

**PREVALENCE AND FACTORS ASSOCIATED WITH SLEEP QUALITY AMONG
UNDERGRADUATE STUDENTS AT THE COLLEGE OF HEALTH SCIENCES,
UNIVERSITY OF NAIROBI, KENYA.**

BY

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**A DISSERTATION SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH IN
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DECLARATION OF ORIGINALITY FORM

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DEDICATION

I dedicate this work to my grandmother, the strongest and hard-working woman I have ever known. I am grateful for all you have done for me. If it was not for your good upbringing, encouragement, support, and prayers I would not have been who I am today. You inspired me tremendously and thank you for always believing in me.

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LIST OF ACRONYMS

CDC	Centers for Disease Control
CHS	College of Health Sciences
EDS	Excessive daytime sleepiness
HBM	Health Belief Model
ODK	Open Data Kit
PSS	Perceived stress scale
PSQI	Pittsburgh Sleep Quality Inventory
SHI	Sleep hygiene Index
SPSS	Statistical Package for the Social Sciences
UoN	University of Nairobi

OPERATIONAL DEFINITIONS

Bedroom environment: These are factors in the bedroom such as temperature, noise, ventilation, lighting, and air quality that may affect the sleep quality among undergraduate students.

Bedroom physical structure: A room where a student sleeps, the nature of bedroom environment, space, furnishing, and the degree of risk with sleep quality.

Perceived sleep quality: This is how undergraduate students regard, comprehend, and interpret their sleep quality in this study.

Perceived stress: The thoughts or feelings a student has about how much stress they are going through at a given point in time during this study period.

Pittsburgh Sleep Quality Inventory: This is a validated self-reported questionnaire that will be used to assess sleep quality over a 1-month time interval among undergraduate students.

Prevalence: Proportion of undergraduate students with an outcome of interest (good or poor sleep quality) at a defined point in time upon completion of this study.

Sleep: This is a repeated natural state of body and mind, with diminished consciousness and inhibited sensory activities of voluntary muscles, and reduced external stimuli.

Sleep behaviours: Practices that impair or enhance sleep quality among undergraduate students.

Sleep hygiene: Practices and habits required to promote good sleep quality among such as exercising, consistent bedtimes, reducing caffeine and alcohol beverages close to bedtime, avoiding using electronic gadgets in bed among undergraduate students.

Sleep quality: This the outcome of this study, which is a binary variable (good or poor sleep quality) as determined by the PSQI.

Subjective sleep quality: In this study, this is how students' self-rate their individual overall sleep quality as fairly good, fairly bad, or very bad.

Undergraduate students: In this study, undergraduate students comprise any student enrolled on a full-time basis but have not yet graduated. These students are attending their classes at the University of Nairobi, College of Health Sciences.

ABSTRACT

Background: Sleep is an indispensable necessity of humankind, imperative for sustaining the quality of life and well-being of all ages. Poor sleep is proven to have an impact on students' academic endeavors and general health. Even though some university students are conversant with health repercussions associated with poor sleep quality, a substantial proportion fail to prioritize sleep health over their academic tasks or deem their health to be at risk.

Objectives: To determine the prevalence and factors associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.

Methodology: An institutional analytic cross-sectional study was carried out at the College of Health Sciences. A stratified random sampling technique was employed with strata being the schools. A Pittsburgh Sleep Quality Inventory was used to measure sleep quality. Out of the 378 participants, 245 were interviewed through a tablet device-based questionnaire running on the Open Data Kit (ODK) application and the remaining 133 students completed an online questionnaire (SurveyMonkey). Descriptive statistics, correlations, bivariate, and multivariate binary logistic regression were performed using the IBM Statistical Package for the Social Sciences (SPSS) version 23 at $p < 0.20$ and $p < 0.05$ level of significance, and a 95% confidence interval.

Results: Out of the 378 participants the majority were females (57.1%) and 42.9% were males. The prevalence of poor sleep quality (PSQI > 5) was 80% among undergraduate students, whereas good sleep quality was 20%. In an adjusted multivariate analysis, factors that were significantly associated with poor sleep quality were perceived stress [AOR:3.15; 95% CI: (1.43, 6.91); $p = 0.004$], room air quality [AOR: 2.32; 95% CI: (1.08, 5.01); $p = 0.0031$], and sleep hygiene [AOR:1.08; 95% CI: (1.03, 1.14); $p = 0.002$].

Conclusion: Findings from this study demonstrated an alarming prevalence of poor sleep quality (PSQI > 5) 80 percent among undergraduate students. This study has shown a significant correlation between perceived stress, sleep hygiene, and sleep quality which suggests that sleep hygiene practices and stress coping strategies should be considered as a potential influence on enhancing good sleep quality. The modifiable risk factors such as perceived stress, sleep hygiene, and room quality were considered potential risks for poor sleep quality.

Recommendations: To improve sleep quality among undergraduate students at the College of Health Sciences, the University should develop sleep hygiene education programs as an intervention and prevention strategy. To alleviate high stress, students should equip each other with better relaxation techniques such as Yoga, meditation, and extracurricular activities and manage their time properly to attain optimal sleep quality and academic functioning.

CHAPTER 1: INTRODUCTION AND BACKGROUND

This chapter outlines the background on sleep quality.

1.1. Background

Sleep is vital in life and is known to significantly contribute to the cognitive, emotional, physical, and overall health of human beings (Paterson, Nutt & Wilson, 2011). Sleep is termed as a repeated natural state of mind and body, that leads to reduced consciousness, diminished sensory activities of voluntary muscle, and rejuvenation of mental and physical functioning. The sleeping cycle is composed of roughly eight hours of night-time sleep and sixteen hours of wakefulness during the day time in humans and is regulated by opposing internal factors: circadian rhythms and homeostasis of sleep (Ohayon et al., 2017). It is acknowledged in the literature that adequate sleep is imperative to process information learned during a period of wakefulness and translate it into useful memory, to allow communication between several components of the brain (Sexton-Radek & Pichler-Mowry, 2011).

Recently, there has been widely epidemiological evidence indicating that sleep health is a public concern globally. It is projected that people who suffer from sleep disorders are approximately 150 million universally and virtually 17% of this population is in developing countries (Berhanu, Mossie, Tadesse & Geleta, 2018). The National Sleep Foundation (2018) depicted that American people who are affected by poor sleep quality are approximately 50 to 70 million. In China, the likelihood of having poor sleep outcomes was reported to be 56.7% in adults with a higher proportion among males (Wu et al., 2018). Whereas, the prevalence of poor sleep quality in Spain stood at 38.2%, as women were essentially twice as likely than men to have poor quality, suggesting sex to be linked with poor sleep quality (Madrid-valero, Martínez-selva, Ribeiro, Sánchez-romera, & Ordo, 2017).

It is generally known that developing and low-income countries are faced with a vast demographic and epidemiological transition. A challenging problem arises in this domain as sleep health remains an unprioritized health issue with less emphasis on the worldwide dimension of this emergent public health concern (Stranger, Tigbe, Gomez-Oliv, Torogood & Kandala, 2012). The outcome from the WHO-SAGE study by Stranger et al., (2012) among average adults in South Africa exhibited that 27.2 % of men and 31.3% of women experienced poor sleep quality. In more African countries such as Ghana, Kenya, and Tanzania, poor sleep quality overall rates ranged from 8.3 % to 12.7 % and it was more pervasive than cancer, HIV and AIDS, cardiovascular diseases, neurophysiological disease, and respiratory diseases (Stranger et al., 2012).

Epidemiological evidence established associations between poor sleep health with premature morbidity and mortality (Adriansen, Childers, Yoder, & Abraham, 2017; Ferrie, Kumari, Salo, Singh-Manoux & Kivimäki, 2011). The aforementioned is as well linked with numerous chronic morbidities such as cardiovascular disease, hypertension, Obesity, Diabetes, and attention-deficit hyperactivity disorder, and Psychiatric conditions (Adriansen et al., 2017; Ferrie et al., 2011).

In educational institutions, university students sacrifice their sleep to pursue good grades in their academic endeavors. Students in the Health fraternity are particularly faced with extensive theoretical and clinical content which leads to long study hours and attending clinical practice. The literature proved that poor sleep health influences academic performance and findings were found to be consistent globally (Ahrberg, Dresler, Niedermaier, Steiger & Genzel, 2012; Al-Kandari et al., 2017; Wang et al., 2016). According to Schlarb & Friedrich (2017), 60% of university students are subjected to poor sleep quality and 7.7% are estimated to meet the eligibility criteria of sleep disorders including Insomnia. The university students who experienced poor sleep were compelled to report physical ailments, high perception of stress,

and utilization of drugs to help them stay awake (Lund, Reider, Whiting & Prichard, 2010; Sahraian & Javadpour, 2010).

A series of recent studies that focused on university students have also revealed that poor sleep quality leads to reduced learning capacity (Ahrberg et al., 2012; Perez-Olmos & Ibanez-Pinilla, 2014; Al-Kandari et al., 2017). Research infers that poor sleep leads to depression (Adams & Kisler, 2013) with detrimental sleep problems in the first semester of studies (Doane, Gress-Smith, & Breitenstein, 2015). Psychological imbalances like reduced alertness, mood variations, performance faults, reduced punctuality for lectures, and grade point average (GPA) has been pointed towards sleep deprivation (Amin et al., 2016). Disturbances in the sleep-wake cycle are associated with severe negative outcomes on mental and physical wellbeing (American Academy of Sleep Medicine, 2015).

Over time, some researchers constructed the Pittsburgh Sleep Quality Inventory (PSQI) that has become a frequently used gold standard and validated standardized self-report measure of sleep quality that determines if an individual is a good or poor sleeper (Buysse, Reynolds, Monk, Berman, & Kupfer, 1988). The basis for constructing the index was on the high occurrence of sleep problems, in addition to the relation of poor sleep quality with medical disorders (Buysse et al., 1988). Sleep quality is an approved clinical construct that is utilized in clinical and non-clinical settings (Almojali, Almalki, Alothman, Masuadi, & Alaqeel, 2017). In particularly Kenya, there are few studies published on sleep health, and these studies rarely examined factors related to sleep quality amongst university students.

1.2. Problem statement

Studies indicate that students lack knowledge of sleep health and the repercussions it has on individuals' well-being (Ahrberg et al., 2012; Perry, Patil & Presley-Cantrell, 2013). This is not an exception for university students as studies indicate a high poor sleep quality prevalence of about 60% higher than any other demographic (Alimirzae, Azzizadeh Forouzi, Abazari & Haghdoost, 2014). Students in the Health fraternity are faced with a greater academic load which could potentially arise to deprivation of sleep. Hence, it is imperative to know the extent of the problem and factors affecting their sleep quality, and if disturbances in their sleep pattern impact their overall well-being and academic life.

Findings from various literature depict that students are less knowledgeable on the health effects derived from sleep deprivation and the impacts on the quality of care and safety rendered to patients (Agarwal, Eryuzlu & Chawla 2015; Thomas, McIntosh, Lamar & Allen, 2017). This negatively impacts the safety of the patients and it could affect proficiency in clinical practice (Agarwal et al., 2015; Thomas et al., 2017). Predisposing factors such as stress and alcohol misuse are regularly tackled in healthcare in isolation despite the negative consequences it has on sleep quality.

Sleep is an understudied health concern (Knowlden, Sharma, & Bernard, 2012a). There are dearth and paucity of data on sleep quality among university students in Kenya, whose study program and culture may differ from other university students. The current study will address this research gap by determining the prevalence and underlying factors of sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.

1.3. Theoretical framework and conceptual model

Rosenstock's Health Belief Model (HBM) was utilized to guide this study (Figure 1). Stretcher & Rosenstock (1997) developed the HBM to explicate and comprehend the health-related behavior of humans. The above-mentioned determines the health behavior of individuals' beliefs and perceptions regarding the disease and the necessary actions accessible to avert the occurrence of the disease. Knowlden & Sharma (2014b) used the HBM to predict sleep behavior among university students in Alabama and it explicated 34 percent of the variation in sleep quality.

Definitions of HBM core constructs and their applicability in this study.

Perceived susceptibility and severity

Hayden (2009) defined this as an individual's valuation of their likelihood to acquire certain morbidity and judgment of its seriousness. In the context of this study, the Individual perception component of the HBM was captured through PSQI seven components to evaluate Individuals' sleep factors (duration of sleep, disturbances in sleep, day dysfunction due to sleepiness, habitual sleep efficiency, usage of sleep medications and subjective sleep quality).

The Modifying factors of the HBM focused on the non-modifiable demographic factors such as sex, and academic level of study.

Perceived facilitators and perceived barriers.

How an individual perceives the value and usefulness of being involved in health promotion behaviors to alleviate and lessen the risks of certain diseases is beneficial. Moreover, individuals' perceived inability to access health care or an obstacle to change behaviors is regarded as barriers (Hayden, 2009).

The likelihood of behavioral change in the HBM components comprised social support, physical activity, caffeine intake, alcohol intake, smartphone usage, perceived stress, and sleep hygiene.

Cues to action

Hayden (2009) defined the aforementioned as people, events, or any other factors that influence people to change their behavior. Sleep hygiene was assessed in this study.

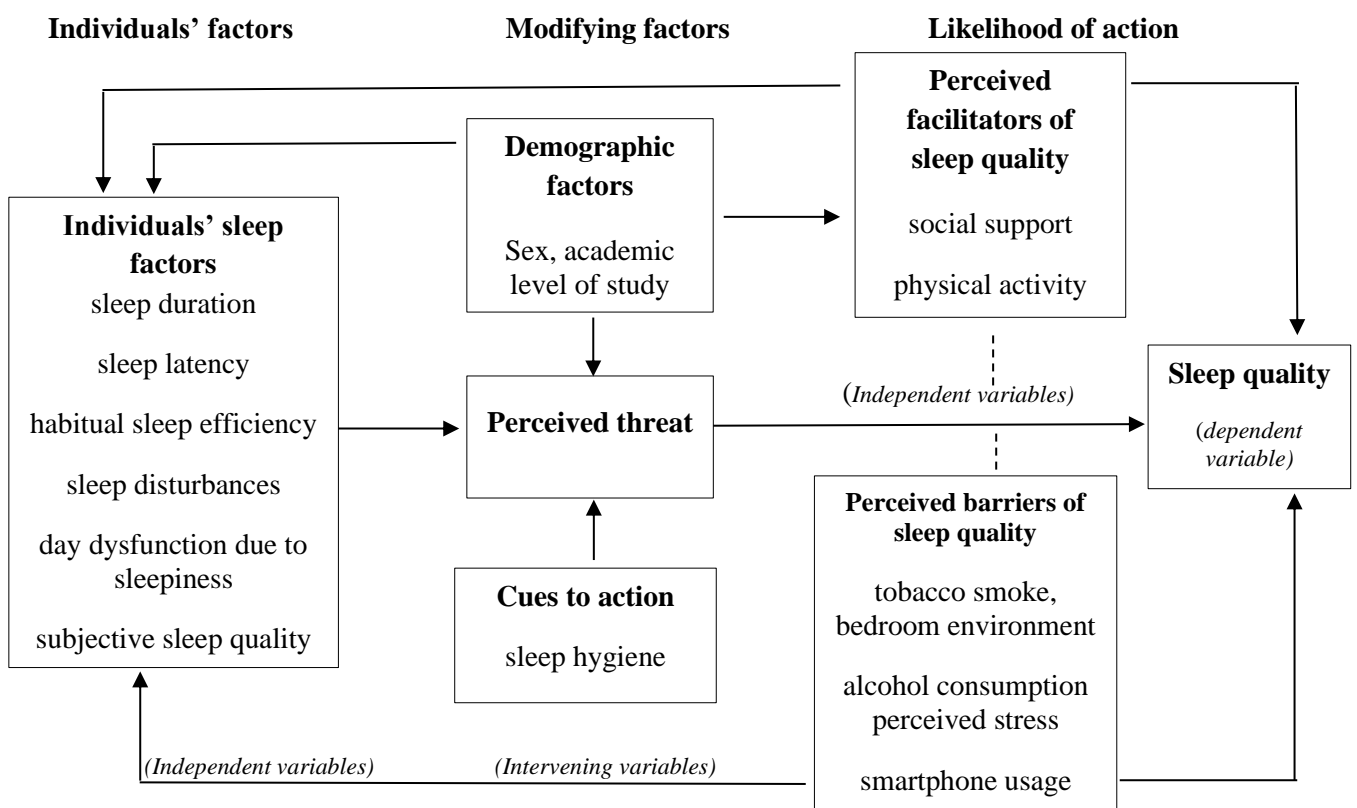


Figure 1. Conceptual framework showing the relationship between factors associated with sleep quality.

1.4. Justification

Despite the significance of sleep in attaining optimal health and quality of life, studies that have concentrated on sleep health indicated that about 60% of university students experience poor sleep outcomes, which is higher than any other demographic (Alimirzae et al, 2014). An appraisal of published literature points out that there is a paucity of studies on sleep health that focused on university students in Kenya. This study, therefore, seeks out to underscore the contributory factors of good or poor sleep quality. Students' welfare programmes in academic institutions should incorporate how poor sleep health affects the general well-being and academic life of students (Perez-Olmos & Ibanez-Pinilla, 2014).

These findings will assist and support learning institutions, educators, clinicians, and students to comprehend the imperativeness of sleep quality and underlying factors to design interventions that promote good sleep health measures. It is anticipated that the basic data will raise and sensitize awareness regarding sleep health. Students will also gain insight to evaluate their individual perceived level of sleep quality and identify the modifiable risk factors associated with poor sleep outcomes. It is also expected that students who are conversant with good sleep hygiene will transfer the knowledge into their clinical practice.

1.5. Research questions

1. What is the prevalence of sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi?
2. What are the factors associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi?
3. What is the perception of sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi?
4. What are the modifiable risk factors associated with poor sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi?

1.6. Research hypothesis

Null Hypothesis

H₀1: There is no association between the demographic factors, sleep behaviors, psychological factors, and sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.

Alternative Hypothesis

H_a1: There is an association between the demographic factors, sleep behaviors, psychological factors, and sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.

1.7. Objectives

1.7.1. Broad objective

To determine the prevalence and factors associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.

1.7.2. Specific objectives

1. To estimate the prevalence of poor sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.
2. To determine facilitators associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.
3. To determine barriers associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.
4. To establish the modifiable risk factors associated with poor sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.

CHAPTER 2: LITERATURE REVIEW

2.0. Introduction

This chapter aims to provide an overview of studies that have been previously conducted on sleep health and associated factors. Comprehensive article searches were conducted on several computerized databases which included PubMed, Web of Science, Hinari, Google scholar, PLOS One, and Science Gate. The search was limited to the extent of peer-reviewed articles in print between 2009 and 2019 except for definitions because there is little extensive literature concentrating on university students.

2.1. The prevalence of poor sleep quality.

Poor sleep is a predominant concern among university students and it is linked with maladaptive behaviours and increased odds of experiencing stress (Vail-Smith, Felts & Becker, 2009; Lund et al., 2010). These findings concur with Agarwal et al., (2015) and Wang et al., (2016) that deprivation of sleep and poor sleep is due to academic stress, workload, and sleep behaviours. A considerable number of university students are predisposed to poor sleep quality. This was confirmed in previous studies by Almojali, Almalki, Alothman, Masuadi & Alaqeel (2017) who found a poor sleep prevalence of 76% among medical students in Saudi Arabia. The high prevalence of poor sleep quality was as well corroborated in more studies by Alimirzae et al., (2014) 77.1%, Benavente, da Silva, Higashi, Guido & Costa (2014) 78.8% and Santos, Martino, Sonati, Faria & Nascimento (2016) 84% among Nursing students in Iran, Portugal, and Canada respectively.

In a study conducted among Sudanese medical students, the poor sleep quality prevalence was 61.4% (Mirghani, Mohammed, Almutadha, & Ahmed, 2015). These findings were also consistent with Lund et al., (2010) whose results exhibited that around 60% of the students

were classified as poor sleepers in a large population of university students in the United States of America.

Lohitashwa, Kadli, Kisan, Sindhuja & Deshpande (2015) reported a poor sleep quality prevalence of 58% among medical students in India, which was a little lower than the above-mentioned prevalence. These findings were also in line with those of Cates, Clark, Woolley & Saunders (2015) whose poor sleep quality prevalence was found to be 56.2% amongst Pharmacy students in Alabama and 52.7% among Ethiopian university students (Lemma et al., 2012a).

2.2. Factors associated with sleep quality.

2.2.1. Individuals' sleep factors.

2.2.1.1. Sleep duration

The duration of sleep is evaluated by the number of hours of sleep per night (Ohayon, 2017). The recommended sleep duration varies from 6 to 8 hours in the average adult population (Centers for Disease Control and Prevention [CDC], 2017). Researchers have reported high estimates of less than 40% of short sleep duration or fewer than seven hours among university students as measured by the PSQI (Taylor & Bramoweth, 2010). Sleep duration is generally known to vary by age, sex, and shorter sleep duration across study populations have been linked to overuse of technology during bedtime, academic and social demands (Taylor et al., 2011; Oluwole, 2011).

Adriansen et al., (2017) reported a sleep duration of 5-6 hours per night, in 61% of the students, with 51% taking daytime naps for at least one hour in Indian, USA. Similarly, Thomas et al., (2017) depicted that 60% of undergraduate students attested sleeping 5 to 6 hours every night before their class and clinical practice. It is also revealed by Lund et al., (2010) that 25% of students admitted that they were sleeping less than six hours per night.

Approximately 60% of student nurses have stated sleeping for less than seven hours every night before their clinical rotations and morning class in Portugal and Texas (Benavente et al., 2014; Thomas et al., 2017). This is in line with Khan, Karachi, Haroon, Murtaza, & Anwar (2016) who depicted that a substantial proportion (78.1%) of medical students in Pakistan slept for less than 7 hours. Additionally, Agarwal et al., (2015) revealed that 56% of medical students in Canada admitted they required roughly seven hours of sleep every night, but then only 16% of students reported sleeping seven hours every night, which showed a discrepancy on what these students acknowledge as the recommended sleep hours of sleep and their duration of sleep.

In contrast, a few students reported a sleep duration for at least 7 hours on average or more, which is considerably higher than the average hours reported by the majority of students. Lemma et al., (2012a) reported that 37.6% of students in Ethiopia slept for 7 hours, 20.8% of Dental students in Brazil slept for eight hours (Serra-Negra et al., 2014) and 29.4% of students in North Texas reported that they were sleeping for eight hours or more (Taylor & Bramoweth, 2010).

2.2.1.2. Sleep disturbances

University students are faced with troubles in their circadian cycle due to the increased stress of the academic setting (Lund et al., 2010; Dreganv & Armstrong, 2010). Sleep disturbances comprise waking up at night, getting up to go to the washroom, snoring, coughing, feeling cold or hot, experiencing bad dreams, feeling pain, and experiencing difficulty in breathing. Students are predisposed to disturbances in their regular sleep than the general population (Cates et al., 2015). The most frequent cause of sleep disturbances among Nursing students comprised of waking up early or during midnight, feeling cold or hot, and struggling to sustain being asleep (Huang, Yang, Wu, Liu & Chen, 2014).

Lemma et al., (2012a) reported that 67.4% of students experienced sleep disturbances less than once a week. In contrast, a large proportion of students in a survey by Corrêa et al., (2017) among students in Brazil, 84.6% reported no sleep disturbances. The CDC (2017) pointed out that it is probable to attain sufficient sleep hours every night but in repose experience sleepiness and tiredness due to disturbances in the sleep cycle that occurred during the night.

2.2.1.3. Sleep latency

This is measured in minutes, to capture the length required to transition from wakefulness to sleep and it differs for every individual (Ohayon, 2017). It is proven in the literature that sleep latency and rapid eye movement (REM) is a useful indicator of sleep an individual is getting (Ohayon et al., 2017). The evaluation of sleep latency is based on the overall number of minutes an individual take to fall asleep every night and when 30 minutes elapse without falling asleep. It is found that a sleep latency consisting of 45 minutes and greater depicts poor sleep outcomes (Ohayon et al., 2017).

Wall (2018) showed that nearly a third of student Nurses had a sleep latency of more than 45 and 10% of them reported a higher sleep latency of 90 minutes. A great proportion of roughly 70% of students stated that they could not establish sleep within a minimum of 30 minutes at least more than once in a week and 31% indicated that they were not able to sustain their sleep within 30 minutes, at least three or more times in a week (Wall, 2018). Similarly, Carter, Chopak-Foss, and Punungwe (2016) indicated that 25% of university students had difficulty sustaining their sleep within a reasonable 30 minutes, at least three or more times per week. Buboltz et al. (2009) discovered that a substantial number of university students required at least 30 minutes to sleep.

2.2.1.4. Day dysfunction due to sleepiness.

This is assessed in an individual to check if they have difficulty sustaining being awake whilst conducting activities such as driving, engaging extracurricular activities, and trouble sustaining enthusiasm to execute duties. It is projected that a considerable proportion of about 50% of university students showed symptoms of dysfunction due to excessive sleepiness during the day (Orzech, Salafsky & Hamilton, 2011).

A survey by Corrêa et al., (2017) among medical students in Brazil, discovered that 50.4% of students experienced difficulty conducting day to day activities more than once a week and 70.6% stated being drowsy was inevitable. In another study conducted by Schlarb & Friedrich (2017) in Germany, findings highlighted that 67% of students had sleep problems that altered their daily functions as a result of morning tiredness and daytime sleepiness.

Taylor, Gardner & Bramoweth (2011) reported that students who experienced decreased daytime functioning suffered from poor quality sleep. These findings correspond with Huang, Yang, Wu, Liu & Chen (2014) whose results showed that students who manifested symptoms suggestive of excessive daytime sleepiness (EDS) reported interferences in their daily activities were 35%, among all who presented with poor sleep outcomes. A considerable proportion of Nursing students (33% to 50%) acknowledged that they were prone to sleeping during daytime activities (Huang et al., 2014). Nursing students' who were first and second academic levels reported having dysfunction during daytime than those students in other class years (Benavente et al., 2014).

In contrast, Wall (2018) found that a great proportion of students (87.4%) stated experiencing being wakeful during the day more than once a week, which is high compared to findings from other studies.

2.2.1.5. Habitual sleep efficiency.

This is expressed as the ratio of the total sleeping hours to the overall number of hours stayed in bed. It is calculated as the ratio of entire sleep time relative to time stayed in bed on the PSQI (Ohayon et al., 2017). In average adults, sleep efficiency that ranges from 65% to 84% depicts good sleep quality although it is not explicitly established in the literature (Ohayon et al., 2017).

In a comparable survey by (Corrêa et al., 2017) among medical students in Brazil, habitual sleep efficiency was found to be 87.9%. This was congruous with Lemma et al., (2012) who indicated that the majority of students (70.2%) had a sleep efficiency of more than 85% and 93% in a study by Lohitashwa et al., (2015) which is recommended for a good quality sleep.

2.2.1.6. Use of sleeping medications.

This is assessed by how frequently sleeping aids and medications are utilized to stay asleep (Buysse et al., 1989). Stimulants use was discovered to be linked with poor sleep outcomes among students in Thailand (Lohsoonthorn et al., 2013). Correspondingly, a survey among students in Germany indicated that sleep medication was frequently utilized to sustain being asleep every night (Wörfel, Gusy, Lohmann, Töpitz, & Kleiber, 2015). It is reported in the literature that Nursing students have used substances or sleeping aid to maintain being awake or assist them to sleep and it accounted for roughly 33% of these students (Thomas et al., 2017). Similarly, a survey by (Corrêa et al., 2017) found that 8.6% of student doctors reported utilizing medication to assist them to sleep at least once a week to stay awake.

On the other hand, Lohitashwa et al., (2015) indicated that the frequency of using sleep medications at least once a week among students was found to be associated with psychological stress but there was no association with sleep quality in differentiation to students who did not utilize any sleeping medications.

2.2.1.7. Subjective sleep quality.

According to the PSQI, individuals could self-rate their individual general sleep quality as either very bad or very good (Buysse et al., 1989). Corrêa et al., (2017) pointed out that closely to 40% of the students considered their overall sleep quality as either fairly bad or very bad. This aforementioned percentage was lower than that conveyed in a study by Rique, Fernandes, Ferreira & de Sousa-Muñoz (2014) which indicated a higher perception of very bad sleep outcomes accounted for 61.5% and 61.9% in female and male students.

Contrarily, findings by Lohitashwa et al., (2015) exhibited that 78% of the students at universities rated, their general sleep quality as fairly good. This in agreement with Lemma et al., (2012a) and Almojali et al., (2017) who reported that 54.3% and 67.7 % of students esteemed their overall sleep quality as fairly good.

Arora, Broglia, Pushpakumar, Lodhi, & Taheri (2013) and Carter et al., (2016) discovered that overestimation of sleep quality could be attributed to students' inadequate knowledge on what constitutes good sleep quality and they tend to over sacrifice their sleep hours to meet their academic demands. Besides, an overestimation of good sleep is connected to the neglect of time spent awake while in bed (Arora et al., 2016).

2.2.2. Demographic factors

2.2.2.1. Sex

Various studies have identified that female students have an increased predisposition to poor sleep health. Chang et al., (2012) documented that females have a greater risk of poor sleep outcomes among freshman students in Taiwan. This finding was similar to results by Alshahrani & Turki (2019) in medical students, who depicted the odds of poor sleep quality were 37% higher among female students when compared to their counterparts.

However, a study by Oluwole (2010) among undergraduate university students in Nigeria, discovered that female students tend to have a longer duration of sleep.

These findings vary from those of Lohitashwa et al., (2015) report that male students suffered more from poor sleep quality and had a propensity to sleep later within a short time as compared to female students. Variations in sleep are indicated in the wide-range population, as women reported a reduction in sleep hours, more sleep disturbances, and high incidence rates of insomnia when compared to men (Green, Espie, Hunt & Benzeval, 2012). In contrast, an Ethiopian study by Lemma, Gelaye, Berhane, Worku, & Williams (2012b) pointed out that sex was not associated with sleep quality. One potential explanation of these differences in various studies could be explicated by the unproportionate number of students in studies.

2.2.2.2. Academic level of study.

In a web-based survey by Brick, Seely & Palermo (2010) among medical students in Portland, the earliest academic levels reported poor sleep quality than those in more advanced academic levels. One potential account for this outcome is that students are still learning to adjust to the academic way of life and coping strategies as they advance in their academic programmes. In an Ethiopian study by Lemma et al., (2012b) among medical students in two different universities, those who were in the fourth year and above, had lower odds of poor sleep than those in the second and third years.

These findings correspond with Benavente et al., (2014) whose comparison across different academic levels of students depicted that first- and second-years Nursing students incurred incidences of poor sleep and increased likelihood of daytime dysfunction when compared to those students in advanced academic levels.

2.2.3. Perceived facilitators of sleep quality.

2.2.3.1. Social support

Research indicates that good sleep practices and social support are among the essential aspects associated with decreased levels of perceived stress and good sleep outcomes. Findings by Wang et al., (2016) indicated that good interpersonal relationship contributes to good sleep quality. This is supported by Perez-Olmos & Ibanez-Pinilla (2014) who concentrated precisely on medical students and concluded that lack of social support is related to sleep deprivation and hence diminished attention leading to poor learning outcomes and risky patient care. Furthermore, insufficient sleep in students aggravates physical violence and intense emotions (Keller, Blincoe, Gilbert, Haak, & DeWall, 2014).

2.2.3.2. Physical activity

Previous research indicated that a better self-perception of health and contentment with physical exercises has better sleep health outcomes. Gerber, Brand, Holsboer-Trachsler, and Pühse (2010) findings revealed an association between habitual exercises and sleep quality as students who exercised regularly had good sleep outcomes. In distinction, Chang et al., (2016) depicted that exercise frequency and exercise intensity was not linked with good sleep outcomes in students who regularly exercised (at least once a week or 2.5 hours per week). These findings were also found to be consistent with the outcomes of a study conducted among resident doctors in India which depicted that there was no association between physical exercises and good sleep quality (Siddalingaiah, Mastin, Moore, Bryson & Singh, 2018).

2.2.4. Perceived barriers to sleep quality.

2.2.4.1. Bedroom environment

Creating a tranquil sleep environment is crucial as it induces a healthful sleep-promoting behaviour (Todd & Mullan 2014). Commonly, in a physical environment; contact to tobacco smoke in the dormitory and air quality (scents, humidity, fragrance, and sweat) increased the possibility of respiratory irritation thus, posing a great risk for poor sleep outcomes (Araujo et al., 2014; Liu, Song, Wang & Liu, 2014). A thermal environment is suggested to be the primary cause of sleep disturbances as the human beings' circadian rhythms are influenced by the body's temperature (Liu et al., 2014; Lan, Lian, Lin, 2016a).

Moreover, Liu et al., (2014) highlighted that air temperature is an important bedroom environment factor because the human body is delicate to ambient air temperature throughout sleep. Similarly, a study by Lan, Tsuzuki, Liu, and Lian (2017b) tested the association between indoor air quality and sleep quality. Discoveries from the aforementioned survey depicted that sleep quality improved with good ventilation although there is still a paucity of experimental studies. Correspondingly, Ekasiwi et al., (2013) indicated that Indonesian adults who reported poor indoor air quality and room air contaminations presented with poor sleep outcomes. Preferred bedroom air temperatures vary greatly between individuals, and due to bedroom structural differences (Strøm-Tejsen, Zukowska, Wargocki & Wyon, 2016). It is not conducive to sleep and to sustain sleep when the bedroom is too cold or too hot (Strøm-Tejsen et al., 2016).

Noise is a known environmental stressor with psychological effects on health. Similarly, noise is amongst the most environmental risks which suggestively compromises sleep health (Brick et al., 2010). Approximately 90% of students have shared cubicles and among them, nearly 41% woke up due to noise from their roommates (Schlarb & Friedrich, 2017).

2.2.4.2. Alcohol consumption

Alcohol consumption is among the known bad sleep habits that partly explicate poor sleep outcomes (Lund et al., 2010). Correspondingly, Vail-Smith et al., (2009) pointed out risky behaviours such as increased alcohol consumption was associated with poor sleep health. Singleton and Wolfson (2009) also revealed that students who consumed a copious amount of alcohol slept fewer hours and late at night. Students with poor sleep outcomes ascertained they drank alcohol and were found to be twice as likely to use alcohol to assist them to sleep (Lund et al., 2010). This finding was substantiated by Mebrahtom, Hiwot & Andualem (2017) who depicted that students who consumed alcohol weekly were likely to incur odds of poor sleep quality compared to non-consumers.

In contrast, a study by Unger (2016) among medical students in Philadelphia, showed no link between alcohol ingesting and sleep quality. This was elucidated by students' profound knowledge of the health effects of alcohol exposure.

2.2.4.3. Caffeine intake

Even though caffeine intake at night is regarded as a poor sleep hygiene practice, it may be occasionally essential to excel in academics (Faris et al., 2017). Students are likely to underrate the prolonged repercussions of consuming caffeine to sustain wakefulness to complete academic work or stay awake longer at night in preparation for the upcoming examination (Thomas et al., 2017). It is discovered that copious caffeine intake leads to daytime sleepiness and sleep disruptions, which further aggravates an increased need for caffeinated beverages to sustain being awake (Unger, 2016).

The above-preceding findings were supported by Lemma et al., (2012b) whose results depicted that the ingestion of one caffeine beverage per week was associated with the likelihood of experiencing poor sleep quality among students in Ethiopia.

2.2.4.4. Duration of mobile phone usage.

Technological distractions including mobile phones and social media usage affect sleep quality negatively (Adams & Kisler, 2017; Demirci, Akgonul, & Akpinar, 2015). These findings were corroborated by Gradisar et al., (2013); Bhatti, Rani, Memon & Wali (2015); Polos et al., (2015) who discovered that stimulating activities performed on gadgets such as smartphones in the hour earlier bedtime was related to poor sleep health among students.

Students enrolled at higher learning institutions are discovered to be second-highest potentially predisposed to the risk of smart gadgets addiction after adolescents who are the highest risk group. If a smartphone is utilized too extremely, it interferes with the daily activities of individuals and directly impacts the overall sleep health (Ahn & Kim, 2015).

2.2.4.5. Stress

Stress is well-defined as an imbalance between someone's requirements and the ability to meet them (Simandan, 2010). Psychological correlates like anxiety, stress, and depressive signs are frequently reported concerns among all university students (Hsieh, Hsu, Liu & Huang, 2011). Various studies have revealed that a certain stress level has a potential benefit of physiological functioning and learning process (favourable stress). It is also well known that high-stress levels have undesirable effects on the mental and physical well-being of students (unfavourable stress) (Behere, Yadav & Behere 2011; Hall, Levenson, & Halser, 2012).

Stress is among the most raised health concerns reported among medical and nursing students universally. It is widely reported students in various countries, for instance in Pakistan (60%),

India (73%), Saudi Arabia (53%), and Ethiopia 34.1% (Behere et al., 2011; Waqas, Khan, Sharif, Khalid & Ali, 2015). Many factors can contribute to stress such as a broad curriculum, abundant academic requirements, and examinations.

Research has provided evidence that healthy sleep practices are among the crucial protective factors related to decreased stress (Almojali et al., 2017; Myers et al., 2012). Some studies have shown a link between stress and sleep quality among university students (Lund et al., 2010; Waqas et al., 2015). In an appraisal of the literature on students' sleep health, results pointed towards mood problems as a significant health repercussion of sleep health (Kloss, Nash, Horsey & Taylor, 2011a). This is congruent with Ahrberg et al., (2012) who discovered that students who scored low exam marks incurred increased odds of severe stress and poor sleep outcomes (Ahrberg et al., 2012).

2.2.5. Sleep hygiene

Sleep hygiene comprises practices and habits such as exercises, that facilitate the promotion of better sleep outcomes, consistent bedtimes, reducing caffeine and alcohol beverages close to bedtime, uncomfortable bed, worrying, and avoiding using electronic gadgets in bed (Thomas et al., 2017). It is indicated in various literature that poor sleep hygiene contributes to poor sleep outcomes, which subsequently impacts health adversely. By increasing good sleep behaviours, university students can improve their sleep quality (Adriansen et al., 2017).

Identifying factors that cause poor sleep outcomes is crucial to avert it (Orzech et al., 2011). Students are known to indulge in poor sleep habits despite being mindful that it impacts their sleep health (Thomas et al., 2017). Vast aspects of sleep hygiene practices can be modified.

Preceding studies have discovered poor sleep hygiene habits and practices were significantly linked with poor sleep health (Vail-Smith et al., 2009; Suen, Tam, & Hon, 2010).

This is in agreement with Voinescu & Szentagotai-tatar (2015) who examined the influence of sleep hygiene behaviors among Romanian students and concluded there was a strong link between sleep hygiene and sleep quality. Similarly, Peach et al., (2016) revealed that sleep hygiene was associated with sleep quality in students based in North Carolina. Conversely, Alshahrani & Turki, (2019) depicted an alarming prevalence of sleep disturbance among student doctors, even though there was no significant association between sleep hygiene and sleep quality.

CHAPTER 3: METHODOLOGY

3.0. Introduction

This chapter highlights the study design, study area, study population, selection criteria of participants, sample size determination and sampling technique, study variables, data collection procedures, quality assurance procedures, ethical considerations, data processing and analysis techniques, and minimization of errors.

3.1. Study design

A cross-sectional design was employed in this study. Quantitative data collection methods were utilized to provide data on the prevalence and factors associated with sleep quality among undergraduate students at the CHS, University of Nairobi. According to Brink, Van der Walt & Van Rensburg (2012), a quantitative approach focuses on systematic procedures and objectivity to assess and measure participants' behaviours through structured research tools to obtain biodata. The study period extended from May 2019 until July 2020.

3.2. Study area

This study was conducted at the CHS, University of Nairobi, situated off Ngong road, Nairobi County, Kenya. The CHS is sited within the premises of Kenyatta National Hospital (KNH), which serves as a regional teaching and referral facility. The CHS has five schools and three institutes namely: School of Medicine (SOM), School of Dental Sciences (SDS), School of Pharmacy (SOPharm), School of Nursing Sciences (SONS), School of Public Health (SPH), Institute of Tropical and Infectious Diseases (UNITID), Kenya AIDS Vaccine Initiative-Institute of Clinical Research (KAVI-ICR), East African Kidney Institute (EAKI).

This study comprised undergraduate students from the School of Medicine, School of Pharmacy, School of Dentistry, and School of Nursing Sciences.

3.3. Study population

3.3.1. Target or parent population

This study targeted all undergraduate students who were attending their classes at the University of Nairobi. The findings may be extrapolated to this populace because this is where the source population was selected.

3.3.2. Study or source population

All the eligible undergraduate students who were attending their classes at the CHS in the schools as mentioned above, at the University of Nairobi. The total number of students registered in the CHS was 4378 with the following breakdown; School of Medicine (2747), School of Pharmacy (653), School of Dentistry (277), and School of Nursing Sciences (420).

3.3.3. Inclusion criteria

This study comprised undergraduate students attending classes at the CHS, University of Nairobi who:

- Agreed to participate and signed consent voluntarily.
- Were registered in Medicine, Pharmacy, Dental, and Nursing School.
- In the first, second, third, and fourth academic level of study.

3.3.4. Exclusion criteria

- Students who did not agree to participate voluntarily with signed consent.
- Students from other departments within the School of Medicine namely: Medical Physiology, Biochemistry, and Medical Laboratory.
- Students from the school of Dentistry, Pharmacy, and Medicine who were in fifth- and sixth-year level of academic study.

3.4. Sample size determination and sampling technique.

3.4.1. Sample size determination.

The sample size was derived using Fisher's formula employed in cross-sectional studies:

$$n = \frac{z^2(PQ)}{d^2}$$

Where:

n = sample size for population > 10, 000

z = normal deviation at the desired confidence interval

p = estimated proportion of an attribute that is present in the population

q = 1-p

d = desired level of precision

The sample size was determined by the above-listed parameters; proportion, according to previous studies on poor sleep quality prevalence which ranged from 55.8 % to 84% (Alimirzae et al., 2014; Lemma et al., 2012b).

The smallest proportion of 55.8% was used instead of 84% to attain a fairly large sample size. Assuming a 5% degree of precision, 80% power, and a 95% confidence interval at 5% type 1 error.

$$n = \frac{(1.96)^2 \times 0.558(1 - 0.558)}{(0.05)^2}$$

$$n = 379$$

The total population for undergraduate students is fewer than 10 000, the above sample size attained for the infinite population was adjusted using the formula below for the desired sample size for this study.

$$an = \frac{n}{1 + \frac{n}{N}}$$

Where:

an = the desired sample size for population < 10 000

n = the calculated sample size

N = the total population

$$n = \frac{379}{1 + \frac{379}{4097}} = 347$$

$n = 347 + 10\%$ non-response rate

$n = 382$

The lowest number of students included in this study was 382.

3.4.2. Sampling technique

A stratified random sampling technique was employed utilizing a comprehensive list of all undergraduate students at the CHS, which was obtained from the academic registrar. The strata were all the schools under CHS and within each stratum, there was a certain number of students: School of Medicine (3422), School of Pharmacy (674), School of Dentistry (320), and school of Nursing (460). Stratified random sampling ensured that each subgroup of the population was proportionately represented within the whole sample population of the research study.

This was conducted to upsurge the accuracy of the total estimations of the study by removing the between-strata variation (Dohoo, Martin & Stryhn, 2012). Subsequently, simple random sampling was employed to select study participants from all the schools in each academic level

once each class list of students from year 1 to year 4 was obtained. The undergraduate students were sampled from each academic level as follow; first year (n =117), second-year (n = 98), third-year (n = 86), and fourth-year (n = 77) (excluding the 5th and 6th years).

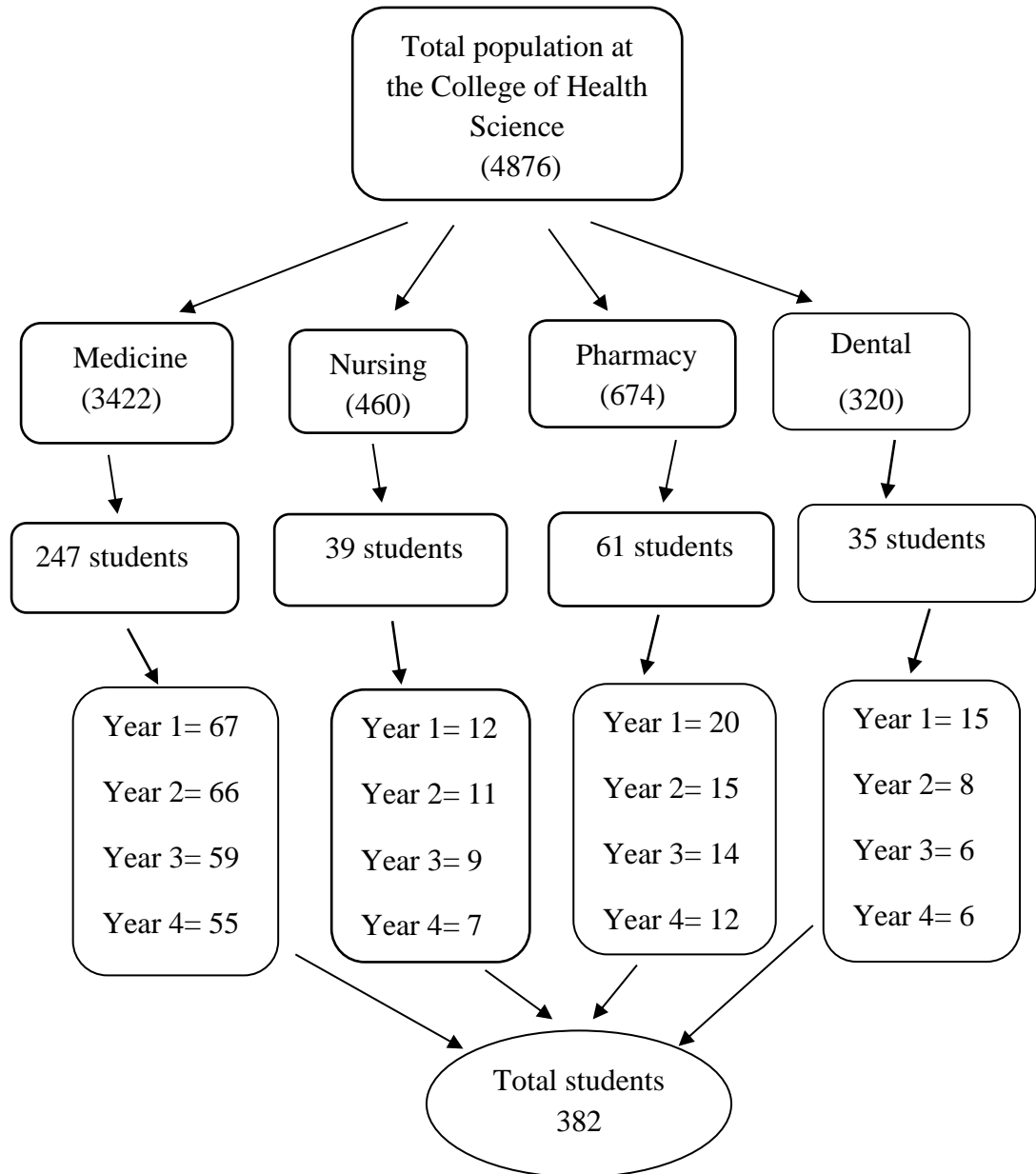


Figure 2: Schematic diagram of random stratification of schools in CHS.

3.5. Study variables

The key outcome variable of interest was sleep quality. This was measured as a dichotomous (binary) whether the participant had good sleep or poor sleep quality in the past month. The independent variables from various literature sources (Alimirzae et al., 2014; Hirshkowitz et al., 2015; Santos et al., 2016) depicted an association with sleep quality as shown in the conceptual framework illustrated in figure 1, chapter 2.

The independent variables were categorized as **Demographic factors** such as age, sex, residence, the field of study, and academic level of study. **Individuals' sleep factors**: duration of sleep, disturbances in sleep, daytime dysfunction due to sleepiness, habitual sleep efficiency, use of sleeping medications, and subjective quality sleep. **Sleep behaviours and psychological factors** that served as perceived facilitators and barriers to sleep quality were: social support, physical activity, caffeine intake, alcohol consumption, smartphone hours, and perceived stress. **Bedroom factors** (tobacco smoke in the room, roommate noise, room air quality, and physical structure of bedroom). **Awareness of sleep**: sleep hygiene.

Table 1: Independent and dependent variables with measurements.

Variable	Description of variable	Measurement of variable
Sleep quality (study outcome)	Sleep quality was defined as good or poor-quality sleep based on the global PSQI score.	<i>Binary</i> : ≤ 5 good sleep quality or > 5 poor sleep quality
Sex	This was captured in two categories.	<i>Binary</i> : female or male
Age	The exact participants' ages were captured.	<i>Continuous</i>
Academic level of study	This was the exact year the student has presently registered.	<i>Ordinal</i> : 1 st , 2 nd , 3 rd , and 4 th -year.

Sleep duration	The average total hours of sleep every night were reported. The exact hours were captured as continuous data during data collection and categorized as ordinal data during the analysis stage.	<i>Ordinal</i> greater than 7 hours, 6 -7 hours, 5-6 hours, less than 5 hours.
Habitual sleep latency	The exact minutes to transit from being awake to sleep were captured as continuous data during data collection and categorized as ordinal data during the analysis stage.	<i>Ordinal:</i> less than 15 minutes, 16-30 minutes, 31-60 minutes, greater than 60 minutes
Sleep disturbances	This was based on 9 sleep disturbances questions from PSQI as follows: Not able to sleep within 30 minutes? Wake up in the middle of the night or early morning? Wake up to use the bathroom? Cannot breathe properly, cough, snore loudly? Feel too hot? Bad dreams? Pain or any other reason?	<i>Ordinal:</i> not during the past month, once a week, twice a week, three times or more a week
Day dysfunction due to sleepiness	This was assessed to check if participants have difficulty sustaining being awake whilst conducting activities such as driving, engaging in extracurricular activities, and trouble sustaining enthusiasm to execute duties.	<i>Ordinal:</i> not during the past month, once a week, twice a week, three times or more a week
Habitual sleep efficiency	This captured the actual hours a student slept divided by the total number of hours spent in bed x 100 %. The exact hours were captured as continuous data during data collection and categorized as ordinal data in data analysis.	<i>Ordinal:</i> ≥ 85%, 75-84 %, 65-74 %, ≤ 65%
Use of sleep medications	How often participants used medicine to assist them to sleep (this could be over the counter or prescribed by a physician) during the past month. This was captured on a Likert scale.	<i>Ordinal:</i> not during the past month, once a week, twice a week, three times or more a week
Subject sleep quality	Participants self-rated their sleep quality. The values were captured on a Likert scale.	<i>Ordinal:</i> very good, fairly good, fairly bad, and very bad
Social support	Students were asked if they count on or are dependent on someone when they needed help (upset, need consolation, and when under pressure or feeling tense).	Nominal: no social support, fellow students, friends, family, social network

Caffeine intake	This captured the number of caffeinated drinks (coffee, black tea, cola, energy drinks) per day.	<i>Ordinal:</i> none, one cup/drink per day, two or more cups/drinks per day
Alcohol consumption	This captured the number of alcoholic beverages in a day and per day and week.	<i>Ordinal:</i> non-consumer, 1-2 drinks per day, More than 2 drinks per week
Physical activity	Participants were asked how often they exercised in a day and per week.	<i>Ordinal:</i> do not exercise, exercise regularly every day, 1-2 hours weekly, at least 3 days in a week
Smartphone hours	The average time spent on a smartphone during the day (over 24 hours) was captured.	<i>Ordinal:</i> less than 2 hours, 3-4 hours, more than 5 hours
Perceived stress (based on Cohen PSS)	The perceived stress scale had scores ranging from (0-13) that was considered as low stress (14-26) as moderate stress and (27-40) was considered as high stress.	<i>Ordinal:</i> mild, moderate, and high stress
Bedroom environment	Participants were asked (adapted a set of questions) regarding the bedroom environment (Ekasiwi et al., 2013) rated on a Likert scale as low perceived risk, medium, and high perceived risk of poor-quality sleep. The sum of responses was scaled and categorized into degrees of risks ranging from 0-8 with high scores indicative of low risk (0-1), medium risk (4-6), and high risk (7-8).	<i>Nominal</i> -Tobacco smoke in the dormitory. -Noise from a roommate. -The air quality of the room, scents (sweat, perfume, humidity). -The physical structure of the bedroom.
Sleep hygiene	Participants were asked 13 questions on sleep hygiene and sleep habits. The determined cut-off points for sleep hygiene was 0-17 as good sleep hygiene, 18-35 intermediate, and 36-52 poor sleep hygiene.	<i>Ordinal:</i> poor sleep hygiene intermediate sleep hygiene good sleep hygiene.

3.6. Data collection procedure

3.6.1. Questionnaires:

The questionnaire was composed of four components namely:

- The researcher designed questionnaire on demographic characteristics, sleep behaviours, and psychosocial factors.
- PERCEIVED STRESS SCALE (PSS)

This is a psychometric tool commonly utilized to assess stress perception. The scale comprises numerous direct questions on the current perception of stress. The PSS was constructed by Cohen, Kamarck, and Mermelstein (1983) and is a popular choice for assisting to comprehend peoples' perception of stress and feelings during certain situations. Evidence for the validity of the tool includes correlation with self-reported health, smoking status, stress measures, help-seeking behaviours, and health services measures (Cohen et al., 1988).

- SLEEP HYGIENE INDEX (SHI)

The SH index is based on a 13-item self-rated tailor-made to measure the practice of sleep hygiene behaviours (Mastin, Bryson & Corwyn, 2006). The 13 items making the index are derivative from the diagnostic criteria for sleep deprivation in the Classification of Sleep Disorders. Participants rate how regularly they indulge in exact behaviours as (always, frequently, sometimes, rarely, never) on a 5-point Likert scale. The 13 items on the index are summed up to yield a final score of sleep hygiene and higher scores are associated with maladaptive sleep hygiene status.

- PITTSBURGH SLEEP QUALITY INVENTORY (PSQI)

The PSQI is a validated and pre-tested tool that has been utilized numerous times in sleep health research among university students (Ahrberg et al., 2012; Kenney, LaBrie, Hummer, & Pham, 2012). The PSQI contains 10 components and this study utilized 7 components of the

PSQI as follows: sleep latency, duration of sleep, habitual sleep efficiency, disturbance of sleep, usage of sleeping medication, daytime dysfunction, and subjective sleep quality (Buysse et al., 1989). All students were asked to self-rate each of these seven aspects of sleep using the Likert scale. The last 3 aspects of the PSQI rated by room or bed partner were excluded because they do not contribute to the PSQI scoring, to get the global score. A PSQI global score was used to evaluate good and poor sleep quality.

3.6.2. Recruitment and training of research assistants.

Two post-graduate students were recruited as research assistants and underwent two days of training that was directed by the primary researcher. The training was primarily focused on how to collect data using ODK, filling in the questionnaires, and how to upload the completed questionnaire on the server. Data collection commenced after the research assistants were fully conversant with the purpose and data collection procedures.

3.6.3. Setting:

The data collection procedure was conducted in a conducive environment around campuses where students attended lectures and conducted their clinical practice (KNH or Chiromo campus). Students who were far from the campuses' vicinity were interviewed at their respective students' hostel (KNH, Main campus, Chiromo, and lower Kabete hostel). In contrast to the above, data collection occurred online among the remaining 133 students. This change in data collection procedure was necessitated by unforeseen and unavoidable circumstances, as students could not be contacted and reached for a physical interview after the college was closed amid the Covid-19 pandemic.

Privacy was ensured throughout data collection by interviewing one student at a time, distantly from other students. Since some of the students' cubicles were shared, one student was kindly excused to leave the cubicle during the interview to ensure privacy.

3.6.4. Data collection and entry

Participants were required to sign a tablet-based consent which contained fields for signature upon approval. The questionnaire was uploaded onto the Open Data Kit (ODK) on the tablet-based software for data collection. Each questionnaire on the ODK contained a participant identifier number.

The principal researcher and research assistants asked participants the research questions and filled in the biodata on the ODK software pre-programmed questionnaires. All completed questionnaires were uploaded to the main server at the end of the day once the target number of participants was met on that specific day.

Out of the 378 participants, only 245 were interviewed through the ODK application and the remaining 133 students completed an online questionnaire (SurveyMonkey), precisely the same with the former. The online questionnaire was accessed by the eligible students through a link sent to their contact numbers and submitted electronically upon completion. This change in data collection procedure was necessitated by unforeseen and unavoidable circumstances, as students could not be contacted and reached for a physical interview after the college was closed amid the Covid-19 pandemic.

3.6.5. Data security and back up

All smartphones for data collection were encrypted and password-protected to ascertain the confidentiality of the participants' biodata. The operating system locks work in such a way that all devices locks for 30 seconds after three failed attempts of entering incorrect data.

The ODK survey files were automatically moved from the devices after a secured transmission was ensured to the server so that each record is in only one location at a time. The data was continuously backed up on each device through an administratively controlled part in case of

unforeseen events such as transmission failure or when a device is lost. The backup data was also password-protected up until the validation and completion of the data collection period.

Lastly, the server was accessed using encrypted hypertext transfer protocol (HTTP) connections over the protected sockets layer (SSL) and secure shell (SSH) protocols. All files received by the server's software were securely stored using Federal Information Processing Standards 140-2 validated Advanced Encryption Standard (AES). This is a widely used computer security standard to ensure authentication techniques to protect data from unauthorized access and coding the data.

3.7. Quality assurance procedures

3.7.1. Pre-test of data collection tools

The preliminary phase of the study was conducted among the undergraduate students at the College of Humanities and Social Sciences, the main campus of UoN. To minimize contamination only students who met a few criteria but not all were comprised in the pilot study to pre-test the research instrument. The results from the pilot study were utilized to evaluate the reliability of the research instrument and improved various aspects of the study. Any imprecision or errors discovered during the pre-test was rectified before the onset of actual data collection. The supervisors reviewed the research questionnaire before data collection.

3.7.2. Data quality control

Face and content validity were done through the review of a research instrument by supervisors. Instrument validity was ensured through the formulation of the research instrument according to research objectives and the relevant literature on sleep health. The reliability of the study instrument was assured through the pilot study as well as a retest procedure.

3.8. Ethical considerations

To ascertain that this study adhered to ethical principles of justice, right to privacy, beneficence, and respect to protect and avert risks, ethical clearance was attained from the KNH/UoN Ethics Review Committee. The appropriate ethical and consent forms are attached as appendices. Only students who signed tablet-based consent were interviewed after detailing the purpose of the study. It was also anticipated that electronic consent lessened anxiety, increased convenience, and allowed students to be more engaged during the interview. The researcher clarified and simplified all the information with the participants, concerning the nature, purpose, and implication of the research study.

The researcher ensured that no identification was on the questionnaires and all the data collected. The participants were ascertained of the anonymity of biodata and confidentiality that any relevant data gathered would only be shared with the researchers and the supervisors of the study. Participants who chose to withdraw from participation were allowed without any stigmatization. No incentives were offered or presented during recruitment.

3.9. Data processing and analysis technique

All the completed questionnaires were sent to the central server when the transmission was deemed possible. The data was exported directly from ODK in its native storage format as a comma-separated values file (CSV file) and accessed through Microsoft Excel 2016 for validation and cleaning. The data was then exported to SPSS version 23 for coding and to detect out of range, and missing values. Frequency cross-tabulation tables were created for categorical variables whereas continuous data were summarized by computing means, medians, and standard deviations.

The PSQI global scores were calculated based on predetermined cut off scores and then classified participants into those with good and poor-quality sleep. Based on PSS, the responses were used to classify the participants into those with mild, moderate, and high stress.

The bivariate analysis was conducted utilizing a binary logistic regression model to assess the association between the independent variables and the dependent variable. Statistical significance was set at the P-value of less than 0.20 ($p < 0.20$), which is a liberal P-value to control negative confounding (Dohoo et al., 2012).

Correlations analysis between sleep hygiene, perceived stress, and sleep quality was carried out to establish the strength of relationships between these variables.

Multivariate logistic regression was conducted utilizing the significant variables from the bivariate analyses to test significant associations. The statistical significance was set at the P-value of less than 0.05 ($p < 0.05$). The insignificant variables were removed from the model in a backward step fashion until the final model was fitted. The odds ratios and 95% CI estimate were utilized to test the associations.

3.10. Minimization of Errors and Biases.

To adjust for confounding, all variables that were significantly associated with the dependent variables at bivariate analysis were considered using binary logistic regression. Adjusted Odds ratios were also provided.

CHAPTER 4: STUDY RESULTS

4.1. Descriptive analysis

4.1.1. Demographic characteristics.

Demographic characteristics of the study participants that were assessed comprised age, sex, residence, the field of study, and year of study. A total of 378 out of 382 participated in the study resulting in a 99 percent response rate. Four of the eligible participants withheld to participate in the study. Out of the 378 participants, 245 were interviewed through a tablet device-based questionnaire running on the Open Data Kit (ODK) application and the remaining 133 students completed an online questionnaire (SurveyMonkey), precisely the same with the former. This was necessitated by unforeseen and unavoidable circumstances, as eligible students could not be contacted and reached for a physical interview amid the Covid-19 pandemic outbreak.

Out of the 378 participants, 57.1% were females and 42.9% were males. A substantial proportion of the participants (31.0%) were in their first year of study. The mean age was 21.81 (SD \pm 2.061) with a range of 17- 30 years. Regarding the field of study, nearly two-thirds (64.8%) of participants were studying Medicine and Surgery. The study also indicated that more than half (56.3%) of the participants resided in urban areas. Table 2 summarises the participants' demographic characteristics.

Table 2: Demographic characteristics and sleep quality status of the study participants (N= 378).

Variable	Category	Frequency (%)	Good sleep quality (n %)	Poor sleep quality (n %)	Total seep quality
Age (m±sd)	20.81±2.016				
Sex	Male	162 (42.9%)	41 (19.0%)	175 (81.0%)	216 (100%)
	Female	216 (57.1%)	35 (26.6%)	127 (78.4)	162 (100%)
Residence	Urban	213 (56.3%)	52 (24.4%)	161 (75.6)	213 (100%)
	Rural	165 (43.7%)	24 (14.5%)	141 (85.5%)	165 (100%)
Field of study	Nursing	39 (10.3%)	5 (12.8%)	34 (87.2%)	39 (100%)
	Dental	33 (8.7%)	6 (18.2%)	27 (81.8%)	33 (100%)
	Pharmacy	61 (16.1%)	16 (26.2%)	45 (73.8%)	61 (100%)
	Medicine	245 (64.8%)	49 (20.0%)	196 (80.0%)	245 (100%)
Academic level of study	1 st Year	117 (31.0%)	23 (19.7%)	94 (80.3%)	117 (100%)
	2 nd Year	98 (25.9%)	15 (15.3%)	83 (84.7%)	98 (100%)
	3 rd Year	86 (22.8%)	23 (26.7%)	63 (73.3%)	86 (100%)
	4 th Year	77 (20.4%)	15 (19.5%)	62 (80.5%)	77 (100%)

*SD (standard deviation)

4.1.2. Prevalence of sleep quality among undergraduate students.

Sleep quality was measured on a continuous level as a binary variable: poor and good sleep quality based on PSQI. The seven subscales scores of the PSQI were summed to produce a final score with scores taking a value of 0 to 21 referred to as global scores.

A global PSQI score greater than 5 was a cutoff reflective of poor sleep quality whereas, a score of less than 5 reflective of good sleep quality. Of the total study population, 302 students (80%) had a score of more than 5 which is linked with poor sleep quality, while 76 students (20%) had a score of less than 5 which is linked with good sleep quality as defined by a PSQI scoring. The average PSQI score was 7.83 (SD± 2.82). The prevalence of poor sleep quality in the past 12 months before this study was 80%, while the prevalence of good sleep quality was only 20% among the undergraduate students at the College of Health Sciences as shown in figure 3 below.

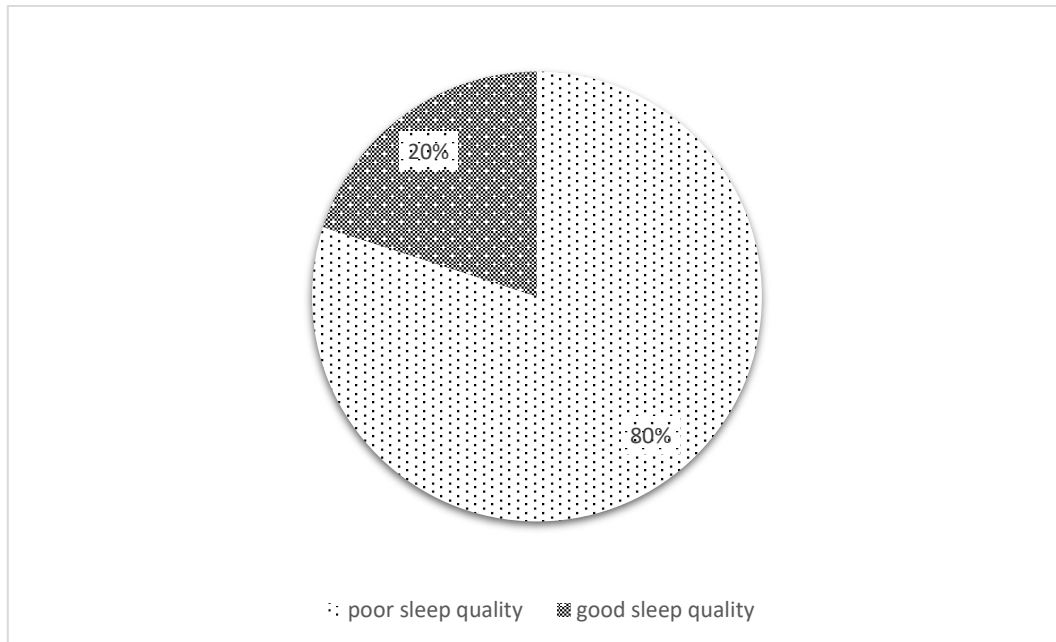


Figure 3: Prevalence of sleep quality among undergraduate students at the College of Health Sciences.

4.1.3. Sleep behaviours and psychological factors of the study participants.

Findings on sleep behavioral and psychological factors (Table 4) indicate that a substantial proportion of participants (56.3%) consumed at least one cup of caffeine beverages per day. The examination of data further depicted that the majority of the students (79.6%) were not consuming alcohol and only (3.7%) reported consuming at least two drinks of alcohol per week. Concerning the usage of smartphones, less than half of the participants (46.0%) reported spending 3-4 hours on their smartphones per day.

On social support, 38.6 % of the participants relied on their family members and 9.3% reported that they would depend on social networks. Less than half of the participants (35.25%) reported that they do not indulge in any physical exercises and 28.0 % exercised for at least an hour per week. A large proportion of participants (95.5%) reported that they had not taken any Narcotics or Sedative medications for any medical condition, psychiatric morbidities, or sleep disorders.

The perceived stress had scores ranging from (0-13) that were considered as mild stress, (14-26) moderate stress and (27-40) high stress. The mean (SD) for PSS was 20.76 (5.68). The majority of the participants (74.9%) had scored moderate stress whereas the minority (8.7%) had scored mild stress. The results are summarized in Table 3.

Table 3: Sleep behaviours, psychological factors, and sleep quality status of study participants (N= 378).

Variable category	Frequency	Good sleep quality	Poor sleep quality	Total sleep quality
Caffeine intake				
None	99 (26.2%)	24 (24.2%)	75 (75.58%)	99 (100%)
1 cup/drink per day	213 (56.3%)	34 (16.0%)	179 (84.0%)	213 (100%)
2 or more cups	66 (17.5%)	18 (27.3%)	48 (72.7%)	66 (100%)
Alcohol consumption				
Non-consumer	301 (79.6%)	66 (21.9%)	23 (78.1%)	89 (100%)
1-2 drinks per day	63 (16.7%)	8 (12.7%)	55 (87.3%)	63 (100%)
2 or more drinks per week	14 (3.7%)	2 (14.3%)	12 (85.7%)	14 (100%)
Smartphone usage				
≤ 2 hours	49 (13.0%)	13 (26.5%)	36 (73.5%)	49 (100%)
3- 4 hours	174 (46.0%)	35 (20.1%)	139 (79.9%)	174 (100%)
≥ 5 hours	155 (41.0%)	27 (18.1%)	128 (81.9%)	155 (100%)
Social support				
None	35 (9.3%)	9 (25.7%)	26 (74.3%)	35 (100%)
Fellow students	36 (9.5%)	7 (19.4%)	29 (80.6%)	36 (100%)
Friends	124 (32.8%)	21 (16.9%)	103 (83.1%)	124 (100%)
Family	146 (38.6%)	35 (24.0%)	111 (76.0%)	146 (100%)
Social networks	37 (9.8%)	27 (10.8%)	33 (89.2%)	60 (100%)
Physical activity				
Do not exercise	133 (35.2%)	29 (21.8%)	104 (78.2%)	133 (100%)
Regularly everyday	74 (19.6%)	16 (21.6%)	58 (78.4%)	74 (100%)
1-2 hours weekly	106 (28.0%)	20 (18.8%)	86 (81.1%)	106 (100%)
At least 3 days in a week	65 (17.2%)	11 (16.9%)	54 (83.1%)	65 (100%)
Perceived stress				
Mild stress	33 (8.7%)	16 (48.5%)	17 (51.5%)	33 (100%)
Moderate stress	283 (74.9%)	56 (19.8%)	227 (80.2%)	283 (100%)
High stress	62 (16.4%)	4 (6.5%)	58 (93.5%)	62 (100%)

**Perceived stress was scored as (0-13) = mild stress, (14-26) = moderate stress, (27-40) = high perceived stress.*

4.1.4. Bedroom environment factors affecting sleep quality.

To comprehend the role of the bedroom environment, the degree of risk for factors affecting the sleep quality was grouped into three categories with scores ranging from 0-8 with higher scores indicative of high risk affecting the quality of sleep. The cut-off for the categories was low risk (0-1), medium risk (4-6), and high risk (7-8). The median score was 4.6 (SD =2.67). The majority of the students (68.0%) reported that smoking tobacco in the bedroom was a high risk that would affect sleep quality. Students who resided in the university hostels were likely to share a dormitory, unlike students who were residing off-campus.

A substantial number of participants (44.4%) reported that noise from a roommate in the bedroom was medium risk. When it comes to room air quality (scents, sweat, perfume, and humidity) 42.9% of participants reported that it was a high risk. On the bedroom physical structure, 38.6 % of participants reported that it was a medium risk as seen in figure 4.

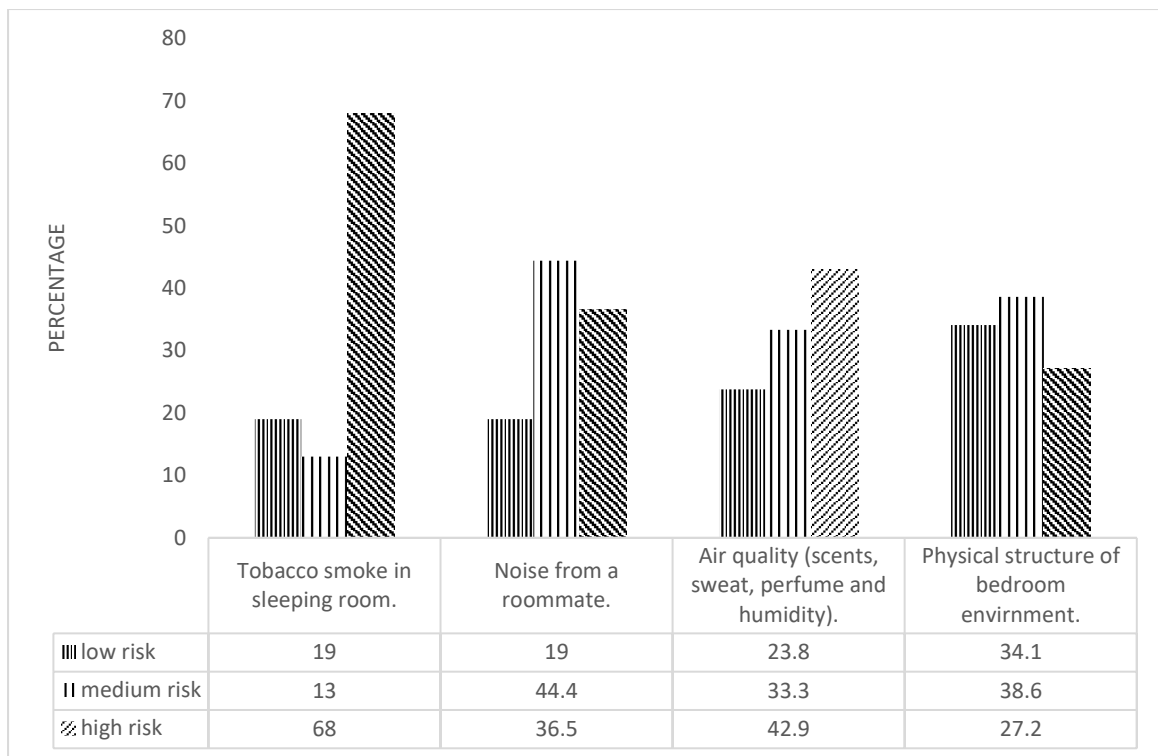


Figure 4: Bedroom environment factors affecting sleep quality among students (N=378).

4.1.5. Sleep hygiene status and PSQI scores.

Sleep hygiene was classified into three categories. The determined cut-off points for sleep hygiene were 0-17 as a good SH, 18-35 intermediate, and 36-52 poor sleep hygiene. The average sleep hygiene score was 20.41 (SD \pm 5.86). Among participants who scored with good sleep hygiene, only 28.6 % were regarded as good sleepers, whereas the majority of the participants, 71.4% were regarded as poor sleepers. A third of the participants had intermediate sleep hygiene. However, 83.9% of these participants were regarded as poor sleepers, only 16.1% were good sleepers. In Table 4, sleep hygiene is presented into three categories with the global PSQI scores. In summary, those with high sleep hygiene scores reported poor sleep.

Table 4: Distribution of participants according to sleep hygiene status and PSQI Sores (N= 370).

Sleep hygiene	Good sleep quality (n%)	Poor sleep quality (n%)	Total
Poor	3 (100%)	0 (0.0%)	3 (100%)
Intermediate	40 (16.1%)	209 (83.9%)	249 (100%)
Good	36 (28.6%)	90 (71.4%)	126 (100%)

**A PSQI global score greater than 5 was indicative of a poor-quality sleeper, whereas a score of 5 or less was indicative of a good-quality sleeper.*

4.1.6. Individual sleep factors and scoring among undergraduate students.

The average reported bedtime for participants was 23H00 PM and waking up time was 06H00 AM. The global PSQI scores of the participants ranged from 1 to 16 with an average score of 7.88 (SD± 2.82). The reported mean number of minutes to fall asleep every night was 19.86 minutes (SD ±15.00) range 2-60 minutes. Virtually, half of the participants (48.9%) stated a sleep latency of 45 minutes or more. Nearly half of participants (n = 172) reported sleeping for about 6-7 hours per night, with 14.4% slept for less than 5 hours only per night and only 10.6% of participants reported that they slept for 7 hours or more per night.

Regarding daytime dysfunction, 45.5% of the participants reported that it occurred less than once a week. Daytime dysfunction included trouble staying awake whilst conducting social activities, academic work, and lack of enthusiasm to complete tasks. When it comes to sleep efficiency, two-thirds of the participants (66.7%) reported 75-85%, only a small proportion of participants (5.8%) reported to have sleep efficiency of less than 65%.

Another individual factor assessed was the use of sleeping medication. More than 80% of the participants reported that they have not used any sleeping medication during the past month, only 1.9% of the total participants had taken any kind of sleep medication (over the counter or prescribed by a physician) to help them to sleep once a week. A substantial proportion of participants (56.6%) rated their general sleep quality as fairly good, only 4.8% rated it very badly. The results are presented in Table 5.

Table 5: Individuals' sleep factors and scoring among undergraduate students.

Variable	Category	Frequency (n)
Sleep duration	greater than 7 hours	40 (10.6%)
	6 -7 hours	172 (45.5%)
	5-6 hours	11 (29.6%)
	< 5 hours	54 (14.3%)
Sleep latency	< 15 minutes	85 (22.5%)
	16-30 minutes	185 (48.9%)
	31-60 minutes	88 (23.3%)
	> 60 minutes	20 (5.3%)
Day time dysfunction	Not during the past month	68 (18.0%)
	Less than once a week	131 (34.7%)
	Once or twice a week	156 (41.3%)
	Three or more times a week	23 (5.9%)
Sleep efficiency	>85%	45 (11.9%)
	75-84%	252 (66.7%)
	65-74%	59 (15.6%)
	< 65%	22 (5.8%)
Sleep disturbance	Not during the past month	21 (5.6%)
	Less than once a week	247 (65.3%)
	Once or twice a week	107 (28.3%)
	Three or more times a week	3 (0.8%)
Use of sleep medications	Not during the past month	307 (81.2%)
	Less than once a week	54 (14.3%)
	Once or twice a week	10 (2.6%)
	Three or more times a week	7 (1.9%)
Subjective sleep quality	Very good	46 (12.2%)
	Fairly good	210 (56.6%)
	Fairly bad	104 (27.5%)
	Very bad	18 (4.8%)

**Scoring based on PSQI*

4.1.7. Frequency of sleep disturbance factors among undergraduate students.

The participants were requested to select how regularly they incurred numerous disturbances in their sleep constructed on a scale with options (Table 9). The most frequent sleep disturbances stated by the participants, based on how regularly they occurred in the past month was waking up in the middle of the night or early morning (n =124) less than once a week. The other most frequent sleep disturbance was feeling too hot (n =130) once or twice a week.

Other reasons reported qualitatively indicated that 45% of participants spent a couple of hours studying until early morning hours which lead to troubled sleep. Additionally, 28% of participants reported internet browsing before bedtime at least once night a week. A small proportion (6%) reported trouble sleeping due to stress and 11% comprised of a noisy roommate, socializing and mental distractions. The findings are displayed in table 6.

Table 6: Frequency of sleep disturbance factors among undergraduate students.

How often have you had troubled sleep because of:	Not during Past month (n%)	Less than once a week (n%)	Once or twice a week (n%)	Three or more times a week (n%)
Cannot get to sleep within 30 minutes.	111 (29.4%)	116 (30.7%)	94 (24.9%)	57 (15.1%)
Wake up in the middle of the night or early morning.	68 (18.0%)	124 (32.8%)	117 (31.0%)	69 (18.3%)
Have to get up to use bathroom.	121 (32.0%)	119 (31.5%)	99 (26.2%)	39 (10.3%)
Cannot breathe comfortably.	207 (54.8%)	99 (26.2%)	54 (14.3%)	18 (4.8%)
Cough or snore loudly	219 (57.9%)	85(22.5%)	64 (16.9%)	10 (2.6%)
Feel too cold.	174 (46.0%)	105 (27.8%)	88 (23.3%)	11 (29%)
Feel too hot.	136 (36.0%)	98 (25.9%)	130 (34.4%)	14 (3.7%)
Have bad dreams.	176 (46.6%)	105 (27.8%)	78 (20.6%)	19 (5.0%)
Have pain.	256 (67.7%)	82 (21.7%)	34 (9.0%)	6 (1.6%)

4.2. Bivariate logistic regression analysis

4.2.1. Demographic factors associated with sleep quality.

Demographic factors and sleep quality were assessed. Based on the bivariate logistic regression analysis $p < 0.20$. There was no statistical significance between sex, academic level of study, and sleep quality. The findings are shown in table 7.

Table 7: Association between socio-demographic factors and sleep quality among undergraduate students (N= 378)

Variable	Category	Good sleep quality (n)	Poor sleep quality (n)	COR (95%CL)	LRT P-value
Sex	Male	35	127	Ref	0.53
	Female	41	175	1.07 (0.67, 1.64)	
Academic level of study	1 st year	23	94	Ref	0.29
	2 nd Year	15	83	0.59 (0.33, 1.09)	
	3 rd Year	23	63	0.66 (0.35, 1.88)	
	4 th Year	15	62	1.09 (0.39, 2.98)	

**Significant variable at $P < 0.20$ Likelihood ratio test (LRT) Reference category (ref)*

4.2.1. Sleep behaviours and psychological affecting sleep quality among undergraduate students.

Association between sleep behaviours, psychological characteristics and sleep quality was assessed. Among the sleep behaviours and psychological factors that were statistically significant with sleep quality in bivariate logistic regression at $p < 0.20$ were caffeine intake [*COR*: 1.11; 95% *CI*: (0.24, 1.24); $p = 0.06$], perceived stress [*COR*: 0.29; 95% *CI*: (0.14, 1.09); $p = 0.00$]. The findings are shown in table 8.

Table 8: Association between sleep behaviours, psychological and sleep quality among undergraduate students (N=378).

Variable	Category	PSQI ≤ 5	PSQI > 5	COR (95%)	P-value
Caffeine intake	None	25	75	Ref	0.06*
	1 cup/dink per day	34	179	1.02 (0.68 - 1.64)	
	2 or more cups/drinks per day	18	48	1.11 (0.24 - 1.24)	
Alcohol consumption	Non-consumer	66	235	Ref	0.21
	1-2 drinks per day	8	55	1.35 (0.57 - 2.64)	
	2 or more drinks per week	2	12	1.87 (0.98 - 3.65)	
Smartphone usage	≤ 2 hours	13	36	Ref	0.45
	3 -4 hours	35	139	0.61 (0.39 – 1.25)	
	≥ 5 hours	28	127	1.17 (0.87 – 3.65)	
Social support	None	9	26	Ref	0.28
	Fellow students	7	29	0.66 (0.85 – 2.36)	
	friends	21	103	0.83 (0.56 – 1.24)	
	Family	35	111	1.54 (0.98 – 2.76)	
	Social networks	4	33	1.38 (0.72 – 2.45)	
Physical activity	Do not exercise	29	104	Ref	0.39
	Regularly everyday	16	58	1.68 (0.56 – 1.34)	
	1-2 hours weekly	20	86	1.18 (0.78 – 1.69)	
	At least 3 days in a week	11	56	1.81 (0.98 – 3.72)	
Perceived stress	Mild stress	16	17	Ref	0.00*
	Moderate stress	56	277	0.29 (0.14 – 1.09)	
	High stress	4	56	0.36 (1.22- 2.75)	

*Significant variable at $P < 0.20$ Likelihood ratio test (LRT) Reference category (ref)

4.2.3. Bedroom environment factors affecting sleep quality among undergraduate students.

Bedroom factors and sleep quality were assessed. Among the bedroom factors, only room air quality was statistically significant with sleep quality in bivariable logistic regression at $p < 0.20$ Room air quality [COR: 2.56; 95% CI: (1.53, 4.47); $p = 0.06$].

Table 9: Association between bedroom environment factors and sleep quality among undergraduate students (N=378).

Variable	Category	PSQI \leq 5	PSQI $>$ 5	COR (95% CI)	LRT P- value
Tobacco smoke	Low risk	72	102	Ref	0.41
	Medium risk	49	198	1.26 (0.78, 2.19)	
	High risk	275	86	1.47 (0.91, 2.68)	
Roommate noise	Low risk	19	53	Ref	0.22
	Medium risk	27	141	0.97 (0.53, 1.79)	
	High risk	30	108	1.44 (0.96, 2.35)	
Room air quality	Low risk	23	67	Ref	0.06*
	Medium risk	14	112	1.26 (0.69, 2.15)	
	High risk	39	123	2.56 (1.53, 4.47)	
Physical structure	Low risk	31	98	Ref	0.21
	Medium risk	23	123	1.45 (0.78, 2.78)	
	High risk	22	81	1.83 (1.14, 3.17)	

*Significant variable at $P < 0.20$ Likelihood ratio test (LRT) Reference category (ref)

4.2.4. Sleep hygiene

Sleep hygiene and sleep quality were assessed. In the bivariate logistic regression analysis, sleep hygiene was statistically significant with sleep quality at $p < 0.20$. Sleep hygiene [COR: 2.26; 95% CI: (1.57, 2.49); $p = 0.001$].

Table 10: Association between sleep hygiene and sleep quality among undergraduate students (N=378).

Variable	Category	PSQI \leq 5	PSQI $>$ 5	COR (95% CL)	LRT P-value
Sleep hygiene	Poor	0	3	Ref	0.001*
	Intermediate	40	209	2.26 (1.57, 2.49)	
	Good	36	90	0.92 (0.54, 1.76)	

*Significant variable at $P < 0.20$ Likelihood ratio test (LRT)

*The determined cut-off points for sleep hygiene were (0-17) as a good S, (18-35) intermediate, and (36-52) poor SH hygiene.

2.4.5. Correlation analysis between perceived stress, sleep hygiene, and sleep quality.

Perceived stress, sleep hygiene, and sleep quality were assessed and significant correlations were found. Sleep hygiene was found to be positively correlated with sleep quality. Perceived stress was positively correlated with sleep quality. A coefficient of ± 1 shows a negative or positive correlation. Sleep hygiene and PSQI; $r = 0.270, p = 0.00$; perceived stress and PSQI; $r = 0.319, p = 0.00$ as shown in table 11.

Table 11: Correlations between perceived stress, sleep hygiene, and sleep quality.

Correlations	Sleep quality	Perceived stress	Sleep hygiene
1. Sleep quality	1		
2. Perceived stress	0.319*	1	
3. Sleep hygiene	0.270*	0.288*	1

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

4.3. Multivariable logistic regression analysis

The following variables were statistically significant with sleep quality in the bivariate logistic regression models and hence fitted in the multivariate logistic regression model: caffeine intake, room air quality, perceived stress, and sleep hygiene (Table 12). The insignificant variable, caffeine intake [AOR:0.74; 95% CI: (0.34, 1.61); $p = 0.447$] was removed from the model in a backward step fashion until the final model was fitted. In the multivariable regression model, only room air quality, perceived stress, and sleep hygiene were statistically significant with sleep quality. These variables in the adjusted multivariate model were considered as potential risk factors of poor sleep quality.

Participants who were moderately stressed were 3.15 times likely to incur poor sleep quality [AOR:3.15; 95% CI: (1.43, 6.91); $p = 0.004$] compared to those who were mildly stressed controlling for room air quality, and sleep hygiene.

Regarding the bedroom environment, participants who indicated that room air quality was a medium risk were 2.32 times likely to experience poor sleep quality [AOR: 2.32; 95% CI: (1.08, 5.01); $p = 0.0031$] compared to those who indicated that it was a low risk, controlling for stress and sleep hygiene.

Participants who had intermediate sleep hygiene were 1.08 times more likely to have poor sleep quality [AOR:1.08; 95% CI: (1.03, 1.14); $p = 0.002$] compared to those who had poor sleep hygiene controlling for room air quality and stress. The findings are summarised in table 12 below.

Table 12: Multivariable logistic regression analysis of the factors associated with poor sleep quality among undergraduate students (N= 378).

Variable	Category	Adjusted odds Ratio	95% CI		P-value
			Lower	Upper	
Room air quality	Low risk	Ref			
	Medium risk	2.32	1.08 – 5.01		0.031
	High risk	0.87	0.45 – 1.65		0.660
Perceived stress	Mild	Ref			
	Moderate	3.15	1.43 – 6.91		0.004
	High	9.64	2.69 – 4. 45		0.000
Sleep hygiene	Poor	Ref			
	Intermediate	1.08	1.03 – 1.14		0.002
	Good	0.85	0.37 – 1.48		0.001

**significant variables at $p < 0.05$*

**ref (Reference category)*

CHAPTER 5: DISCUSSIONS, CONCLUSION, AND RECOMMENDATIONS.

5.1. Discussions

The main objective of this study was to assess the prevalence and factors associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi. Sleep quality was measured on a continuous level as a binary variable: poor and good sleep quality using the PSQI, which is proved to have a Cronbach's alpha of 0.83 in previously published studies (Voinescu & Szentagotai-tatar, 2015; Alshahrani & Turki, 2019). The PSQI subscales scores were totaled to produce a final score with values ranging from 0 to 21 referred to as global scores. A global PSQI score greater than 5 was a cutoff reflective of poor sleep quality whereas, a score of less than 5 reflective of good sleep quality.

Of the total study population, 302 students (80%) had a score of more than 5 which is associated with poor sleep quality, while 78 students (20%) had a score of less than 5 which is associated with good sleep quality as defined by a PSQI scoring. The prevalence of poor sleep quality in the past 12 months before this study was 80 percent while the prevalence of good sleep quality was only 20 percent among the undergraduate students at the College of Health Sciences. The high prevalence of poor sleep quality in this study is comparable to previous studies by Almojali et al., (2017) who found a poor sleep prevalence of 76%, Alimirzae et al., (2014) 77.1%, Benavente et al., (2014) 78.8% and Santos et al., (2016) 84% among Medical and Nursing students in Saudi Arabia, Iran, Portugal, and Canada respectively.

The high poor sleep quality in the current study could be attributed to academic stress, which possibly influences or alter students' sleep habits. This is supported by other studies by Hajjar-muça & Duffy (2014); Huang et al., (2014) who indicated that students are more vulnerable to poor sleep and sleep disturbances because of multiple environmental influences that impact their sleep-wake behavior.

Students have the autonomy to select bedtimes, attend to academic demands, and indulge in extracurricular activities. Khan et al., (2016) reported (54.7%) of the students confessed sacrificing nocturnal sleep hours to meet academic demands and 39.2% acknowledged that they had troubled sleeping because of persistent anxieties and academic stress.

Among the specific objectives, the present study intended to determine the facilitators associated with sleep quality among undergraduate students at the College of Health Sciences. In terms of the facilitators, social support and physical activity were not statistically significant with sleep quality. In contrast, Wang et al., (2016) indicated that good interpersonal relationship was associated with sleep quality. Regarding physical activity findings from this study were consistent with Siddalingaiah et al., (2018) who conducted a study among resident doctors in India and depicted that there was no statistical significance between physical exercises and good sleep quality.

Regarding the barriers associated with sleep quality, stress, and room air quality were statistically associated with sleep quality. The Perceived stress scale yielded a reliability coefficient (Cronbach's alpha) of 0.730. Perceived stress was strongly correlated with sleep quality (Spearman rank correlation, $r = 0.319$, $p = 000$). Findings from the present study demonstrated that 80.2 percent of students who had moderate stress were categorized as poor-quality sleepers. Students who were moderately stressed were 3.15 times likely to incur poor sleep quality compared to those who were mildly stressed. This finding is corroborated by Behere et al., 2011); Waqas et al., (2015) who yielded evidence of stress as an influence on poor sleep quality with a significant association ($p = 0.001$) among students in India and Pakistan with a stress prevalence of 63% and 53% respectively.

Hall et al., (2012) suggest that emotions and sleep are bidirectional, and there is evidence that perceived stress predicts sleep. The alarmingly high stress among students could be attributed

to long hours of extensive learning as students reduce their nocturnal sleep time to have extra hours for learning, especially in the weeks preceding an examination. This is corroborated by Hall et al., (2012); Ahrberg et al., (2016) explanation that academic workload may create a stressful environment as students navigate how to cope and adjust with the learning process.

Furthermore, the adjusted multivariable regression model depicted that students who indicated room air quality as medium risk were 2.32 times likely to have poor sleep quality compared to those who rated it as low risk. Correspondingly, Ekasiwi et al., (2013) indicated that Indonesian adults who reported poor indoor air quality and room air contaminations presented with poor sleep outcomes. In contrast, Lan et al., (2017b) tested the association between indoor air quality and sleep quality and revealed that sleep quality improved significantly with good ventilation although there is still a paucity of experimental studies.

The sleep hygiene index is proved to have a good test-retest reliability of 0.83 and an internal consistency of 0.66 in previously published studies (Voinescu & Szentagotai-tatar, 2015; Peach, Gaultney, & Gray, 2016). In the current study, sleep hygiene was strongly correlated with PSQI (Spearman rank correlation, $r = 0.270$, $p = .000$). Students who had intermediate sleep hygiene were 1.08 times more likely to experience poor sleep quality than those who had poor sleep hygiene. This is in agreement with Voinescu & Szentagotai-tatar (2015) who tested the influence of sleep hygiene behaviors among Romanian students and discovered that sleep hygiene was associated with odds of poor sleep quality. Conversely, Alshahrani & Turki, (2019) reported that sleep hygiene was not a significant explanatory factor for sleep quality.

Consuming 1 cup of caffeine per day was not associated with sleep quality in the adjusted multivariate model. This result is congruent with Almojali et al., (2017) who found no significant association was found between daily caffeine intake and sleep quality. Conversely, Mebrahtom et al., (2017) depicted that intake of one caffeine-containing beverage per day was

associated with increased odds of poor sleep quality [*AOR: 1.29; 95% CI: (1.02, 1.64); p = 0.005*] among students in Ethiopia. Caffeine intake was not captured in terms of the brand and (in grams or milligrams) in the present study as different caffeine contents may be varied.

No statistical significance was found when alcohol consumption and sleep quality were assessed. This finding is consistent with Unger (2016) who depicted that alcohol ingestion and sleep quality were not significantly associated with a study among medical students in Philadelphia. The above findings were suggestively linked to students' profound knowledge of the effects of alcohol.

Regarding smartphone usage, the current study found no statistical association. However, Mebrahtom et al., (2017) revealed that the utilization of electronic gadgets for more than two hours before bedtime was associated with poor sleep quality in comparison to students who used their electronic devices for one hour before bedtime among students. This variation could be that participants had no correct recall of how much time spent on their smartphones and no gold standard tool was used in this study to capture smartphone usage.

Based on the socio-demographic factors, there was no significant association between sex, academic level of study, and sleep quality. This was consistent with Lemma et al., (2012a) who depicted that sex was not associated with sleep quality. Contrarily, a study by Alshahrani & Turki (2019) revealed the likelihoods of poor sleep quality were 37% higher [*AOR = 1.37, 95% CI: (1.08, 1.73); p = 0.001*] among female students when compared with male students.

There was no statistical association in different academic levels of study. Conversely, an Ethiopian study by Lemma et al., (2012a) among medical students in two different universities, indicated that fourth-year students and above had lower likelihoods of poor sleep than students in the second and third years. This distinction by the academic level of study was perchance explicated by the unproportionate strata of students and the restricted sample size of this study.

All the variables that were statistically significant with the sleep quality in the adjusted multivariate model were considered as potential modifiable risk factors of poor sleep quality. These factors were perceived stress [*AOR*:3.15; 95% *CI*: (1.43, 6.91); *p* = 0.004], room air quality [*AOR*: 2.32; 95% *CI*: (1.08, 5.01); *p* = 0.0031], and sleep hygiene [*AOR*:1.08; 95% *CI*: (1.03, 1.14); *p* = 0.002].

5.2. Strength and study limitations

The current study contributes to sleep health research by indicating significant correlations between perceived stress, sleep hygiene, and sleep quality among university students. Findings could suggest intervention targeting the improvement of sleep quality and mental health among students.

Even though the present study yielded novel findings within the College of Health Sciences students, numerous limitations were evident. Firstly, this study was cross-sectional which made it difficult to separate cause from effect because the exposure and outcome were observed simultaneously. Secondly, self-report information was used to measure sleep quality and it relied on the participants to be precise and truthful when responding to the questions. Participants were not asked to record their sleep habits for at least 1 month before the study and they may have recalled their sleep habits imprecisely.

Thirdly, participants were not asked the brands and volume of consumption (in grams or milligrams) as different caffeine contents may be varied. Lastly, out of the 378 participants, 245 were interviewed through a tablet device-based questionnaire running on the Open Data Kit (ODK) application and the remaining 133 students completed an online questionnaire (SurveyMonkey), precisely the same with the former. This was necessitated by unforeseen and unavoidable circumstances, as eligible students could not be contacted and reached for a physical interview amid the Covid-19 pandemic. This could have resulted in differences because of two varied approaches in collecting data and thus influencing sleep quality ratings. Additional factors may have influenced or enhanced sleep quality such as academic schedules, and unknown health morbidities that were not included in the study.

5.3. Conclusion

Findings from this study demonstrated an alarming prevalence of poor sleep quality (80 percent) among undergraduate students. This study has shown a significant correlation between perceived stress, sleep hygiene awareness, and sleep quality, which suggests that sleep hygiene awareness and stress coping strategies should be suggested as a potential influence on enhancing sleep quality. The university students are among the top at-risk demographic for poor sleep outcomes which pose deleterious health effects. The modifiable risk factors such as perceived stress, sleep hygiene, and room quality were considered to be potential risks for poor sleep quality.

5.4. Recommendations

To improve the sleep quality among undergraduate students at the College of Health Sciences, the University should:

1. Develop sleep hygiene educational programmes as an intervention and prevention strategy. This is deemed necessary to improve students' knowledge of the significance of adopting healthy sleep practices that will instill long-lasting sleep health and translate this knowledge into their practice.
2. To alleviate high stress, students should equip each other with better relaxation techniques such as Yoga, meditation, and extracurricular activities and manage their time properly to attain optimal sleep quality and academic functioning.
3. Consideration for future research should require participants to possess a sleep diary during the study period that will be updated daily to ascertain precise results and alleviate the risk of recall bias.
4. Further research is required to assess interventions to reduce poor sleep quality among students. This research could employ longitudinal data gathering that will be examined for variations over time.

Policy implication

The findings demonstrated an alarmingly high prevalence of poor sleep quality among undergraduate students. Incorporating sleep quality outcomes from this study in the existing health policies of the University of Nairobi health services (Students health division) will impart healthy sleep practices and promote sleep behaviour changes for a university context.

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APPENDICES

Appendix I: CONSENT INFORMATION

Title of Study: Prevalence and associated factors for sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi, Kenya.

Principal Researcher: Libertine N.K.M Hauwanga

Institution: University of Nairobi, School of Public Health

Phone number: +254743224822

E-mail address: libertine.hauwanga@gmail.com

Introduction:

I would like to tell you about a study being conducted by Libertine N.K.M Hauwanga, a Master of Public Health Student at the School of public health, University of Nairobi. The purpose of this consent form is to provide you with the information you will need to help you decide whether or not to be a participant in the study. Feel free to ask any questions about the purpose of the research, what happens if you participate in the study, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions to your satisfaction, you may decide to be in the study or not. This process is called informed consent. Once you understand and agree to be in the study, I will request you to sign your name on this form. You should understand the general principles, which apply to all participants in medical research: i) your decision to participate is voluntary. ii) You may withdraw from the study at any time without necessarily giving a reason for your withdrawal iii) Refusal to participate in the research will not affect the services you are entitled to in this health facility or other facilities. We will give you a copy of this form for your records.

May I continue? YES /NO

This study has approval by The Kenyatta National Hospital-University of Nairobi Ethics and Research Committee protocol No._____

WHAT IS THIS STUDY ABOUT?

The investigator listed above is interviewing undergraduate students at the College of Health Sciences of the University of Nairobi. The purpose of the interview is to determine the prevalence and associated factors for sleep quality. Participants in this research study will be asked questions about their sociodemographic characteristics, perception of sleep quality, sleep behaviors and Psychosocial factors, and knowledge on sleep hygiene and sleep habits using a validated questionnaire. There will be approximately 382 participants who will be randomly selected within the campus to participate in the study. We are asking for your consent to consider participating in this study.

WHAT WILL HAPPEN IF YOU DECIDE TO BE IN THIS RESEARCH STUDY?

If you agree to participate in this study, the following things will happen:

You will be interviewed by a trained interviewer in a private area where you feel comfortable answering questions. The interview will last approximately 40 minutes.

We will ask for a telephone number where we can contact you if necessary. If you agree to provide your contact information, it will be used only by people working for this study and will never be shared with others.

ARE THERE ANY RISKS, HARMS DISCOMFORTS ASSOCIATED WITH THIS STUDY?

Medical research has the potential to introduce psychological, social, emotional, and physical risks. One potential risk of being in the study is the loss of privacy. We will keep everything you tell us as confidential as possible. We will use a code number to identify you in a password-protected computer database and will keep all of our paper records in a locked file cabinet. However, no system of protecting your confidentiality can be secure, so it is still possible that someone could find out you were in this study and could find out information about you. Also, answering questions in the interview may be uncomfortable for you. If there are any questions you do not want to answer, you can skip them. You have the right to refuse the interview or any questions asked during the interview.

We will do everything we can to ensure that this is done in private.

ARE THERE ANY BENEFITS BEING IN THIS STUDY?

There is no direct benefit to you from participating in the study. However, your responses will help us to determine the prevalence and factors associated with sleep quality which can help to improve the sleep hygiene and overall health of the students. The results of this study will provide an in-depth comprehension of how smartphone overuse impacts the quality of sleep.

WILL BEING IN THIS STUDY COST YOU ANYTHING?

Participating in this study will not cost you anything apart from the 45 minutes or so of your time.

WILL YOU GET REFUND FOR ANY MONEY SPENT AS PART OF THIS STUDY?

We shall not provide any monetary refund for participating in the study.

WHAT IF YOU HAVE QUESTIONS IN FUTURE?

If you have further questions or concerns about participating in this study, please call or send a text message to the investigator at the number provided at the bottom of this page. For more information about your rights as a research participant, you may contact the Secretary/Chairperson, Kenyatta National Hospital-University of Nairobi Ethics and Research Committee Telephone No. 2726300 Ext. 44102 email uonknh_erc@uonbi.ac.ke.

WHAT ARE YOUR OTHER CHOICES?

Your decision to participate in research is voluntary. You are free to decline participation in the study and you can withdraw from the study at any time without injustice or loss of any benefits.

CONSENT FORM (STATEMENT OF CONSENT)

Participant's statement

I have read this consent form or had the information read to me. I have had the chance to discuss this research study with a study counselor. I have had my questions answered in a language that I understand. The risks and benefits have been explained to me. I understand that my participation in this study is voluntary and that I may choose to withdraw at any time. I freely agree to participate in this research study.

I understand that all efforts will be made to keep information regarding my identity confidential.

(Signature of Participant)

(Date)

(Participant's name – printed)

Statement of Person Who Obtained Consent

The information in this document has been discussed with the participant or, where appropriate, with the participant’s legally authorized representative. The participant has indicated that he or she understands the risks, benefits, and procedures involved with participation in this research study.

(Signature of Person who Obtained Consent)

(Date)

(Name of Person who Obtained Consent - printed)

Appendix II: QUESTIONNAIRE

Prevalence and factors associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi.
--

Component A

Instructions:

1. Please complete all questions.
2. Choose one appropriate answer by using (x) and write where it is required.
3. The questionnaire contains 3 components, please answer them all.

Survey Information

Campus name :

Date of interview:

Participant ID:

Interviewer ID:

Has consent obtained?

Yes		No	
-----	--	----	--

If NO, END SURVEY

SECTION A: RESPONDENT DEMOGRAPHIC INFORMATION

1. How old you? (Age in years)

--

2. Sex

Female		Male	
--------	--	------	--

3. What is your date of birth? (dd-mm-year)

--	--	--

4. What is your residence of origin?

Urban		Rural	
-------	--	-------	--

5. What is your field of study?

Nursing science	
Dental science	
Pharmacy science	
Medicine science	

5. What Year of study are you currently?

1 st year		2 nd year		3 rd year		4 th year	
-------------------------	--	-------------------------	--	-------------------------	--	-------------------------	--

SECTION B: SLEEP BEHAVIORS AND PSYCHOLOGICAL FACTORS.

The following section contains questions on individual and sleep behavioural factors that pertain to your sleep. Please strive to give honest answers.

1. How much caffeine do you consume per day?

(0) none	
(1) one cup/drink	
(2) two or more cups/drinks	

2. How much alcohol do you consume per week?

Non-consumer	
1-2 drinks per week	
More than 2 drinks per week	

3. How many hours do you spend on your phone per day?

≤ 2 hours	
3-4 hours	
≥ 5 hours	

4. How would the following bedroom environment factors affect your quality of sleep?
Indicate (x) in the most appropriate answer.

Bedroom environment	Low risk	Medium risk	High risk
Tobacco smoke in the sleeping dormitory.			
Noise from a roommate			
The air quality of the room, scents (sweat, perfume, and humidity.			
The physical structure of the bedroom environment			

5. Whom do you count to on to be dependable when you need help, need consolation, feeling upset, under pressure, and intense?

None	
Fellow students	
Friends	
Family	
Social networks	

6. How often do you exercise in a week? Tick (x) on the most appropriate answer.

Regularly everyday	
Do not exercise	
1-2 hours weekly	
At least 3 days in a week	

7. Are you presently taking narcotics or sedative medication for any medically diagnosed conditions, psychiatric morbidities, or sleep disorders?

Yes		No	
-----	--	----	--

SECTION C: SLEEP HYGIENE

1. The following questions will assess your sleep hygiene practices. Please tick (x) on the most appropriate answer.

No	Question	Always	Frequently	Sometimes	Rarely	Never
1	You take daytime naps lasting two or more hours close to bedtime.					
2	I go to bed at different times from day to day.					
3	I get out of bed at different times from day to day.					
4	I exercise to the point of sweating within 1 hour of going to bed.					
5	I stay in bed longer than I should two or three times a week.					
6	I use alcohol, tobacco, or caffeine within 4hrs of going to bed or after going to bed.					
7	I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).					
8	I go to bed feeling stressed, angry, upset, or nervous.					
9	I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study).					
10	I sleep on an uncomfortable bed (for example poor mattress or pillow, too much or not enough blankets).					
11	I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).					

12	I do important work before bedtime (for example pay bills, schedule, or study).					
13	I think, plan, or worry when I am in bed.					

Component B: Perceived Stress Scale

Instruction

In each case, you will be asked to indicate how often you felt or thought a certain way during last month. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly.

For each question choose the following alternatives:

0 = never 1 = almost never 2 = sometimes 3 = fairly often 4 = very often

_____ 1. In the last month, how often have you been upset because of something that happened unexpectedly?

_____ 2. In the last month, how often have you felt that you were unable to control the important things in your life?

_____ 3. In the last month, how often have you felt nervous and stressed?

_____ 4. In the last month, how often have you felt confident about your ability to handle your personal problems?

_____ 5. In the last month, how often have you felt that things were going your way?

_____ 6. In the last month, how often have you found that you could not cope with all the things that you had to do?

_____ 7. In the last month, how often have you been able to control irritations in your life?

_____ 8. In the last month, how often have you felt that you were on top of things?

_____ 9. In the last month, how often have you been angered because of things that

happened that were outside of your control?

_____ 10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Component C: Sleep Quality Assessment (PSQI)

INSTRUCTIONS:

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. For question 5-9 kindly tick with (x) the most appropriate answer among the four options provided. Question 5.J you are required to describe your answer. Please answer all questions.

Please answer all questions.

During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. What time have you usually gotten up in the morning? _____
4. How many hours of actual sleep did you get at night? _____
5. How many hours do you spend in bed? _____

6. During the past month, how often have you had trouble sleeping because you	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
A. Cannot get to sleep within 30 minutes				
B. Wake up in the middle of the night or early morning.				
C. Have to get up to use the bathroom				
D. Cannot breathe comfortably				
E. Cough or snore loudly				
F. Feel too cold				
G. Feel too hot				
H. Have bad dreams				

I. Have pain				
J. Other reason (s), please describe, including how often you have had trouble sleeping because of this reason (s):				
7. During the past month, how often have you taken medicine (prescribed or “over the counter”) to help you sleep?				
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in the social activity?				
9. During the past month, how much of a problem has it been for you to keep up the enthusiasm to get things done?				
10. During the past month, how would you rate your sleep quality overall?				
	Very good	Fairly good	Fairly bad	Very bad

Thank you for participating in this study.

Appendix III: SCORING THE PSQI

The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument used to measure the quality and patterns of sleep in adults. It differentiates “poor” from “good” sleep quality by measuring seven areas (components): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month.

In scoring the PSQI, seven component scores are derived, each scored 0 (no difficulty) to 3 (severe difficulty). The component scores are summed to produce a global score (range 0 to 21). Higher scores indicate worse sleep quality.

Component 1: Subjective sleep quality (question 9)

<u>Response to Q9</u>	<u>Component 1 score</u>
Very good	0
Fairly good	1
Fairly bad	2
Very bad	3

Component 1 score: _____

Component 2: Sleep latency (questions 2 and 5a)

<u>Response to Q2</u>	<u>Component 2/Q2 subscore</u>
< 15 minutes	0
16-30 minutes	1
31-60 minutes	2
> 60 minutes	3

<u>Response to Q5a</u>	<u>Component 2/Q5a subscore</u>
Not during past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Sum of Q2 and Q5a subscores Component 2 score

0	0
1-2	1
3-4	2
5-6	3

Component 2 score: _____

Component 3: Sleep duration (question 4)

Response to Q4 Component 3 score

> 7 hours	0
6-7 hours	1
5-6 hours	2
< 5 hours	3

Component 3 score: _____

Component 4: Sleep efficiency (questions 1, 3, and 4)

Sleep efficiency = (# hours slept/# hours in bed) X 100%

hours slept—question 4

hours in bed—calculated from responses to questions 1 and 3

Sleep efficiency Component 4 score

> 85%	0
75-84%	1
65-74%	2
< 65%	3

Component 4 score: _____

Component 5: Sleep disturbance—questions 5b-5j

Questions 5b to 5j should be scored as follows:

Not during past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

<u>Sum of 5b to 5j scores</u>	<u>Component 5 score</u>
0	0
1-9	1
10-18	2
19-27	3

Component 5 score: _____

Component 6: Use of sleep medication—question 6

<u>Response to Q6</u>	<u>Component 6 score</u>
Not during past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Component 6 score: _____

Component 7: Daytime dysfunction questions 7 and 8

<u>Response to Q7</u>	<u>Component 7/Q7 subscore</u>
Not during past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Response to Q8 Component 7/Q8 subscore

No problem at all	0
Only a very slight problem	1
Somewhat of a problem	2
A very big problem	3

<u>Sum of Q7 and Q8 subscores</u>	<u>Component 7 score</u>
0	0
1-2	1
3-4	2
5-6	3

Component 7 score: _____

Global PSQI Score: Sum of seven component scores: _____

Copyright notice: The Pittsburgh Sleep Quality Index (PSQI) is copyrighted by Daniel J. Buysse, M.D. Permission has been granted to reproduce the scale on this website for clinicians to use in their practice and for researchers to use in non-industry studies. For other uses of the scale, the owner of the copyright should be contacted.

Citation: Buysse, DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ: The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric research and practice. *Psychiatry Research* 28:193-213, 1989.

Appendix IV: PERCEIVED STRESS SCORE

The Perceived Stress Scale (PSS) is a classic stress assessment instrument. The tool was originally developed in 1983, and it remains a popular choice for helping us understand how different situations affect our feelings and our perceived stress.

Determine PSS score by following these directions:

- ✓ First, reverse your scores for questions 4, 5, 7, and 8. On these 4 questions, change the scores like this:
0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0.
 - ✓ Now add up scores for each item to get a total. Total score is _____.
 - ✓ Individual scores on the PSS can range from 0 to 40 with higher scores indicating higher perceived stress.
-
- Scores ranging from 0-13 would be considered low stress.
 - Scores ranging from 14-26 would be considered moderate stress.
 - Scores ranging from 27-40 would be considered high perceived stress.

Appendix V: SLEEP HYGIENE INDEX

The Sleep Hygiene Awareness Index was developed to assess the practice of sleep hygiene behaviors. Sleep hygiene is based on behaviors and environmental variables thought to cause or lead to relatively poor sleep quality rather than measuring outcomes.

Participants indicate how frequently they indulge in specific behaviours (always, frequently, sometimes, rarely, never) on a 5-point Likert scale. Total scores are summed up to yield a global assessment of sleep hygiene.

Determine the Sleep hygiene awareness score by following these directions:

Always = 4 Frequently = 3 Sometimes = 2 Rarely= 1 Never = 0

- ✓ Now add up scores for each item to get a total. Total score is _____.
- Scores ranging from 0-17 would be considered as good sleep hygiene awareness.
- Scores ranging from 18-35 would be considered as intermediate sleep hygiene awareness.
- Scores ranging from 36-52 would be considered as poor sleep hygiene awareness.

Appendix VI: KNH- ERC APPROVAL LETTER



UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel: (254-020) 2726000 Ext 44355

Ref: KNH-ERC/A/397

Libertine N.K.M. Hauwanga
Reg. No. H57/6843/2017
School of Public Health
College of Health Sciences
University of Nairobi

Dear Libertine,

RESEARCH PROPOSAL: PREVALENCE AND FACTORS ASSOCIATED WITH SLEEP QUALITY AMONG UNDERGRADUATE STUDENTS AT THE COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF NAIROBI, KENYA (P626/07/2019)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 22nd October 2019 – 21st October 2020.

This approval is subject to compliance with the following requirements:

- a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
- b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
- c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
- d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
- e. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. *(Attach a comprehensive progress report to support the renewal).*
- f. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

Protect to discover



KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 725300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

22nd October, 2019



For more details consult the KNH- UoN ERC website <http://www.erc.uonbi.ac.ke>

Yours sincerely,



PROF. M. E. CHINDIA
SECRETARY, KNH-UoN ERC

- c.c. The Principal, College of Health Sciences, UoN
 The Director, CS, KNH
 The Chairperson, KNH- UoN ERC
 The Assistant Director, Health Information, KNH
 The Director, School of Public Health, UoN
 Supervisors: Prof. Joyce Olenga (UoN), Dr. Susan A. Nyawade (UoN)

Appendix VII: PRINCIPAL'S APPROVAL LETTER



UNIVERSITY OF NAIROBI COLLEGE OF HEALTH SCIENCES

OFFICE OF THE PRINCIPAL

Telephone: 254 721665077
Tel: KNH 2726300 Ext. 43673
Telegrams: Varsity Nairobi
Email: principal-chs@uonbi.ac.ke

Kenyatta National Hospital
P.O. Box 19676, Nairobi 00202
Kenya

REF: UON/CHS/1/1

February 17, 2020

Dean, School of Medicine
Dean, School of Dental Sciences
Dean, School of Pharmacy
Director, School of Nursing

Dear Sir/Madam,

INTRODUCTION LETTER FOR MS. LIBERTINE N.K.M. HAUWANGA (H57/6843/2017)

Ms. Libertine is a student pursuing Masters of Public Health in the School of Public Health, University of Nairobi. Her Research Proposal: ***"Prevalence and factors associated with sleep quality among undergraduate students at the College of Health Sciences, University of Nairobi, Kenya"*** (P626/07/2019) has been approved by the KNH-UoN ERC (see the attached).

This is to kindly request you to accord her any necessary assistance in accessing your undergraduate students as she embarks in data collection for the aforementioned study.

Yours sincerely,

Leonard M. Musyoka
Registrar/Secretary
College of Health Sciences

Copy to: Asst. Registrar, School of Medicine
Asst. Registrar, School of Dental Sciences
Asst. Administrator, School of Pharmacy
Asst. Administrator, School of Nursing
✓ Ms. Libertine N.K.M. Hauwanga (libertine.hauwanga@gmail.com +254-743224822)

LMM/jnn



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Quality Management System Excellence in University Education and Training

Appendix VIII: PILOT STUDY APPROVAL LETTER



**UNIVERSITY OF NAIROBI
COLLEGE OF HUMANITIES AND SOCIAL SCIENCES
OFFICE OF THE PRINCIPAL**

Telegrams: "Varsity",
Telephone: +254 2 331 8262
Ext. 28056 or 28024
VOIP: 3201/3202/3235

P.O Box 30197-00100, G.P.O
Nairobi, Kenya
Email: principal-chss@uonbi.ac.ke
Website: www.uonbi.ac.ke

UON/CHSS/9/14 Vol. 3

February 20, 2020

Libertine N.K.M. Hauwanga (H57/6843/2017)
C/o School of Public Health
College of Health Sciences

0743 224 822/libertine.hauwanga@gmail.com

Dear Hauwanga,

**RE: REQUEST TO CONDUCT A PRELIMINARY STUDY AMONG
UNDERGRADUATE STUDENTS IN THE COLLEGE OF HUMANITIES AND
SOCIAL SCIENCES, UNIVERSITY OF NAIROBI**

Reference is made to your letter to the Principal, CHSS on the above subject dated February 05, 2020.

This is to inform you that your request has been considered and approved. Please be free to consult the Principal's Office, CHSS in case further assistance on the same is required.

A handwritten signature in blue ink, appearing to read 'Philip K. Mutunga'.

Philip K. Mutunga
For: Registrar/Secretary
College of Humanities and Social Sciences

cc Director, School of Public Health

Pkm

PREVALENCE AND FACTORS ASSOCIATED WITH SLEEP QUALITY AMONG UNDERGRADUATE STUDENTS AT THE COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF NAIROBI, KENYA

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