation, refinement, and reorganisation, as well as mood control, pain sensitivity, immune function, and appetite regulation.

The sleep-wake cycle is regulated by a complex interplay of factors, including sleep stages, duration of alertness before sleep, and depth of sleep. Sleep stages manifest in a rhythmic, repetitive pattern throughout the night, with different stages serving distinct functions (Mendelson, 2017). For example, slow-wave sleep is thought to be beneficial for schema creation and integration, while rapid eye movement sleep may be more beneficial for schema disintegration (Landmann et al., 2014).

Research has shown that sleep protects newly formed memories from forgetting or degeneration during wakefulness (Werchan & Gómez, 2014). Sleep also aids in the abstraction of rules, integration of knowledge into existing schemas, and innovation that requires the disbandment of established patterns (Landmann et al., 2014). Emotions have been shown to influence the way memories are reorganized during sleep, and sleep disturbances may contribute to impaired memory reorganization and the development of mental diseases (Walker, 2018; Landmann et al., 2014).

In conclusion, sleep is a complex and multifaceted process that plays a critical role in maintaining physical and mental health. Further research is needed to fully understand the mechanisms behind sleep-related memory reorganization and its implications for mental health.

2.4 Effects of Sleep Deprivation or Sleep Loss

Both sleep deprivation and sleep restriction alter the amount of sleep gained in comparison to the length of wake time. The purpose of sleep deprivation protocols is to maintain constant wakefulness over a period of time that would normally be spent sleeping. Sleep restriction methods, often known as 'partial sleep deprivation,' impose a reduced sleep chance over numerous nights. Due to the fact that sleep deprivation and sleep restriction have a different time course of sleep loss, their impact on subjective

and objective measures of performance and sleepiness, as well as on other physiological parameters, may differ (Bianchi, Wang, & Klerman, 2012).

Several explanations have been advanced to explain why extended awake impairs cognitive performance (Alhola, & Polo-Kantola, 2007). The hypotheses can be broadly classified into two camps, in which sleep deprivation is considered to have either broad impacts on alertness and attention, or selective effects on specific brain structures and functions. Additionally, there have been reports of individual variability in these effects (Alhola & Polo-Kantola, 2007).

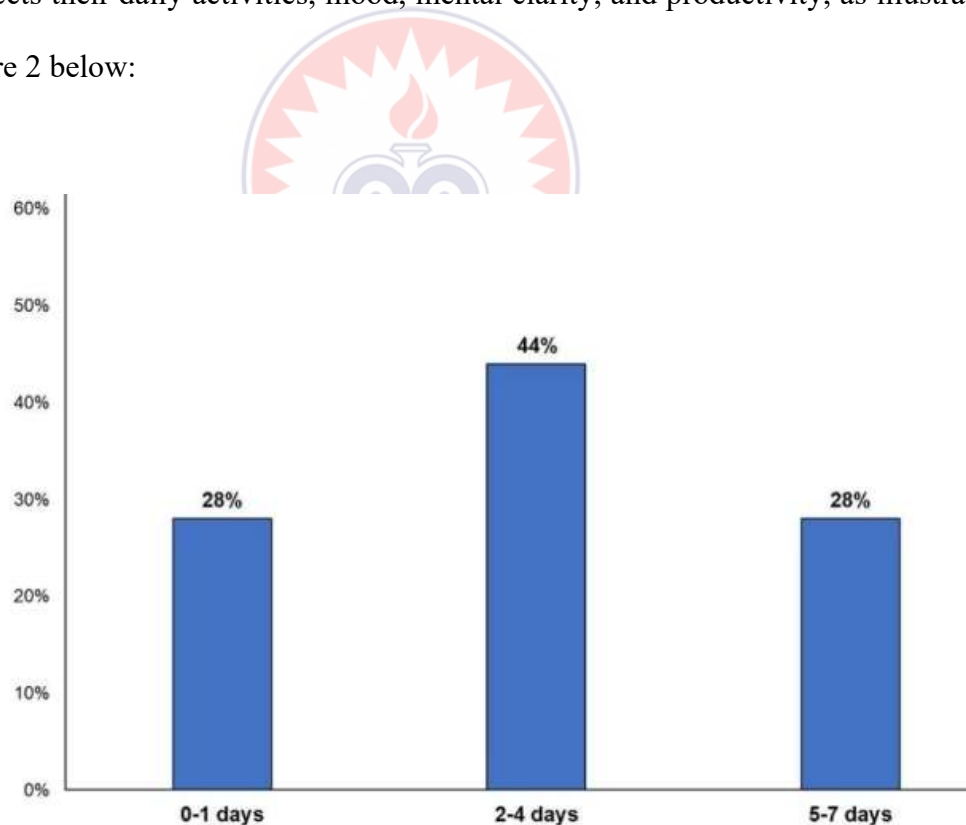
The general explanation for sleep regulation is based on the two-process model. Cognitive impairments would be mediated by lower alertness and attention, as evidenced by lapses, slowed responses, and wake-state instability (Alhola, & Polo-Kantola, 2007). Attentional lapses, or brief periods of inattention, have been attributed as the primary cause of the decline in cognitive function associated with sleep deprivation (Alhola & Polo-Kantola, 2007; Doran, Van Dongen, & Dinges, 2001). The lapses are induced by microsleeps, which are defined as extremely brief bouts of sleep-like electroencephalographic (EEG) activity (Harrison & Horne, 2000). Initially, it was believed that cognitive function remained nearly intact between lapses, although slowing of cognitive processing has been seen in the absence of lapsing (Doran et al., 2001). According to these ideas, performance under sleep deprivation is most likely to degrade in long, easy, and monotonous tasks that require reaction time or vigilance (Alhola, & Polo-Kantola, 2007). Along with the lapses and reaction slowness, sleep deprivation has been associated with significant changes in attentiveness and effort. From the idea of wake-state instability, these oscillations result in performance variation (Doran et al., 2001).

According to selective impact explanations, sleep deprivation inhibits the functioning of specific brain areas, hence impairing cognitive performance. This is also referred to as the sleep-based neuropsychological perspective (Babkoff et al., 2005). Sleep deprivation is particularly detrimental to cognitive abilities that rely on the prefrontal cortex. Higher functions such as language, executive functions, divergent thinking, and creativity are included in this category. To demonstrate the sleep deprivation effect, the tests must be challenging, novel, and engaging. Achieving a high level of performance requires cognitive flexibility and spontaneity. Additionally, this hypothesis argues that participants' performance on basic and lengthy activities degrades solely owing to boredom (Harrison & Horne, 2000; Alhola, & Polo-Kantola, 2007).

Numerous cross-sectional and longitudinal population-based observational studies have been conducted to examine the associations between sleep duration and diabetes, obesity, and metabolic syndrome (Lemma et al., 2012; Cappuccio et al., 2008). Cappuccio et al. discovered three meta-analyses of prospective research on sleep duration and diabetes. Each of the three studies discovered a significant relationship between insufficient sleep and the occurrence of type 2 diabetes (Holliday et al., 2013; Shan et al., 2015). A meta-analysis of cross-sectional studies discovered a substantial negative correlation between sleep hours and body mass index; nevertheless, short sleep duration was related with obesity (Cappuccio et al., 2008). A meta-analysis of longitudinal studies found a link between insufficient sleep and incidence of obesity (Fatima, Doi, & Manun, 2016). Two meta-analyses of cross-sectional studies discovered an association between inadequate sleep duration and the prevalence of metabolic syndrome (Cappuccio et al., 2008).

Sleep deprivation lowers cognitive performance, however it is unknown which cognitive processes are harmed. Overall performance on the semantic encoding test with varying stimulus onset asynchrony is impaired by total sleep loss. Total sleep deprivation appears to have a more selective effect, presumably impairing information integration (Honn et al., 2018).

In the United States, the Nationwide Sleep Foundation (2020) surveyed a random national sample of 1,011 adults, with a margin of sampling error of 3.4 points for the entire sample. According to the National Sleep Foundations (2020), Americans experience sleepiness on an average of three days per week, with many reporting that this affects their daily activities, mood, mental clarity, and productivity, as illustrated in Figure 2 below:



Number of days of Americans feeling sleepy within a week

Figure 2: Days of feeling sleepy within a week

To a greater extent, sleep problems and/or disturbed sleep have been associated with suicide, with research examining suicidal ideation, suicide attempts, and completed suicides. While there is evidence that suicidality is associated with sleep disturbance, there is far less information about whether sleep disturbance is a valid predictor of future suicidality (Norra, Richter, & Juckel, 2011). The National Comorbidity Survey Replication discovered that sleep problems (difficulty initiating sleep, maintaining sleep, and waking up early in the morning) were associated with an increased risk of suicidality, that is, suicidal ideation, plans, or attempts (Wojnar et al., 2009).

McMillan and Edwards (2013) speculate that proper sleep is critical for physical and mental health, cognitive and motor learning, and risk reduction. Sleep health among students (particularly student nurses) was identified as a substantial information gap that could inform both educational health and safety measures. Participants (student nurses) were asked to complete three self-report questionnaires in order to identify a variety of sleep-related health and safety concerns. The questionnaires included the Pittsburgh Sleep Quality Index (PSQI; Buysse, 1989); the Epworth Sleepiness Scale (ESS; Johns, 1991); and the Student Sleep Health Survey. Two hundred and sixty-two (262) baccalaureate nursing students (90 percent female) in years two (n=90), three (n=93), and four (n=78) at a large midwestern Canadian university were included in the study. Sixty-six (66%) reported an insufficient amount of sleep while 52% indicated a poor or acceptable quality of sleep.

McMillan and Edwards (2013) reported that third-year students experienced the most daytime sleepiness as measured by the ESS. In over half (57.6 percent) of respondents, participants reported of sleep problems related to moderate to severe stress. Nursing

students reported fatigue-related personal work injuries/near-injuries (4.6%), patient safety events (13.7%), and car accidents/near-accidents on the way home (4.6%).

Reduced sleep has been linked to an increased risk of death as well as a variety of more specific health concerns. There is an increased risk of death (up to roughly 12 percent) for people who sleep less than or significantly more than 7 hours (Mendelson, 2017). Inadequate sleep has been linked to chronic illnesses such as hypertension, diabetes, depression, and obesity, according to the US Institute of Medicine and Centers for Disease Control and Prevention. Specific examples include the fact that short sleepers, both children and adults, are more likely to develop obesity, and that both shorter and longer sleepers have a higher risk of acquiring type 2 diabetes in adults. Similar research on hypertension has, however, yielded less conclusive results. Short sleep duration has been linked to an increased risk of coronary heart disease in women (Mendelson, 2017).

Due to the demands of modern lifestyles, the general population's average sleep duration has been continuously decreasing (Kraus & Rabin, 2012; Swanson, 2013). (Kraus & Rabin, 2012; Swanson et al., 2011; Meerlo et al., 2008). The average amount of sleep that people in Western countries get each night is 6.8 hours, which is 1.5 hours less than it was a century ago. This decline in sleep duration is referred to as "sleep loss" in developed countries (Nagai, Hoshida, & Kario, 2010).

Total lack of sleep has also been linked to hyperphagia in rodents and people (Spiegel et al., 2004a). The term "hyperphagia" refers to an enormous appetite and an excessively high desire for food. On the other side, habitual low sleep duration has been linked to hypertension, particularly in middle age, according to research by Calhoun and Harding (2010). Even after adjusting for other hypertensive risk factors, persistent

sleeplessness seems to be linked to an increased risk of hypertension in middle-aged people. In healthy adults, one night of complete sleep deprivation causes blood pressure to rise (Ogawa et al., 2003; Kato et al., 2000).

According to Dean et al. (2012), persons under the age of 60 who are both male and female have a relationship between sleep duration and blood pressure. Dean et al. also noted that persons under the age of 60 who get less than 5 to 6 hours of sleep are more likely to acquire hypertension. A chronic medical disorder called hypertension is marked by chronically high blood pressure in the arteries (Mucci et al, 2016).

The force that blood exerts on the walls of blood arteries while the heart pumps blood is referred to as blood pressure (Mucci et al, 2016). Typically, a sphygmomanometer is placed in the upper arm to monitor blood pressure in millimeters of mercury (mm Hg). Systolic blood pressure (the first number) and diastolic blood pressure (the second number) are the two numbers used to represent blood pressure (Hodgkinson et al., 2017). The systolic blood (the first or upper number) pressure represents how much force the blood applies to the artery walls each time the heart beats (Hodgkinson et al., 2017) while diastolic blood pressure (the second or lower number) represents how much force the blood applies to the artery walls between heartbeats (Hodgkinson et al., 2017).

The American Heart Association (2022a) recognises five blood pressure ranges. Normal, Elevated, Hypertension Stage 1, Hypertension Stage 2, and Hypertensive Crisis are among them. One sign of a person's heart health is their blood pressure. If the pressure is too great, it may result in severe health issues and even death.

Table 1: Blood Pressure Stages

Blood Pressure Category	Systolic /mm Hg (Upper Number)		Diastolic /mm Hg (Lower Number)
Normal	less than 120	and	less than 80
Elevated	120- 129	and	less than 80
High Blood Pressure (Hypertension) Stage 1	130- 139	or	80-89
High Blood Pressure (Hypertension) Stage 2	140 or higher	or	90 or higher
Hypertensive Crisis (Emergency Care)	Higher than 180	and/ or	higher than 120

Source: American Heart Association (2022a)

As indicated in Table 1, the American Heart Association (2022a) defines a normal blood pressure reading as less than 120/80 mmHg. Furthermore, the Association specifies that hypotension occurs when an individual's systolic blood pressure is 90 mmHg or lower and their diastolic blood pressure is 60 mmHg or lower (American Heart Association, 2022a). Due to the loss of oxygen-rich blood, severe hypotension increases the likelihood of organ damage. Severe hypotension, arising from diminished oxygenated blood flow, heightens the risk of organ damage and syncope (American Heart Association, 2022a). According to Table 1, blood pressure is classified as elevated when readings consistently fall within the range of 120-129 mmHg systolic and less than 80 mmHg diastolic (American Heart Association, 2022a). Individuals with elevated blood pressure are likely to develop high blood pressure if the condition is not controlled. When blood pressure consistently ranges between 130-139 systolic or

80-89 diastolic mm Hg, hypertension stage 1 is present (American Heart Association, 2022a). Based on one's risk of atherosclerotic cardiovascular disease (ASCVD), such as a heart attack or stroke, the medical physician may prescribe lifestyle changes and blood pressure medication at this stage of hypertension (American Heart Association, 2022a).

Blood pressure is classified as elevated when readings persistently measure between 120 and 129 mm Hg systolic and below 80 mm Hg diastolic, as detailed in table 1 (American Heart Association, 2022a). Individuals with elevated blood pressure face an increased likelihood of progressing to hypertension if left unmanaged (American Heart Association, 2022a). A regular systolic pressure of 130–139 mm Hg or a diastolic pressure of 80–89 mm Hg denotes stage 1 hypertension (American Heart Association, 2022a). At this point, depending on one's risk of atherosclerotic cardiovascular disease (ASCVD) (including myocardial infarction or stroke) the clinician may advise lifestyle modifications alongside antihypertensive therapy. Numerous demographic, behavioral, and psychosocial factors are linked to hypertension (Tremblay, Nahodyl, Mesa, Vilchez, & Elfassy, 2024; Khan et al., 2022). Age, ethnicity, geographic regions, lower income, lower educational attainment, and worse quality public health services are some examples of demographic factors linked to cardiovascular illnesses (Tremblay et al., 2024). Hypertension associates with a variety of demographic, behavioural and psychosocial determinants (Tremblay et al., 2024; Khan et al., 2022). Among the demographic contributors to cardiovascular disease are advancing age, ethnic background, geographical location, reduced income, limited educational levels and inadequate public health provision (Tremblay et al., 2024).

Although hypertension is initially asymptomatic, it eventually develops into a serious risk factor for kidney, cardiovascular, and cerebrovascular disorders, which are substantial contributors to morbidity and mortality in industrialized nations. Over 25% of adults worldwide are thought to be affected by hypertension, a complicated condition. It is categorized based on both the values of the resting blood pressure and its etiology (primary and secondary hypertension) (elevated systolic, diastolic, and pulse pressure). A complex interplay between genes and several environmental risk factors, such as aging, smoking, inactivity, being overweight or obese, eating too much salt, stress, sadness, and anxiety, leads to hypertension. Millions of people are affected by anxiety and depressive disorders each year, which are the most frequently diagnosed mental illnesses. These conditions are both characterised by affective, cognitive, psychomotor, and neurovegetative symptoms. Additionally, stress from the workplace has been identified as a significant risk factor for cardiovascular disease and hypertension. Psychosocial stress, physical stress, and chemical stress are the three types of stresses or stressors (Nozoe & Munemoto, 2002). According to Nozoe and Munemoto (2002), the majority of hypertension patients (that is, 78%) think that stress is a cause of their condition. Although hypertension often remains without symptoms initially, it ultimately becomes a major risk factor for renal, cardiovascular and cerebrovascular diseases, all of which substantially drive morbidity and mortality in developed nations. It affects over one quarter of the adult population globally and represents a multifaceted disorder. Hypertension is classified by resting blood-pressure levels and by its origin (primary or secondary) and by elevations in systolic, diastolic and pulse pressures. Its development reflects a complex interaction between genetic predispositions and environmental risk factors such as advancing age, tobacco use, physical inactivity, obesity, excessive salt intake, stress, depression and anxiety.

Anxiety and depressive disorders, the most common mental-health diagnoses, afflict millions annually and manifest through emotional, cognitive, psychomotor and neurovegetative symptoms. Furthermore, occupational stress emerges as a prominent risk factor for both cardiovascular disease and hypertension. Stressors may be psychosocial, physical or chemical in nature (Nozoe & Munemoto, 2002). Nozoe and Munemoto (2002) reported that 78% of individuals with hypertension attribute their condition, at least in part, to stress.

Cross-sectional studies of adults, incorporating multivariable adjustment, have demonstrated a significant link between sleep duration and blood pressure (Stranges et al., 2010; Choi et al., 2008; Gottlieb et al., 2006). For example, the Sleep Heart Health Study reported that participants who typically slept less than 5 hours or more than 9 hours nightly exhibited a greater prevalence of hypertension compared with those sleeping 7–8 hours (Nagai et al., 2010). This association remained robust after controlling for potential confounders such as age, sex, ethnicity, apnea-hypopnea index, body mass index, caffeine and alcohol intake, smoking, insomnia and depressive symptoms, sleep efficiency, diabetes mellitus and cardiovascular disease (Nagai et al., 2010). However, some findings contradict this relationship: further adjusted studies observed no significant link between short sleep duration and elevated blood pressure among individuals younger than 60 years (Knutson et al., 2009; Hall et al., 2008; Kawada, Okada, & Amezawa, 2008; Bjorvatn et al., 2007).

According to Palagini et al. (2013), persistent insomnia and sleep loss (including experimental sleep deprivation and short sleep duration) are each independently linked to higher blood pressure and a higher risk of hypertension (obesity, mood and other sleep disorders). Sleep loss in adults, usually refers to shorter sleep duration than the

average required amount of 7 to 8 hours per night (Colten et al., 2006). In adults, sleep loss typically denotes obtaining fewer than the recommended seven to eight hours of sleep each night (Colten et al., 2006). Sleep loss brought on by persistent sleep deprivation may have a chronic stressor effect (Palagini et al., 2013). Palagini et al. added that prolonged sleep deprivation can act as a long-term stressor on the body.

Response to stress involves neuronal and endocrine pathways that enable bidirectional transmission between the brain's autonomic, cardiovascular, and immunological systems and the hippocampus, amygdala, and other regions of the prefrontal cortex (Palagini et al., 2013). Through an experimental study, Palagini et al. found that, even after controlling for other risk variables, sleep deprivation, short sleep duration, and chronic insomnia are linked to higher blood pressure and a greater risk of hypertension. Other recent research have revealed that sleep disturbances (such as trouble falling asleep or staying asleep) are linked to hypertension and that sleep deprivation is a risk factor for hypertension (Makarem et al., 2019; Seravalle, Mancia, & Grassi, 2018; Thomas & Calhoun, 2017; Itani, Jike, Watanabe, & Kaneita, 2017). Hypertension stage 2 occurs when blood pressure consistently ranges at or above 140/90 mm Hg (American Heart Association, 2022a). At this stage of hypertension, clinicians will likely prescribe a combination of blood pressure medications and lifestyle modifications. When the blood pressure suddenly exceeds 180/120 mm Hg, the hypertensive crisis stage is present (American Heart Association, 2022a). This stage of hypertension necessitates medical attention. The symptoms may include chest pain, shortness of breath, numbness/weakness, and vision or speech difficulties (American Heart Association, 2022a).

Individuals exhibiting hypertensive diathesis- precipitated by environmental influences like stress and obesity- tend to both develop and advance in hypertensive pathology (Nagai et al., 2010). Given that the stress response in the cardiovascular system is induced by interactions between environmental stimuli and an individual's situational cognition, the development of hypertension is contingent on individual differences in situational cognition. Maintaining optimal blood pressure is crucial for reducing the risk of life-threatening conditions such as heart attack, heart failure, and stroke (American Heart Association, 2022b).

Research suggests that hypertension is a leading cause of cardiovascular disease and premature death globally (Fuchs & Whelton, 2020). Despite a stable or slight decrease in average blood pressure over the past four decades, likely due to widespread medication use (Mills et al., 2020), the overall prevalence of hypertension has increased, particularly in low- and middle-income countries. Notably, these countries have a higher hypertension prevalence (31.5%, affecting 1.04 billion people) compared to high-income countries (28.2%, affecting 349 million people) (Mills et al., 2020).

According to Mills et al., the prevalence of hypertension among adults was higher in low- and middle-income countries (31.5%; 1.04 billion people) than in high-income countries (28.2%; 349 million people). Variations in the levels of hypertension risk factors, such as high sodium intake, low potassium intake, obesity, alcohol consumption, physical inactivity, and unhealthy diet, may explain a portion of the regional heterogeneity in the prevalence of hypertension (Mills et al., 2020). Population aging, urbanization, and related lifestyle changes (such as an unhealthy diet and lack of physical activity) may explain the increased prevalence of hypertension in low- and

middle-income countries, similar to the trends observed in blood pressure (Ibrahim & Damasceno, 2012).

Hypertension describes a medical state of persistently elevated and unmanaged blood pressure (American Heart Association, 2022a). When it is neglected, uncontrolled hypertension can precipitate various severe health complications. According to the Global Burden of Diseases (GBD) Risk Factor Collaborators (2018), high blood pressure can damage the blood vessels in the heart, which in turn increases the risk of heart attack and stroke. It is a significant risk factor for chronic kidney disease (CKD) and other forms of cardiovascular disease (GBD, 2018). Work-related stress is regarded as a major risk factor for hypertension and cardiovascular disease (Mucci et al., 2016). It is estimated that more than a quarter of the world's adult population suffers from hypertension (Mucci et al., 2016).

According to the American Heart Association (2022a), harm inflicted by high blood pressure (hypertension) generally accrues gradually. If left undetected or uncontrolled, high blood pressure can precipitate heart attack, stroke, heart failure, kidney disease or failure, vision loss, sexual dysfunction and angina (or chest pain) (American Heart Association, 2022a). Adults obtaining fewer than seven hours of sleep each night are more likely to report experiencing health issues, including heart attack, asthma and depression (Centers for Disease Control and Prevention, 2022). Recent studies have observed a higher prevalence of short sleep duration among males compared to females (Centers for Disease Control and Prevention, 2021).

Sleep disturbances may elevate an individual's blood pressure over time (Calhoun & Harding, 2010). High blood pressure constitutes one of the foremost risk factors for heart disease and stroke. Approximately 75 million Americans-one in every three

adults have high blood pressure (Centers for Disease Control and Prevention, 2022). The majority of adults require at least seven hours of sleep each night (Centers for Disease Control and Prevention, 2021; Hirshkowitz et al., 2015).

However, over one-third of American adults have reported not obtaining the recommended amount of sleep (Centers for Disease Control and Prevention, 2022). Adults who sleep fewer than seven hours each night are more inclined to report experiencing health issues such as heart attacks, asthma, strokes, and depression (AASM, 2005). Some of these health conditions elevate the risk of developing heart disease, heart attacks, and strokes (Centers for Disease Control and Prevention, 2022). Generally, during normal sleep, an individual's blood pressure decreases. Experiencing sleep disturbances can result in blood pressure remaining elevated for extended periods. (Centers for Disease Control and Prevention, 2021). High blood pressure stands as one of the primary risk factors for heart disease and stroke (Centers for Disease Control and Prevention, 2021; Mills et al., 2020). Type 2 diabetes is a condition characterised by the accumulation of sugar in the bloodstream, which can harm blood vessels (Centers for Disease Control and Prevention, 2021). Centers for Disease Control and Prevention (2021) observed that achieving sufficient quality sleep may assist individuals in enhancing blood sugar regulation. Van Cauter (2011) suggested that sleep deprivation is linked to insulin resistance and glucose intolerance. Grandner et al. (2016) identified a connection between sleep disorders and an increased risk of diabetes. Attaining adequate quality sleep may aid individuals in improving blood sugar control (Grandner et al., 2016). St-Onge et al. (2011) proposed that reduced sleep leads to increased energy and fat consumption without altering energy expenditure in individuals of normal weight, potentially explaining the observed associations between sleep and obesity. Therefore, insufficient sleep can contribute to unhealthy weight gain (Chaput & Dutil,

2016). This is particularly pertinent for children and adolescents, who require more sleep than adults (AASM, 2005).

Sleep requirements can differ among individuals (AASM, 2005); thus, recommendations regarding sleep duration are vital for monitoring and informing policies, interventions, and public awareness of healthy sleep practices. Chaput and Dutil (2016) asserted that numerous factors contribute to insufficient sleep, and chronic sleep deprivation can impede academic performance, health, and safety, especially among adolescents. Securing a good night's sleep is as crucial as maintaining a healthy diet and engaging in physical activity for overall well-being. Moreover, sleep habits influence dietary choices and screen time behaviours, thereby affecting an individual's body weight (Chaput & Dutil, 2016).

Insomnia is associated with elevated blood pressure and heart disease (Buysse, 2013). Buysse (2013) characterised insomnia as a prevalent clinical condition marked by difficulties in initiating or maintaining sleep, accompanied by symptoms such as irritability or fatigue during waking hours. Insomnia can make it challenging to fall asleep, stay asleep, or may cause early awakenings with an inability to return to sleep. Over time, inadequate sleep can lead to detrimental habits that negatively impact heart health, including increased stress levels, diminished motivation for physical activity, and poor dietary choices. High blood pressure harms the arteries, potentially causing blockages that restrict blood flow to the heart muscle, ultimately resulting in a heart attack (CDC, 2020). It can also cause blood vessels supplying the brain with oxygen and blood to rupture or become blocked, leading to a stroke. The additional strain placed on the heart by elevated blood pressure may cause the heart to enlarge and lose its efficiency in pumping blood, which can result in heart failure. Furthermore, high

blood pressure can impair the arteries surrounding the kidneys, disrupting their capacity to filter blood properly-a major contributor to kidney disease or kidney failure. In some cases, high blood pressure puts pressure on or damages the blood vessels in the eyes, potentially causing vision impairment. It can also lead to erectile dysfunction in men and may be linked to decreased libido in women. Over time, persistent high blood pressure can lead to heart conditions such as microvascular disease (MVD), which is often associated with chest pain, medically known as angina (American Heart Association, 2022b).

Research conducted among middle-aged individuals indicates that high systolic blood pressure negatively impacts memory, information acquisition, and retrieval (Varalakshmi et al., 2020; Skoog, 2003). While the deterioration in cognitive function tends to be gradual and subtle (Varalakshmi et al., 2020), it becomes more evident over extended periods. Investigations among students have also shown that high systolic blood pressure impairs cognitive abilities, with stress and anxiety identified as significant factors contributing to hypertension (Adams, 2010; Varalakshmi et al., 2020). Historically, blood pressure readings of 140/90 mmHg or higher were considered the principal indicator of cardiovascular risk (Sunkara & Ahsan, 2017). However, more recent evidence suggests that blood pressure levels ranging between 120–139/80–89 mmHg-classified as pre-hypertension-are not only more common but also significantly elevate cardiovascular (CV) risk (Sunkara & Ahsan, 2017; Huang et al., 2013).

Although blood pressure typically fluctuates throughout the day, sustained high levels can cause damage to the heart and trigger a range of health complications. According to the Centers for Disease Control and Prevention (CDC, 2020), hypertension increases

the likelihood of developing heart disease and experiencing a stroke-both of which are among the leading causes of death in the United States. In 2020 alone, hypertension was identified as the primary or contributing cause in over 670,000 deaths across the country (CDC, 2022). Persistently high blood pressure can place excessive strain on the heart, damage the blood vessels, and heighten the risk of heart attacks, strokes, and complications involving the eyes or kidneys. Approximately 47% of adults in the United States-equating to 116 million individuals-have hypertension, defined as a systolic blood pressure exceeding 130 mmHg or a diastolic reading above 80 mmHg, or are on antihypertensive medication (Centers for Disease Control and Prevention, 2021). The CDC (2021) further noted that a higher percentage of men (50%) suffer from hypertension compared to women (44%) in the United States.

Anxiety and elevated blood pressure often occur together. Feelings of anxiety can raise blood pressure, and conversely, hypertension can provoke anxious sensations (Mucci et al., 2016). Clinicians define anxiety as intense worry or fear, which manifests physically through a faster heart rate and shallow breathing. Episodes of anxiety may cause a transient rise in blood pressure. Conversely, chronic hypertension can leave individuals feeling worried about their health and prospects for the future. Anxiety prompts the release of stress hormones in the body (American Heart Association, 2022a), which increase heart rate and constrict blood vessels—both of which can markedly elevate blood pressure. Healthcare professionals attribute “white coat hypertension”—where a patient’s blood pressure readings are consistently higher in a clinical setting than at home—to anxiety (American Heart Association, 2022a). Such anxiety-driven blood pressure spikes are temporary and subside as the anxiety eases; however, persistent high anxiety can damage the heart, kidneys, and blood vessels in much the same way that sustained hypertension does. It is important to note that heart

rate-the number of beats per minute-and blood pressure do not always rise in tandem: an increased heart rate does not necessarily produce an equivalent rise in blood pressure.

A 16-year longitudinal study of 2,798 middle-aged men in Copenhagen found that an elevated resting heart rate represents an independent mortality risk factor, regardless of physical fitness, leisure-time activity, or other major cardiovascular risks (Jensen et al., 2013). Jensen and colleagues further reported that mortality risk rose in a graded fashion with higher resting heart rates, even after accounting for fitness levels, physical activity, and factors such as smoking. They proposed that a faster resting heart rate may encourage atherosclerosis and plaque rupture by increasing cardiac workload, reducing arterial compliance, and heightening stress on arterial walls (Jensen et al., 2013), reflecting the pathophysiological mechanisms suggested by Palatini (2007) and Di Francesco & Camm (2004). Jensen et al. also observed an inverse relationship between resting heart rate and physical fitness.

Anxiety is an emotional state marked by tension, worried thoughts, and physiological changes such as raised blood pressure (Mucci et al., 2016). Although often used interchangeably, anxiety differs from fear (Mucci et al., 2016). Notably, rates of anxiety, depression, suicidal thoughts, and self-harm among young adults are on the rise, with the advent of digital media and electronic communication thought to be contributing factors (Mucci et al., 2016).

Middle-aged men experiencing high levels of tension or anxiety were found to be 2.19 times more likely to develop hypertension compared to those without such stress-related factors (Nozoe & Munemoto, 2002). Nozoe and Munemoto asserted that individuals with a heavy workload experience a more significant rise in blood pressure.

Hypertension is recognised as a multifactorial genetic condition, brought about by the interplay between genetic predisposition and environmental influences (Centers for Disease Control and Prevention, 2022). In essence, hypertension is thought to emerge from a combination of hereditary susceptibility and external factors such as stress, dietary habits, obesity, high cholesterol levels, smoking, and alcohol use (Nozoe & Munemoto, 2002). Chronic stress causes the release of hormones that compel the heart to pump more forcefully and the blood vessels to constrict (Nozoe & Munemoto, 2002). This may explain why cardiovascular stress responses stem from the interaction between environmental triggers and how individuals perceive their specific situations (Mucci et al., 2016).

Varalakshmi et al. (2020) observed a positive correlation among elevated blood pressure, stress, anxiety, and cognitive failure, noting that increased levels of stress and anxiety negatively impacted cognition. They posited that stress and anxiety are among the factors capable of impairing cognitive function by raising otherwise normal blood pressure levels. Womble (2001) suggested that stress could adversely affect students' academic performance. Gasperin et al. (2009) found that individuals with heightened responses to stress-inducing tasks were 21% more likely to experience a rise in blood pressure than those who responded less intensely.

Cognitive failure tends to be common among students and can be mitigated to a certain degree (Varalakshmi, Karthick, & Jothy, 2020). Anxiety and hypertension often occur together, with each capable of exacerbating the other (American Heart Association, 2021). Anxiety can contribute to the development of high blood pressure, while the presence of hypertension may, in turn, provoke anxiety. The American Psychological Association (APA) defines anxiety as a state of worry or nervous tension, which may

manifest through physical symptoms such as a raised heart rate and sweating. The APA also indicates that anxiety can lead to an increase in blood pressure. Furthermore, living with chronic hypertension may lead to anxiety regarding one's health and future. Severe forms of hypertension may even directly provoke anxiety (American Heart Association, 2021). Anxiety represents the body's innate response to stress, making it natural to feel anxious when anticipating a significant event. This occurs as the body releases stress hormones. A 2021 study by the American Heart Association (AHA) identified a strong link between elevated cortisol and dopamine levels and an accompanying rise in blood pressure. These hormones accelerate heart rate and narrow the blood vessels. Stress can cause temporary surges in blood pressure, and sustained stress may result in health complications such as anxiety, depression, insomnia, fatigue, poor decision-making (linked to memory problems), elevated blood pressure, and an increased heart rate. Individuals with pronounced anxiety face a greater risk of hypertension than those with lower anxiety levels. Researchers emphasise the importance of early identification and management of anxiety, particularly in hypertensive individuals (Varalakshmi, Karthick, & Jothy, 2020). Typically, increases in blood pressure due to anxiety are temporary and subside once the anxiety diminishes (Varalakshmi et al., 2020).

Sleep and its homeostatic roles may help suppress the basal activity of key autonomic neuroendocrine stress responses and the pro-inflammatory system (Palagini et al., 2013). However, inadequate sleep caused by chronic restriction or insomnia could serve as a persistent stressor, undermining the body's ability to maintain internal stability. Such conditions can result in overstimulation of stress systems, ultimately reducing stress resilience and harming overall health (Palagini et al., 2013). Persistent short sleep duration may contribute to the onset and persistence of hypertension. Calhoun and

Harding (2010) concluded that insufficient sleep is linked to an elevated risk of developing hypertension.

2.5 Sleep and Academic Performance

Both the quality and duration of sleep in children differ markedly from those of adults (Iglowstein, Jenni, Molinari, & Largo, 2003). Sleep evolves gradually with age, and by ten years old, children exhibit sleep patterns akin to adults, although they still average around 10 hours per night (Iglowstein et al., 2003). In the majority of adult-focused investigations, “short sleep” has been defined as sleeping less than five hours, or no more than five hours (<5 hours or ≤ 5 hours) per night- whether considering total 24-hour sleep time, nocturnal sleep, weekday sleep, or a weighted average of weekday and weekend sleep (Cappuccio et al., 2008). Chronic stress exposure has been proposed as a contributing factor to elevated blood pressure (Gasperin et al., 2009).

Kelly, Kelly and Clanton (2001) divided sleepers into three groups: short sleepers, average sleepers and long sleepers. Short sleepers were those who, when self-scheduling, averaged six hours or fewer of sleep (Kelly et al., 2001). Average sleepers obtained seven to eight hours, while long sleepers achieved nine or more hours within a 24-hour period. Womble (2001) observed that long sleepers tended to report higher GPAs. Sleeping for shorter durations has been associated with increased anxiety and stress-both of which can impair academic performance (Kelly et al., 2001). Such anxiety and stress may curtail students’ attention spans, resulting in a higher incidence of errors during examinations (Womble, 2001).

Estevan et al. (2021) examined how sitting a school examination affected the previous night’s sleep among first-year undergraduates, as well as the link between sleep duration and examination performance. They carried out two surveys among freshmen

at Uruguay's Universidad de la República. In Survey One, 97 students from the School of Sciences took the test simultaneously; in Survey Two, 252 students from the School of Psychology undertook the test in four successive shifts. Both surveys revealed a high prevalence of irregularly brief sleep: over half of respondents in the first survey and around a third in the second reported an average nightly sleep duration of less than seven hours. In both cohorts, the night before the examination saw shorter sleep than on typical nights, with more than 10 % of students not sleeping at all (Estevan et al., 2021). In Survey Two, sleep duration increased for later test shifts ($F(3,248) = 4.6$, $p = 0.004$). Logit regression analyses confirmed a positive association between sleep length and test scores in both samples. The authors concluded that delaying test start times might mitigate sleep deprivation's effects and thereby enhance academic performance. They further recommended that educational policies should alert students to the detrimental impact of sleep deprivation on learning and its broader consequences.

In both surveys, most students postponed their bedtime the night before the test, thereby reducing their sleep duration, and more than 10 % did not sleep at all before the examination (Estevan et al., 2021). Sleep duration showed a strong correlation with the number of correct answers, and thus with academic grades. When examining these effects across shifts in Survey Two, Estevan et al. (2021) found that postponing test start times led to both longer sleep and improved performance. Adequate sleep before a test positively correlates with examination scores, course grades and semester GPA (Zeek et al., 2015). Similar levels of sleep deprivation have been documented previously among Uruguayan undergraduates (Tassinio et al., 2016), reflecting the numerous consequences of chronic insufficient sleep in student populations (Becker et al., 2018; Lemma et al., 2014).

Sitting an examination significantly alters students' nocturnal sleep patterns, a phenomenon also observed through actigraphy and questionnaires in younger pupils (Zunhammer, Eichhammer, & Busch, 2014; Astill et al., 2013). Hartwig and Dunlosky (2012) argue that students frequently sacrifice sleep to gain extra study time before tests or exams. Irrespective of the scheduled test time, students tend to delay their bedtime by about one hour on the eve of an examination (Hartwig & Dunlosky, 2012).

While some investigations report a positive link between consistent sleep duration and academic grades, other researchers emphasise the importance of stable sleep quality over mere duration (Okano et al. 2019). Studies by (Okano et al. 2019; Taylor & Bramoweth, 2010; Gilbert & Weaver (2010), Bray (2008) and Medeiros et al. (2001) underscore how consistent sleep quality more strongly predicts academic success. Okano et al. (2019) found a relationship between regular sleep duration and test performance only in their first survey: odds of correct answers rose with longer sleep. In their second survey, the previous night's sleep duration predicted performance but was a stronger predictor in Survey One than in Survey Two. Converting predicted correct-answer rates into grades showed that eight-hour sleepers achieved passing marks, whereas all-nighters did not (Okano et al., 2019). Scullin and Gao (2018) similarly reported that long sleepers outperformed short sleepers on assessments. Divergences in regression coefficients and explained variance between surveys may reflect differences in question formats (true/false versus multiple choice) as guessing correctly is inherently more likely in true/false items.

School and examination scheduling can serve as a valuable tool for further examining the influence of test start times on sleep and performance (Goldin, Sigman, Braier, Golombek, & Leone, 2020; Estevan et al., 2018). Estevan et al. (2021) observed that

delaying test start times increased sleep duration the night before. Afternoon-shift students slept substantially longer than their morning counterparts and achieved markedly better performance in later shifts. Enhanced performance among late-shift students appeared more attributable to increased sleep length than to differences in study time, which remained consistent across shifts. Additionally, chronotype-related performance variations may further explain observed shift-related differences (Borisenkov, Perminova, & Kosova, 2010; Eliasson, Lettieri, & Eliasson, 2010).

The study by Estevan et al. (2021) is limited by its reliance on self-reported surveys, which tend to overestimate sleep duration relative to objective measures (Lauderdale et al., 2008). Consequently, the true prevalence of short sleep among undergraduates may be considerably higher. Confirmatory actigraphy data from Scullin and Gao (2018) echoed similar patterns of sleep loss during exam periods. Elevated anxiety levels before tests may underlie both sleep disturbances and poorer performance; however, Estevan et al. (2021) reported no increase in sleep latency—a common anxiety indicator—prior to examinations (Becker et al., 2018; Papadimitriou & Linkowski, 2005). Analysing personality-related variables may yield deeper insights into how students' sleep routines and study practices interact before exams.

Estevan et al. (2021) additionally found that many university students fail to obtain sufficient sleep. They demonstrated that examination-taking alters students' sleep habits and that sleep duration the night before a test correlates with performance. Although delaying school and test start times has been associated with longer sleep and enhanced academic achievement, Estevan et al. (2021) suggest this benefit may be modest. Given the vital role of regular sleep, it seems a cost-effective strategy for

improving both academic outcomes and student well-being (Prichard, 2020; Prichard & Hartmann, 2019).

Chowrira, Smith, Dubois and Roll (2019) examined sleep duration and its effects on two introductory university courses taken by first-year students. They employed the Productive Failure (PF) method, which reverses traditional instruction by having learners attempt challenging problems before receiving explicit teaching. Although learners often produce suboptimal solutions—hence “Failure”—this process helps them encode core ideas and better grasp subsequent instruction. In a quasi-experiment within a large-enrolment introductory biology course, one section (295 students) used PF for two topics, while another (279 students) used standard active learning. After ample practice and feedback, both cohorts sat a midterm. PF students outperformed their peers by about five percentage points on relevant topics, with the effect especially pronounced among lower-achieving students. Only low-performing pupils showed gains on the final exam. This intervention, combined with sufficient sleep, holds promise for reforming large introductory courses.

However, in the Okano et al. (2019) study, wearable activity trackers were distributed to 100 students in an introductory chemistry class (88 completed the study), enabling correlations between multiple sleep parameters and in-class performance on quizzes and midterms. Improved sleep quality, duration and regularity were all associated with higher grades (Okano et al., 2019). Although no association emerged between sleep on the night before a test and performance, sleep length and quality over the preceding week and month correlated positively with grades. Sleep-related variables accounted for about 25 % of the variance in academic outcomes, providing objective evidence that enhanced sleep contributes substantially to university students’ academic success.

Fakhari, Kheradmand and Dolatkhah (2016) used a questionnaire to assess sleep duration the night before examinations and related exam scores in a convenience sample of 200 students (62 % male, 38 % female). Student codes on exam papers facilitated access to individual scores, and analyses were performed using SPSS 16. They found the mean sleep duration prior to exams was 6.43 hours, with a mean exam score of 15.46. Students who slept only at night achieved significantly higher scores than those who napped during the day. Moreover, those who slept 6–10 hours in the 24 hours before an exam scored notably better than peers with under 6 hours (Fakhari et al., 2016). Marital status, gender and residence did not influence exam performance (Fakhari et al., 2016).

2.6 Summary of Chapter Two

Sleep plays a vital role in the well-being of students, particularly those in higher education. Estevan et al. (2021) and Watson et al. (2015) have indicated that adults are recommended to obtain between 7-9 hours of sleep daily; however, numerous students fail to achieve this recommended duration. Sleep is considered essential for the body's restorative functions, including energy conservation, thermoregulation, and tissue repair (Maquet, 2001). Moreover, it is crucial for cognitive functions, especially memory consolidation (Stickgold, 2005; Maquet, 2001). Conversely, sleep deprivation seems to stimulate the sympathetic nervous system, leading to elevated blood pressure (Ogawa et al., 2003) and increased cortisol secretion (Lac & Chamoux, 2003). This deprivation may also impair immune function and contribute to metabolic issues such as insulin resistance (Spiegel et al., 2005). Individuals experiencing sleep deprivation often show diminished cognitive performance and mood disturbances (Philibert, 2005). Students at universities report much poorer sleep quality, including irregular sleep cycles and sleep deprivation. Again, university students sleep much less than the daily

suggested quantity for their age group that promotes appropriate cognitive functioning (Raley et al., 2016). Students frequently forego sleep in order to fulfill social and academic obligations. Additionally, they (university students) experience more daytime tiredness than the average population. Additionally, students' sleep cycles are always changing, and often have terrible sleeping habits the night before a test. All of these variables may have an effect on various areas of the life of a typical university student, including mood, immune system function, and even substance misuse (Orzech et al., 2011).

University students frequently report significantly poorer sleep quality, characterised by irregular sleep patterns and insufficient sleep. Additionally, they tend to sleep less than the daily recommended amount for their age group, which is necessary for optimal cognitive functioning (Raley et al., 2016). Students often sacrifice sleep to meet social and academic commitments. Furthermore, they experience greater daytime sleepiness compared to the general population. Their sleep schedules are often inconsistent, and they commonly exhibit poor sleep habits, particularly on the night preceding examinations. These factors can adversely affect various aspects of a typical university student's life, including mood, immune system function, and even lead to substance misuse (Orzech et al., 2011).

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Overview

This chapter discusses the methods and procedures used for carrying out the research. It presents the study area, research design, population, sampling, instruments, sampling procedures and data analysis.

3.1 Study Area

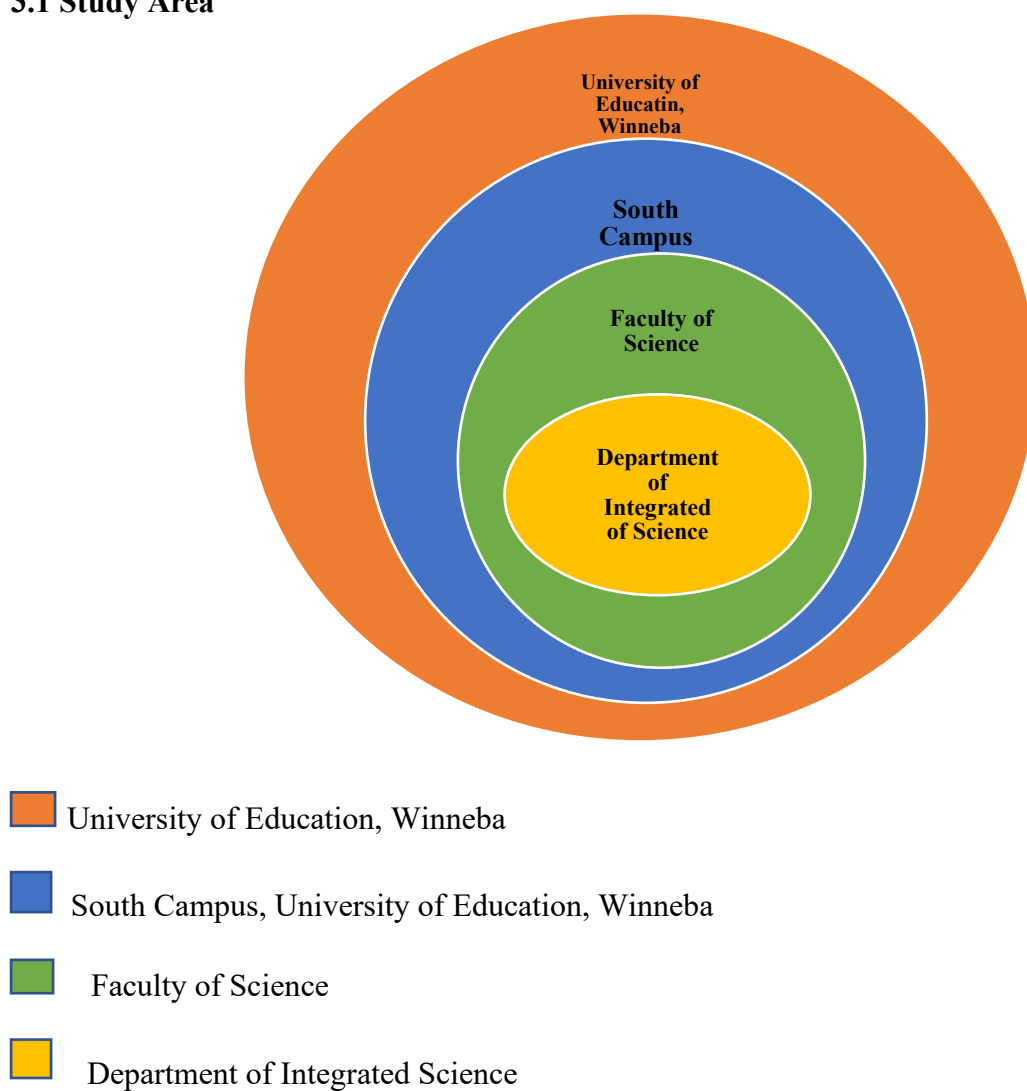


Figure 3: The study area of the research population

This research study was conducted in the geographical area of Winneba in the Central Region of Ghana. The study was carried out at the Department of Integrated Science. Department of Integrated Science is one of the departments at the Faculty of Science at the South Campus of University of Education, Winneba. Students at the Integrated Science Department were chosen because of easy accessibility and convenience.

3.2 Research Design

In a study, a research design refers to the techniques for collecting, analysing, interpreting, and reporting data (Creswell & Plano-Clark, 2011). In other words, the research design determines how the required data are collected and analyzed, as well as how all of this can be used to answer the research question. There are three types of research designs based on their end purpose, according to Robson (2002): exploratory, descriptive, and explanatory. When there is not enough information regarding a phenomenon or a problem that has not been precisely characterized, exploratory research is conducted. The goal of exploratory research is not to provide definitive solutions to the research questions, but rather to explore and study issues in depth.

This study employed a cross-sectional study design. Cohen, Manion and Morrison (2018) defined a cross-sectional study as one that produces a ‘snapshot’ of a population at a specific point in time. The cross-sectional study’s single data collection point serves as a baseline for exploring retrospective or prospective trends (Cohen et al., 2018).

It included 60 integrated science students at the University of Education, Winneba in Ghana. 15 participants with Cumulative Grade Point Average within the range of the First Class (≥ 3.6 to 4.0), Second Class Upper (≥ 3.0 to 3.5) and Lower (≥ 2.5 to 2.9), and Third Class Divisions (< 2.5) across the three levels (level 100, 200, and 300)

were carefully selected to represent the sample size of 60. The study employed cross-sectional study because cross-sectional studies are generally useful for exploring relationships or links between variables (Bryman, 2016; Bryman, 2006), and they are comparatively less resource-intensive (Silverman, 2016) and more cost-effective (Frankfort-Nachmias, 2015) than other research work such as longitudinal studies . Again, cross-sectional studies can be generalizable to the population if the sample is representative of the sample population (Babbie, 2016). Lastly, cross-sectional studies can provide a snapshot of the population at a specific or particular point in time (Neuman, 2014).

3.3 Population

Creswell (2012) defines a population is a group of people who share similar features. Any group of humans or non-human elements, such as items, educational institutions, time units, or geographic locations, constitutes a population. The population for this study included all the students at the University of Education, Winneba. The total population of University of Education, Winneba for 2022/2023 academic year was 61,257, data gathered from University of Education, Winneba.

3.4 Target Population

The target population of this study includes all undergraduate science students at the Faculty of Science at the University of Education, Winneba. The target population for this study was 4,597 in the 2022/2023 academic year.

3.5 Accessible Population

The accessible population included: the Level 100 integrated science students which were 256, the Level 200 Integrated Science Students which were 157 and the Level

300 Integrated Science Students were 145 at the University of Education, Winneba in the 2022/2023 academic year.

3.6 Sample Size

Access is a critical issue that must be decided early in the research process. Researchers must guarantee that access is not just permissible but also feasible (Cohen et al., 2018). The sample size for this study was 60. The research selected the 60 participants because the wrist-watch (sleep monitoring device) was expensive. As a student of the Department of Science, the research found it more practical and convenient to select Level 100, Level 200 and Level 300 integrated science students of the University of Education, Winneba.

Table 2 presents the distribution of the research sample. The males (30, 50%) and the females (30, 50%) comprised the sample.

Table 2: Distribution of research sample (integrated science students)

	Sex	First Class	Second Class Upper	Second Class Lower	Third Class	Total
Level 100	F	5		5		
	M		5		5	20
			5		5	
Level 200	F					
	M	5		5		20
Level 300	F		5		5	
	M	5		5		20
Total		15	15	15	15	60

3.7 Sampling Technique

According to Yin (2009), the unit of analysis should be concrete (a real-world phenomena), not abstract. Defining the unit of analysis enables the difficult question of what defines a case to be addressed (Cohen et al., 2018). In this light, the research selected to investigate a real-world phenomenon: sleep, more precisely, sleep habit and its correlation with academic performance. The research selected the sample using purposive sampling procedure, a non-probability sampling technique.

3.7.1 Non-probability Sampling

Kothari (2004) defines non-probability sampling is that sampling procedure which does not afford any basis for estimating the probability that each item in the population has of being included in the sample. Non-probability sampling is also known as deliberate sampling, purposive sampling and judgement sampling. In this type of sampling, items for the sample are selected deliberately in this study; his choice concerning the items remains supreme. In other words, non-probability sampling allows the research to purposively choose the particular units of the universe for constituting a sample on the basis that the small mass that they so select out of a huge one will be typical or representative of the whole. Thus, the judgement of the research of the study plays an important part in this sampling design. In such a design, personal element has a great chance of entering into the selection of the sample. The research may select a sample which shall yield results favourable to his point of view and if that happens, the entire inquiry may get vitiated. Thus, there is always the danger of bias entering into this type of sampling technique. But if the investigators are impartial, work without bias and have the necessary experience so as to take sound judgement, the results obtained from an analysis of deliberately selected sample may be tolerably reliable. However, in such a sampling, there is no assurance that every element has some specifiable chance of

being included. Sampling error in this type of sampling cannot be estimated and the element of bias, great or small, is always there. As such this sampling design is rarely adopted in large inquiries of importance. However, in small inquiries and researches by individuals, this design may be adopted because of the relative advantage of time and money inherent in this method of sampling (Kothari, 2004).

The research used non-probability sampling for this study. Cohen et al. (2018) noted the selectivity which is built into a non-probability sample is derived from the research targeting a particular group, in the full knowledge that it does not represent the wider population; it simply represents itself. This is frequently the case in small samples or small-scale research, for example, one or two schools, two or three groups of students, a particular group of teachers, where no attempt to generalise is desired. It is also frequently the case for ethnographic research, action research or case study research. Small-scale research often uses non-probability samples because, despite their non-representativeness, they are far less complicated to set up, are considerably less expensive and can prove perfectly adequate as the research did not seek to generalise their findings beyond the selected sample, Level 100 to Level 300 Integrated Science students at the University of Education, Winneba. In sampling subjects for this research study, the research employed convenience sampling. However, for small inquiries and research conducted by people, this design may be used due to the relative time and cost savings associated with this form of sampling (Kothari, 2004).

For this investigation, the research used non-probability sampling. Cohen et al. (2018) argued that the selectivity inherent in a non-probability sample stems from the research's deliberate targeting of a certain group, fully aware that it does not represent the larger population; rather, it represents itself. This is typically the case with tiny

samples or small-scale studies, such as one or two schools, two or three student groups, or a small number of students, where no attempt at generalization is desired. This is also commonly the case when conducting ethnographic, action, or case study research. Small-scale research frequently employs non-probability samples because, despite their non-representative nature, they are significantly easier to set up, significantly less expensive, and can prove perfectly adequate if the research is not attempting to generalise their findings beyond the selected sample (Cohen et al., 2018). Therefore, the research did not wish to generalise his findings beyond the sample of Level 100-Level 300 Integrated Science students at the University of Education, Winneba. For this reason, the research used convenience sampling to select respondents for this research study for the want of time and limited financial constraints.

3.7.2 Purposive sampling

In purposive sampling, often (but by no means exclusively) a feature of qualitative research, the research handpicks the cases to be included in the sample on the basis of his/her judgement of their typicality or possession of the particular characteristic(s) being sought. The research assembled the sample to meet his/her specific needs. Purposive sampling was employed for this research in order: to achieve representativeness, to enable comparisons to be made, to focus on specific, unique issues or cases, to generate theory through the gradual accumulation of data from different sources (Teddlie & Yu, 2007). Purposive sampling provides greater depth to research study than probability sampling; on the other hand it provides less breadth to the study than probability sampling (Teddlie & Yu, 2007; Cohen et al., 2018). The research selected the sample using purposive sampling technique for the purpose of the unique characteristics of the research sample.

3.8 Research Instruments

The instruments the research used for collecting data in this study included observation and self-reported questionnaire. Cohen et al. (2018) agrees with Long (2015) that discussions of validity in mixed method research is still at an infant stage. Long advocated for wider acceptance of validity in mixed method research rather than restricting validity in mixed method research to matters of design, procedures, methods and techniques, which brings to mind the idea of logic of justification (Cohen et al., 2018). The questionnaire tends to be more reliable than interview; as it provides anonymity and encourages greater honesty. However, dishonesty and falsification might not be able to be discovered in a questionnaire, especially in internet questionnaires, where even the factual details about a respondent may be false. Because of this reason, the research preferred face-to-face questionnaire to internet questionnaire. For a broader embrace of validity, the study incorporated: sincerity, legitimacy, truthfulness, rightness and comprehensibility in 'action oriented to mutual understanding' (Long, 2015).

3.8.1 Content Validity of the Questionnaire

The ability of the selected items to reflect the variables of the construct in the measure is characterized as content validity, also known as definition validity and logical validity. This type of validity considers how well an instrument's elements accurately represent the content domain (Zamanzadeh et al., 2015). The extent to which the items on a test are fairly reflective of the full domain the test tries to measure is referred to as content validity.

To demonstrate this type of validity, the instrument must demonstrate that it covers the domain or item it claims to cover equitably and comprehensively. Because of the time

constraints or respondents' incentive to finish, for example, a lengthy questionnaire, it is doubtful that each problem will be covered in its entirety. If this is the case, the study must ensure that the elements of the main issue to be covered in the research are both a fair representation of the larger issue under investigation (and their weighting), as well as that the elements chosen for the research sample are addressed in depth and breadth. In order to ensure content validity, the research considered all related topics related to sleep habits when the Questionnaire and Observation items were constructed.

3.8.2 Construct Validity of the Questionnaire

The construct validity of a test or instrument refers to its ability to measure a concept, characteristic, or other theoretical entity (Strauss & Smith, 2009). To ensure construct validity, the research had to ensure that his or her interpretation of a given issue was consistent with other interpretations of the same underlying issue. For this reason, the term 'academic performance' in this study was defined as and limited only to: mid-semester and end of semester scores.

The Cronbach's alpha reliability coefficient of the questionnaire items was 0.7. This was done by assigning numerical values to participants' responses after which SPSS was used to calculate Cronbach's alpha reliability coefficient.

3.8.3 Validity and Reliability of Observation

Observational research which is more structured in its nature, yields quantitative data (Cohen et al., 2018). Further, to ensure validity, the observation research instrument was pilot-tested (Cohen et al., 2018). This was to ensure that the sleep monitoring device was efficient and reliable (Cohen et al., 2018). The smart wrist-watch sleep monitoring device (sleep tracker) which was piloted tested before had a reliability of 95%. Validity was assured in the data collected because the participants were promised

that they would get to keep the wrist-watch gadgets (sleep monitoring device) after the data collection which made the participants to fully partake in the data collection process.

3.8.4 Triangulation

The employment of two or more data gathering methods in the study of some element of human behavior is known as triangulation (Cohen et al., 2018). In the social sciences, triangulation is also known as numerous approaches or the multi-method approach. Triangulation is a physical measurement technique in which many locational markers are employed to locate a single site or objective in its original and literal sense. By analogy, in the social sciences, triangle methodologies aim to map out, or explain more thoroughly, the diversity and complexity of human behavior by investigating it from multiple perspectives and using both quantitative and qualitative data. Therefore, the research investigated sleep habits and its impact on academic performance by collecting and analysing qualitative and quantitative data using self-reported questionnaire and observation.

There are various types of triangulations (Cohen et al., 2018). They include: time triangulation, space triangulation, combined levels of triangulation, theoretical triangulation, investigator triangulation and methodological triangulation (Cohen et al., 2018). By combining cross-sectional and longitudinal designs, time triangulation aims at accounting for the causes of change and process.

According to Cohen et al. (2018), diachronic reliability is concerned with the consistency of observations over time, whereas synchronic reliability is concerned with the similarity of data collected at the same time. By employing cross-cultural

methodologies, space triangulation seeks to overcome the parochialism of research conducted in the same nation or within the same subculture.

Combined levels of triangulation employ more than one level of analysis from the three main levels employed in the social sciences, namely the individual level, the interactive level (groups), and the level of collectivities (organizational, cultural or societal).

Instead of relying solely on one viewpoint, theoretical triangulation incorporates multiple or opposing hypotheses. However, when more than one observer is involved, data is discovered separately by each observer in investigator triangulation. Methodological triangulation employs either the same method on multiple times or different approaches on the same subject.

Among the various types of triangulation, the research used investigator triangulation, theoretical triangulation, and methodological triangulation. This because the study engaged more than one observer (participant), as data was discovered independently by more than one observer (participant). The research also used theoretical triangulation since the research revolved three hypotheses (thus, multiple hypotheses). On different occasions of data collection, different instruments (thus, self-reported questionnaire and observation) were used to gather data on the same object of study.

3.9 Data Collection Procedure

Many case studies, according to Cohen et al. (2018), use a variety of approaches and data. In case studies, observation and participant observation are frequently the primary sources of data, but they are far from the only ones. According to Yin (2009), the research gathered data by combining a variety of sources, including documents (individual participating students' exam papers), direct observation (observing

participants' conducts and behaviors in examination halls), physical artefacts (participants' examination hall seating arrangements), and archival records.

Multiple sources of evidence provide a case with both convergent and concurrent validity, but they require the research to be able to manage and synthesize a variety of different types of data at the same time. As a result, a case study evidence database (Yin, 2009) is advocated for, which consists of two types of collection: the data itself, which is gathered, recorded, and organized by entry, and data analysis, report, comments, and narrative on the data.

Participants of this study first signed a consent form assuring them of anonymity and confidentiality. The questionnaire was distributed to all Level 100 to Level 300 Integrated Science students at the University of Education, Winneba who willingly expressed their interest in participating in the research study; purposive sampling was used to determine the research sample size. Participants were selected based on the academic class (level) of students and gender. Again, the sampling included the following nominal characteristics: age range, university level, department, and nationality. This allowed visualization of the degree of congruence or disjunction between the responses of the various subgroups.

The data collection strategy was multi-method (observation and self-reported questionnaire), and it was conducted longitudinally over one academic semester at the Department of Integrated Science, University of Education, Winneba.

The questionnaire was pilot-tested on integrated science students who shared similar traits with the selected sample for the study. From the feedback obtained after piloting, the questionnaire items were refined. Also, the items in the questionnaire that proved

difficult for student to respond to, were reframed to make it more understandable. The pilot study helped the researcher to draw a base-line for the validity and reliability of the questionnaire and the procedures to be followed for the study.

Below is a table showing the plan for collecting data using observation as a research instrument.

Table 3: Plan for Collecting Data using Observation

Duration	Activities
5 days	For training participants and pilot testing of sleep monitoring device/ sleep tracker
1 week	Initial stage of taking data in the semester to monitor random activities of participants
1 week	Taking data prior to Mid-Semester Exams
1 week	Taking data during Mid-Semester Exams
1 week	Random taking data with the sleep monitoring device/ sleep tracker to monitor activities of participants after writing their Mid-Semester exams
1 week	Taking data prior to End of Semester Exams
1 week	Taking data during End of Semester Exams
1 week	Random taking data to monitor activities of participants after writing End of Semester Exams

Samples of students were taken through 5 days of training and pilot tested the sleep monitoring device (smart bracelet wrist watch). Within this period, participants familiarised themselves with the smart bracelet wrist watch. The smart bracelet wrist watch recorded the following parameters: sleep duration, blood pressure (systolic and diastolic pressure), and heart beat rates. In one week (1 week), the research collected data at the beginning of the semester. There was random taking of data with the sleep monitoring device (smart bracelet wrist watch) to monitor activities of participants after

they finished writing their Mid-Semester exams and during Mid-Semester Exams period. The research, again, used one week prior to and one week during End of Semester Exams to take data. Finally, the research used another one week to randomly take data to monitor activities of participants after writing End of Semester Exams. Each data readings of the sleep monitoring device (smart bracelet wrist watch) was recorded 10 minutes after waking up in the morning throughout the second semester of 2022/2023 Academic year.

3.10 Data Analysis

Pearson correlation and linear regression were used to analyse quantitative data. The Pearson correlation coefficient indicates how strong a linear link exists between two variables. It has a range of values from -1 to 1, with -1 indicating total negative linear correlation, 0 indicating no correlation, and +1 indicating total positive linear correlation. Cohen et al. (2018) recommends that Pearson product moment should be used when analysing data of two continuous variables; interval or ratio scale. Cohen et al. (2018) speculated correlational techniques are generally intended to determine the relationship between the two variables, the direction of the relationship between two sets of data, and the magnitude of the association between two variables.

Numerical data was processed with SPSS, and it enabled the responses from Level 100 to Level 300 Integrated Science students at the Department of Science, University of Education, Winneba to be analysed. Qualitative data was analysed using protocols of content analysis of percentages and tables.

3.11 Ethical Issues

The research took into account ethical issues as listed by Cohen et al. (2018). Cohen et al. addressed ethical issues by preaching against the following practices when conducting research:

- involving people without their knowledge or consent
- coercing them to participate in a research study
- withholding information about the true nature of the research
- deceiving participants in other ways
- inducing them to commit acts diminishing their self-esteem
- violating rights of self-determination (example in studies seeking to promote individual change)
- exposing participants to physical or mental stress
- invading participants' privacy
- withholding benefits from some participants (example; in comparison groups)
- not treating participants fairly, or with consideration, or with respect.

All participants signed consent forms and were assured of confidentiality and anonymity, and that the research results would not influence their grades.

3.12 Summary of The Chapter Three (Research Methodology)

Based on the five stages as cited in Cohen et al. (2018), the research methodology was conducted in five phases:

Phase One: Development and operationalization

- i. A review of literature and commercially produced instruments
- ii Clarification of the research questions
- iii Clarification of methodology and sampling

Phase Two: Instrumentation and the piloting of the instruments

- i. Questionnaire development and piloting
- ii. Gathering of observational data

Phase Three: Data collection

Data collection proceeded in the following sequences:

The self-reported questionnaire was administered, and observation was used to gather the observational data.

Phase Four: Data analysis and interpretation

Numerical data was processed with SPSS, and it enabled the responses from Level 100 to Level 300 integrated science students at the Department of Integrated Science, University of Education, Winneba to be analysed. Qualitative data was analysed using protocols of content analysis.

Phase Five: Reporting

A full report on the findings included conclusions, implications and recommendations

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results of the study and discusses the research findings.

4.1 Demographic Profile

The demographic profile of students is shown in Figure. The results show that equal proportion of male (30, 50%) and female students (30, 50%) participated in the study. That is, both male and females were equally represented in this study, ensuring gender equality. This finding differs from a study conducted by Lemma et al. (2012) in an Ethiopian tertiary institution that showed that the male respondents (1672, 78%) that participated in the study were more than their female counterparts (471, 22.0%).

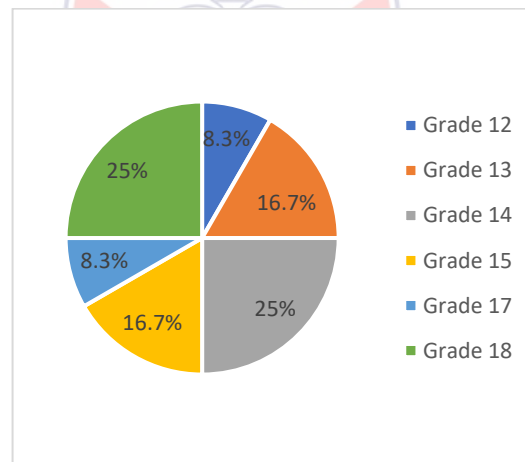


Figure 4: Demographic profile of participants' entry grade

From figure 4, the minimum and the maximum Entry Grade of students were 12 and 18, respectively. Half of the students (50 %) had Entry Grades of 14 and 18. Few students (8.2-16.7 %) had entry grades of between 11 and 18. The decreasing order of students' entry grade was 14, 18 > 13, 15 > 12 and 17. Similar sample of University students was used by Aciro, Luo and Zhang (2023) in a study.

The average age of participants was 23 years, with the age range between 19-29 years. The study reported that few participants (5, 8.3%) reported temporary hypertension crisis stage 1. This finding was similar to that of Putri et al. (2025) who reported that hypertension was less than 10% prevalent among young adults.

4.2 Evaluation of Self-Reported Sleep Habits Among Students

The self-reported sleep habits among participants are presented in Table 13. The results show that one out of every three students reported that bedroom intrusive noise affected students' sleep environment while one out of four students mentioned that high room temperature and sharing of room with others influenced their sleep. Few participants (<20 %) indicated that, and bedroom intrusive light affected their sleep.

Table 4: Self-reported sleep habits among students

S/N	Question	Responses	
		Level of response	Frequency (%)
1	Which of these sleep environment variables affect your sleep most?	Temperature too high	15 (25%)
		Room sharing	15 (25%)
		Bedroom intrusive noise	20 (33.3%)
		Bedroom intrusive light	10 (16.7%)
2	How many hours of sleep do you get on average during any given night?	4 hours	10 (16.7%)
		5 hours	35 (58.3%)
		6 hours	10 (16.7%)
		8 hours	5 (8.3%)
3	Do you feel that you get enough sleep?	Yes	10 (16.7%)
		No	50 (83.33%)
4	Do you have any suspicion that you may have a sleeping disorder?	Yes	55 (92.0%)
		No	5 (8.0%)
5	How many times do you wake up during the night on average?	None	0
		1	20 (33.3%)
		2	35 (58.3%)
		3	5 (8.3%)

Table 4: Self-reported sleep habits among students (cont'd)

S/N	Question	Response	
		Level of response	Frequency (%)
6	How often do you sleep during lectures?	Rarely	10 (16.7%)
		Occasionally	35 (58.3%)
		Frequently	15 (25%)
7	Do you think sleep deprivation adversely affect your academic performance?	Yes	45 (75.0%)
		No	15 (25.0%)
8	How many days in a week do you sleep during lectures?	Never	5 (8.3%)
		1 day	10 (16.7%)
		2 days	20 (33.3%)
		3 days	5 (8.3%)
		4 days	5 (8.3%)
		5 days	10 (16.7%)
		7 days	5 (8.3%)
9	Are you on a regular sleep schedule in a week (that is; falling asleep and waking up at the same time daily)?	Never	20 (33.3%)
		Sometimes	10 (16.7%)
		During the week days	10 (16.7%)
		On the weekends	10 (16.7%)
10	Do any of the flowing factors impact your sleep quality?	Always	10 (16.7%)
		Medication	5(8.3%)
		Stressful lifestyle	15(25%)
		Classroom schedule	15(25%)
		Course workload	20(33.3%)
		Video games/video	5(8.3%)

From Table 4, 1 out of every 6 students reported sleeping 4 or 6 hours at any given night. More than half of the students (35, 58.3%) reported sleeping 5 hours while few reported sleeping 8 hours in any given night. Moreover, a significant number of students (>80 %) reported not having enough sleep and experienced sleep disorder. This suggest that most students had inadequate sleep at any given night. The outcome of study carried out in Karachi, Pakistan among university students showed that the students experienced poor sleep quality, which had a negative effect on their academic performance (Maheshwari & Shaukat, 2019). This finding agrees with that obtained in this study. Disturbed and inadequate sleep judgement impairment, agitation, irritability

and inability to process information in both short term and long term (Maheshwari & Shaukat, 2019). On average, close to 60 % of the students waked up twice at night when sleeping and occasionally sleep during lecture periods. Furthermore, a significant proportion of students (<70 %) reported that sleep deprivation adversely affected their academic performance. Furthermore, 1 out of 3 students reported sleeping twice a day during weekly lectures and asserted that course workload affects their sleep quality. Few students said stressful lifestyle and classroom schedules affect their sleep quality. A thorough analysis of the results shows that the sleep habit among students was bad. The study discovered that the sleep habits among the integrated science students were not encouraging. This concurs with a study carried out by Maheshwari and Shaukat (2019) in Pakistan which reported that university students experienced bad sleep habits. It was further reiterated that the poor sleep habits among students had a negative effect on their academic performance. Finding of this study showed that more than half of the students (35, 58.3%) reported sleeping 5 hours. In addition, a significant number of students (>80 %) reported not having enough sleep and experienced sleep disorder, indicating that most students had inadequate sleep at any given night. On average, close to 60 % of the students waked up twice at night when sleeping and occasionally sleep during lecture period, suggesting that students experienced distorted sleep patterns.

In summary, the integrated science undergraduate students had inadequate sleep during both mid and end-of-semester examinations. The prospective integrated science teachers in level 100 to 300 had poor sleep habits. The greater proportion of the students (<70 %) reported that sleep deprivation adversely affected their academic performance. This worrying and call for immediate short- and long-term actions to mediate the situation. Policy makers and academic counsellors need to develop targeted interventions such as sleep education programs to help students establish proper sleep

habits to mitigate the long-term health consequences among students. Again, university policies such as start times for lectures, assignment workloads, and extracurricular activity should be scheduled to accommodate students' sleep needs.

4.3 Students' Academic Performance in Mid-Semester Examination

Assessing students' academic performance is important during teaching and learning. Table 5: presents the academic scores of participants in the mid-semester physics examination.

Table 5: Performance of students in mid-semester physics examination

Scores (%)	Level 100	Level 200	Level 300	Remarks
<50	0	0	0	Poor
50-75	0	15	5	Average
>75	20	5	15	Excellent

Table 6: Performance of students in mid-semester chemistry examinations

Scores (%)	Level 100	Level 200	Level 300	Remarks
<50	0	0	0	Poor
50-75	0	15	5	Average
>75	20	5	15	Excellent

Table 7: Performance of students in mid-semester biology examination

Scores (%)	Level 100	Level 200	Level 300	Remarks
<50	0	0	0	Poor
50-75	0	10	10	Average
>75	20	10	10	Excellent

The results show that the academic scores of students in the mid-semester examinations for the three aspects of integrated science differ. There was statistically significant variation between the students mean scores for the three aspects of integrated science ($p < 0.05$), according to Table 8. The null hypothesis that there is no statistically significant difference between students means scores in physics, chemistry and biology mid-semester examinations was rejected. The finding of study concur with a research conducted in Nigeria, which reported that there was a significant variation in students mean scores in physics, chemistry and biology (Stephen, 2016).

Analysis of results in table 5-7, reveals that all students (20, 100%) in level 100 had a score greater than 75 in the mid-semester examinations for three aspects of integrated science. Again, from table 5 and 6, a significant proportion of students (15, 75%) in level 300 had a score greater 75 in the physics and chemistry examinations. On the contrary, only 5 students constituting 25 % had a score higher than 75 in the physics and chemistry examinations. Level 100 and 300 students who had a score ranging from 50-75 in the physics and chemistry mid-semester examinations constituted 75 and 25 %, respectively. It is worth noting none of the participants recorded a score below 50% for all the three aspects of integrated science.

The level 100 students performed better in mid-semester examinations for the three aspects of integrated science than students in level 200 and 300 due to the flexible nature and less workload of the level 100 integrated science curriculum. Furthermore, the level 200 students had better academic scores in biology than the physics and chemistry mid-semester examinations. Conversely, the 300 participants obtained better academic scores in physics and chemistry than biology mid-semester examinations.

The academic scores and performance of students in the mid-semester physics examination was encouraging.

Table 8: ANOVA results of students scores in mid-semester examinations

Variable	Sum of squares	Mean squares		F-value	p-value
		Between Groups	Within groups		
Physics	1772.500	886.250	71.447	12.4042	0.0000
Chemistry	3680.833	1840.417	61.645	29.8552	0.0000
Biology	1880.833	940.417	71.623	13.1301	0.0000

4.3 Students' Academic Performance in End-of-Semester Examination

The academic scores and performance of students in the end-of-semester examinations are highlighted in Table 9, 10 and 11.

Table 9: Performance of students in end-of-semester physics examination

Scores (%)	Level 100	Level 200	Level 300	Remarks
<50	0	0	0	Poor
50-75	15	10	10	Average
>75	5	10	10	Excellent

Table 10: Performance of students in end-of-semester chemistry exams

Scores (%)	Level 100	Level 200	Level 300	Remarks
<50	0	5	0	Poor
50-75	20	10	15	Average
>75	0	5	5	Excellent

Table 11: Performance of students in end of semester biology examinations

Scores (%)	Level 100	Level 200	Level 300	Remarks
<50	0	0	0	Poor
50-75	15	10	10	Average
>75	5	10	10	Excellent

Analysis of results shows (Table 12) that there was a statistically significant variation in students mean scores in physics, chemistry and biology end-of-semester examinations (<0.05). The null hypothesis that there is no significant difference between the students mean scores in the end-of-semester examination for physics, chemistry and biology was rejected. From table 9-12, a greater number of level 100 students ($<70\%$) obtained academic scores ranging from 50 – 75 in the end-of-semester examinations for the three aspects of integrated science while roughly 50-75 % of the level 200 and 300 students had scores ranging from 50-75 in the end-of-semesters examinations for physics, chemistry and biology. It was found that none of the students at the various undergraduate levels had below 50 in the end-of-semester examinations for biology and physics. On the contrary, some level 200 students (25 %) obtained scores below 50 in chemistry end-of-semester examination (table 10), suggesting that chemistry is difficult to some integrated science level 200 students as compared to physics and biology.

From table 11, half of the level 200 and 300 participants (50 %) had scores above 75 in physics and biology end-of-semester examinations. Only 25 % of participants recorded scores above 75 in the end-of-semester examination for physics and biology. None of the level 100 students recorded scores above 75 % in end-of-semester chemistry examination. Besides, about 25 % of the level 200 and 300 students obtained scores

above 75 in end-of-semester chemistry examination, indicating that chemistry is the difficult aspect of integrated science at all levels among the students. The level 200 and 300 students performed better compared to the level 100 students in the end-of-semester physics and biology Examinations. This could be attributed to the fact that the level 200 and 300 students are familiar with the nature of questions facilitators set in the end-of-semester physics and biology examinations. Comparatively, the academic scores and performance of students in the mid-semester examinations were higher compared to those obtained in the end-of-semester examinations due to the less workload on students during the mid-semester than the end-of-semester examinations as reported in table 13. According to Table 13, there is a statistically significant difference between mid-semester and end-of-semester integrated science examination scores ($p < 0.05$).

Table 12: ANOVA results of students' scores in end-of-semester examinations

Variable	Sum of squares	Mean squares		F-value	p-value
		Between Groups	Within groups		
Physics	223.333	111.667	32.303	3.4569	0.0383
Chemistry	1635.833	817.917	86.974	9.4040	0.0000
Biology	1250.833	625.417	118.640	5.2715	0.0079

Table 13: Independent t-test results of mid-semester and end of Semester exam scores

Examinations	Min	Mean $\pm$ SD	Max	t-statistic	p-value
Mid-Semester	62.3	77.583 $\pm$ 7.9	87.3	7.1919	0.0001
End of Semester	54.0	71.483 $\pm$ 6.7	82.7		

The study found that the academic scores of students in both mid and end-of semester examinations for the three aspects of integrated science statistically differed significant ($p < 0.05$). The academic scores and performance of students in the mid-semester examination was better compared to the end-of-semester examination due to the less workload on students during the mid-semester than the end-of-semester examinations. Again, the level 100 students performed better in mid-semester examinations for the three aspects of integrated science than students in level 200 and 300 due to the flexible nature and less workload of the level 100 integrated science curriculum. Furthermore, some level 200 students (25 %) obtained scores below 50 in chemistry end-of-semester examination, suggesting that chemistry is difficult to some integrated science level 200 students as compared to physics and biology. Besides, about 25 % of the level 200 and 300 students obtained scores above 75 in end-of-semester chemistry examination, indicating that chemistry is the difficult aspect of integrated science at all levels among the students.

4.4 Students' sleep duration, sleep debt and vital statistics

The sleep duration and the heart rates of participants at the beginning, during and after mid-semester examination periods are presented in Table 14 while figure 4.2 presents the average levels of sleep debt among students. The systolic and diastolic blood pressure levels of students measured during the study period are highlighted in Table 15 and 16.

Critical analysis of the results reveals that students experienced lower sleep hours during examination periods than beginning and after examinations. The sleep duration observed after end-of-semester examination (7.26 hours) was higher compared to those obtained during the beginning (6.00 hours), mid-semester (3.70 hours) and end-of-

semester examination periods (2.72 hours), on average. According to Table 14, the lowest sleep hours among students was experienced during the end-of-semester examination due to the immense course workload and learning activities. The lower sleep hours among students during the mid-semester and end-of-semester examinations suggests that students experience massive sleep debt or deprivation during examination periods than non-examination periods as shown in Figure 6. The study found that the number of hours students slept at the beginning of the semester, during mid-semester and end-of-semester periods were below the acceptable range of values of 7-8 hours, on average. However, from table 14 the mean student sleep duration after the end-of-semester examination falls within the acceptable range of values (7-9 hours), indicating that students had enough sleep after examinations.

Table 14: Sleep duration and heartbeat rate of students

Variable	Sleep duration (hours)			Heartbeat rate (BPM)		
	Min	Mean $\pm$ SD	Max	Min	Mean $\pm$ SD	Max
Beginning the semester	3.00	6.00 $\pm$ 1.30	7.86	70.0	73.58 $\pm$ 2.52	77.0
Mid-semester	0.00	3.70 $\pm$ 1.30	4.88	73.0	77.08 $\pm$ 3.23	82.0
End-of-semester	0.00	2.72 $\pm$ 1.09	3.93	73.0	79.42 $\pm$ 3.07	85.0
After exams	6.00	7.26 $\pm$ 0.81	8.63	68.0	73.33 $\pm$ 3.89	82.0

BPM = Beat per minutes, SD = standard deviation

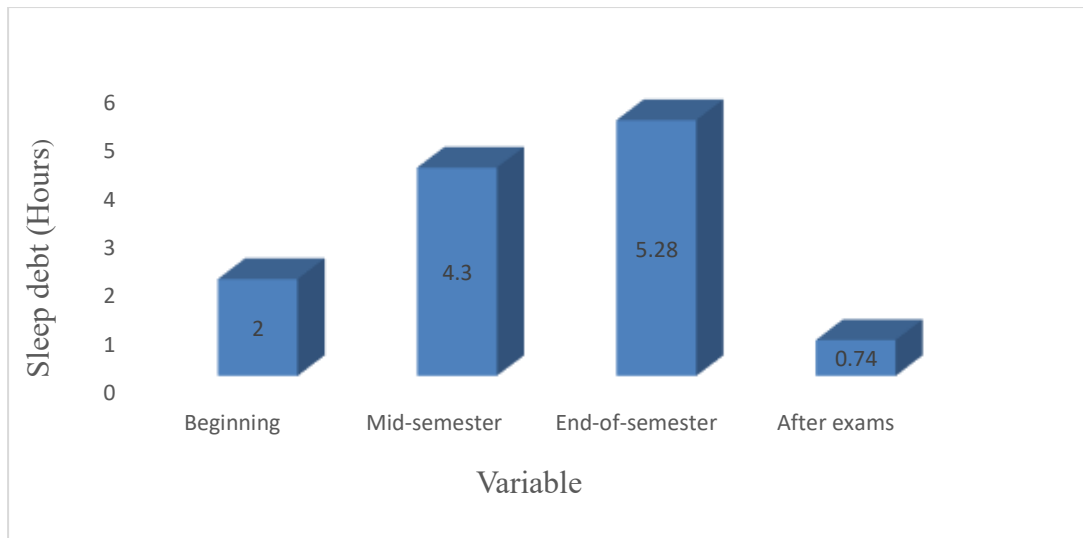


Figure 5: Average levels of sleep debt among students

Table 15: Systolic and diastolic blood pressure of students

Variables		Systolic Blood Pressure (mmHg)			Diastolic Blood Pressure (mmHg)		
		Min	Mean $\pm$ SD	Max	Min	Mean $\pm$ SD	Max
Beginning Semester	the	100	112.25 $\pm$ 7.41	119	63	70.00 $\pm$ 4.71	77
Mid-Semester		122	125.33 $\pm$ 2.30	129	71	75.08 $\pm$ 3.09	79
End of Semester		128	134.08 $\pm$ 2.95	139	79	84.25 $\pm$ 2.89	89
After Exams		98	111.00 $\pm$ 6.43	119	60	69.58 $\pm$ 5.61	79

From table 14, the levels of students' heartbeat rates ranged from 70-77, 73-82, 79-85 and 68-82 BPM at the beginning of the semester, during mid-semester and end-of-semester examinations. The highest mean levels of students' heartbeat rate and systolic and diastolic pressure were recorded during the end-of-semester examination followed by mid-semester examination while the lowest mean levels were obtained after end-of-semester examination. The increase in the students' heartbeat rates, and their diastolic and systolic pressures during the examinations could be attributed to the anxiety and loss of sleep during mid-semester and end-of-semester examinations. On average, the

heartbeat rates of participants at the study periods were within the normal acceptable range values of 60-100 BPM as recommended by the American Heart Association (2021). Besides, the average students' systolic blood pressure levels at the beginning and after examinations fall within the American Heart Association (2021) permissible values of 90-120 mmHg, indicating that the systolic pressure levels of students were normal. On the contrary, the average levels of systolic blood pressure of 125.33 and 134.08 mmHg measured among students during the mid and end-of-semester, respectively surpassed the threshold limit values of 90-120 as reported in table 15. This is a matter of concern from the health perspective. The loss of sleep coupled with stress could account for the significant levels of systolic blood pressure during the mid and end-of-semester examinations. Furthermore, the mean levels of diastolic blood pressure of 70.00 and 69.58 mmHg found in the beginning and after examinations, respectively, fall within the American Heart Association (2021) permissible values of 60-70 mmHg. Nonetheless, the average diastolic blood pressure levels of 75.08 and 84.25 mmHg recorded during mid and end-of-semester, respectively, were higher than the threshold values. According to Egan, Knutzen, and Tarantino (2011), university students experience sleep disorders, elevated stress, and high blood pressure due to intense academic performance requirements. On this premise, the high diastolic blood pressure recorded among students during mid and end-of-semester examinations could be attributed to massive sleep debt and stress due to the huge academic workload.

In summary, the average levels of systolic blood pressure of 125.33 and 134.08 mmHg measured among students during the mid and end-of-semester, respectively surpassed the threshold limit values of 90-120. This is a matter of concern from the health perspective. The loss of sleep coupled with stress could account for the significant levels of systolic blood pressure during the mid and end-of-semester examinations.

According to Egan et al. (2011), university students experience sleep disorders, elevated stress, and high blood pressure due to intense academic performance requirements. On this premise, the high diastolic blood pressure recorded among students during mid and end-of-semester examinations could be attributed to massive sleep debt and stress due to the huge academic workload.

4.5 Correlation between sleep habit variables and vital signs

The statistical correlation between sleep duration (SD) and students' systolic blood pressure (SBP) is shown in Table 16.

Table 16: Correlation analysis between systolic blood pressure and sleep duration

Exam Type	Variable	Sleep duration
Mid-semester exam	SBP	-0.72
	Exam scores	0.80
End-of-semester exam	SBP	-0.67
	Exam scores	0.77

*SBP = systolic blood pressure

From Table 16, there was a strong negative correlation between systolic blood pressure and sleep duration among students during both mid and end-of-semester examinations ($r = -0.67$ to -0.72). This finding was the same as that of Gangwisch (2014) who posited that short sleep duration is associated with an increased risk of hypertension. This suggests that a decrease in sleep duration during examination period increases systolic blood pressure of the students till it becomes normal. According to Womble (2001), experiencing prolonged sleep duration relieves students from stress thereby leading to a reduction in other health-related issues such as blood pressure. Therefore, there is a need for university students to practice sleep hygiene to promote good health and wellbeing. There was a substantial association between academic scores and sleep

duration ($r = 0.77-0.80$), suggesting that students' sleep duration influenced their academic scores. This finding was the same as that of researchers who speculated that short sleep duration was associated with lower academic scores (O'Brien, O'Brien, & Gershman, 2020; Dewald et al., 2010; Kelly et al., 2001).



CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter focuses on the summary of the findings, conclusions and recommendations based on the findings of this study.

5.1 Summary of Key Findings

The key findings of the study are summarised below:

The study's findings demonstrated that the sleep habits among the integrated science students were not encouraging. The greater proportion of the students (<70 %) reported that sleep deprivation adversely affected their academic performance. Finding of this study showed that more than half of the students (35, 58.3%) reported sleeping 5 hours and experienced sleep disorder and debt. The lowest sleep hours among students was experienced during the end-of-semester examination due to the immense course workload and learning activities.

The academic scores and performance of students in the mid-semester examination was better compared to the end-of-semester examination. Moreover, the integrated science students had better scores in biology and physics examinations than chemistry examinations. The academic scores of students in both mid and end-of semester examinations for the three aspects of integrated science statistically differed significant ($p < 0.05$).

The average levels of systolic blood pressure of 125.33 and 134.08 mmHg measured among students during the mid and end-of-semester, respectively surpassed the threshold limit values of 90-120. There was a strong negative correlation between

systolic blood pressure and sleep duration among students during both mid and end-of-semester examinations ($r=-0.67-0.72$). There was a substantial association between academic scores and sleep duration ($r = 0.77-0.80$), suggesting that students' sleep duration influenced their academic scores.

The research found out that sleep habits of the Integrated Science students at University of Education had significant influence on their academic performance, and health conditions.

5.2 Conclusions

The academic scores and performance of students in the mid-semester examination was better compared to the end-of-semester examination. Moreover, the integrated science students had better scores in biology and physics examinations than chemistry examinations. The average levels of systolic blood pressure of 125.33 and 134.08 mmHg measured among students during the mid and end-of-semester, respectively surpassed the threshold limit values of 90-120. More than half of the students (35, 58.3%) reported sleeping 5 hours and experienced sleep disorder causing massive sleep debt. The lowest sleep hours among students were experienced during the end-of-semester examination due to the immense course workload and learning activities. All in all, the sleep habits among the integrated science students were not encouraging. Students reported that sleep deprivation adversely affected their academic performance. Statistically, students' sleep duration influenced their academic scores ($r = 0.77-0.80$). Policy makers and academic counsellors need to develop targeted interventions such as sleep education programs to help students establish proper sleep habits and abate sleep debt health-related issues among students.

5.3 Recommendations

This study recommends that integrated science students at the University of Education, Winneba should practice time management to meet the University's rigorous academic requirements. Lecturers in the department of integrated science should also adjust assignments and project workloads to accommodate students' needs and lifestyles, so that their sleep is not compromised.

There should be no form of technology or electronic media (laptops, mobile phones, game consoles and or television sets) near the bedside, or preferably not in the bedroom where possible. The research can speculate that prevalent electronic devices usage before bedtime exert negative influence on sleep duration.

Integrated science students should limit their use of social media before bedtime, as it prevents them from obtaining 7 to 8 hours of sleep per day. There are multifactorial causes of low academic performance among students, yet the research can speculate bad sleep habits of students may be a major cause of low academic performance.

5.4 Suggestions for Further Study

Based on this research work, the following suggestions were made:

- Science Educationist should investigate the influence of sleep habits on the academic performance for all undergraduate students at the Faculty of Science at the University of Education, Winneba.
- Lecturers should investigate large sample sizes from different departments in the University of Education, Winneba in future related studies on this same topic to further explore the findings of this research.
- There is the need to investigate the long-term effects of insufficient sleep duration on the life span (mortality) of individuals with life-long academic

achievements goals in a longitudinal study. Besides, the prevalence of obesity and diabetes among the middle-aged full time undergraduate students with inadequate sleep duration need to be explored by researchers.



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APPENDICES

Appendices A

Sleep Habits and Academic Performance of University Students

Participants' Background History

Please answer the questionnaire by ticking the appropriate box. Once you have finished, please return the questionnaire to the primary investigator.

1. What is your gender:

Male. ☐ Female ☐

2. What is your age group?

17-18 years ☐ 19-20 years ☐ 21-22years ☐ 23-24 years ☐

25-26 years ☐ 27-28 years ☐ 29-30 years ☐ 31-32years ☐

33-34 years ☐ 35-36 years ☐ 37-38 years ☐ 39-40 years ☐

41-42 years ☐ 43-44 years ☐ 45 -46 years ☐ 47-48 years ☐

49-50 years ☐

Any other age category: From ___ to ___

3. What is your student classification at the institution:

Level 100 ☐ Level 200 ☐ Level 300 ☐

4. What is your WASSCE/SSCE Entry Grade into the University of Education, Winneba?

6 ☐ 7 ☐ 8 ☐ ☐ 10 ☐ 11 ☐

12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐

18 ☐ 19 ☐ 20 ☐ 21 ☐

Any Other Grade ☐

5. How many courses are you taking?

1 Course ☐ 2 Courses ☐ 3 Courses ☐ 4 Courses ☐

5 Courses ☐ 6 courses ☐ 6+ courses ☐

6. When do your classes normally begin each day?

7am ☐ 8am ☐ 9am ☐ 10am ☐ 11am ☐

12pm ☐ 1pm ☐ 2pm ☐ 3pm ☐ 4pm ☐

7. What is your cumulative GPA?

GPA of 3.50 or higher (Mostly As) ☐

GPA of 3.0 to 3.49 (Some As and Bs) ☐

GPA of 2.50 to 2.99 (Some Bs and Cs) ☐

GPA less than 2.00 (Lower than Cs) ☐

Sleep Habits Evaluation

8. Which of these sleep environment variables affect your sleep most?

Temperature too high ☐ Temperature too low ☐ Bed sharing ☐

Room sharing ☐ Bedroom intrusive noise ☐ Bedroom intrusive light ☐

Any other state : _____

9. How many hours of sleep do you get on average during any given night?

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐

9 ☐ 10 ☐ 10+ ☐

10. Do you feel that you get a sufficient amount of sleep?

Yes ☐ No ☐

11. Do you have any suspicion that you may have a sleeping disorder?

Yes ☐ No ☐

12. How many times do you wake up during the night on average?

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 10+ ☐

13. How often do you experience daytime sleepiness?

Never ☐ Rarely ☐ Occasionally ☐ Frequently ☐

14. How often do you experience difficulty in recalling answers when writing exams?

Never ☐ Rarely ☐ Occasionally ☐ Frequently ☐

15. How often do you believe your daytime sleepiness affects your academic performance?

Never ☐ Daily ☐ Weekly ☐ Monthly ☐

16. How many days in a week do you sleep during lectures?

Never ☐ 1 day ☐ 2 days ☐ 3 days ☐
4 days ☐ 5 days ☐ 6 days ☐ 7 days ☐

17. Are you on a regular sleep schedule in a week (that is; falling asleep and waking up at the same time?

Never ☐ Sometimes ☐ During the Week ☐
On the Weekends ☐ Always ☐

18. Do you think any of the following may have an impact on your quality of sleep?

Medication ☐ Stressful Lifestyle ☐ Work Schedule ☐
Class Schedule ☐ Course Workload ☐ Psychological Condition ☐

19. On a night before an exam, rate the amount of sleep hours compared to your normal sleep hours:

Much Less ☐ Less ☐ Average ☐ More ☐ Much More ☐

20. Do you use any of the following sleep aids?

Caffeine ☐ Sleeping pill/tablet ☐ Guided Imagery Meditation ☐

Nicotine ☐ Alcohol ☐ None ☐

Any Other State: _____

21. Which of the following do you think best enhances your duration of sleep?

Deep Breathing ☐ Muscle Relaxation ☐ Sleep Diary ☐

Regular Exercise ☐ Soothing Music ☐ None ☐

Any Other State: _____

Rate the following items on a scale of 0 to 10

22. Rate the impact of fully packed lectures in a day on your stress level

0 ☐

1-2 ☐

3-4 ☐

5-6 ☐

7-8 ☐

9-10 ☐



23. Rate the impact of stress on your duration of sleep

0 ☐

1-2 ☐

3-4 ☐

5-6 ☐

7-8 ☐

9-10 ☐

24. Rate the impact of sleep habits on your academic performance

0 ☐

1-2 ☐

3-4 ☐

5-6 ☐

7-8 ☐

9-10 ☐



Appendix B

Blood pressure (mmHg) readings of integrated science students at University of Education, Winneba

Before Exams Period	Mid-Semester Exams Period	End Of Semester Exams Period	After Exams Period
102 / 64	124 /70	131/82	98/72
111/67	122/69	133/84	101/74
117/73	125/77	135/87	116/70
119/65	128/74	134/81	116/70
109/74	126/77	137/86	108/72
121/75	126/75	135/89	119/76
114/76	126/79	132/86	115/65
112/68	129/71	136/84	113/70
100/70	127/72	139/88	112/60
102/63	122/74	132/86	118/79
118/68	122/75	128/79	106/71
122/77	127/79	137/89	110/65

Appendix C

Average Diastolic Blood Pressure Readings of Integrated Science Students at
University of Education, Winneba

Levels	Before Exams Period (mmHg)	Mid-Semester Exams Period (mmHg)	End Of Semester Exams Period (mmHg)	After Exams Period (mmHg)
	64	70	82	72
	67	69	84	74
Level 100	73	77	87	70
	65	74	81	70
Average	67.25	72.5	83.5	71.5
	74	77	86	72
	75	75	89	76
Level 200	76	79	86	65
	68	71	84	70
Average	73.25	75.5	86.25	70.75
	70	72	88	60
	63	74	86	79
Level 300	68	75	79	71
	77	79	89	65
Average	69.5	75.0	85.5	68.75

Appendix D

Mid-semester exams scores of students

Date of Recording	24th Jan. 2023	24th Jan. 2023	24th Jan. 2023	
Participants	Physics	Chemistry	Biology	Average Mid-Semester Exams Scores (100%)
1	80	90	92	87.3
2	80	90	92	87.3
3	80	90	92	87.3
4	80	90	92	87.3
5	80	90	92	87.3
6	89	83	80	84
7	89	83	80	84
8	89	83	80	84
9	89	83	80	84
10	89	83	80	84
11	82	80	92	84.7
12	82	80	92	84.7
13	82	80	92	84.7
14	82	80	92	84.7
15	82	80	92	84.7
16	76	83	90	83
17	76	83	90	83

18	76	83	90	83
19	76	83	90	83
20	76	83	90	83
21	65	64	58	62.3
22	65	64	58	62.3
23	65	64	58	62.3
24	65	64	58	62.3
25	65	64	58	62.3
26	55	85	90	76.7
27	55	85	90	76.7
28	55	85	90	76.7
29	55	85	90	76.7
30	55	85	90	76.7
31	74	59	72	68.3
32	74	59	72	68.3
33	74	59	72	68.3
34	74	59	72	68.3
35	74	59	72	68.3
36	80	55	83	72.7
37	80	55	83	72.7
38	80	55	83	72.7
39	80	55	83	72.7
40	80	55	83	72.7
41	80	80	74	78

42	80	80	74	78
43	80	80	74	78
44	80	80	74	78
45	80	80	74	78
46	80	81	80	80.3
47	80	81	80	80.3
48	80	81	80	80.3
49	80	81	80	80.3
50	80	81	80	80.3
51	85	87	86	86
52	85	87	86	86
53	85	87	86	86
54	85	87	86	86
55	85	87	86	86
56	60	72	71	67.7
57	60	72	71	67.7
58	60	72	71	67.7
59	60	72	71	67.7
60	60	72	71	67.7

Appendix E

End of semester examination scores

Date	24th Jan. 2023	24th Jan. 2023	24th Jan. 2023	
Participants	Physics	Chemistry	Biology	Average End of Semester Exams Scores (100%)
1	66	75	83	74.7
2	66	75	83	74.7
3	66	75	83	74.7
4	66	75	83	74.7
5	66	75	83	74.7
6	78	72	69	73
7	78	72	69	73
8	78	72	69	73
9	78	72	69	73
10	78	72	69	73
11	72	69	71	70.7
12	72	69	71	70.7
13	72	69	71	70.7
14	72	69	71	70.7
15	72	69	71	70.7
16	75	65	88	76
17	75	65	88	76

18	75	65	88	76
19	75	65	88	76
20	75	65	88	76
21	70	41	51	54
22	70	41	51	54
23	70	41	51	54
24	70	41	51	54
25	70	41	51	54
26	71	59	79	69.7
27	71	59	79	69.7
28	71	59	79	69.7
29	71	59	79	69.7
30	71	59	79	69.7
31	80	64	74	72.7
32	80	64	74	72.7
33	80	64	74	72.7
34	80	64	74	72.7
35	80	64	74	72.7
36	88	76	63	75.7
37	88	76	63	75.7
38	88	76	63	75.7
39	88	76	63	75.7
40	88	76	63	75.7
41	71	74	71	72

42	71	74	71	72
43	71	74	71	72
44	71	74	71	72
45	71	74	71	72
46	81	65	50	65.3
47	81	65	50	65.3
48	81	65	50	65.3
49	81	65	50	65.3
50	81	65	50	65.3
51	80	85	83	82.7
52	80	85	83	82.7
53	80	85	83	82.7
54	80	85	83	82.7
55	80	85	83	82.7
56	73	63	78	71.3
57	73	63	78	71.3
58	73	63	78	71.3
59	73	63	78	71.3
60	73	63	78	71.3

Appendix F

Summary of sleep durations of students in a semester

Participants	Beginning the Semester (min)	Mid-Semester Exams Period (min)	End of Semester Exams Period (min)	After Exams Period (min)
1	472	293	220	518
2	472	293	220	518
3	472	293	220	518
4	472	293	220	518
5	472	293	220	518
6	394	160	99	446
7	394	160	99	446
8	394	160	99	446
9	394	160	99	446
10	394	160	99	446
11	182	182	144	409
12	182	182	144	409
13	182	182	144	409
14	182	182	144	409
15	182	182	144	409
16	313	241	217	418
17	313	241	217	418
18	313	241	217	418
19	313	241	217	418

20	313	241	217	418
21	463	0	0	487
22	463	0	0	487
23	463	0	0	487
24	463	0	0	487
25	463	0	0	487
26	435	260	236	446
27	435	260	236	446
28	435	260	236	446
29	435	260	236	446
30	435	260	236	446
31	367	260	185	390
32	367	260	185	390
33	367	260	185	390
34	367	260	185	390
35	367	260	185	390
36	333	267	200	343
37	333	267	200	343
38	333	267	200	343
39	333	267	200	343
40	333	267	200	343
41	364	245	182	450
42	364	245	182	450
43	364	245	182	450

44	364	245	182	450
45	364	245	182	450
46	403	270	152	500
47	403	270	152	500
48	403	270	152	500
49	403	270	152	500
50	403	270	152	500
51	317	272	215	437
52	317	272	215	437
53	317	272	215	437
54	317	272	215	437
55	317	272	215	437
56	290	193	109	385
57	290	193	109	385
58	290	193	109	385
59	290	193	109	385
60	290	193	109	385

Appendix G

Average sleep debt of students in a semester per 8 hours (480mins)

S/N	Before Exams (min)	Mid Semester Exams (min)	End of Semester Exams (min)	After Exams (min)
1	-8	-187	-260	+38
2	-8	-187	-260	+38
3	-8	-187	-260	+38
4	-8	-187	-260	+38
5	-8	-187	-260	+38
6	-86	-320	-381	-34
7	-86	-320	-381	-34
8	-86	-320	-381	-34
9	-86	-320	-381	-34
10	-86	-320	-381	-34
11	-298	-298	-336	-81
12	-298	-298	-336	-81
13	-298	-298	-336	-81
14	-298	-298	-336	-81
15	-298	-298	-336	-81
16	-167	-239	-263	-62
17	-167	-239	-263	-62
18	-167	-239	-263	-62
19	-167	-239	-263	-62
20	-167	-239	-263	-62
21	-17	-480	-480	+7
22	-17	-480	-480	+7
23	-17	-480	-480	+7
24	-17	-480	-480	+7
25	-17	-480	-480	+7
26	-45	220	-244	-34
27	-45	220	-244	-34

28	-45	220	-244	-34
29	-45	220	-244	-34
30	-45	220	-244	-34
31	-113	-220	-295	-90
32	-113	-220	-295	-90
33	-113	-220	-295	-90
34	-113	-220	-295	-90
35	-113	-220	-295	-90
36	-147	-213	-280	-137
37	-147	-213	-280	-137
38	-147	-213	-280	-137
39	-147	-213	-280	-137
40	-147	-213	-280	-137
41	-116	-235	-298	-30
42	-116	-235	-298	-30
43	-116	-235	-298	-30
44	-116	-235	-298	-30
45	-116	-235	-298	-30
46	-77	-210	-328	+20
47	-77	-210	-328	+20
48	-77	-210	-328	+20
49	-77	-210	-328	+20
50	-77	-210	328	+20
51	-163	-208	-184	-43
52	-163	-208	-184	-43
53	-163	-208	-184	-43
54	-163	-208	-184	-43
55	-163	-208	-184	-43
56	-190	-287	-371	-95
57	-190	-287	-371	-95
58	-190	-287	-371	-95
59	-190	-287	-371	-95
-60	-190	-287	-371	-95

* Negative (-)/ sleep debt; Positive (+)/ hypersomnia

Appendix H

Individual sleep durations of students at the beginning of the semester

Daily Sleep Durations of Participants Before Writing Exams Period							
Date	18th	19th	20th	21st	22nd	23rd	24th
	Sept.,	Sept.	Sept	Sept.	Sept.	Sept.	Sept.
	2022	2022	2022	2022	2022	2022	2022
Participants	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	497	471	485	472	460	438	481
2	497	471	485	472	460	438	481
3	497	471	485	472	460	438	481
4	497	471	485	472	460	438	481
5	497	471	485	472	460	438	481
6	391	404	412	400	393	360	398
7	391	404	412	400	393	360	398
8	391	404	412	400	393	360	398
9	391	404	412	400	393	360	398
10	391	404	412	400	393	360	398
11	167	210	182	200	126	182	208
12	167	210	182	200	126	182	208
13	167	210	182	200	126	182	208
14	167	210	182	200	126	182	208
15	167	210	182	200	126	182	208
16	321	361	309	302	316	289	293

17	321	361	309	302	316	289	293
18	321	361	309	302	316	289	293
19	321	361	309	302	316	289	293
20	321	361	309	302	316	289	293
21	442	465	444	456	485	479	469
22	442	465	444	456	485	479	469
23	442	465	444	456	485	479	469
24	442	465	444	456	485	479	469
25	442	465	444	456	485	479	469
26	458	447	432	445	438	401	424
27	458	447	432	445	438	401	424
28	458	447	432	445	438	401	424
29	458	447	432	445	438	401	424
30	458	447	432	445	438	401	424
31	345	339	360	354	350	381	440
32	345	339	360	354	350	381	440
33	345	339	360	354	350	381	440
34	345	339	360	354	350	381	440
35	345	339	360	354	350	381	440
36	383	341	315	299	326	352	315
37	383	341	315	299	326	352	315
38	383	341	315	299	326	352	315
39	383	341	315	299	326	352	315
40	383	341	315	299	326	352	315

41	296	391	350	384	409	369	350
42	296	391	350	384	409	369	350
43	296	391	350	384	409	369	350
44	296	391	350	384	409	369	350
45	296	391	350	384	409	369	350
46	427	414	439	392	395	408	347
47	427	414	439	392	395	408	347
48	427	414	439	392	395	408	347
49	427	414	439	392	395	408	347
50	427	414	439	392	395	408	347
51	318	296	257	231	353	375	389
52	318	296	257	231	353	375	389
53	318	296	257	231	353	375	389
54	318	296	257	231	353	375	389
55	318	296	257	231	353	375	389
56	305	338	304	299	289	278	234
57	405	348	304	299	289	278	234
58	405	348	304	299	289	278	234
59	405	348	304	299	289	278	234
60	405	348	304	299	289	278	234

Individual sleep durations of students during mid-semester examinations

Date	3rd Oct. 2022	5th Oct. 2022	7th Oct. 2022	
Participants	Day 1	Day 2	Day 3	Average Sleep Duration of Participants (min)
1	200	308	371	293
2	200	308	371	293
3	200	308	371	293
4	200	308	371	293
5	200	308	371	293
6	102	154	223	160
7	102	154	223	160
8	102	154	223	160
9	102	154	223	160
10	102	154	223	160
11	165	182	198	182
12	165	182	198	182
13	165	182	198	182
14	165	182	198	182
15	165	182	198	182
16	224	233	266	241
17	224	233	266	241
18	224	233	266	241

19	224	233	266	241
20	224	233	266	241
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
24	0	0	0	0
25	0	0	0	0
26	153	324	302	260
27	153	324	302	260
28	153	324	302	260
29	153	324	302	260
30	153	324	302	260
31	228	260	292	260
32	228	260	292	260
33	228	260	292	260
34	228	260	292	260
35	228	260	292	260
36	206	281	313	267
37	206	281	313	267
38	206	281	313	267
39	206	281	313	267
40	206	281	313	267
41	281	152	302	245
42	281	152	302	245

43	281	152	302	245
44	281	152	302	245
45	281	152	302	245
46	300	184	326	270
47	300	184	326	270
48	300	184	326	270
49	300	184	326	270
50	300	184	326	270
51	189	295	331	272
52	189	295	331	272
53	189	295	331	272
54	189	295	331	272
55	189	295	331	272
56	201	185	192	193
57	201	185	192	193
58	201	185	192	193
59	201	185	192	193
60	201	185	192	193

Individual sleep durations of students during end of semester examinations

	Physics	Chemistry	Biology	
Date	21st Nov. 2022	24th Nov. 2022	29th Nov. 2022	
Participants	Day 1	Day 2	Day 3	Average Sleep Duration of Participants (min)
1	210	228	221	220
2	210	228	221	220
3	210	228	221	220
4	210	228	221	220
5	210	228	221	220
6	96	97	105	99
7	96	97	105	99
8	96	97	105	99
9	96	97	105	99
10	96	97	105	99
11	128	150	154	144
12	128	150	154	144
13	128	150	154	144
14	128	150	154	144
15	128	150	154	144
16	201	209	241	217
17	201	209	241	217
18	201	209	241	217

19	201	209	241	217
20	201	209	241	217
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
24	0	0	0	0
25	0	0	0	0
26	212	253	243	236
27	212	253	243	236
28	212	253	243	236
29	212	253	243	236
30	212	253	243	236
31	196	187	173	185
32	196	187	173	185
33	196	187	173	185
34	196	187	173	185
35	196	187	173	185
36	194	205	201	200
37	194	205	201	200
38	194	205	201	200
39	194	205	201	200
40	194	205	201	200
41	179	186	182	182
42	179	186	182	182

43	179	186	182	182
44	179	186	182	182
45	179	186	182	182
46	146	168	142	152
47	146	168	142	152
48	146	168	142	152
49	146	168	142	152
50	146	168	142	152
51	208	200	236	215
52	208	200	236	215
53	208	200	236	215
54	208	200	236	215
55	208	200	236	215
56	101	112	114	109
57	101	112	114	109
58	101	112	114	109
59	101	112	114	109
60	101	112	114	109

Individual sleep durations of students after writing semester examinations

Date	8th Oct. 2022	9th Oct. 2022	10th Oct. 2022	11th Oct. 2022	9th Dec. 2022	10th Dec. 2022	11th Dec. 2022	
Part icipa nts	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Mean Sleep Duration of Participants (min)
1	491	514	490	502	525	531	450	500
2	491	514	490	502	525	531	450	500
3	491	514	490	502	525	531	450	500
4	491	514	490	502	525	531	450	500
5	491	514	490	502	525	531	450	500
6	525	513	501	519	510	520	528	516
7	525	513	501	519	510	520	528	516
8	525	513	501	519	510	520	528	516
9	525	513	501	519	510	520	528	516
10	525	513	501	519	510	520	528	516
11	397	413	418	402	434	408	391	409
12	397	413	418	402	434	408	391	409
13	397	413	418	402	434	408	391	409
14	397	413	418	402	434	408	391	409
15	397	413	418	402	434	408	391	409
16	400	445	420	417	413	421	411	418

17	400	445	420	417	413	421	411	418
18	400	445	420	417	413	421	411	418
19	400	445	420	417	413	421	411	418
20	400	445	420	417	413	421	411	418
21	557	554	585	559	571	588	577	570
22	557	554	585	559	571	588	577	570
23	557	554	585	559	571	588	577	570
24	557	554	585	559	571	588	577	570
25	557	554	585	559	571	588	577	570
26	460	474	451	431	436	428	445	446
27	460	474	451	431	436	428	445	446
28	460	474	451	431	436	428	445	446
29	460	474	451	431	436	428	445	446
30	460	474	451	431	436	428	445	446
31	410	396	416	372	383	422	331	390
32	410	396	416	372	383	422	331	390
33	410	396	416	372	383	422	331	390
34	410	396	416	372	383	422	331	390
35	410	396	416	372	383	422	331	390
36	341	366	323	334	371	301	367	343
37	341	366	323	334	371	301	367	343
38	341	366	323	334	371	301	367	343
39	341	366	323	334	371	301	367	343
40	341	366	323	334	371	301	367	343

41	441	457	448	466	435	465	441	450
42	441	457	448	466	435	465	441	450
43	441	457	448	466	435	465	441	450
44	441	457	448	466	435	465	441	450
45	441	457	448	466	435	465	441	450
46	459	512	492	527	521	513	477	500
47	459	512	492	527	521	513	477	500
48	459	512	492	527	521	513	477	500
49	459	512	492	527	521	513	477	500
50	459	512	492	527	521	513	477	500
51	441	445	430	432	461	423	428	437
52	441	445	430	432	461	423	428	437
53	441	445	430	432	461	423	428	437
54	441	445	430	432	461	423	428	437
55	441	445	430	432	461	423	428	437
56	415	335	405	389	367	361	423	385
57	415	335	405	389	367	361	423	385
58	415	335	405	389	367	361	423	385
59	415	335	405	389	367	361	423	385
60	415	335	405	389	367	361	423	385

Appendix I**Systolic blood pressure at the beginning of the semester**

	18th Sept., 2022	19th Sept. 2022	20th Sept 2022	21st Sept. 2022	22nd Sept. 2022	23rd Sept. 2022	24th Sept. 2022
Participants	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	106	100	105	98	101	102	104
2	106	100	105	98	101	102	104
3	106	100	105	98	101	102	104
4	106	100	105	98	101	102	104
5	106	100	105	98	101	102	104
6	119	119	118	119	119	118	119
7	119	119	118	119	119	118	119
8	119	119	118	119	119	118	119
9	119	119	118	119	119	118	119
10	119	119	118	119	119	118	119
11	114	119	117	118	115	118	118
12	114	119	117	118	115	118	118
13	114	119	117	118	115	118	118
14	114	119	117	118	115	118	118
15	114	119	117	118	115	118	118
16	119	106	108	110	112	111	112
17	119	106	108	110	112	111	112

18	119	106	108	110	112	111	112
19	119	106	108	110	112	111	112
20	119	106	108	110	112	111	112
21	119	106	108	117	107	116	112
22	119	106	108	117	107	116	112
23	119	106	108	117	107	116	112
24	119	106	108	117	107	116	112
25	119	106	108	117	107	116	112
26	104	107	101	111	112	112	115
27	104	107	101	111	112	112	115
28	104	107	101	111	112	112	115
29	104	107	101	111	112	112	115
30	104	107	101	111	112	112	115
31	120	122	121	121	121	123	120
32	120	122	121	124	121	123	120
33	120	122	121	124	121	123	120
34	120	122	121	124	121	123	120
35	120	122	121	124	121	123	120
36	117	114	117	115	114	111	112
37	117	114	117	115	114	111	112
38	117	114	117	115	114	111	112
39	117	114	117	115	114	111	112
40	117	114	117	115	114	111	112
41	100	100	100	102	101	101	98

42	100	100	100	102	101	101	98
43	100	100	100	102	101	101	98
44	100	100	100	102	101	101	98
45	100	100	100	102	101	101	98
46	101	104	103	102	100	100	102
47	101	104	103	102	100	100	102
48	101	104	103	102	100	100	102
49	101	104	103	102	100	100	102
50	101	104	103	102	100	100	102
51	119	118	117	116	119	118	119
52	119	118	117	116	119	118	119
53	119	118	117	116	119	118	119
54	119	118	117	116	119	118	119
55	119	118	117	116	119	118	119
56	120	121	120	123	121	125	122
57	120	121	120	123	121	125	122
58	120	121	120	123	121	125	122
59	120	121	120	123	121	125	122
60	120	121	120	123	121	125	122

Systolic blood pressure of students during the mid-semester examinations

	Daily Systolic Blood Pressure During Mid-Semester Exams Period			
Date	3rd Oct. 2022	5th Oct. 2022	7th Oct. 2022	
Participants	Day 1	Day 2	Day 3	Average Individual Readings (mmHg)
1	125	123	123	124
2	125	123	123	124
3	125	123	123	124
4	125	123	123	124
5	125	123	123	124
6	129	128	128	128
7	129	128	128	128
8	129	128	128	128
9	129	128	128	128
10	129	128	128	128
11	124	125	127	125
12	124	125	127	125
13	124	125	127	125
14	124	125	127	125
15	124	125	127	125
16	124	121	120	122
17	124	121	120	122
18	124	121	120	122

19	124	121	120	122
20	124	121	120	122
21	128	129	129	129
22	128	129	129	129
23	128	129	129	129
24	128	129	129	129
25	128	129	129	129
26	126	126	126	126
27	126	126	126	126
28	126	126	126	126
29	126	126	126	126
30	126	126	126	126
31	127	125	126	126
32	127	125	126	126
33	127	125	126	126
34	127	125	126	126
35	127	125	126	126
36	126	124	127	126
37	126	124	127	126
38	126	124	127	126
39	126	124	127	126
40	126	124	127	126
41	127	126	129	127
42	127	126	129	127

43	127	126	129	127
44	127	126	129	127
45	127	126	129	127
46	121	122	124	122
47	121	122	124	122
48	121	122	124	122
49	121	122	124	122
50	121	122	124	122
51	122	122	122	122
52	122	122	122	122
53	122	122	122	122
54	122	122	122	122
55	122	122	122	122
56	125	126	129	127
57	125	126	129	127
58	125	126	129	127
59	125	126	129	127
60	125	126	129	127

Systolic blood pressure of students during end of semester examinations

	Physics	Chemistry	Biology	
Date	21st Nov. 2022	24th Nov. 2022	29th Nov. 2022	
Participants	Day 1	Day 2	Day 3	Average of Participants Systolic Blood Pressure (mmHg)
1	130	132	131	131
2	130	132	131	131
3	130	132	131	131
4	130	132	131	131
5	130	132	131	131
6	135	133	134	134
7	135	133	134	134
8	135	133	134	134
9	135	133	134	134
10	135	133	134	134
11	133	136	137	135
12	133	136	137	135
13	133	136	137	135
14	133	136	137	135
15	133	136	137	135
16	131	134	133	133
17	131	134	133	133

18	131	134	133	133
19	131	134	133	133
20	131	134	133	133
21	133	137	137	136
22	133	137	137	136
23	133	137	137	136
24	133	137	137	136
25	133	137	137	136
26	138	139	133	137
27	138	139	133	137
28	138	139	133	137
29	138	139	133	137
30	138	139	133	137
31	133	135	136	135
32	133	135	136	135
33	133	135	136	135
34	133	135	136	135
35	133	135	136	135
36	131	132	133	132
37	131	132	133	132
38	131	132	133	132
39	131	132	133	132
40	131	132	133	132
41	139	139	138	139

42	139	139	138	139
43	139	139	138	139
44	139	139	138	139
45	139	139	138	139
46	130	134	132	132
47	130	134	132	132
48	130	134	132	132
49	130	134	132	132
50	130	134	132	132
51	126	130	128	128
52	126	130	128	128
53	126	130	128	128
54	126	130	128	128
55	126	130	128	128
56	138	137	137	137
57	138	137	137	137
58	138	137	137	137
59	138	137	137	137
60	138	137	137	137

Systolic blood pressure after writing examinations

Daily Systolic Blood Pressure After Writing Mid and End of Sem Exams							
Date	8th Oct. 2022	9th Oct. 2022	10th Oct. 2022	11th Oct. 2022	9th Dec. 2022	10th Dec. 2022	11th Dec. 2022
Participants	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	100	97	98	97	96	101	99
2	100	97	98	97	96	101	99
3	100	97	98	97	96	101	99
4	100	97	98	97	96	101	99
5	100	97	98	97	96	101	99
6	118	113	115	114	117	118	115
7	118	113	115	114	117	118	115
8	118	113	115	114	117	118	115
9	118	113	115	114	117	118	115
10	118	113	115	114	117	118	115
11	117	114	116	115	117	118	115
12	117	114	116	115	117	118	115
13	117	114	116	115	117	118	115
14	117	114	116	115	117	118	115

15	117	114	116	115	117	118	115
16	100	102	102	103	100	101	99
17	100	102	102	103	100	101	99
18	100	102	102	103	100	101	99
19	100	102	102	103	100	101	99
20	100	102	102	103	100	101	99
21	116	113	111	115	111	114	110
22	116	113	111	115	111	114	110
23	116	113	111	115	111	114	110
24	116	113	111	115	111	114	110
25	116	113	111	115	111	114	110
26	107	106	107	105	106	111	114
27	107	106	107	105	106	111	114
28	107	106	107	105	106	111	114
29	107	106	107	105	106	111	114
30	107	106	107	105	106	111	114
31	119	119	118	119	119	119	118
32	119	119	118	119	119	119	118
33	119	119	118	119	119	119	118
34	119	119	118	119	119	119	118
35	119	119	118	119	119	119	118
36	116	115	114	114	116	114	117
37	116	115	114	114	116	114	117
38	116	115	114	114	116	114	117

39	116	115	114	114	116	114	117
40	116	115	114	114	116	114	117
41	114	109	112	113	110	112	113
42	114	109	112	113	110	112	113
43	114	109	112	113	110	112	113
44	114	109	112	113	110	112	113
45	114	109	112	113	110	112	113
46	117	119	119	118	116	119	117
47	117	119	119	118	116	119	117
48	117	119	119	118	116	119	117
49	117	119	119	118	116	119	117
50	117	119	119	118	116	119	117
51	109	108	107	107	105	105	103
52	109	108	107	107	105	105	103
53	109	108	107	107	105	105	103
54	109	108	107	107	105	105	103
55	109	108	107	107	105	105	103
56	110	110	111	108	109	113	108
57	110	110	111	108	109	113	108
58	110	110	111	108	109	113	108
59	110	110	111	108	109	113	108
60	110	110	111	108	109	113	108

Appendix J**Diastolic blood pressure at the beginning of the semester**

Date	18th Sept., 2022	19th Sept. 2022	20th Sept 2022	21st Sept. 2022	22nd Sept. 2022	23rd Sept. 2022	24th Sept. 2022
Participants	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	62	62	63	64	65	65	67
2	62	62	63	64	65	65	67
3	62	62	63	64	65	65	67
4	62	62	63	64	65	65	67
5	62	62	63	64	65	65	67
6	68	70	67	68	69	68	68
7	68	70	67	68	69	68	68
8	68	70	67	68	69	68	68
9	68	70	67	68	69	68	68
10	68	70	67	68	69	68	68
11	72	73	72	75	74	72	72
12	72	73	72	75	74	72	72
13	72	73	72	75	74	72	72
14	72	73	72	75	74	72	72
15	72	73	72	75	74	72	72
16	69	62	63	67	67	64	65
17	69	62	63	67	67	64	65

18	69	62	63	67	67	64	65
19	69	62	63	67	67	64	65
20	69	62	63	67	67	64	65
21	75	73	73	73	75	74	73
22	75	73	73	73	75	74	73
23	75	73	73	73	75	74	73
24	75	73	73	73	75	74	73
25	75	73	73	73	75	74	73
26	73	74	78	75	73	74	75
27	73	74	78	75	73	74	75
28	73	74	78	75	73	74	75
29	73	74	78	75	73	74	75
30	73	74	78	75	73	74	75
31	77	74	79	73	76	75	77
32	77	74	79	73	76	75	77
33	77	74	79	73	76	75	77
34	77	74	79	73	76	75	77
35	77	74	79	73	76	75	77
36	69	69	67	65	66	67	70
37	69	69	67	65	66	67	70
38	69	69	67	65	66	67	70
39	69	69	67	65	66	67	70
40	69	69	67	65	66	67	70
41	75	70	74	66	70	66	71

42	75	70	74	66	70	66	71
43	75	70	74	66	70	66	71
44	75	70	74	66	70	66	71
45	75	70	74	66	70	66	71
46	62	61	63	63	65	63	62
47	62	61	63	63	65	63	62
48	62	61	63	63	65	63	62
49	62	61	63	63	65	63	62
50	62	61	63	63	65	63	62
51	69	69	62	67	67	68	73
52	69	69	62	67	67	68	73
53	69	69	62	67	67	68	73
54	69	69	62	67	67	68	73
55	69	69	62	67	67	68	73
56	78	79	78	77	75	78	74
57	78	79	78	77	75	78	74
58	78	79	78	77	75	78	74
59	78	79	78	77	75	78	74
60	78	79	78	77	75	78	74

Diastolic blood pressure during mid-semester examinations

Daily Diastolic Blood Pressure During Mid-Semester Exams (mmHg)	Physics	Chem istry	Biology	
Date	3rd Oct. 2022	5th Oct. 2022	7th Oct. 2022	
Participants	Day 1	Day 2	Day 3	Average Diastolic Blood Pressure (mmHg)
1	73	72	71	72
2	73	72	71	72
3	73	72	71	72
4	73	72	71	72
5	73	72	71	72
6	68	71	73	71
7	68	71	73	71
8	68	71	73	71
9	68	71	73	71
10	68	71	73	71
11	79	79	75	78
12	79	79	75	78
13	79	79	75	78
14	79	79	75	78

15	79	79	75	78
16	79	77	74	77
17	79	77	74	77
18	79	77	74	77
19	79	77	74	77
20	79	77	74	77
21	76	77	64	74
22	76	77	64	74
23	76	77	64	74
24	76	77	64	74
25	76	77	64	74
26	73	78	74	75
27	73	78	74	75
28	73	78	74	75
29	73	78	74	75
30	73	78	74	75
31	78	79	79	79
32	78	79	79	79
33	78	79	79	79
34	78	79	79	79
35	78	79	79	79
36	70	72	70	71
37	70	72	70	71
38	70	72	70	71

39	70	72	70	71
40	70	72	70	71
41	70	73	73	72
42	70	73	73	72
43	70	73	73	72
44	70	73	73	72
45	70	73	73	72
46	72	79	71	74
47	72	79	71	74
48	72	79	71	74
49	72	79	71	74
50	72	79	71	74
51	79	79	79	79
52	79	79	79	79
53	79	79	79	79
54	79	79	79	79
55	79	79	79	79
56	79	79	79	79
57	79	79	79	79
58	79	79	79	79
59	79	79	79	79
60	79	79	79	79

Diastolic blood pressure of students during end of semester examinations

Daily Diastolic Blood Pressure During End of Semster Exams (mmHg)	Physic s	Chem istry	Biology	
Date	21st Nov. 2022	24th Nov. 2022	29th Nov. 2022	
Participants	Day 1	Day 2	Day 3	Average Diastolic Blood Pressure (mmHg)
1	81	82	83	82
2	81	82	83	82
3	81	82	83	82
4	81	82	83	82
5	81	82	83	82
6	83	84	84	84
7	83	84	84	84
8	83	84	84	84
9	83	84	84	84
10	83	84	84	84
11	87	88	86	87
12	87	88	86	87
13	87	88	86	87
14	87	88	86	87

15	87	88	86	87
16	81	82	81	81
17	81	82	81	81
18	81	82	81	81
19	81	82	81	81
20	81	82	81	81
21	82	81	82	81
22	82	81	82	81
23	82	81	82	81
24	82	81	82	81
25	82	81	82	81
26	87	86	89	87
27	87	86	89	87
28	87	86	89	87
29	87	86	89	87
30	87	86	89	87
31	86	86	87	86
32	86	86	87	86
33	86	86	87	86
34	86	86	87	86
35	86	86	87	86
36	85	84	83	84
37	85	84	83	84
38	85	84	83	84

39	85	84	83	84
40	85	84	83	84
41	86	85	84	85
42	86	85	84	85
43	86	85	84	85
44	86	85	84	85
45	86	85	84	85
46	85	87	85	86
47	85	87	85	86
48	85	87	85	86
49	85	87	85	86
50	85	87	85	86
51	79	80	79	79
52	79	80	79	79
53	79	80	79	79
54	79	80	79	79
55	79	80	79	79
56	89	89	88	89
57	89	89	88	89
58	89	89	88	89
59	89	89	88	89
60	89	89	88	89

Diastolic blood pressure after writing examinations

Date	8th Oct. 2022	9th Oct. 2022	10th Oct. 2022	30th Nov. 2022	9th Dec. 2022	10th Dec. 2022	11th Dec. 2022	
Part icip ants	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Mean Individual's Diastolic Blood Pressure (mmHg)
1	70	73	71	73	73	70	74	72
2	70	73	71	73	73	70	74	72
3	70	73	71	73	73	70	74	72
4	70	73	71	73	73	70	74	72
5	70	73	71	73	73	70	74	72
6	79	75	74	72	70	73	75	74
7	79	75	74	72	70	73	75	74
8	79	75	74	72	70	73	75	74
9	79	75	74	72	70	73	75	74
10	79	75	74	72	70	73	75	74
11	63	61	62	61	60	61	60	61
12	63	61	62	61	60	61	60	61
13	63	61	62	61	60	61	60	61
14	63	61	62	61	60	61	60	61
15	63	61	62	61	60	61	60	61
16	69	69	71	72	69	70	71	70
17	69	69	71	72	69	70	71	70

18	69	69	71	72	69	70	71	70
19	69	69	71	72	69	70	71	70
20	69	69	71	72	69	70	71	70
21	72	76	70	69	70	74	72	72
22	72	76	70	69	70	74	72	72
23	72	76	70	69	70	74	72	72
24	72	76	70	69	70	74	72	72
25	72	76	70	69	70	74	72	72
26	74	77	73	78	79	74	77	76
27	74	77	73	78	79	74	77	76
28	74	77	73	78	79	74	77	76
29	74	77	73	78	79	74	77	76
30	74	77	73	78	79	74	77	76
31	64	63	66	66	67	65	65	65
32	64	63	66	66	67	65	65	65
33	64	63	66	66	67	65	65	65
34	64	63	66	66	67	65	66	65
35	64	63	66	66	67	65	66	65
36	71	70	70	70	70	71	70	70
37	71	70	70	70	70	71	70	70
38	71	70	70	70	70	71	70	70
39	71	70	70	70	70	71	70	70
40	71	70	70	70	70	71	70	70
41	60	60	60	60	60	61	61	60

42	60	60	60	60	60	61	61	60
43	60	60	60	60	60	61	61	60
44	60	60	60	60	60	61	61	60
45	60	60	60	60	60	61	61	60
46	79	79	79	79	79	77	78	79
47	79	79	79	79	79	77	78	79
48	79	79	79	79	79	77	78	79
49	79	79	79	79	79	77	78	79
50	79	79	79	79	79	77	78	79
51	72	70	72	70	71	70	72	71
52	72	70	72	70	71	70	72	71
53	72	70	72	70	71	70	72	71
54	72	70	72	70	71	70	72	71
55	72	70	72	70	71	70	72	71
56	66	63	67	65	64	66	65	65
57	66	63	67	65	64	66	65	65
58	66	63	67	65	64	66	65	65
59	66	63	67	65	64	66	65	65
60	66	63	67	65	64	66	65	65

Appendix K

Daily heart beat rates (BPM) at the beginning of the semester

Daily Heart Rates of Participants Before Writing Exams							
Date	18th Sept., 2022	19th Sept. 2022	20th Sept 2022	21st Sept. 2022	22nd Sept. 2022	23rd Sept. 2022	24th Sept. 2022
Partici pants	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	72	68	70	71	71	68	72
2	72	68	70	71	71	68	72
3	72	68	70	71	71	68	72
4	72	68	70	71	71	68	72
5	72	68	70	71	71	68	72
6	72	73	71	72	73	70	71
7	72	73	71	72	73	70	71
8	72	73	71	72	73	70	71
9	72	73	71	72	73	70	71
10	72	73	71	72	73	70	71
11	78	76	77	77	77	76	78
12	78	76	77	77	77	76	78
13	78	76	77	77	77	76	78
14	78	76	77	77	77	76	78

15	78	76	77	77	77	76	78
16	75	75	78	75	77	76	76
17	75	75	78	75	77	76	76
18	75	75	78	75	77	76	76
19	75	75	78	75	77	76	76
20	75	75	78	75	77	76	76
21	75	76	76	75	76	76	75
22	75	76	76	75	76	76	75
23	75	76	76	75	76	76	75
24	75	76	76	75	76	76	75
25	75	76	76	75	76	76	75
26	70	71	70	72	71	70	70
27	70	71	70	72	71	70	70
28	70	71	70	72	71	70	70
29	70	71	70	72	71	70	70
30	70	71	70	72	71	70	70
31	74	75	73	71	74	72	73
32	74	75	73	71	74	72	73
33	74	75	73	71	74	72	73
34	74	75	73	71	74	72	73
35	74	75	73	71	74	72	73
36	73	73	72	72	73	70	71
37	73	73	72	72	73	70	71
38	73	73	72	72	73	70	71

39	73	73	72	72	73	70	71
40	73	73	72	72	73	70	71
41	71	72	69	70	71	69	70
42	71	72	69	70	71	69	70
43	71	72	69	70	71	69	70
44	71	72	69	70	71	69	70
45	71	72	69	70	71	69	70
46	74	75	74	75	74	73	74
47	74	75	74	75	74	73	74
48	74	75	74	75	74	73	74
49	74	75	74	75	74	73	74
50	74	75	74	75	74	73	74
51	75	75	76	76	75	76	74
52	75	75	76	76	75	76	74
53	75	75	76	76	75	76	74
54	75	75	76	76	75	76	74
55	75	75	76	76	75	76	74
56	77	77	76	77	76	75	78
57	77	77	76	77	76	75	78
58	77	77	76	77	76	75	78
59	77	77	76	77	76	75	78
60	77	77	76	77	76	75	78

Daily heart beat rates (BPM) during mid-semester examinations

Daily Heart Rates During Mid Semester Exams	Physics	Chemistry	Biology	
	3rd Oct. 2022	5th Oct. 2022	7th Oct. 2022	
Participants	Day 1	Day 2	Day 3	Average Heart Rate During Mid-Semester
1	80	82	80	81
2	80	82	80	81
3	80	82	80	81
4	80	82	80	81
5	80	82	80	81
6	76	78	77	77
7	76	78	77	77
8	76	78	77	77
9	76	78	77	77
10	76	78	77	77
11	78	79	79	79
12	78	79	79	79
13	78	79	79	79
14	78	79	79	79
15	78	79	79	79
16	82	81	82	82

17	82	81	82	82
18	82	81	82	82
19	82	81	82	82
20	82	81	82	82
21	80	79	83	81
22	80	79	83	81
23	80	79	83	81
24	80	79	83	81
25	80	79	83	81
26	74	77	77	76
27	74	77	77	76
28	74	77	77	76
29	74	77	77	76
30	74	77	77	76
31	74	72	73	73
32	74	72	73	73
33	74	72	73	73
34	74	72	73	73
35	74	72	73	73
36	77	75	74	74
37	77	75	74	74
38	77	75	74	74
39	77	75	74	74
40	77	75	74	74

41	74	76	72	73
42	74	76	72	73
43	74	76	72	73
44	74	76	72	73
45	74	76	72	73
46	79	79	79	79
47	79	79	79	79
48	79	79	79	79
49	79	79	79	79
50	79	79	79	79
51	78	76	77	77
52	78	76	77	77
53	78	76	77	77
54	78	76	77	77
55	78	76	77	77
56	74	71	74	73
57	74	71	74	73
58	74	71	74	73
59	74	71	74	73
60	74	71	74	73

Daily heart beat rates (BPM) during end of semester examination

Daily Heart Rates During End of Semester Exams				
Date	21st Nov. 2022	24th Nov. 2022	29th Nov. 2022	
Participants	Day 1 (Physics)	Day 2 (Chemistry)	Day 3 (Biology)	Average Heart Rates During End of Semester
1	80	81	81	81
2	80	81	81	81
3	80	81	81	81
4	80	81	81	81
5	80	81	81	81
6	77	78	78	78
7	77	78	78	78
8	77	78	78	78
9	77	78	78	78
10	77	78	78	78
11	81	81	81	81
12	81	81	81	81
13	81	81	81	81
14	81	81	81	81
15	81	81	81	81
16	83	83	82	83

17	83	83	82	83
18	83	83	82	83
19	83	83	82	83
20	83	83	82	83
21	78	78	78	78
22	78	78	78	78
23	78	78	78	78
24	78	78	78	78
25	78	78	78	78
26	73	73	73	73
27	73	73	73	73
28	73	73	73	73
29	73	73	73	73
30	73	73	73	73
31	78	78	78	78
32	78	78	78	78
33	78	78	78	78
34	78	78	78	78
35	78	78	78	78
36	79	79	79	79
37	79	79	79	79
38	79	79	79	79
39	79	79	79	79
40	79	79	79	79

41	77	78	79	78
42	77	78	79	78
43	77	78	79	78
44	77	78	79	78
45	77	78	79	78
46	76	76	79	77
47	76	76	79	77
48	76	76	79	77
49	76	76	79	77
50	76	76	79	77
51	85	85	85	85
52	85	85	85	85
53	85	85	85	85
54	85	85	85	85
55	85	85	85	85
56	81	82	82	82
57	81	82	82	82
58	81	82	82	82
59	81	82	82	82
60	81	82	82	82

Daily heart beat rates (BPM) after writing end of semester examinations

Date	30th Nov 2022	1 st Dec. 2022	2nd Dec. 2022	11th Oct. 2022	9th Dec. 2022	10th Dec. 2022	11th Dec. 2022
Participants	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	74	75	75	74	73	74	72
2	74	75	75	74	73	74	72
3	74	75	75	74	73	74	72
4	74	75	75	74	73	74	72
5	74	75	75	74	73	74	72
6	67	68	68	69	68	70	69
7	67	68	68	69	68	70	69
8	67	68	68	69	68	70	69
9	67	68	68	69	68	70	69
10	67	68	68	69	68	70	69
11	72	72	73	73	70	71	73
12	72	72	73	73	70	71	73
13	72	72	73	73	70	71	73
14	72	72	73	73	70	71	73
15	72	72	73	73	70	71	73
16	74	74	73	74	74	74	74
17	74	74	73	74	74	74	74
18	74	74	73	74	74	74	74

19	74	74	73	74	74	74	74
20	74	74	73	74	74	74	74
21	70	69	70	70	69	72	71
22	70	69	70	70	69	72	71
23	70	69	70	70	69	72	71
24	70	69	70	70	69	72	71
25	70	69	70	70	69	72	71
26	73	73	71	70	73	72	72
27	73	73	71	70	73	72	72
28	73	73	71	70	73	72	72
29	73	73	71	70	73	72	72
30	73	73	71	70	73	72	72
31	74	74	73	74	74	73	75
32	74	74	73	74	74	73	75
33	74	74	73	74	74	73	75
34	74	74	73	74	74	73	75
35	74	74	73	74	74	73	75
36	72	71	70	71	70	71	74
37	72	71	70	71	70	71	74
38	72	71	70	71	70	71	74
39	72	71	70	71	70	71	74
40	72	71	70	71	70	71	74
41	69	69	70	70	69	69	69
42	69	69	70	70	69	69	69

43	69	69	70	70	69	69	69
44	69	69	70	70	69	69	69
45	69	69	70	70	69	69	69
46	74	74	76	74	75	76	73
47	74	74	76	74	75	76	73
48	74	74	76	74	75	76	73
49	74	74	76	74	75	76	73
50	74	74	76	74	75	76	73
51	79	79	78	79	79	78	79
52	79	79	78	79	79	78	79
53	79	79	78	79	79	78	79
54	79	79	78	79	79	78	79
55	79	79	78	79	79	78	79
56	82	82	82	82	82	81	80
57	82	82	82	82	82	81	80
58	82	82	82	82	82	81	80
59	82	82	82	82	82	81	80
60	82	82	82	82	82	81	80

Appendix L

Research Topic: Exploring Integrated Science Students' Sleep Habits, Vital Statistics, and Academic Performance

Dear Participant,

The study invites you to participate in a research study exploring sleep habits, vital statistics, and academic performance among integrated science students. Your participation will help to better understand the factors influencing academic success and overall well-being.

Methods:

1. Questionnaire: You will complete a questionnaire about your sleep habits, vital statistics, and academic performance.
2. Focus Group Interview: You will participate in a focus group discussion with fellow students to share your experiences and perspectives.
3. Sleep Monitoring Device (Wrist Watch): You will wear a wrist watch-like device to track your sleep patterns for in the semester.

Risks and benefits of the study:

- Risks: No known risks
- Benefits: Contributing to a better understanding of sleep habits and academic performance, potentially informing strategies to improve student well-being

Confidentiality:

- Your responses and data will be kept confidential and anonymous
- Identifying information will be removed from all data collected

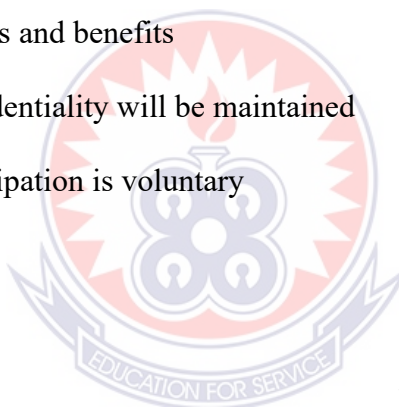
Voluntary Participation:

- Your participation is voluntary
- You may withdraw at any time without penalty or loss of benefits

Informed Consent:

By signing below, I:

- Confirm I am an integrated science student
- Understand the study's purpose and methods
- Agree to participate in the questionnaire, focus group interview, and sleep monitoring device
- Acknowledge the risks and benefits
- Understand my confidentiality will be maintained
- Understand my participation is voluntary



Signature: _____

Date: _____