The Effects of Sleep Deprivation on the Cognitive Performance through the General Weighted Average (GWA) of Medical Technology students for the Academic Year 2020 - 2021 of the University of Santo Tomas

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Abstract: Numerous research have claimed the prevalence of sleep deprivation among college students, which affects their academic performance and physical health. This study has determined the effects of sleep deprivation on the cognitive performance of students using their general weighted average (GWA) as its basis. Moreover, the study intends to distinguish factors that assist the development of sleep deprivation of the students, and will attempt to determine connections regarding sleep deprivation. Variables including the lifestyle, study habits, and intelligence quotient (IQ) level of the students are excluded from this study. There were two surveys conducted to profile and to assess the sleeping habits of the 334 Medical Technology students enrolled at the University of Santo Tomas for the academic year 2020 to 2021. Data gathered are summarized and interpreted through graphs and charts using the software IBM SPSS 22. Further, the statistical test Pearson's Correlation Coefficient was used to measure the strength of the relationship between sleep deprivation and the student's academic performance. Results revealed that the students' general weighted average (GWA) is not affected by the number of sleeping hours. Hence, there is a negligible correlation between sleep and cognitive performance. Nonetheless, there are other factors considered to influence cognitive function, thereby consequently affecting one's academic performance. These factors may include distractions, study habits, memory retention level, attention span, level of concentration, and stress.

Key Words: — ***Sleep, Sleep Deprivation, Academic Performance, Factors, General Weighted Average (GWA), Cognitive Performance.***

I. INTRODUCTION

Academic success can be manifested through high academic performance and completion of educational benchmarks. High levels of academic performance are the ideal goal for future applications such as college applications or job applications.

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Based on the grade-point average (GPA), the academic performance of students can be assessed and measured. This implies that GPA is a way of determining the academic achievement of the students regarding the courses given for the year. Given this premise, a good GPA is highly correlated to academic success and great career outcomes [79]. In the Philippines, it is the general weighted average (GWA) used to evaluate the overall scholastic standing of the students.

The transitions across grade levels come along with credits which require more effort to be exerted, thereby, resulting in students' tendency to overextend their working hours in certain situations with the purpose of accomplishing necessary tasks, and complying with their requirements. With this, their sleep is

compromised and eventually leads to sleep deprivation. Further, several studies have found that working overtime is associated with disturbed or shorter duration of sleep [11; 29; 38; 57; 60; 77].

Sleep is a vital component of a person's health and well-being, which in turn, affects academic and workplace performances [56]. Sleep deprivation gives rise to impairment of attention, concentration, memory, performance, and vigilance; hence, it is deemed to play a facilitating role in learning and memory processes. Moreover, it is a common issue in the students' community, especially among college students. The researchers dwell on this topic to educate and raise awareness to fellow students and other individuals concerning the effects of sleep deprivation on academic performance. A minimum of seven to nine hours of sleep must be acquired to maintain optimum performance throughout the day [53]. A person is considered to be sleep deprived when he or she lacks the required amount of sleep. Previous studies on sleep deprivation evaluated the effect of sleep deprivation on the cognitive processes of an individual. The researchers predicted that students who were considered as sleep-deprived have poor performance on the cognitive tasks compared to those with sufficient sleep; however, results revealed that sleep-deprived participants have higher concentration and effort than those who were not sleep-deprived.

The study of Croft et al. in 2016 stated that there were different opinions regarding the effect of time schedule on the sleep quality and academic performance of the students [27]. A correlation was found in the research study of Ming et al. in 2011, wherein earlier school time schedules increase the rate of sleep-deprived students [52]. Reports in the literature of Smith in 2016 include that sleep deprivation may be caused by the surroundings of the individual [73]. The sleep environment is created by numerous variables such as noise or loud sounds caused by other people, the presence of light, and temperature change. Aside from that, other studies have shown that stress, difficulties with stress management, and negative mood are related to poor sleep quality and insufficient sleep. Given this, the hypothesis of this research indicates that there is a significant relationship between sleep deprivation and the academic performance of UST Medical Technology for academic year 2020 – 2021.

II. Review of Related Literature

2.1 Sleep

The American Sleep Association in 2017 defined sleep as the human's natural, passive response wherein the body falls into less responsiveness and disengages in a restorative state [7]. While asleep, there's inefficiency of the body to react with stimuli from the surrounding environment causing inhibition of neurotransmission in the brain due to modified consciousness. These behavioral changes contribute to the renewal and growth process that sleep provides, which is said to be a vital mechanism for sustaining the overall performance of an individual and to prolong the quality of life [46]. With this, evidence from scientists highly supports the fact that sleep is linked with competent performances with regards to academics and work [18]. The amount of 7 to 8 hours of sleep is the general average requirement of an adult to regulate metabolic, emotional, and cognitive functions within a day [62]. However, due to certain factors, this requirement is not further achieved which results in sleep deprivation.

2.2 Sleep Deprivation

As defined by the American Thoracic Society, sleep deprivation occurs when an individual fails to get the adequate amount of sleep needed [9]. In other words, it is the lack of sufficient restorative sleep over a cumulative period. In this modern era, sleep deprivation has been recognized as a health problem. Lifestyle factors physiologically contribute to melatonin alteration, which then can lead to sleep deprivation [49]. Further, the focus of an individual is also affected resulting in difficulty in learning new information and acquiring new skills [33]. The Centers for Disease Control and Prevention considers insufficient sleep as a public health epidemic [19]. On average, most adults need at least seven to eight hours of sleep each night. Without getting enough hours of sleep, an individual may experience notable differences from his or her biological, psychological, and cognitive processes. Aside from the excessive daytime sleepiness, other symptoms manifested by individuals suffering from ongoing sleep deprivation include constant yawning, moodiness, irritability, fatigue, increased appetite, carbohydrate craving, and sleep inertia or grogginess [30]. Sleep deprivation can also impair or delay simple reactions, attention lapses may become frequent, and behavior becomes increasingly erratic and unstable [47].

A variety of internal and external factors that disrupt the balance of the sleep-wake system include the environmental, medical, habitual, and psychological causes.

2.3 Inadequate Sleep Hygiene

Bad sleeping practices are one of the key reasons for sleep deprivation. According to Hershner and Chervin in 2014, poor sleep etiquette is due to several considerations such as environmental, psychological, behavioral, or even medical reasons [39]. These can inhibit the promotion of the restoration and renewal process during sleep.

2.3.1 Sleep-wake Schedule

Human beings possess individually distinct circadian rhythms, which are the cycles within the body that drive internal functions and processes that are necessary for a person's daily performance [75]. The sleep-wake cycle is one cycle controlled by this biological mechanism. It is the standard pattern of a person's time of sleep and of the time the person is awake, which is followed by the body to maintain its overall function. Several factors within the body can affect the sleep-wake cycle including the hormone melatonin which is said to be one of the clock markers of the body. An increase in melatonin is observed when sleep onset begins, making the person, who has been awake for about 16 hours, feel tired and fatigued; by the end of the sleep cycle, the aforementioned hormone will eventually decrease [82]. Aside from melatonin, other hormones are also greatly affected by the variation of sleep-wake schedules. These include cortisol and growth hormones elevated before waking up and during sleep, respectively, and other differing metabolic and energy-retaining hormones that differ within the day [34].

The possible reason for altered timing of sleep duration is the fact that individuals play different roles in society, wherein this difference could affect the schedule or duration of one's sleep. Vallesteros et al. in 2018 suggest that people who engage in work during the night or working at night shifts, are those who have great disruption of sleep quantity and quality, which in turn affects their overall work performance, psychological and physical state, and they are more prone to risks in their workplace [80]. Students also suffer the same fate due to the fact that they tend to sacrifice their sleep for academic compliance, which is why sleep deprivation is common to students, especially at the college level [44]. Being able to function properly in the workplace requires a desirable amount of energy for a working individual to do their optimal duties and responsibilities during the day [10]. Unfortunately, the rapid phase of modern lifestyle is prohibiting workers and students to attain such requirements.

2.3.2 Sleep environment

Sleep quality and quantity inconsistency between people is also probably due to their surroundings as to where they sleep. It has a symbiotic relationship with humans, wherein it can be a hindrance or a promoter of sleep [32]. In managing sleep hygiene, the amount of light, noise, temperature, and other components in the environment are considered. A minimized light exposure during the start of the sleep cycle and before the student will be awake is recommended in research regarding college sleep environments. Relaxing noise is also to be substituted when going to sleep [71]. Another research conducted by Sandberg et al. in 2012 has revealed that the quality of sleep is significantly correlated with temperature, wherein the majority of the respondents that have an air conditioning unit in their household had better sleep during days that they had to experience humid weathers [65]. Although there is an implication of weakness regarding the cause of sleep deprivation due to its qualitative methodology, it is still considered important for further awareness [41].

2.3.4 Substances

Gooley et al. in 2019 stated that alcohol and sleep deprivation have detrimental effects on an individual's cognitive functioning [83]. The sleep process and neuromuscular performance due to its stimulatory effects on the brain are likely to be affected when alcohol is consumed before sleep [64]. This can lead to increased fatigue sensations and decreased motivation from the effects of changes in cerebral dopamine and adenosine levels. In terms of the effects of alcohol and sleep deprivation on the individual's reaction time, the combination of both led to a significant decrease in reaction time for the high and low stimulus intensity [48]. The additive effect of alcohol intoxication and lack of sleep in impairing an individual's performance is known to be potentially dangerous and can increase the risk for accidents to happen [35].

Anderson et al. in 2018 cited that many sleep-deprived individuals depend on caffeine as a psychoactive drug to mitigate the cognitive effects of inadequate sleep and to restore optical work performance [6]. Researchers have proposed adenosine as a homeostatic sleep factor that increases in the brain during wakefulness. Caffeine present in coffee acts as an adenosine receptor antagonist, inhibiting the efforts of adenosine and restoring decrements in the reaction time due to

sleep deprivation. While coffee energized and increased reaction time, its effects reported poor sleep quality among individuals and may therefore cause a detrimental effect later.

Khan and Uddin's 2020 study identifies that unhealthy dietary behaviors have also been highly associated with poor sleep quality and sleep-induced anxiety among individuals who consume sweetened beverages and carbonated soft drinks daily [45]. This is in comparison with those moderate to non-consumer counterparts. Consumption of foods rich in carbohydrates and calorie-dense foods are associated with disturbed and insufficient sleep. Soft drinks often contain high levels of sugar and a portion of caffeine which can highly affect mood changes as well as contribute to physiological and chemical changes in the body. Recent studies also supported that lavish consumption of fast-food or soft drinks had lower odds of having sleep satisfaction [63].

2.3.5 Technology

Bowers and Moyer in 2020 stated that numerous studies proved consistency between the relationship of technology-use and poor sleep outcomes [13]. Reasons such as phone addiction, school-related work, and updates on trends appear to be factors for producing sleep-deprived college students. Technology-use is prevalently associated with adolescents' and adults' bedtime routines. According to Statista Research Department in 2020, the average time spent on the internet by a mobile phone user in the Philippines is around 9.5 hours, approximately 5 hours was spent on social media [74]. This can be a major contributing factor for assessing a person's self-regulation and bed-time procrastination, both factors affecting an individual's sleep quality.

Sleep deprivation can also have a significant effect on students' achievement and learning. It affects development, learning, and memory through its effects on the brain and mental process [21]. Schlarb et al. in 2017 established the great impact of sleep deprivation on the student's daily life, such an example would be the grade point average [70]. The disorderliness in the daily lives of the students also comes from the causes of sleep deprivation. The study included that insufficient sleep reduces alertness and daytime energy for students, making them too unlikely to follow a predetermined schedule and task due to fatigue. This trend is likely to produce a lower academic performance, which will be reflected in the students' General Weighted Average.

2.4 Sleep Disorder and Illnesses

Deprivation of sleep is possibly not only due to physiological or behavioral factors, but it can also be due to certain ailments in the body, leading to alteration of sleep. Sleep disorders, in accordance with the third edition of the International Classification of Sleep Disorders, have been outlined into major categories of seven distinct groups [69]. These are namely insomnia, sleep-relevant breathing illnesses, parasomnias, circadian rhythm disorders, hypersomnia, sleep-related movement problems, and others.

One of the most common sleep-related breathing problems is sleep apnea, wherein it is associated with loud habitual snoring, abnormal movements, choking, or heartburn [23]. This is due to the obstruction or collapsed airflow, which causes the individual to grasp for oxygen and will result in sleep disruption. Another common ailment is insomnia, which is described as the struggling attempt to fall asleep, or an extended period of nocturnal awakeness, of at least one month [28].

An outcome from a research poll by Swanson et al. in 2010 has found out that respondents suffering from an occurring sleep illness suffer from more work impediments, such as problems on cognitive or emotional performances, than those who were not [76]. When it comes to students, sleep disorders may affect their overall academic performance and they may not receive optimal productivity in school [39].

2.5 Consequences of Sleep Deprivation

2.5.1 Health

A study conducted by Okunowo et.al in 2019 said that sleep deprivation increases the chance of developing hypertension [58]. Also, it has been found that people who are sleep deprived and are overweight are more likely to develop hypertension compared to those who are sleeping 7-9 hours every day. Aside from that, inadequate sleep can also be linked to the development of cardiovascular diseases, diabetes, cancer, metabolic syndrome, and neuroendocrine abnormalities [36]. Sleep is also necessary for cellular and molecular repairs and optimizing sleep can enhance and regulate metabolism, appetite, immune functions, and endothelial cells. Mental health can also be linked to sleep because neural areas that facilitate emotions and executive functions are more sensitive when sleep deprived. Zou et.al in 2020 conducted a study among male college students and found a positive, bidirectional relationship between sleep and mental health [84]. Poor sleep quality is associated with changes in mental health status such

as depression, anxiety, and stress. Furthermore, the researchers reported poorer sleep quality can be a risk factor in developing Alzheimer's disease.

2.5.2 Weight

Kaar, J L et.al in 2018 found that lack of sleep can be a significant factor in gaining and being overweight or obese [42]. In this study, they found out that sleep deprivation affects the participants by inducing health behaviors associated with obesity like low fruit diet, prolonged screen time, and lack of physical activity. But it was also found that even without these health behaviors, lack of sleep alone can be a link in developing obesity. A study conducted by Camargo et.al in 2020 found that poor sleep quality leads to problems in sleeping which, therefore, contributed to participants having greater waistline and weight on their follow-ups compared to their baseline counterparts [17]. The study also lays out possible correlations between sleep deprivation and obesity such as having more time frame to eat high energy-dense foods even without the feeling of hunger. Another correlation is inadequate physical activity and hormonal changes.

2.5.3 Safety

Sleep deprivation plays a critical role in causing serious accidents in recent decades. Insufficient sleep can have a significant effect on both long-term and short-term consequences for an individual. In the short-term consequence, sleep-deprived. individuals have shown to have reduced alertness, decreased reaction time, shortened span attention, and weak judgment capacity, poor memory, reduced concentration, and reduced awareness of their surroundings [72]. Lack of sleep takes a major toll on the perception and judgment of an individual. This, in turn, may increase the risk of an individual obtaining serious accidents and injury. Kalsi et al. in 2018 stated that lack of sleep is a major cause of fatal motor vehicle accidents [43]. A factor of it is linked to drowsy driving by tired drivers. As a result, the lack of sleep becomes a major contributor to road accidents. Workplace mistakes and accidents are also often associated with insufficient sleep. Fatigues caused by insufficient sleep can result in performance deterioration at work [5]. It also makes cognitive processes slow and less responsive. Sleep-deprived individuals may show difficulty in maintaining focus which increases their risk of becoming easily distracted at work. At the same time, sleep-deprived individuals are associated with an increased brain activity related to risky decision making. This can result in an increase in the number of errors, and poor cognitive assimilation.

2.6 Sleep Deprivation and Cognitive Performance

Partial sleep deprivation affects cognitive performance in terms of working memory compared to those who are getting enough sleep [68]. It has been found out that both placeboes induced, and sleep-deprived participants experienced the same level of sleepiness. Yet, the placebo group improved in performances conducted on their working memory compared to those who were sleep deprived. A study conducted by De Zeeuw and Canto in 2020 in mice, revealed that sleep- deprived mice affected their performance on Eyeball Conditioning (EBC) tasks and Conditioned Response (CR) [31]. Furthermore, it has been found that lack of sleep affects synaptic plasticity which causes a delay in the consolidation of new information. Also, cerebellar learning with appropriate sleeping helps in the formation of declarative memory as well as sleeping after conducting motor responses such as sports activities enhances performance.

Gruber et al. in 2019 compared the school performance of students with total sleep time showed that students who sleep less than normal have poorer school performance compared to those who are sleeping optimally which resulted in better grades [36]. Aside from that, students who were given enough sleep performed better in tasks related to reaction time, memory, executive functioning, and sustained attention and improvement in the Conners' Global index. Therefore, sleep is essential for achieving academic success because it allows better memory consolidation while also maintaining their emotional health. Moyano et.al in 2019 found out that sleep helps shorten the amount of time needed for restabilization and reconsolidation of new information and that slow waves (such as slow oscillation and delta waves) are also beneficial in retrieving relevant information [54]. Another study conducted by Brunet et.al in 2020 found that there is a link between partial sleep deprivation and decision making [14]. Inadequate sleep affects the cognitive function of the brain and tends to impair the decision-making of the participants taking on riskier decisions especially if there is a reward involved. However, participants who have an increased REM sleep had lesser chances of choosing a riskier decision. A disruption in the REM sleep also showed similar signs and response patterns of the participants. Functional neuroimaging of the brain in a sleep-deprived person showed that there is a decline of connectivity between the reward system which consists of the mesolimbic

and striated areas and the prefrontal cortex which impaired the activity to assess emotion, reward, and punishment. Sleep deprivation also affects the medial prefrontal cortex in releasing glutamine to the nucleus accumbens which influences motivation and reward response.

2.7 Sleep Deprivation and Academic Performance

As stated by Vyazovskiy in 2015, sleep facilitates the cognition of an individual through maintaining concentration, executive functions, sensorimotor integration, and memory processing [81]. However, aside from the cognitive health, the academic performance of university students is also affected by the sleep regularity, quantity, and quality that an individual acquires [50]. The systematic review conducted by Bueno, Moreno, Muro, M. Ruiz, MA Ruiz & Plasencia in 2020 showed that poor academic performance is usually correlated to sleep deprivation [15].

Sleep deprivation impairs most cognitive domains of students including simple attention, intricate attention, working memory, short-term memory, and estimated efforts to complete tasks, thereby negatively affecting their performance in the academe [3]. The prevalence of sleep disturbances has been observed among university students which upsets their quality of sleep and increases their risk of excessive daytime sleepiness [4]. There have been numerous studies that show the detrimental effect of daytime sleepiness and sleep deprivation on the academic performance of medical students [25]. The cross-sectional study conducted by Ahmed, Elbadawi & Mirghani in 2015 showed the correlation between excessive daytime sleepiness and poor academic achievement of medical students [2]. Moreover, academic performance is also indirectly affected by sleep deprivation through tardiness or school absence of students [8].

However, other than sleep deprivation, the management of non-academic issues such as stress is also considered an important factor for the academic success of students [1]. According to Shankar & Park in 2016, stress also affects cognitive performance including attention and level of concentration consequently affecting the academic success of students [59].

2.8 Theoretical Framework

The Conservation of Resources (COR) theory was used in understanding the effect of sleep deprivation on the academic performance of the students. In this theory, resources, which are categorized into four: objects, conditions, energies, and personal characteristics, play a significant role. The COR theory developed by Hobfoll (1998) is a comprehensive framework consisting of two principles and four corollaries that are applied with the purpose of understanding human behavior by putting emphasis on the resources of individuals and groups.

The primacy of loss principle, which is the first principle of the COR theory, states that loss of resources is more salient than the gain of resources. Aside from being more powerful in terms of magnitude, the resource loss also impacts people more rapidly. In response to the loss experienced by individuals and groups, the second principle emphasizes resource investment of the people in pursuance of the protection against possible resource loss, reclamation of loss, and acquisition of resources [37].

From the two principles, the COR theory proposes a number of corollaries to counter the occurrence of stressful conditions at the individual and organizational levels. In the first corollary, the relationship between resource possession, and vulnerability, and resilience to resource loss is established. It is stipulated that individuals and groups with greater resources are less likely to lose their resources and instead gain more of them. Contrary, those that have limited or lacking resources are more vulnerable to resource loss and less likely to acquire resources. Resource loss cycle and resource gain spirals are highlighted by the second and third corollary wherein initial resource losses generate future losses and initial resource gains generate future gains respectively. Last, it is stated in the fourth corollary that lack of resources entails defensive attempts of individuals and groups to conserve remaining resources [37].

Initially, the COR theory is one of the two leading theories to explain the relationship between stress and trauma along with the pioneering theory of Lazarus and Folkman (1984) [40]. However, this theory is also applicable to other topics such as sleep health in line with several conducted fatigue studies [22; 24].

For this study, the constructs identified were resources (e.g. objects, conditions, personal characteristics, and energies), stress, sleep health, cognitive performance, and academic performance.

2.9 Conceptual Framework

The academic performance of UST Medical Technology students for the academic year 2020 to 2021 is affected by many factors. One of these factors is discussed in this study, which is

sleep deprivation. Using the COR theory as the theoretical framework, the proposed model is shown below.

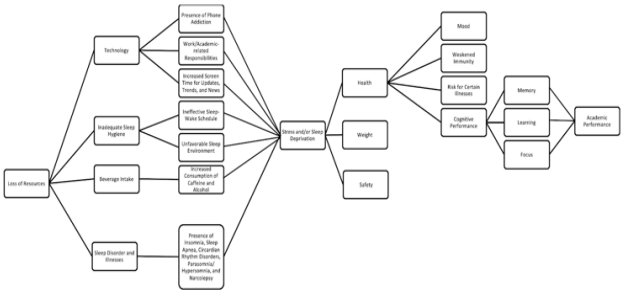

Fig.1. Overview of the conceptual framework of the study

The recognized resources include the objects, conditions, personal characteristics, and energies. In this study, objects pertaining to the reduced consumption of caffeine and alcohol. On the other hand, conditions are adequate sleep hygiene through an effective sleep-wake schedule and a conducive sleep environment. As for the personal characteristics, the resistance to disorders and illnesses related to sleep is associated. Last, for the energies, the efficient use of technology (absence of phone addiction, increased productivity in work/ academic-related responsibilities, and decreased screen time due to constant updates and trends) is identified.

Based on the COR theory, it is hypothesized that high levels of stress or sleep deprivation are induced by the loss of these resources, thereby affecting cognitive performance which consequently impacts the academic performance of students. Thus, a negative relationship between stress and/or sleep deprivation, cognitive and academic performance is presumed.

III. Research Methods

3.1 Research Design

The study is correlational research that involves the measurement and assessment of two variables for the establishment of a statistical relationship [51]. For this matter, the study aims to determine the effect of sleep deprivation on the cognitive performance of medical technology students at the University of Santo Tomas of the academic year 2020-2021 based on data collected through a survey with regards to their academic performance and sleep hours. In this study, the extent of a relationship between the two variables: the lack of sleep and the cognitive performance measured using the general weighted average (GWA) of students is determined through the analysis of data.

3.2 Data Measure/ Instrumentation

The study was conducted through surveys disseminated via social media platforms (e.g. Facebook) and messaging applications (e.g. Facebook Messenger, Gmail, etc.). These mediums were used to communicate with the respondents, or with the presidents of the respective sections in the Department of Medical Technology of University of Santo Tomas for ease in the survey questionnaire distribution, and data collection process.

The consent and survey questionnaire, which consisted of the adopted questions from the Pittsburgh Sleep Quality Index (PSQI), and several questions made by the researchers that were validated using Cronbach's alpha and Statistical Package for Social Sciences (SPSS), were given to the participants of the study.

Prior to answering the questionnaire, an informed consent was provided for the assurance of the privacy and confidentiality of the information collected from the respondents. Following the instructions on how to go about the survey, the next part asked for the name, age, section, and gender of the participants. As for the important part, there were eight questions with different choices for the respondents to select from. The reasons which contribute to the respondent's lack of sleep were asked followed by the respondent's attention span during lecture sessions. The third question inquired about the number of hours spent by the respondent on studying and attending classes each day. The respondents were then asked for his or her average number of hours of sleep every day as well as the hours of sleep he or she needs to be able to function at their best. Subsequent to this, the respondents were asked for his or her opinion whether he or she believes that sleep affects his or her cognitive performance and function. The respondents were asked to select his or her general weighted average (GWA) for the first semester of the academic year 2020 to 2021 from a list of nine GWA brackets. In relation to the previous question, the respondent was queried finally if his or her GWA in the first semester changed negatively due to sleep deprivation. The determination of whether students are considered to be sleep deprived or not will be analyzed as well as the correlation of the two variables: the lack of sleep and the cognitive performance

measured using the general weighted average (GWA) of students is made based on the results gathered.

3.3 Data Gathering Procedure

The researchers aimed to correlate the relationship between sleep deprivation and its effects on the cognitive performance of Medical Technology students of the University of Santo Tomas using the students' general weighted average (GWA) as the basis. Data was gathered through a survey. For the procedure, participants of this study were selected from the Medical Technology students of the University of Santo Tomas. There are a total of 346 students coming from the first-year level, 485 students from the second-year level, 930 students for the third-year level, and 258 students from the fourth year level for a total of 2019 Medical Technology students enrolled for the academic year 2020 to 2021. Using Slovin's formula, n=N/(1+N e2); where N is the population, n is the sample size, and e is the amount of error tolerance, a total of 334 Medical Technology students were expected to be given the survey.

To avoid bias, fishbowl sampling was used, wherein sections from medical technology students of the academic year 2020 to 2021 were randomly selected by individually placing each section on a piece of paper then put in a bowl. These papers were chosen randomly and they represented the sections that were given the survey. This survey consisted of general questions where some questions were adopted from the Pittsburgh Sleep Quality Index (PSQI) and through this survey, based on the results, the determination of which students are considered to be sleep deprived or not was analyzed.

An orientation on the nature and purpose of the study was given to the selected participants before proceeding to the actual survey. After the participants have been oriented, a questionnaire was provided for the profiling of the participants. The questionnaires would allow the researchers to identify and backtrack the source of answers obtained from the participants. Data from 334 selected participants was collected using google forms. The data gathered from this research was tallied and computed for interpretation. Along with the primary data, the researchers made use of secondary resources in the form of published articles and literature to support the survey results.

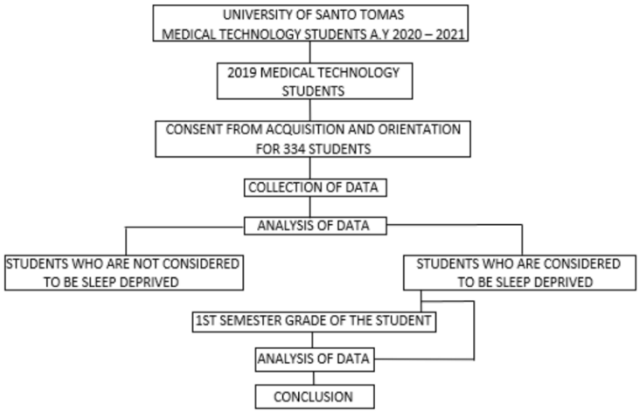

Fig.2. Summary of the procedure regarding the data collection of the study

IV. RESULTS AND DISCUSSION

A total of 346 Medical Technology students were expected to answer the survey given that there are two sections selected via the fishbowl method to receive the surveys for each year level. Despite a minimum of 334 Medical Technology students needed based on Slovin's formula to suffice the needed number of respondents to represent the population, only 309 students answered the survey. Though there was not a large response rate, the researchers were able to at least have 252 sleep-deprived respondents and 57 respondents that were not sleep-deprived. Based on the answers of these 252 sleep-deprived respondents, charts and graphs were made to incorporate and summarize the responses.

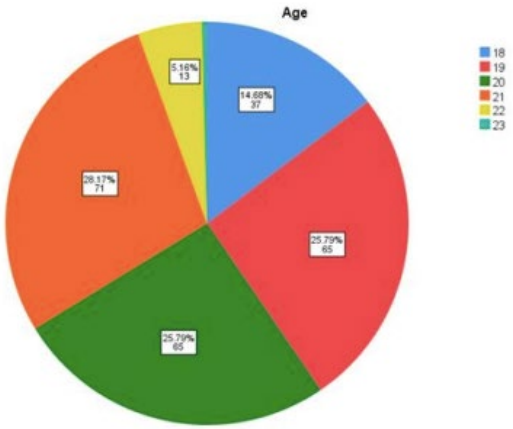

Fig.3. The age of the respondents.

The age of the respondents is shown in Figure 3. Majority (28.17%) of the respondents were 21 years old. While 65 respondents (25.8%) were 20 years old, 65 respondents (25.79%) were 19 years old, 37 respondents (14.68%) were 18 years old, 13 respondents (5.16%) were 22 years old, and 1 respondent (0.4%) was 23 years old.

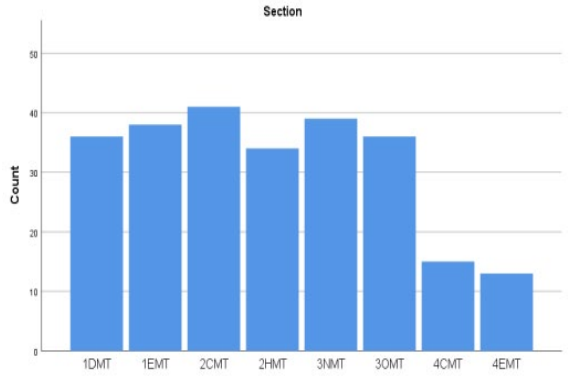

Fig.4. The percentage of respondents from each section that was given a survey.

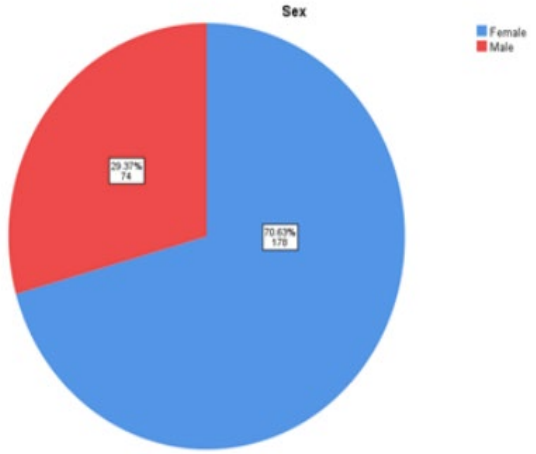

Fig.5. A comparison between the gender of the students.

Figure 4 presents the percentage of respondents from each section that was given a survey. There were two sections per year level selected via the fishbowl method to receive the survey forms. For the first-year level, the sections selected were that of 1DMT and 1EMT. 1DMT has 36 respondents (14.3%) while 1EMT has 38 respondents (15.1%). For the second-year level, the sections 2CMT and 2HMT were selected with 41 respondents (16.3%) and 34 respondents (13.5%) respectively. For the sections from the third-year level, sections 3NMT and 3OMT were selected. 3NMT has 39 respondents (15.5%) while 3OMT has 36 respondents (14.3%). For the fourth-year sections, 4CMT and 4EMT were selected with 15 respondents (6.0%) and 13 respondents (5.2%), respectively. Figure 5 reveals that from the students that were given a survey, the majority of them are female (70.63%) while the rest are males (29.37%).

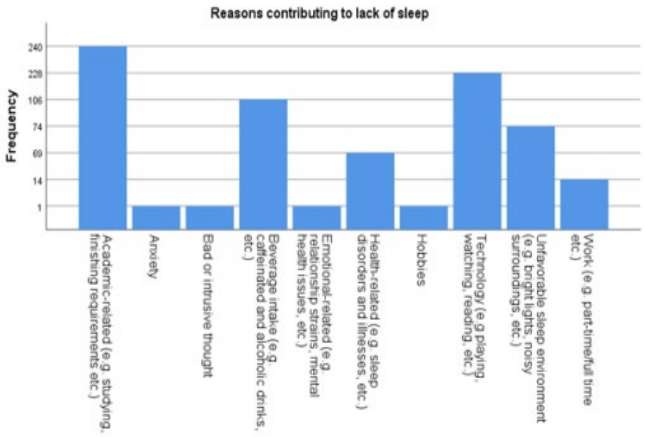

Fig.6. Reasons contributing to lack of sleep.

In figure 6, it appears that the majority of the respondents (32.7%) answered that one of the reasons that contributed to their lack of sleep is academic-related. 78 respondents (31.0%) said that technology is one of the reasons contributing to their lack of sleep. 36 respondents (14.4%) answered that one of the reasons that contributed to their lack of sleep is due to beverage intake of caffeinated and alcoholic drinks, etc. 26 respondents (10.1%) said that an unfavorable sleep environment is one of the reasons that contributed to their lack of sleep. 24 respondents (9.4%) answered that one of the reasons that contributed to their lack of sleep is health-related reasons. While 5 respondents (1.9%) said that work is one of the reasons that contributed to their lack of sleep.

There were some (0.5%) who answered other reasons that contributed to their lack of sleep including emotional-related, hobbies, anxiety, or bad/intrusive thoughts.

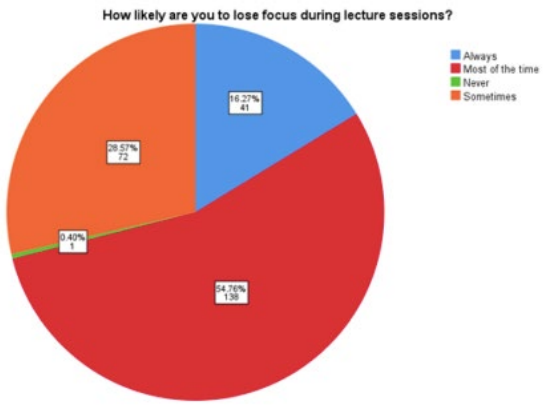

Fig.7. Likelihood of the respondents to lose focus during classes.

As seen in Figure 7, the pie chart focuses on how often the student loses their attention during lecture sessions, 138 respondents (54.76%) said that most of the time they lose their focus, while 72 respondents (28.57%) sometimes lose their focus and 41 (16.27%) were likely to lose their focus and 1 respondent (0.4%) said they never lose their focus during lecture sessions.

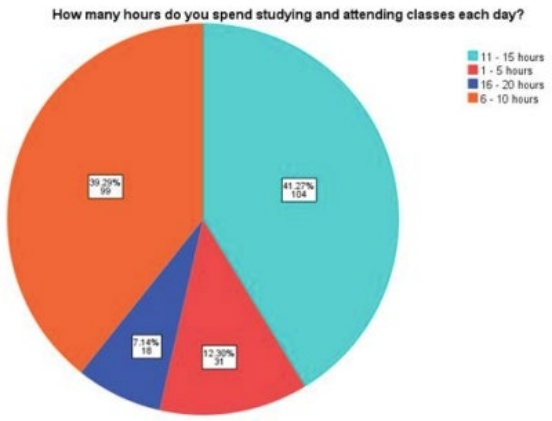

Fig.8. Hours in studying and attending classes each day.

Figure 8 reveals how many hours the students spend their time on studying and attending classes each day. Out of the 252 respondents, 104 respondents (41.27%) have around 11 to 15 hours of studying. Meanwhile, 99 respondents (39.29%) have 6 to 10 hours of studying, 31 respondents (12.3%) have 1 to 5 hours of studying, and the remaining 18 respondents (7.14%) have 16 to 20 hours of studying and attending lecture sessions each day.

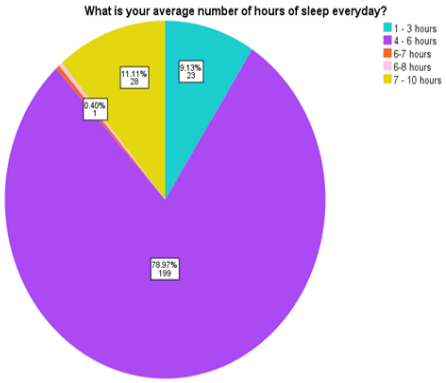

Fig.9. Total hours of sleep.

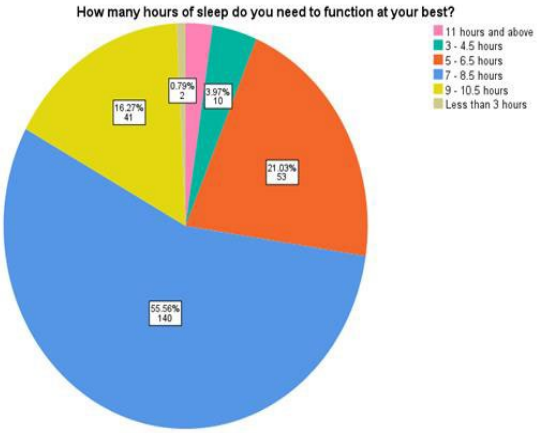

Fig.10. Total Hours of sleep that the respondents needed to function.

In Figure 9, the majority of the respondents have around 4 to 6 hours of sleep every day while the rest have 7 to 10 hours of sleep and 1 to 3 hours of sleep, with 6 to 8 hours being the latest. Figure 10 focuses on how many hours of sleep is needed to function at their best. 140 respondents (55.56%) must have 7 to 8.5 hours of sleep to function while 53 respondents (21.03%) said that 5-6.5 hours of sleep is needed for them to function. 41 respondents (16.27%) must have around 9 to 10.5 hours of sleep to function and 10 respondents (3.97%) said that 3 to 4.5 hours of sleep to function and 6 respondents (2.4%) said that 11 hours and above of sleep is needed to function at their best while the other 2 respondents (0.79%) have less than 3 hours of sleep to function.

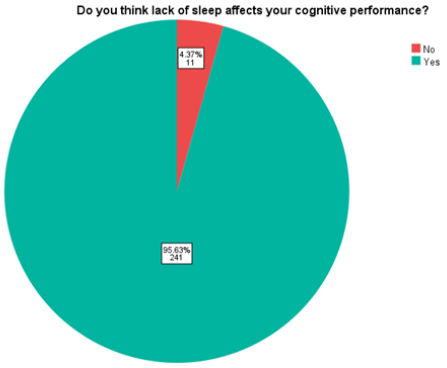

Fig.11. A comparison of whether lack of sleep affect's one's cognitive performance.

Figure 11 illustrates the percentage of respondents that think lack of sleep has an impact on one's cognitive performance as well as individuals that think otherwise. From the data collected, the majority of the students with a percentage of 95.63% think that sleep affects their cognitive performance. On the other hand, 11 respondents (4.37%) suppose that sleep does not influence the functioning of their multiple mental abilities.

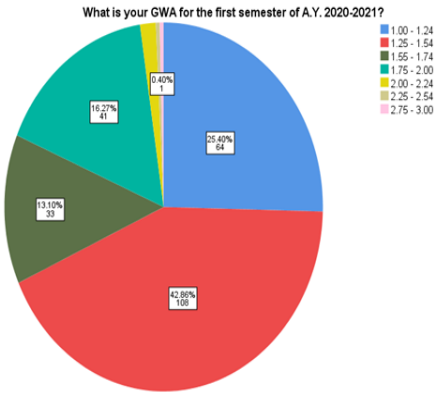

Fig.12. GWA for the first semester of A.Y. 2020-2021 of the respondents.

The percentages of the GWA for the first semester of A.Y. 2020-2021 of the students are presented on figure 12. Based on the gathered data, 108 students (42.86%) obtained a GWA of 1.25 to 1.54, comprising the majority of the responses. This is followed by 64 respondents (25.4%) with a GWA of 1.00 to 1.24. There were 41 students (16.27%) who obtained a GWA between 1.75 and 2.00. Furthermore, 33 respondents attained a GWA between 1.55 and 1.74, which makes up 13.1% of the total respondents.

Meanwhile, there were 4 students (1.57%) who acquired a GWA between 2.00 and 2.24. There was also 1 respondent respectively for GWA of 2.25 to 2.54, and 2.75 to 3.00, garnering the lowest percentage of 0.4%.

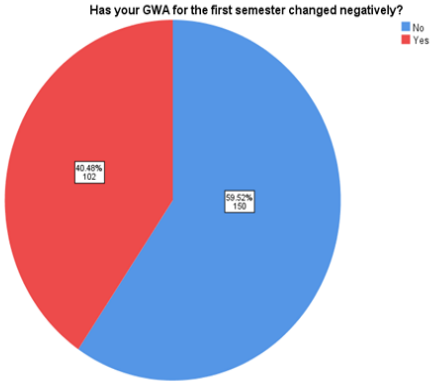

Fig.13. A comparison whether GWA for the first semester changed negatively.

Figure 13 demonstrates the number of students that have observed a negative change on their GWA for the first semester and those that have not. Based on the data collected, 150 respondents (59.52%) said that their GWA for the first semester has not changed negatively, making up more than half of the total respondents. However, the remaining 102 students (40.48%) indicated that a negative change has been noticed on their GWA for the first semester.

Table.1. A table showing the number of sleeping hours and its frequency.

Number of Sleeping hours	Frequency	Percentage
1-3 hours	23	9.1%
4 - 6 hours	199	79.0%
6-7 hours	1	0.4%
6-8 hours	1	0.4%
7-10 hours	28	11.0%
TOTAL	252	100%

Table.2. A table showing the student's GWA for the first semester of the A. Y. 2020 to 2021 and its frequency.

GWA for the first semester of the A.Y. 2020 to 2021	Frequency	Percentage
1.00 – 1.24	64	25.4%
1.25 – 1.54	108	42.95
1.55 – 1.74	33	13.1%
1.75 – 2.00	41	16.3%
2.00 – 2.24	4	1.6%
2.25 – 2.54	1	0.4%
2.75 – 3.00	1	0.4%
TOTAL	252	100%

Table.3. Correlation between the sleeping hours and academic performance (GWA).

		r value	Strength	p-value	Sig
Sleeping Hours	Academic Performance	-.002		p = 0.972 > 0.05	NS

Table.4. Rule of thumb for interpreting the correlation coefficient strength.

Size of Correlation	Interpretation
0.90 to 1.00 (-0.90 to -1.00)	Very high positive (negative) correlation
0.70 to 0.90 (-0.70 to -0.90)	High positive (negative) correlation
0.50 to 0.70 (-0.50 to -0.70)	Moderate positive (negative) correlation
0.30 to 0.50 (-0.30 to -0.50)	Low positive (negative) correlation
0.00 to 0.30 (0.00 to -0.30)	Negligible correlation

The researchers have conducted the study on 346 participants but only 309 of them answered the survey questionnaire. This equates to a response rate of 89.31%. Considering that the researchers did not get a perfect response rate, it was found at least more than 115 respondents were sleep-deprived.

Analysis of Pearson's correlation coefficient found that there was a negligible correlation between the two variables: number of sleeping hours, and academic performance (GWA), having a value of r = -.002 (Table 3). Further, it has been found that there is negative correlation indicating inverse relationship wherein one variable increase while the other decreases. Given that the significance level is at .05, the strength of relationship of the number of sleeping hours has little to no significance academic performance, thereby, supporting the null hypothesis of the study which states no negative impact on the cognitive performance of medical technology students of University of Santo Tomas of the A.Y. 2020-2021. The correlation yielded is not in line with the correlation obtained from other researches such as the study conducted by Alba et.al. (2015) wherein medical students performed poorly due to lack of sleep and the research done by Ahmed et.al (2015) which shows a p-value of <0.05 signifying that there is a correlation between lack of sleep and academic performance.

V. Conclusion

Pearson's correlation coefficient analysis revealed that there is a negligible correlation between the two variables: the number of sleeping hours and the academic performance (general weighted average) of the participants (Table 3). In conclusion, the cognitive performance of the sleep-deprived subjects, in this case, their General Weighted Average (GWA) is not affected by the number of sleeping hours.

Nonetheless, there are other factors considered to influence cognitive function, thereby consequently affecting one's academic performance. These factors may include distractions, study habits, memory retention level, attention span, level of concentration, and stress. Despite the impairment of sleep health, it is still possible for a sleep-deprived individual to acquire good scores as a result of the hours spent all night studying and/or completing requirements. Moreover, the study was conducted during the COVID-19 pandemic, therefore the classes were held in an online setting. Given this premise, the respondents needed less time for preparation (for traveling, taking a shower, etc), and more for their academics. Although engagement in different forms of academic dishonesty such as cheating, plagiarism, impersonation, and the likes are an additional temptation to the students in the enhanced virtual mode of classes which may also explain how it is possible to acquire good grades even though the student is sleep deprived.

Recommendations:

To improve the study design, the following recommendations are presented based on the findings and conclusions of the study:

- Future researchers should take into consideration that the study was conducted during the COVID-19 pandemic where class settings were held online. Since the study was solely conducted in an online setting, researchers are encouraged to conduct a similar study in a face-to-face setting to also ensure that participants were monitored and properly guided in answering the questionnaires. Along with that, a schedule should also be allotted to provide adequate time for the respondents to accomplish the survey. This can also aid in producing better output.
- Future researchers are encouraged to get the actual value of the respondent's grades (GWA) rather than choosing between ranges so that the scale of the data is on interval or ratio. A significant relationship between sleep and academic performance was not found in this study; hence other factors that can possibly affect the academic performance of the respondents other than sleep deprivation must also be considered by future researchers. In view of that, future researchers are encouraged to conduct similar studies utilizing other variables that could affect the students' academic performance. This research utilized students' General Weighted Average (GWA) as a basis for their cognitive performance, however, there are other measurements that can be used as a basis for correlation (e.g. IQ). With that, the intelligence quotient (IQ) of the respondents should also be measured as it is a factor contributing to academic performance.
- Future researchers are also encouraged to utilize measuring devices (e.g. watch, sensor strips, tracking pad, etc.) and sleep tracking applications (e.g. SleepScore, SleepWatch, etc.) to identify the number of hours of sleep of the respondents. This is to ensure that the duration of sleep is monitored and tracked accurately. On that note, it is important to compare different brands of the said devices in terms of their accuracy or sleep tracking capability prior to selecting and using the preferred measuring device. Future researchers should also consider a different method of gathering data from the respondents. In this study, respondents were randomly chosen based on what section will be selected via fishbowl sampling. This limited the researchers to fully maximize the number of expected respondents in the research since not all of the students in the chosen section are willing to participate in the study. Aside from that, larger sample size must be taken into account in order to generate more precise and reliable results and to be able to identify outliers easily thereby preventing misleading statistics.
- Medical Technology students of the University of Santo Tomas are advised to practice proper sleep hygiene since based on the results of this research, majority of the respondents are sleep deprived and not getting the number of hours of sleep for them to function properly. Moreover, these students are also recommended to apply suitable time management with their study schedule, since most of the respondents in this study are sleep deprived due to academic-related reasons.
- The Faculty of Pharmacy should consider the fact that the respondents, which are students under the Department of Medical Technology, are studying and attending classes for 11-15 hours each day. Along with that, majority of these students are likely to lose focus most of the time during their lecture sessions. With that being said, the Faculty of Pharmacy, as well as the whole University of Santo Tomas community, are encouraged to lessen the hours spent by the students in attending their classes in order for them to prevent the loss of focus during class hours and to give them the necessary time to rest or sleep, improving their cognitive performance.
- The negative effects of sleep deprivation on cognitive performance is supported by existing literature. With the help of the results gathered in the study, the faculty should consider limiting the assessments required on a certain subject. With this, educators from the faculty are encouraged to test and evaluate the student's academic capabilities while considering the number of hours that a student can spend on a specific activity.

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