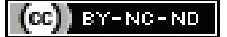


Health Sciences Students' Knowledge, Attitudes, and Awareness of the Effects of Sleep Quality on the Brain: A Cross-sectional Study

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ABSTRACT

Introduction: Sleep is a fundamental necessity for the human body, particularly for ensuring optimal brain function, and health science students are predisposed to experiencing lower-quality sleep than the general population.

Aim: To assess the knowledge, attitudes, and awareness of health science students regarding the influence of sleep quality on the brain.

Materials and Methods: This descriptive cross-sectional study included male and female students from diverse Colleges at King Saud bin Abdulaziz University for Health Sciences in Jeddah, Saudi Arabia, encompassing the College of Science and Health Professions, College of Medicine, College of Applied Medical Sciences, and College of Nursing. The study spanned one year, commencing in September 2022 and concluding in September 2023. It included 361 participants who completed a self-administered validated questionnaire. Participants were chosen through non probability consecutive sampling, and the questionnaire covered demographic characteristics, attitudes towards sleep quality, awareness of its importance, and knowledge of its impact on the brain. Data analysis encompassed descriptive

statistics and inferential tests, including the Independent t-test, and Chi-square test with a significance level of p-value <0.05.

Results: Female students exhibited a higher likelihood of disagreeing (p-value=0.006) with the notion that sleep quality does not impact memory conversion compared to males. Additionally, a significant number of female students (p-value=0.009) acknowledged the correlation between anxiety and insomnia, which was not as prevalent among males. Among the participants, 66.8% were females, and 33.2% were males. Common presleep behaviours included avoiding tea/coffee (76.5%) and using smartphones before bedtime (90.6%). While awareness of sleep quality's influence on memory recall was high (72.0%), comprehension of its connection with seizures in epilepsy was relatively lower.

Conclusion: This study underscores the significance of assessing attitudes, knowledge, and awareness regarding sleep quality among health science students. Notable gender variations were observed, with females demonstrating greater awareness of sleep's impacts on memory and insomnia related to anxiety. Consequently, sleep education initiatives and fostering healthy sleep habits among students in health science disciplines are essential.

Keywords: Glymphatic system, Melatonin, Obesity, Sleep hygiene

INTRODUCTION

Adequate sleep is now widely acknowledged as a critical factor in maintaining good mental, emotional, and physical health. Healthy sleep is defined by sufficient duration, favorable quality, suitable timing, and the absence of sleep-related disorders [1]. Sleep consists of two major patterns: Rapid Eye Movement (REM) and Non Rapid Eye Movement (NREM) sleep. It is further subdivided into four sleep stages. The first stage is the lightest stage of sleep, lasting 1 to 5 minutes and characterised by muscle tone in the skeletal muscles. As the heart rate and body temperature drop, the individual enters the second stage of sleep, which lasts around 25 minutes. The third stage is deep sleep, which is tough for a person to wake up from. REM is the final sleep stage in which dreaming occurs [2]. Scientific evidence suggests that REM sleep is associated with brain development [3]. It has been reported that a lack of sleep can significantly impact mental performance, resulting in reduced alertness, impaired attention, and slower cognitive processing [4].

It is widely acknowledged that sleep timing can vary significantly from person to person due to intrinsic and external factors such as genetics, age, health state, school/work schedule, and lifestyle [5]. According to recommendations from the National Sleep Foundation, United States adults between the ages of 18 and 64 years should aim for approximately seven to nine hours of sleep per night [6]. Research has demonstrated that a lack of sleep can

have numerous adverse effects on health, behaviour, mood, and academic performance, particularly during significant physical and emotional changes [7]. Furthermore, the impact of sleep on brain health is substantial and manifests in unexpected ways. Lack of sleep not only affects memory and concentration in the short-term but also causes long-term neurological dysfunction [8].

Sleep deprivation has been reported to result in brain activity alterations in self-control, suppression, judgement and decision-making [9]. A study using functional Magnetic Resonance Imaging (fMRI) on sleep-deprived healthy individuals found that a lack of sleep led to decreased working memory function [10]. In a meta-analysis conducted by Schmid D et al., the importance of sleep in the consolidation of motor memories among healthy human volunteers was underscored [11]. Lack of sleep, whether in quantity or quality, is linked to difficulty controlling appetite, leading to obesity, metabolic syndrome, diabetes, or hypertension later in life [12]. Additionally, being overweight or obese increases the likelihood of having sleep disorders, including obstructive sleep apnoea, driving to oxidative stress and systemic inflammation where the circadian clock is days regulated, eventually worsening sleep quality [12,13].

Health science students are particularly susceptible to poor sleep, especially among the general population [14]. Due to their long study and high-class hours, clinical internship, high academic pressure, night work shift, emotional stress, lifestyle decisions, and frequent

use of social media [14]. Reports suggest that adolescents in Saudi Arabia have shorter sleep durations than those in the United Kingdom, possibly due to poor sleep hygiene [15]. The community must acknowledge the significance of sleep quality to tackle this issue effectively [16]. There is a lack of literature exploring health science students' awareness, knowledge, and attitude towards the quality of their sleep and its influence on brain function. This study aims to assess the knowledge, attitudes, and awareness of the impact of sleep quality on the brain among health sciences students at King Saud bin Abdulaziz University for Health Sciences in Jeddah, Saudi Arabia.

MATERIALS AND METHODS

This descriptive cross-sectional study focuses on male and female students enrolled in various colleges at King Saud bin Abdulaziz University for Health Sciences in Jeddah, Saudi Arabia. The study includes students from the College of Science and Health Professions (COSHP), College of Medicine (COM), College of Applied Medical Sciences (CAMS), and College of Nursing (CON). The study lasted a year, starting in September 2022 and concluding in September 2023. Approval from the Institutional Review Board (IRB) was granted for the study, which included the questionnaire survey and consent forms (Study number SP22J/129/08). The survey was accessible online from January to April 2023.

Inclusion criteria: Male and female health sciences students, who were enrolled in various colleges at King Saud bin Abdulaziz University for Health Sciences in Jeddah, Saudi Arabia during the study period were included in the study.

Exclusion criteria: Students from universities apart from King Saud bin Abdulaziz University for Health Sciences were excluded from the study.

Sample size: Using Raosoft® software, the sample size for the study was determined to be 342 students, with a confidence level of 95%, a response distribution of 50%, and a margin of error of $\pm 5\%$. Participants were chosen through a non probability consecutive sampling method. However, 361 participants participated in the survey.

An ensemble of independent subject experts scrutinized the content validity of the questions, whereas a group of medical education specialists evaluated the questionnaire's face validity. The questionnaire's reliability was assessed by conducting a pilot survey with 35 individuals outside the study population. The reliability coefficient Cronbach's alpha ($\alpha=0.92$) was computed.

This survey was conducted online among study participants after obtaining informed consent from each participant. To mitigate acquiescence bias, a mix of positively and negatively worded items in the questionnaire were used. Reverse scoring was employed for negatively worded items in the questionnaire to ensure respondents' attentiveness to the content of the questions rather than consistently choosing the same response option. Subsequently, following data collection, the scores for the reverse-scored items were reverted to match the scoring of the remaining questionnaire items.

The questionnaire comprised four sections:

Section 1 focusing on demographic characteristics, featuring four questions;

Section 2 addressing the attitudes of health science students towards sleep quality, containing 13 questions;

Section 3 examining the awareness of health science students regarding the significance of sleep quality, consisting of 13 questions; and

Section 4 exploring the knowledge of health science students regarding the significance of sleep quality and its impact on the brain, encompassing 12 questions.

Sections 1 and 2 consisted of closed-ended questions. Sections 3 and 4 employed a five-point Likert scale, structured from "strongly disagree" to "strongly agree". These two sections have been measured as numerical variables to simplify the presentation and understanding of the readers, so a higher percentage meant higher agreement among the respondents.

The questionnaire was disseminated using a Google survey form and shared online via WhatsApp and email. The study aimed to collect data on health science students' attitudes, knowledge, and awareness, with these variables considered dependent factors. Independent factors included gender, academic year, and college.

STATISTICAL ANALYSIS

Data were initially recorded in an Excel spreadsheet and subsequently imported into Statistical Package for Social Sciences (SPSS) version 20.0 (IBM, Chicago, Illinois, USA) for analysis. Descriptive analysis was performed using frequency and percentage calculations for categorical variables such as gender and city of residence. Likert scale responses to the questionnaire were computed with percentages in descriptive presentation, while the mean was used to compare the outcomes. The analysis involved conducting Chi-square tests and Independent t-tests to explore gender variations in responses whenever applicable. A significance threshold below 0.05 was deemed statistically significant.

RESULTS

A total of 361 students from King Saud bin Abdulaziz University for Health Sciences in Jeddah, Saudi Arabia, were involved in the study. They filled out a survey questionnaire, and their demographic information is detailed in [Table/Fig-1]. Among the participants, 241 were identified as female (66.8%), while 120 were male (33.2%).

| Parameters | n (%) |
|--------------------------------|------------|
| Gender | |
| Male | 120 (33.2) |
| Female | 241 (66.8) |
| City of residence | |
| Jeddah | 311 (86.1) |
| Makkah | 49 (13.6) |
| Yanbu | 1 (0.3) |
| College | |
| Applied medical sciences | 112 (31.0) |
| Medicine | 94 (26.0) |
| Nursing | 53 (14.7) |
| Science and health professions | 102 (28.3) |
| Current academic year | |
| First year | 75 (20.8) |
| Second year | 84 (23.3) |
| Third year | 59 (16.3) |
| Fourth year | 108 (29.9) |
| Fifth year | 25 (6.9) |
| Sixth year | 10 (2.8) |

[Table/Fig-1]: Demographic characteristics of the study participants (n=361).

The study unveiled that students maintained an average nightly sleep duration of 6.1 hours [Table/Fig-2]. Notably, 168 (46.5%) of participants rarely experienced nocturnal awakenings, yet 254 (70.4%) reported feeling drowsy during the daytime. Most students refrained from consuming tea or coffee before bedtime 276 (76.5%) and avoided smoking shisha/cigarettes 331 (91.7%). Moreover, only 122 (33.8%) of students maintained a consistent physical exercise regimen. Regarding presleep habits, many participants did not engage in activities such as listening to music 316 (87.5%) or keeping bedroom lights on while sleeping 305 (84.5%). A significant

portion 327 (90.6%) of respondents acknowledged using their phones before bedtime. In comparison, 247(68.4%) reported having difficulty waking up in the morning.

| 1. What is your sleep duration at night? 6.1±2.06 (Mean±SD) | |
|--|------------|
| Questions | n (%) |
| 2. Do you wake up during your sleep at night? | |
| No | 86 (23.8) |
| I rarely wake up | 168 (46.5) |
| I frequently wake up | 107 (29.7) |
| 3. Do you feel sleepy during the daytime? | |
| No | 107 (29.6) |
| Yes | 254 (70.4) |
| 4. Do you have a fixed wake-up time during the weekdays, even if you go to bed late? | |
| No, my wake-up time varies | 194 (53.7) |
| Yes, I have a fixed wake-up time | 167 (46.3) |
| 5. Do you drink coffee/tea one hour before you sleep? | |
| No | 276 (76.5) |
| Yes | 85 (23.5) |
| 6. Do you smoke shisha/cigarettes one hour before you sleep? | |
| No | 331 (91.7) |
| Yes | 30 (8.3) |
| 7. Do you snore during your sleep? | |
| No | 248 (68.7) |
| I am not aware | 83 (23.0) |
| Yes | 30 (8.3) |
| 8. Do you engage in screen time on your mobile phone while in bed just before falling asleep? | |
| No | 34 (9.4) |
| Yes | 327 (90.6) |
| 9. Do you do physical exercise? If your answer is yes, kindly answer the following question. | |
| No | 239 (66.2) |
| Yes | 122 (33.8) |
| If you exercise, how many days do you exercise per week? (n=122) | |
| 1 | 8 (6.6) |
| 2 | 18 (14.8) |
| 3 | 31 (25.4) |
| 4 | 29 (23.8) |
| 5 | 22 (18.0) |
| 6 | 8 (6.5) |
| 7 | 6 (4.9) |
| 10. Do you sleep for a longer duration during weekends/holidays to compensate for your lack of sleep during the weekdays? | |
| No | 54 (15.0) |
| Yes | 307 (85.0) |
| 11. Do you sleep with your bedroom lights on? | |
| No | 305 (84.5) |
| Yes | 56 (15.5) |
| 12. Do you listen to music before or during your sleep? | |
| No | 316 (87.5) |
| Yes | 45 (12.5) |
| 13. Do you have difficulty waking up in the morning? | |
| No | 114 (31.6) |
| Yes | 247 (68.4) |

[Table/Fig-2]: Attitude of study participants (n=361).

In the awareness segment, among 361 participants, 260 (72.0%) strongly affirmed the significance of sleep quality for memory recall

[Table/Fig-3]. Furthermore, approximately 120 (33.2%) strongly agreed that the blue light emitted from devices disrupts sleep quality, while 145 (40.2%) acknowledged that consuming caffeine before sleeping reduces total sleep time. Moreover, 168 (46.5%) participants concurred that individuals with insomnia are more likely

| Questions | n (%) |
|---|------------|
| 1. Good sleep quality is essential for recalling your memory. | |
| Strongly disagree | 5 (1.4) |
| Disagree | 2 (0.6) |
| Neutral | 24 (6.6) |
| Agree | 70 (19.4) |
| Strongly agree | 260 (72.0) |
| 2. Good sleep quality is not important in converting short-term memory into long-term memory (memory consolidation). | |
| Strongly disagree | 113 (31.3) |
| Disagree | 123 (34.1) |
| Neutral | 52 (14.4) |
| Agree | 36 (10.0) |
| Strongly agree | 37 (10.2) |
| 3. Regular exercise improves sleep quality. | |
| Strongly disagree | 1 (0.3) |
| Disagree | 9 (2.5) |
| Neutral | 51 (14.1) |
| Agree | 131 (36.3) |
| Strongly agree | 169 (46.8) |
| 4. Blue light emitted from devices, such as smartphones, tablets, and computer screens, interferes with sleep quality. | |
| Strongly disagree | 6 (1.7) |
| Disagree | 21 (5.8) |
| Neutral | 87 (24.1) |
| Agree | 127 (35.2) |
| Strongly agree | 120 (33.2) |
| 5. The sleeping environment (dark, quiet, and cool room temperature) is not important in providing good sleep quality. | |
| Strongly disagree | 187 (51.8) |
| Disagree | 98 (27.1) |
| Neutral | 21 (5.8) |
| Agree | 27 (7.5) |
| Strongly agree | 28 (7.8) |
| 6. Caffeine intake before sleeping reduces the total sleep time. | |
| Strongly disagree | 8 (2.2) |
| Disagree | 22 (6.1) |
| Neutral | 52 (14.4) |
| Agree | 145 (40.2) |
| Strongly agree | 134 (37.1) |
| 7. Individuals with insomnia (inability to sleep) are more prone to mental depression. | |
| Strongly disagree | 1 (0.3) |
| Disagree | 11 (3.0) |
| Neutral | 60 (16.6) |
| Agree | 168 (46.5) |
| Strongly agree | 121 (33.5) |
| 8. Anxiety is one of the causes of insomnia (inability to sleep). | |
| Strongly disagree | 3 (0.8) |
| Disagree | 11 (3.0) |
| Neutral | 29 (8.0) |
| Agree | 134 (37.1) |
| Strongly agree | 184 (51.0) |

| 9. Nicotine does not affect sleep quality. | |
|---|------------|
| Strongly disagree | 106 (29.4) |
| Disagree | 109 (30.2) |
| Neutral | 102 (28.3) |
| Agree | 26 (7.2) |
| Strongly agree | 18 (5.0) |
| 10. Poor sleep quality can lead to inappropriate judgment and difficulty focusing. | |
| Strongly disagree | 3 (0.8) |
| Disagree | 15 (4.2) |
| Neutral | 42 (11.6) |
| Agree | 149 (41.3) |
| Strongly agree | 152 (42.1) |
| 11. Lack of sleep is not associated with a high-risk of obesity (increased body weight). | |
| Strongly disagree | 55 (15.2) |
| Disagree | 114 (31.6) |
| Neutral | 119 (33.0) |
| Agree | 48 (13.3) |
| Strongly agree | 25 (6.9) |
| 12. A good quality sleep is essential in restoring brain neurotransmitters. | |
| Strongly disagree | 3 (0.8) |
| Disagree | 4 (1.1) |
| Neutral | 50 (13.9) |
| Agree | 140 (38.8) |
| Strongly agree | 164 (45.4) |
| 13. Lack of sleep influences the mood and behaviour of the individual. | |
| Strongly disagree | 1 (0.3) |
| Disagree | 8 (2.2) |
| Neutral | 29 (8.0) |
| Agree | 80 (22.2) |
| Strongly agree | 243 (67.3) |

[Table/Fig-3]: Awareness levels of the study participants (n=361).

to suffer from anxiety. However, 114 (31.6%) participants did not agree to the question concerning association between lack of sleep and high obesity risk.

In the knowledge section, among the 361 participants, 215 (59.6%) expressed neutrality concerning the association between overusing sleeping pills and dementia [Table/Fig-4]. Regarding sleep-related health issues, 154 (42.7%) agreed, and 147 (40.7%) strongly agreed that lack of sleep contributes to migraines and tension headaches. Furthermore, 133 (36.8%) strongly agreed, and 100 (27.7%) agreed that melatonin plays a role in regulating sleep. Additionally, 143 (39.6%) agreed, and 87 (24.1%) strongly agreed that insufficient sleep leads to amygdala activation, potentially causing mood disorders. In addressing negative questions within the questionnaire, participants demonstrated a good understanding regarding the statement “Poor sleep quality does not increase the risk of Alzheimer’s disease,” with 63 (17.5%) strongly disagreeing and 112 (31.0%) disagreeing. Similarly, for the statement “Sleep deprivation does not negatively affect working memory,” 95 (26.3%) strongly disagreed, and 160 (44.3%) disagreed. However, regarding the negative statement “Poor sleep quality will not trigger seizures in people with epilepsy,” only 30 (8.3%) of participants exhibited a good comprehension of this question.

When analysing the questionnaire data, an independent t-test was conducted to examine gender differences in study participants’ responses. A notable proportion of female students (p-value=0.006) disagreed with the assertion that sleep quality is inconsequential for converting short-term memory into long-term memory compared to males [Table/Fig-5]. Furthermore, a significant number of female students (p-value=0.009) strongly agreed that anxiety could be a contributing factor to insomnia, in contrast to males.

| Questions | n (%) |
|--|--------------|
| Obstructive sleep apnoea has an important role in decreasing sleep quality | |
| Strongly disagree | 3 (0.8) |
| Disagree | 3 (0.8) |
| Neutral | 66 (18.4) |
| Agree | 121 (33.5) |
| Strongly agree | 168 (46.5) |
| Excessive use of hypnotics (sleeping pills) results in dementia (memory loss) | |
| Strongly disagree | 6 (1.7) |
| Disagree | 27 (7.5) |
| Neutral | 215 (59.6) |
| Agree | 76 (21.1) |
| Strongly agree | 37 (10.2) |
| Lack of sleep is associated with migraine and tension headaches | |
| Disagree | 10 (2.8) |
| Neutral | 50 (13.9) |
| Agree | 154 (42.7) |
| Strongly agree | 147 (40.7) |
| The hormone melatonin has an important role in the control of the sleep-wake cycle | |
| Strongly disagree | 1 (0.3) |
| Disagree | 12 (3.3) |
| Neutral | 115 (31.9) |
| Agree | 100 (27.7) |
| Strongly agree | 133 (36.8) |
| Poor sleep quality does not increase the risk of Alzheimer’s disease | |
| Strongly disagree | 63 (17.5) |
| Disagree | 112 (31.0) |
| Neutral | 129 (35.7) |
| Agree | 34 (9.4) |
| Strongly agree | 23 (6.4) |
| The lack of sleep increases the activity of the Amygdala (a brain structure that controls emotions) and results in mood disorders | |
| Strongly disagree | 5 (1.4) |
| Disagree | 20 (5.5) |
| Neutral | 106 (29.4) |
| Agree | 143 (39.6) |
| Strongly agree | 87 (24.1) |
| Sleep deprivation does not negatively affect the working memory | |
| Strongly disagree | 95 (26.3) |
| Disagree | 160 (44.3) |
| Neutral | 58 (16.1) |
| Agree | 26 (7.2) |
| Strongly agree | 22 (6.1) |
| Exercise improves sleep by increasing the slow-wave sleep | |
| Strongly disagree | 2 (0.6) |
| Disagree | 15 (4.2) |
| Neutral | 160 (44.3) |
| Agree | 129 (35.7) |
| Strongly agree | 55 (15.2) |
| Sleep deprivation (a lack of sleep) is not a risk factor for strokes | |
| Strongly disagree | 57 (15.8) |
| Disagree | 118 (32.7) |
| Neutral | 129 (35.7) |
| Agree | 40 (11.1) |
| Strongly agree | 17 (4.7) |

| Poor sleep quality will not trigger seizures in people with epilepsy | |
|--|------------|
| Strongly disagree | 52 (14.4) |
| Disagree | 104 (28.8) |
| Neutral | 149 (41.3) |
| Agree | 26 (7.2) |
| Strongly agree | 30 (8.3) |
| Good sleep facilitates the clearing of metabolites from the brain | |
| Strongly disagree | 4 (1.1) |
| Disagree | 10 (2.8) |
| Neutral | 104 (28.8) |
| Agree | 150 (41.6) |
| Strongly agree | 93 (25.8) |
| Sleep deprivation (lack of sleep) is associated with oxidative stress in the brain | |
| Strongly disagree | 2 (0.6) |
| Disagree | 11 (3.0) |
| Neutral | 133 (36.8) |
| Agree | 141 (39.1) |
| Strongly agree | 74 (20.5) |

[Table/Fig-4]: Knowledge levels of the study participants (n=361).

When comparing gender differences in the knowledge section of the questionnaire [Table/Fig-6], no significant differences were observed in knowledge levels between male and female students.

In the gender comparison conducted in [Table/Fig-7] notable differences emerged between male and female participants. The findings indicate that a higher proportion of males (31.7%) compared to females (19.9%) reported not waking up during sleep, showing a significant difference (p-value <0.001). A larger percentage of females (71.0%) reported not engaging in physical exercise compared to males (56.7%) (p-value=0.007). More females (20.3%) reported sleeping with bedroom lights on compared to males (5.8%) (p<0.001). A higher proportion of females (73.0%) reported difficulty waking up compared to males (59.2%) (p-value=0.008).

DISCUSSION

The objective of this study was to assess the knowledge, attitude, and awareness of health science students about the impact of sleep quality on the brain. The results revealed that the average nightly sleep duration of the participants was 6.1 hours, and many reported experiencing daytime drowsiness. While most of them avoided consuming tea or coffee before going to bed, the usage of mobile phones before sleeping was quite common. The participants

| Questions | Gender | N | Mean±SD | 95% CI | p-value |
|--|--------|-----|----------|----------------|---------|
| Good sleep quality is essential for recalling your memory | Male | 120 | 4.6±0.77 | (-0.21, 0.13) | 0.645 |
| | Female | 241 | 4.6±0.75 | | |
| Good sleep quality is not important in converting short-term memory into long-term memory | Male | 120 | 2.1±1.18 | (-0.68, -0.11) | 0.006 |
| | Female | 241 | 2.5±1.33 | | |
| Regular exercise improves sleep quality | Male | 120 | 4.3±0.74 | (-0.17, 0.19) | 0.918 |
| | Female | 241 | 4.3±0.85 | | |
| Blue light emitted from devices, such as smartphones, tablets, and computer screens, interferes with sleep quality | Male | 120 | 4.0±0.94 | (-0.17, 0.26) | 0.650 |
| | Female | 241 | 3.9±1.00 | | |
| The sleeping environment is not important in providing good sleep quality | Male | 120 | 1.8±1.15 | (-0.48, 0.07) | 0.137 |
| | Female | 241 | 2.0±1.30 | | |
| Caffeine intake before sleeping reduces the total sleep time | Male | 120 | 3.9±0.91 | (-0.36, 0.07) | 0.184 |
| | Female | 241 | 4.1±1.01 | | |
| Individuals with insomnia are more prone to mental depression | Male | 120 | 4.1±0.75 | (-0.16, 0.19) | 0.886 |
| | Female | 241 | 4.1±0.82 | | |
| Anxiety is one of the causes of insomnia | Male | 120 | 4.2±0.82 | (-0.42, -0.06) | 0.009 |
| | Female | 241 | 4.4±0.81 | | |
| Nicotine does not affect sleep quality | Male | 120 | 2.4±1.05 | (-0.09, 0.40) | 0.225 |
| | Female | 241 | 2.2±1.14 | | |
| Poor sleep quality can lead to inappropriate judgment and difficulty focusing | Male | 120 | 4.2±0.77 | (-0.17, 0.21) | 0.856 |
| | Female | 241 | 4.2±0.91 | | |
| Lack of sleep is not associated with a high-risk of obesity (increased body weight) | Male | 120 | 2.7±1.09 | (-0.21, 0.28) | 0.771 |
| | Female | 241 | 2.6±1.11 | | |
| A good quality sleep is essential in restoring brain neurotransmitters | Male | 120 | 4.2±0.76 | (-0.24, 0.11) | 0.465 |
| | Female | 241 | 4.3±0.82 | | |
| Lack of sleep influences the mood and behaviour of the individual | Male | 120 | 4.5±0.73 | (-0.19, 0.14) | 0.789 |
| | Female | 241 | 4.5±0.77 | | |

[Table/Fig-5]: Comparison between the mean values of male and female respondents concerning awareness.
Test applied: Independent t-test; significance level of p<0.05

| Questions | Gender | N | Mean±SD | 95% CI | p-value |
|---|--------|-----|----------|---------------|---------|
| Obstructive sleep apnoea has an important role in decreasing sleep quality | Male | 120 | 4.4±0.72 | (-0.01, 0.36) | 0.060 |
| | Female | 241 | 4.2±0.88 | | |
| Excessive use of hypnotics (sleeping pills) results in dementia (memory loss) | Male | 120 | 3.2±0.77 | (-0.34, 0.02) | 0.078 |
| | Female | 241 | 3.4±0.84 | | |
| Lack of sleep is associated with migraine and tension headaches | Male | 120 | 4.2±0.76 | (-0.24, 0.10) | 0.425 |
| | Female | 241 | 4.2±0.79 | | |

| | | | | | |
|---|--------|-----|----------|---------------|-------|
| The hormone melatonin has an important role in the control of the sleep-wake cycle | Male | 120 | 4.0±0.88 | (-0.13, 0.28) | 0.468 |
| | Female | 241 | 4.0±0.94 | | |
| Poor sleep quality does not increase the risk of Alzheimer’s disease | Male | 120 | 2.5±1.08 | (-0.28, 0.19) | 0.720 |
| | Female | 241 | 2.6±1.09 | | |
| The lack of sleep increases the activity of the Amygdala (a brain structure that controls emotions) and results in mood disorders | Male | 120 | 3.7±0.79 | (-0.38, 0.02) | 0.079 |
| | Female | 241 | 3.9±0.97 | | |
| Sleep deprivation does not negatively affect the working memory | Male | 120 | 2.2±1.04 | (-0.30, 0.18) | 0.618 |
| | Female | 241 | 2.2±1.13 | | |
| Exercise improves sleep by increasing the slow-wave sleep | Male | 120 | 3.6±0.71 | (-0.26, 0.10) | 0.400 |
| | Female | 241 | 3.6±0.86 | | |
| Sleep deprivation (a lack of sleep) is not a risk factor for strokes | Male | 120 | 2.5±0.98 | (-0.35, 0.11) | 0.306 |
| | Female | 241 | 2.6±1.06 | | |
| Poor sleep quality will not trigger seizures in people with epilepsy | Male | 120 | 2.6±1.02 | (-0.33, 0.14) | 0.440 |
| | Female | 241 | 2.7±1.10 | | |
| Good sleep facilitates the clearing of metabolites from the brain | Male | 120 | 4.0±0.79 | (-0.09, 0.29) | 0.283 |
| | Female | 241 | 3.8±0.90 | | |
| Sleep deprivation (lack of sleep) is associated with oxidative stress in the brain | Male | 120 | 3.8±0.74 | (-0.20, 0.17) | 0.885 |
| | Female | 241 | 3.8±0.87 | | |

[Table/Fig-6]: Comparison between the mean values of male and female respondents regarding their knowledge.
 Test applied: Independent t-test; significance level of p<0.05

| Questions | Male | Female | p-value |
|--|------------|------------|---------|
| What is your sleep duration at night in hours? (Mean±SD) | | | |
| | 6.3±1.76 | 6.0±2.20 | 0.145 |
| | n (%) | n (%) | |
| Do you wake up during your sleep at night? | | | |
| No | 38 (31.7) | 48 (19.9) | <0.001 |
| I rarely wake up | 62 (51.7) | 106 (44.0) | |
| I frequently wake up | 20 (16.7) | 87 (36.1) | |
| Do you feel sleepy during the daytime? | | | |
| No | 42 (35.0) | 65 (27.0) | 0.116 |
| Yes | 78 (65.0) | 176 (73.0) | |
| Do you have a fixed wake-up time during the weekdays, even if you go to bed late? | | | |
| No, my wake-up time varies | 61 (50.8) | 133 (55.2) | 0.435 |
| Yes, I have a fixed wake-up time | 59 (49.2) | 108 (44.8) | |
| Do you drink coffee/tea one hour before you sleep? | | | |
| No | 102 (85.0) | 174 (72.2) | 0.007 |
| Yes | 18 (15.0) | 67 (27.8) | |
| Do you smoke shisha/cigarettes one hour before you sleep? | | | |
| No | 102 (85.0) | 229 (95.0) | <0.001 |
| Yes | 18 (15.0) | 12 (5.0) | |
| Do you snore during your sleep? | | | |
| No | 71 (59.2) | 177 (73.4) | 0.002 |
| I am not aware | 31 (25.8) | 52 (21.6) | |
| Yes | 18 (15.0) | 12 (5.0) | |
| Do you spend time looking at your mobile phone’s screen (for reading/ watching news, movies or by using social media), when you are on your bed, just before you sleep? | | | |
| No | 14 (11.7) | 20 (8.3) | 0.302 |
| Yes | 106 (88.3) | 221 (91.7) | |
| Do you do physical exercise?, if your answer is 2 kindly answer the following question. | | | |
| No | 68 (56.7) | 171 (71.0) | 0.007 |
| Yes | 52 (43.3) | 70 (29.0) | |
| If you exercise, how many days do you exercise per week? (Mean±SD) | | | |
| | 4.0±1.41 | 3.5±1.55 | 0.069 |

| | n (%) | n (%) | |
|--|------------|------------|--------|
| Do you sleep for a longer duration during weekends/holidays to compensate for your lack of sleep during the weekdays? | | | |
| No | 17 (14.2) | 37 (15.4) | 0.766 |
| Yes | 103 (85.8) | 204 (84.6) | |
| Do you sleep with your bedroom lights on? | | | |
| No | 113 (94.2) | 192 (79.7) | <0.001 |
| Yes | 7 (5.8) | 49 (20.3) | |
| Do you listen to music before or during your sleep? | | | |
| No | 111 (92.5) | 205 (85.1) | 0.044 |
| Yes | 9 (7.5) | 36 (14.9) | |
| Do you have difficulty when you wake up in the morning? | | | |
| No | 49 (40.8) | 65 (27.0) | 0.008 |
| Yes | 71 (59.2) | 176 (73.0) | |

[Table/Fig-7]: Comparison of the mean values between male and female respondents regarding their attitudes.
 Test applied: Independent t-test, Chi-square test; significance level of p<0.05

had mixed knowledge levels when it came to sleep-related health issues and negative statements. Notably, gender differences were observed, especially in their attitudes towards memory conversion and the link between anxiety and insomnia, with females expressing stronger views.

The mean night time sleep duration of the study participants was six hours, which is one hour less than the optimal range of 7-9 hours, as reported in a previous study conducted by the National Sleep Foundation of the United States [6]. A notably higher number of individuals reported experiencing drowsiness in the afternoon, suggesting an indication of poor sleep quality. Previous studies have suggested a link between increased smartphone usage among adolescents and a decline in sleep quality, along with associated issues such as daytime drowsiness, insomnia, inadequate sleep duration, and delayed onset of sleep [17,18].

According to the research findings, most students (90.6%) of the surveyed population tend to use their smartphones before going to bed. Despite being aware of the adverse effects of blue light emitted by cell phones on sleep quality, participants exhibited a contrary behaviour by engaging with their phones shortly before going to sleep. Using electronic devices at night has been linked to poor sleep quality. An average of five hours of smartphone usage is associated with insomnia and decreased sleep duration

[17]. Studies have shown that exposure to screen light reduces melatonin levels, suppressing the desire to fall asleep before bedtime [19]. Exposure to electronic device screens delays sleep onset, reduces REM sleep, and suppresses melatonin secretion [19]. The exposure to blue light emitted by electronic devices before bedtime could have reduced melatonin production, potentially impacting the study participants' sleep quality. It has been documented that heightened daytime sleepiness correlates with poor sleep quality [20]. In this study, 70.4% of the participants reported experiencing heightened daytime sleepiness [Table/Fig-2]. This observation could establish a connection between increased daytime sleepiness and poor sleep quality. The data analysis of the questionnaire revealed a clear comprehension among participants regarding melatonin's role in regulating the sleep-wake cycle. Moreover, the study findings indicated that 85% of students demonstrated insufficient sleep habits, frequently compensating for weekday sleep deficits by extending their weekend sleep duration. Furthermore, both organic and pharmacological supplements can impact sleep hygiene. However, participants showed a significant lack of awareness regarding the potential risks associated with the misuse of hypnotic medications such as benzodiazepines, which may result in severe side-effects [21]. To elaborate, benzodiazepine toxicity can cause various Central Nervous System (CNS) effects, particularly at higher doses. Additionally, it can lead to overdose, withdrawal symptoms due to physiological dependence, and the development of sedative-hypnotic use disorder [21]. Likewise, 76.5% of students involved in this study stated that they refrained from consuming coffee or tea within one hour before bedtime. This finding contrasts with a study conducted in Saudi Arabia, where most individuals consumed caffeine primarily in the morning rather than at night [22].

The present research delves into the connection between exercise and sleep hygiene, an aspect that is often neglected. In this study, a notable percentage of students (66.2%) stated their lack of physical activity, echoing findings from a previous study conducted in Saudi Arabia [23], which linked poor sleep quality with physical inactivity among students. The study participants shared the same level of knowledge as those in the previous study, who were also unaware of the positive effects physical exercise can have in improving sleep quality. An earlier investigation discovered that listening to music can enhance subjective sleep quality across all age groups, improving sleep [24]. Nonetheless, 87.5% of students in this study concurred that they do not listen to music before bedtime. This study indicates that nearly half of the students had limited knowledge concerning the correlation between sleep duration and strokes, as well as the connection between inadequate sleep and a heightened risk of obesity. It has been reported that poor sleep quality can lead to an increased risk of obesity [1]. Reduced sleep duration increases the risk of obesity and stroke in individuals with hypertension and diabetes mellitus [25]. In addition to stroke, individuals with epilepsy experience poorer sleep quality than those without, which significantly lowers their quality of life and may trigger seizures [26]. However, the participants in this study had diminished views about the causal relationship between poor sleep quality and seizures.

Moreover, the study showed that students were well-informed about the impact of obstructive sleep apnoea on sleep quality. Obstructive sleep apnoea reportedly alters patients' circadian clocks, which are strongly associated with glucose regulation [13]. Research has documented insomnia as a predictive factor for anxiety [27], and participants in this study exhibited a notable awareness of this relationship. Interestingly, female participants showed significantly higher awareness compared to males in this regard. Research has shown that insufficient sleep not only impacts short-term memory and concentration but also leads to long-term neurological dysfunction [8]. While examining this study's findings, it was evident that female participants displayed a higher level of awareness regarding the significance of good sleep quality for memory recall than males.

There is a reciprocal relationship between migraines, tension headaches, and sleep disturbances. This indicates that headaches can cause sleep problems and vice versa [28]. Moreover, the current study found that participants acknowledged the correlation between inadequate sleep and migraines and tension headaches. The prevalence of sleep deprivation in today's fast-paced society has emerged as a significant health concern. Given its profound effects on brain function, it can lead to severe implications for one's overall health. This was supported by an increasing volume of research demonstrating the crucial role of sleep in facilitating the glymphatic system's function, which is responsible for removing metabolic waste products from the CNS [29]. The fact that the glymphatic system is more active during regular sleep than during alertness suggests that sleep is necessary for cleaning the brain [29]. Notably, the students participating in this research are aware of these effects. One study highlighted the crucial role of the amygdala in sleep and emotional regulation [30]. The participants in this study exhibited a strong understanding of this association.

When comparing attitudes by gender, a higher percentage of females reported a lack of participation in physical exercise compared to males, and a greater proportion of females reported difficulty waking up compared to males. Exercise has been reported to improve sleep quality [31]. Research has suggested that physical activity and sleep quality may be influenced by various mechanisms, including the release of endorphins that can potentially lower stress and anxiety levels, resulting in increased relaxation and better sleep [32]. More female participants in this study reported sleeping with bedroom lights on compared to males. A recent study highlighted a link between bedroom light exposure and reduced sleep efficiency [33]. Understanding the influence of bedroom light on sleep quality is crucial.

This study highlights the significance of addressing sleep quality among health science students through customised sleep education initiatives. Tailored interventions based on gender may be necessary to cater to the varying attitudes towards sleep. Additionally, filling knowledge gaps regarding the impact of sleep on brain function could enable students to make well-informed decisions about their sleep habits, ultimately enhancing their overall wellbeing. Future research could focus on evaluating the effectiveness of customised sleep education interventions for health science students while tracking changes in sleep quality over time. Diversifying participant samples across universities and regions would improve generalisability, while comparative studies across cultures could shed light on cultural influences on sleep behaviours. Exploring the long-term effects of improved sleep on academic performance and mental health outcomes among health science students could aid in developing comprehensive wellness programs to promote healthy sleep habits in this population.

Limitation(s)

A constraint of this study lies in its dependence on self-reported data, potentially leading to response bias and inaccuracies. Furthermore, the cross-sectional design hinders the establishment of causal relationships between variables. Moreover, the study's sample was confined to a single university in Jeddah, Saudi Arabia, potentially restricting the applicability of the results to broader populations. Subsequent studies could consider longitudinal designs and include a more diverse range of participants to enhance the reliability and generalisability of the results.

CONCLUSION(S)

This study examined the knowledge, attitudes, and awareness regarding the impact of sleep quality on the brain among health sciences students at King Saud bin Abdulaziz University for Health Sciences in Jeddah, Saudi Arabia. The findings highlight the significance of improving sleep quality among these students, indicating notable knowledge disparities and varied attitudes, especially among females, who demonstrate greater awareness

in certain areas. Gender distinctions were evident in participants' attitudes toward sleep, emphasising the importance of tailored sleep education programs addressing gender-specific issues. Such initiatives offer potential for enhancing students' overall well-being and academic performance.

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